

DIVISION OF WATER RESOURCES
Office of the State Engineer

People, Water and Stewardship

Water Supply, Engineering, and Investigations

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2005 Annual Report

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Water Supply, Engineering, and Investigations

Forward

The Water Supply, Engineering, and Investigations organization is comprised of a multi-disciplined staff of engineers, geologists, hydrologists, technicians and support staff. We are an integral part of nearly every activity within the Division of Water Resources spanning a broad spectrum of technical and engineering responsibilities.

The key resource and critical component necessary for the accomplishment of all that is discussed in the following is the highly skilled, dedicated and innovative staff. An organization chart and staffing are provided at the end of this report. Several staff participated in activities to foster teamwork in the accomplishment of DWR's mission. **I want to take this opportunity to personally thank each member of the staff for their support dedication and teamwork during 2005. With the many retirements several members of the staff in both in the Denver office and division offices have taken on additional workload with only my personal thanks, I am very proud to work with each of them.**

The following report provides only the highlights of 2005, much of the day-to-day routine customer service and program accomplishment is too vast to include in the limited space of an annual report. Coordination with other local, state and federal agencies continues to be a key goal of our organization. In addition the staff is involved as leaders with many state and national professional organizations that reflect favorably on DWR. This annual report was compiled with tremendous assistance from the staff.

Dam Safety Branch

The Colorado Division of Water Resources' Dam Safety Branch mission is to prevent the loss of life and property damage and protect against the loss of water supplies due to the failure of dams in Colorado. The Dam Safety Program accomplishes that mission primarily through Safety Evaluations of Existing Dams (SEED) to determine the safe storage levels of reservoirs within the state. Additional program tools include a comprehensive set of regulations, policies, and procedures for the design, construction, and maintenance of dams; the safe operation of reservoirs; and emergency preparedness planning.

The Dam Safety Program is managed by the State Engineer in accordance with Title 37, Article 87 of C.R.S. and the Livestock Water Tank Act, Title 35, Article 49 of C.R.S. The program is implemented by the State Engineer through the Dam Safety Branch and the Division field offices. The Branch currently consists of a branch chief, dam safety engineers, and design review engineers. Currently, the program oversees a total of about 2,900 dams in Colorado with 1,886 dams of jurisdictional size. Of these, about 1,763 are non-federal dams. Of the non-federal dams, approximately 598 --- or about one-third of the total non-federal dams in Colorado --- are classified as dams that, in the event of a failure, would be expected to cause loss of life and/or significant property damage within the flood plain areas below the dams..

Through the diligent field observations of dam safety engineers statewide, several near-incidents were acted upon in time to diffuse potentially dangerous situations. As a direct result of these actions, no loss of life or significant property damage occurred in Colorado in the 2004-05 timeframe. This is attributed to the increased awareness and responsibility of the dam owners for their dams --- including emergency preparedness planning --- and to the enforcement of the regulations, policies, and procedures by our office.

The State Engineer's Office approved the plans and specifications for nine new dams and for a total of 35 alteration, modification, or enlargement projects of existing dams. Hydrology studies were also approved for determination of the inflow design flood for spillway design. The estimated cost of construction for the submitted plans and specifications was over \$38.5 million.

During FY 04-05, a total of 699 dam safety inspections and 190 construction inspections were conducted for a total of 888 inspections. In addition, 122 follow-up inspections were performed. At the conclusion of the reporting period, there were 189 dams restricted from full storage due to various structural deficiencies such as significant leakage, cracking and sliding of embankments, and inadequate spillways. Total storage restricted was 134,492 acre-feet. The restrictions provide risk reduction for the public and environment until the deficiencies identified are corrected. Although many dams were repaired and removed from the restricted list within the last year, a number of dams were also added to the list during the same time period. The change in the restriction from the same time last year resulted in a slight increase in the number of dams on the restricted list while the volume of the restrictions decreased approximately 3,000 acre-feet. Approximately half of the dams on the Colorado Division of Water Resources restricted list have been on that list for ten years or longer.

The Dam Safety Branch continues to use risk-based tools to help evaluate and prioritize the jurisdictional dams in Colorado in order to use program resources more efficiently and effectively.

Interagency coordination occurs as necessary. An Memorandum of Understanding (MOU) has been executed with the Division of Wildlife (DOW) regarding the responsibilities of each agency in carrying out the safety inspection of DOW dams. The DOW is making safety inspections of their Class 3 (low hazard) dams.

The Colorado Water Conservation Board (CWCB) makes its construction fund available to assist owners with the repair of their dams. The Dam Safety Branch closely coordinates the review and approval and final acceptance of CWCB funded dam construction and/or rehabilitation projects.

Federal Dam Safety Coordination

Routine inspections of federal dams by Dam Safety Engineers have been curtailed in accordance with a legislative audit recommendation. The Branch, however, will participate in the evaluation of the safety of some federal dams for special issues and performance problem evaluations, in accordance with the procedure for obtaining approval to participate in these inspections. Less than about ten hours were spent this fiscal year participating in these safety inspections at a cost of less than \$450.

Memorandums of Understanding have been executed with the U.S. Bureau of Reclamation (USBR), the U.S. Bureau of Land Management (BLM), and the Air Force Academy (AFA) relating to dam safety activities in Colorado. An MOU is in development for the Fort Carson Army installation, and another one is being developed with the U.S. Forest Service, Rocky Mountain Region, to provide coordination of mutual responsibilities for dam safety and their Travel Management Plan for the National Forests. (This is necessary to provide access to private dams located within the forests.) MOU's are being pursued with the other federal agencies as well, such as the U.S. Army Corps of Engineers (USCOE) and the Federal Energy Regulatory Commission (FERC), to assure that the dams under their jurisdiction are being maintained in a safe condition and to coordinate activities and exchange of information and data. These MOU's provide for the exchange of safety-related information of dams under each agency's jurisdiction.

In the past, the Branch has performed safety inspections of dams that are regulated by the Federal Energy Regulatory Commission. In accordance with an agreement (since a formal MOU was not completed) with FERC, they were to furnish copies of their reports for Branch records. More recently, the Branch had curtailed participation in FERC regulated dams in accordance with a state of Colorado internal audit. However, during a recent review of the agreement and procedures for administration of FERC regulated dams, the need for a change in the current policy was identified. It was determined that the Dam Safety Branch does not regularly receive copies of FERC safety inspection reports. Further, it was clarified that unlike USBR and USCOE dams, the FERC does not own the dams they regulate and, in most cases, the dams are owned by Colorado based entities. To ensure the safety of the citizens of Colorado, it was determined that Dam Safety Branch engineers would resume performing dam safety inspection of FERC regulated dams in Colorado. A policy statement indicating this revised procedure is to be developed and approved by the State Engineer.

Revisions to Rules and Regulations

This year, a serious effort was been made toward the revision and updating of the *Rules and Regulations for Dam Safety and Dam Construction*, (Rules) which were last revised in 1988. Major steps were taken in the revision process and the proposed revisions were presented to all the dam safety engineers for review and comment. Following several months of vigorous review and discussion within the Dam Safety Branch, the proposed rules were posted on the Dam Safety Branch web site for public comment. Several presentations were made to the engineering communities on the Front Range and the western slope to describe the proposed Rule revisions and elicit comments. Many comments were received, with most of them being positive.

The key changes to the Rules as described in the public presentations included: elimination of the Intermediate dam size; revision and updating (to National Standards) dam hazard classification nomenclature; revisions to the methodology for determining the Inflow Design Flood and spillway sizing; reduction of Probable Maximum Precipitation (PMP) due to elevation effects; and, general update and clean-up.

Based on comments from consulting engineers on the Front Range, several consultant-lead committees were formed to take a closer look at updating specific sections of the rules. Committees for Geotechnical Engineering, Concrete Dam Engineering and Engineering Geology were formed to address specific areas of the Rules. In the fall of 2005, committees provided their comments to the Dam Safety Branch for consideration and possible inclusion into the new Rules. This process of open review and comment has resulted in positive communication between the dam owners, their engineers and the State Dam Safety Regulators. This communication has allowed all to agree that the safety of general public is of paramount concern when discussing the operation and regulation of dams in Colorado.

Extreme Precipitation Study

The hydrologic evaluation of spillways on dams located above elevation 7,500 feet has been on hold for a number of years. The hold status is predicated by uncertainties in the existing tools and methodologies available to determine the Probable Maximum Precipitation (PMP) in high altitude watersheds in the state. Although long considered a factor, the real effects of terrain and 14,000-foot mountains on the tools used to predict and quantify extreme precipitation events has not been wholly understood or accounted for by the commonly available tools or methods, most of which are nearly 40 years old. It is believed that a more accurate estimate of the probable maximum precipitation in the mountainous area could save millions of dollars in the construction of spillways for dams.

In the summer of 2005, discussions began between the Dam Safety Branch and consulting hydrometeorologists regarding the use of Geographic Information System (GIS) technology to solve the long-standing extreme precipitation dilemma. Based upon those discussions, in the fall of 2005, a proposal was developed to provide an Extreme Precipitation Analysis Tool (EPAT) for use in dam safety and rehabilitation studies within specific regions of the state. The EPAT proposal was accepted in the fall of 2005 and will be funded by the Dam Safety Branch NDSP grant and the Colorado Water Conservation Board (CWCB). The tool will be developed for various regions within the state starting

on the western slope. The development of the first tool is expected to be delivered to the Dam Safety Branch for testing in the spring of 2006.

Hydrologic Basin Response Study

The determination of spillway adequacy is based upon the development of an Inflow Design Flood (IDF) for the watershed above a given dam. The analysis of spillway adequacy for dams within much of the state has been on hold for some time due to questions regarding estimates of extreme precipitation. A second part of the development of an IDF has to do with how the watershed reacts to the extreme precipitation event. Many “Basin Response Factors” can effect how much precipitation (water) from a given magnitude event actually “runs off” and needs to be safely handled by the spillway and passed through the reservoir to prevent overtopping the dam. As with the methodologies used for estimating extreme precipitation, the methods of estimating basin response factors used in determining the IDF are based on past research and have not been updated in over 40 years. Additionally, in many cases the empirically based response factors are based on studies performed in other states, making their application within Colorado questionable.

The problems associated with choosing appropriate basin response factors for Colorado watersheds have long been known within the Dam Safety Branch. There are large cost implications associated with spillways in Colorado as a direct result of estimating basin response factors.

During the spring of 2005, efforts were begun to solve this problem and provide more accuracy in choosing basin response factors and determining IDF’s. A nationally recognized consulting hydrologist was retained to study the problem of hydrologic basin response specifically in Colorado. The goals of the study were developed by the Dam Safety Branch and generally include investigation and documentation of the use of data and information available to estimate watershed parameters for use in IDF studies. The scope of the study also includes the development of guidelines and procedures that when used by engineers and hydrologists with appropriate training and relevant experience, will produce consistent and reasonable IDF hydrographs throughout the state.

The study is being performed under the direction and review of a select group of dam safety engineers with expertise in hydrology. The study has been ongoing since the summer of 2005 and the study schedule indicates Colorado specific basin response guidelines and procedures will be available for use in late 2006.

National Dam Safety Program Assistance Grants

With the passage of the National Dam Safety Program Act (NDSP), PL 104-303, and its subsequent funding, Colorado has applied for and received assistance grants each year since 1998. An additional grant was approved for 2005. These funds were used to provide advanced training to the Dam Safety Branch personnel in the fields of dam safety and risk analysis. Additional training is provided under the technical seminar provisions of the Act. The grant funds are also used to acquire emergency communication equipment, upgrade computers, and purchase engineering computer software programs and other equipment. Future grants may be available each year under the Act, subject to appropriations.

A critical element in the Dam Safety Program is the continued training of our personnel to maintain a high level of technical competency, to keep up with changing technology, to develop additional

management and communication skills, and to keep abreast of changes in the development of dam safety programs across the country. The following training opportunities were achieved this fiscal year:

1. HEC-RAS/HEC-HMS Training with Art Miller of Penn State University, Denver, CO (attended by 9 dam safety engineers);
2. FEMA Workshop on Potential Failure Modes Analysis, Emmitsburg, MD (attended by 2 dam safety engineers);
3. ASCE Earthquake Induced Ground Motion Technical Seminar, Washington, D.C. (attended by 1 dam safety engineer);
4. ASDSO Western Regional Conference, Santa Fe, NM (attended by 2 dam safety engineers);
5. ASDSO Annual Conference, Orlando, FL (attended by 3 dam safety engineers);
6. ASDSO Advanced Technical Seminar on Dam Failure Analysis, Salt Lake City, UT (attended by 3 dam safety engineers)

Integration of Risk Assessment

Colorado has relied on an inspection/standards based program for over 20 years to assure the safety of dams in the state. While inspection activities are necessary and provide a basis for dam inventories, evaluation of hazard classifications, and site conditions at dams, too many serious incidents and even failures of dams in Colorado are still occurring. After attending an ASDSO workshop in 1999 on risk assessment, dam safety engineers decided to explore ways to include risk assessment in the Dam Safety Program as a tool for identifying potential failure modes at existing dam and to focus resources at the dams having the greatest risk of failure and significant consequences.

The Dam Safety Branch has embarked on a program to utilize Risk-Based methods to rank dams according to potential failure modes and consequences. An Intergovernmental Agreement between the Bureau of Reclamation (USBR) and the Dam Safety Branch was issued to allow the USBR to revise their Risk-Based Profiling System (RBPS) to meet the needs of the Colorado Dam Safety program. The goal of the Colorado RBPS program was to develop a relatively simple (to the user) software tool to quickly rank the relative condition of Class 1 (High Hazard) and Class 2 (Moderate Hazard) dams in the state. The rankings would then be used to more efficiently allocate resources to those dams determined to present the greatest risk to public safety.

After several iterations of evaluating prototype software, in the summer of 2005, a RPBS software tool suitable for use by the Dam Safety Branch was delivered. Since the software was delivered at a time when safety evaluation of existing dam field inspections were at their peak, the tool was temporarily shelved. More recently, a commitment was made by all dam safety engineers to have RPBS rankings for the Class 1 and 2 dams in their areas of responsibility no later than March 1, 2006. Those rankings will be an important tool for the dam safety engineers as they develop schedules and priorities for the 2005-06 inspection season.

Once the Dam Safety Engineers become familiar with the RPBS tool, additional application of the Risk-Based methodologies --- including increased implementation of Failure Modes and Consequence Evaluations (FMCE) --- will be pursued.

Water Supply Branch

Introduction

The protection of Colorado's water resources is a complex and vital challenge to the employees that serve in the Division of Water Resources. Recognizing the importance and value of our responsibilities, the following highlights some of the activities and accomplishments achieved by the staff during 2005. The administrative and functional responsibilities performed include:

- ◆ Analysis and approval of pending Substitute Water Supply Plans (SWSP's).
- ◆ Subdivision review, analysis, and comment to Colorado counties for proposed housing developments in regard to water supply adequacy.
- ◆ Perform all functions of groundwater well analysis and permitting.
- ◆ Conduct engineering analyses and groundwater well permitting functions for the designated groundwater basins. Also serve as technical staff for the Colorado Groundwater Commission.
- ◆ Perform litigation management for our involvement within the judicial and water court processes and expert witness testimony. Coordinate activities with the seven Water Divisions, the seven Water Courts, and legal counsel provided through the Colorado Attorney General's Office.
- ◆ Conduct engineering and technical analyses into all facets of water resource engineering, planning, and administration.
- ◆ Provide water resources training and education to attorneys, consulting engineers, federal/state/county officials, school children and water users through a variety of formal and informal presentations.

The following narrative is a synopsis of our activities in each of these major areas of responsibilities and our anticipated goals for the next year.

Substitute Water Supply Plans

The authority to evaluate and issue substitute water supply plans (SWSPs) is vested exclusively to the State Engineer's Office. During 2005, this office reviewed and acted upon 209 general substitute water supply plans (including emergencies) and 59 SWSPs related to gravel pits.

Subdivision Review

Subdivision water supply plan reviews must be conducted within 21 days to meet statutory time restrictions. We often satisfy this requirement in substantially less than 21 days. During 2005, a total of 426 subdivision referrals were received and acted upon by this office. This function requires perpetual information sharing and communication with all Colorado counties.

Designated Groundwater Basins and Colorado Groundwater Commission

In performance of their duties, the Designated Basins staff issued 696 small capacity well permits, 247 large capacity permits/Determination of Water Rights, 62 change application approvals, and were involved in 22 enforcement actions. Staff begun the evaluation for the issuance of final permits in the Upper Big Sandy Designated Ground Water Basin and continued the same process for the Southern High Plains Basin. During 2005, Staff issued only 34 final permits. However, Staff conducted two trips to the Southern High Plains that facilitated the collection of several hundred Statements of Beneficial Use in the basin. Staff also participated in 22 Ground Water Commission administrative hearings and/or court cases.

Staff worked with the Ground Water Commission to propose changes to the existing rules (which, however, were not adopted). Staff also participated in one variance hearing and one appeal hearing in front of the Ground Water Commission. Staff worked on migrating some of our Denver Basin Aquifer permitting information into digital format using GIS. A member of the designated basins team also joined other staff members in revamping the Division of Water Resources website.

The staff continues to be active participants in designated basin groundwater management through consultation with the Groundwater Management District and the Republican River Water Conservation District. Staff from the designated basins also met with Elbert and El Paso Counties regarding Subdivisions.

Staff conducted a project to assign permit numbers to all wells without permit numbers that have a CWCB ID number, a Map Filing or a decreed water right within the Upper Big Sandy and Kiowa-Bijou Designated Basins.

Staff began working on a project to document all permitted irrigated acres within the Upper Big Sandy Designated Basin within GIS shape files.

Groundwater Well Permitting

The groundwater evaluation staff received and acted upon 8,931 applications for well permits in 2005. Of this total, 443 were emergency applications for replacement wells. The well permitting staff continues to process and analyze well permit applications, Monitoring-Hole Notices (1,161), Changes in Ownership/Address (5,731), Well Construction and Test Reports (7,477), and Pump Installation Reports (4,066).

Other Referrals

The Division of Water Resources is a referral agency for other State and Federal agencies including the Colorado Division of Minerals and Geology, the Army Corps of Engineers, and the Colorado Department of Public Health and Environment and miscellaneous Federal agencies regarding environmental assessments and environmental impact statements. Staff acted on 199 referrals from these agencies.

Water Quality Activity

Staff received two consultation requests from the Water Quality Control Commission during 2005. The first request addressed one party's concerns about possible water rights impacts attributable to proposed changes in temperature standards that were part of WQCC's Rulemaking Hearing for Consideration of Revisions to Basic Standards and Methodologies for Surface Water (Regulation #31), held on June 13, 2005.

The second request was related to WQCC's Rulemaking Hearing for revisions to water quality standards for the Eagle River that was held on December 12, 2005. Prior to the hearing, the party that had raised the concern over water rights that would have required the consultation decided to refrain from actually requesting the consultation, so we did not formally respond.

Special Projects

- Surface Water Supply Index Report to Water Availability Task Force
- Colorado Farm Show
- Colorado State Fair
- Support to Water Quality Control Commission
- Aims Community College (October 7, 2005)
- Real Estate Appraisers presenter (October 18, 2005)
- SEO Forum (November 21, 2005)
- Presenters at the CSU Cooperative Extension Service Conferences
- Presenter at the International Ground Source Heat Pump Association
- Presentations to local groups regarding water matters, administration, water issues and drought
- Coalbed Methane Stream Depletion Assessment Study – Northern San Juan Basin, Colorado
- Technical Advisors to the roundtables for SWSI and the IBCC

- Staff traveled to Sterling to meet with the Logan County Planning Department regarding the SEO's review of subdivisions and cluster developments.
- Staff traveled to Golden to meet with the Jefferson County Planning Department regarding the SEO's review of subdivisions and general well permit questions and issues.

2005 Legislation

The following is a summary of selected bills that passed taken from the January 2006 edition of the Colorado Ground Water Association Newsletter, prepared by Carrie Ciliberto. Also viewable via the internet at www.coloradogroundwater.org.

Senate Bill 05-133 – Sponsored by Senator Entz and Representative Gallegos – Effective April 14, 2005 -Amends C.R.S. § 37-92-103: This bill clarifies the statutory definition of abandonment of a water right. The bill provides that the statutory presumption of abandonment (10 years of non-use) does not apply to water rights, or portions thereof, that are used for any of the following: (1) land fallowing; (2) water banking programs; (3) federal land conservation programs; and (4) approved water conservation programs.

Senate Bill 05-161 – Sponsored by Senator Isgar and Representative Penry – Effective April 6, 2005 – Amends C.R.S. § 37-91-106: This bill eliminates the requirement that private drillers and pump installers pass a state examination before drilling a well or installing a pump on their own land(s) for their own private use.

Senate Bill 05-226 – Sponsored by Senator Owen and Representative Plant – Effective April 28, 2005: This bill creates a damages payment fund for the Kansas v. Colorado Arkansas River Compact case. The fund provides full payment of the nearly \$34.8 million owed by the state of Colorado to the state of Kansas. As soon as practicable on or after April 28, 2005, the state treasurer shall transfer monies to the fund as follows: (1) \$15.5 million from the perpetual base account of the severance tax trust fund; (2) \$15.5 million from the operational account of the severance tax trust fund; and (3) \$3,796,129 from the local government severance tax fund.

House Bill 05-1039 – Sponsored by Representative Curry and Senator Isgar – Effective August 8, 2005 – Amends C.R.S. § 37-83-105: This bill eliminates the requirement that water rights loaned to the Colorado Water Conservation Board for instream flow purposes may only be done so after the Governor declares a drought emergency. Such loans are limited to operating 120 days per year and only three years out of a 10- year period; however, an additional 10- year period may be invoked if the loan was not exercised during the initial 10-year period.

House Bill 05-1156 – Sponsored by Representative Riesberg and Senator Grossman – Portions effective April 5, 2005 and portions effective January 1, 2006 – Amends C.R.S. § 37-92-302: Effective April 5, 2005, the water referee may send a water court ruling via regular U.S. mail or electronic mail versus certified or registered U.S. mail. The following laws are effective January 1, 2006: (1) water clerks will post the water resumes on the internet versus sending them via regular U.S. mail, unless the water referee has reason to believe a person would be affected, in which case a copy of the resume will be sent to such person via regular U.S. mail or electronic mail; (2) water clerks will provide a paper copy of the water resume for a fee; (3) newspapers will bill applicants (versus water clerks) for water

application publication costs; and (4) applicants (versus water clerks) are required to notify potentially affected landowners.

House Bill 05-1177 – Sponsored by Representative Penry and Senator Isgar – Effective June 7, 2005 – Creates the “Colorado Water for the 21st Century Act” (see C.R.S. §§ 37-75-105 and 106): This Act creates and specifies membership qualifications for basin roundtables in each of the seven water divisions (South Platte; Arkansas; Rio Grande; Gunnison; Colorado; Yampa-White; and Dolores, San Miguel, and San Juan basin roundtables), the North Platte roundtable, and the Denver metropolitan area roundtable. As soon as practicable, each roundtable shall establish bylaws, operating procedures, goals and objectives, and select two representatives to serve on the interbasin compact committee. The bill authorizes the Governor to appoint six interbasin compact committee members, including a director of compact negotiations. The bill specifies the qualifications of such members, stating that the members shall come from “geographically diverse parts of the state and shall include individuals with expertise in environmental, recreational, local governmental, industrial, and agricultural matters”, with no more than three affiliated with the same political party. The bill requires preparation of water supply needs and availability analyses, creation of a legally binding charter regarding interbasin compacts, and establishment of a public education and outreach program.

House Bill 05-1254 – Sponsored by Representative Plant and Senator Grossman – Effective June 7, 2005 – Amends C.R.S. §§ 37-60-126, 127, and 39-29-109: This bill establishes a water efficiency grant program effective from July 1, 2005 through June 30, 2008. The program is designed to promote water conservation efforts among local water providers. The program limits grants to those who supply, distribute or provide retail water to customers.

Litigation

To perform our statutory responsibilities, litigation continues to consume a significant amount of time, effort, and expense for the Division of Water Resources. The following table describes the number of

Division	Applications	Statements of Opposition & Motions to Intervene	Opposition Percentage
1	394	21	5.3%
2	113	7	6.2%
3	25	1	4%
4	314	-	0.0%
5	362	5	1.4%
6	83	1	1.2%
7	108	-	0.0%
Total	1,399	35	2.5%

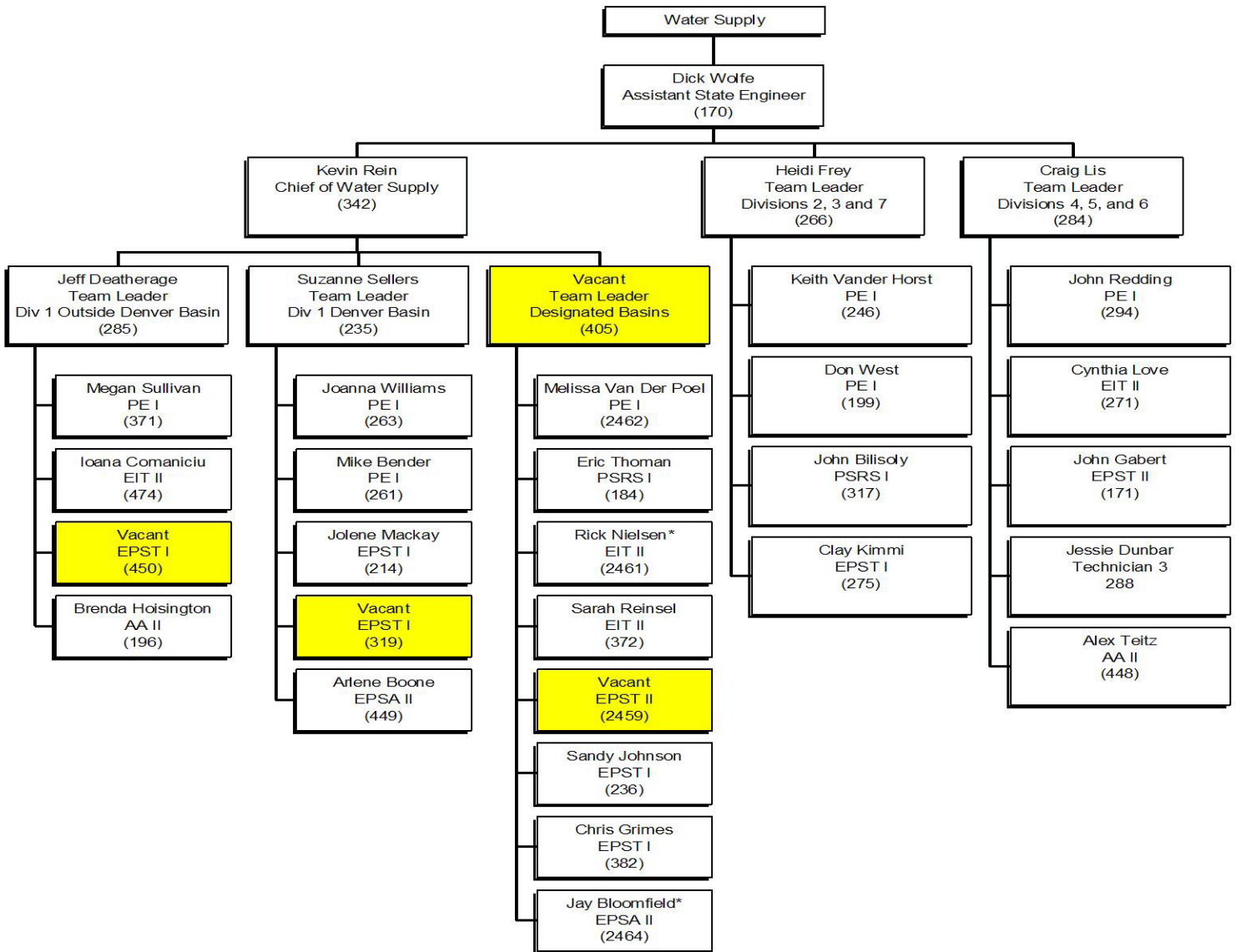
water court applications filed in 2005 and formal Statements of Opposition and Motions to Intervene filed on behalf of the DWR:

As depicted in the table below, the number of applications or cases filed in water court continued to decline for the third consecutive year.

Cases	2000	2001	2002	2003	2004	2005
1	265	346	441	527	468	394
2	153	151	189	119	148	113
3	44	45	61	60	41	25
4	250	318	349	345	236	314
5	307	443	510	443	345	362
6	86	146	143	132	67	83
7	100	121	138	129	118	108
Total	1205	1570	1831	1755	1423	1399

Personnel

- On October 10, 2005, Suzanne Sellers was appointed as the Team Leader of the Denver Basin Team, which would leave the Designated Basins Team Leader position vacant through the end of the year.
- Patrick Tyler left for a position with the hydrographic branch. Patrick's position was primarily involved with the issuance of well permits. This position remains vacant at this time.
- Hired Melissa van der Poel on February 7, 2005 as a Professional Engineer I in the Designated Basins Team.
- Rich Cooper, a Physical Scientist Research Scientist I, was killed in an auto accident on April 25, 2005.
- Promoted Eric Thoman to fill the Physical Scientist Research Scientist I position vacated by Rich Cooper in the Designated Basins Team.
- Kevin Rein was appointed Chief of Water Supply on September 1, 2005.
- Brenda Hoisington transferred from her position as receptionist to the position of Administrative Assistant for Team 1 on June 20, 2005.
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Geotechnical Services Branch

The Geotechnical Services Branch provides expertise in the disciplines of geology, hydrogeology, engineering geology, geophysics, well construction and satellite assisted surveying. The branch primarily responds to requests by internal or external customers, assisting in general investigations, ground water litigation, ground water data collection and reporting and technical assistance to the Board of Examiners and Groundwater Commission.

The Branch is currently fully staffed and consists of three geologists/hydrogeologist, five well inspectors, and a part-time data entry person. Dave McElhaney is Chief of the Branch, Michael Schaub is the Branch senior geologist, and Elizabeth Pottorff is staff hydrogeologist. Elizabeth was hired into the branch in July 2005 and comes from the Colorado Department of Public Health and Environment where she had been employed as a hydrogeologist since 1997. Jessie Dunbar assists the Geotechnical Services Branch and supports the Board of Examiners by reviewing and inputting data from more than 13,000 reports submitted annually for pump installation, well construction and well abandonment.

Enactment of Senate Bill 03-045 established a requirement for a well inspection program under the direction of the State Engineer. Because the program is developed primarily to support the enforcement efforts of the Board of Examiners and is closely associated with the support activities of the Geotechnical Services Branch, the Well Inspection Group has been assigned to the Branch. The association is working very well.

The following is a summary of work done by the Geotechnical Services Branch in 2005.

By the Numbers (approximate)

The following is a statistical summary of the branch activities.

General Investigations

The Branch is involved in a variety of geologic, geohydrologic and geotechnical studies and projects. The following provides a brief description of the key activities in 2005.

- Coal Bed Methane (CBM) – Dave McElhaney has assumed responsibility as the lead geologist in questions related to the development of coal bed methane and the aquifer/CBM relationship. A study of the potential effects of ground water pumping by CBM wells was commissioned by DWR in 2005, in cooperation with CGS and COGCC, and the draft report of the study results was reviewed in December.
- SPDSS - The Branch has provided water level data and geophysical log information to the state's ground water consultant in their data collection efforts and provided technical review of a series of maps produced from the data and associated reports to insure that geologic and hydrogeologic issues have been addressed.
- U.S.G.S. Modeling - The Branch has provided geophysical log information and data to the U.S. Geological Survey as it begins an effort to produce a new Modflow ground water model for the Denver Basin. It is anticipated that the Branch will provide some technical review of the model results.
- C.G.S. Mapping - The Colorado Geological Survey continues its interest and effort in describing the rocks of the Denver Basin that comprise the Denver Basin aquifers. The Geotechnical Services Branch will provide technical review of the products of the mapping efforts.

Ground Water Commission

The Branch continued to assist the Groundwater Commission through the monitoring of groundwater levels and technical support to the Commission and staff. A few of the activities that warrant highlight are presented below.

- Monitoring of water levels in over 1500 wells covering almost 3/4 of the state are done annually and published by the branch in a series 10 annual reports.
- The staff provided technical support to the well permitting staff. Michael Schaub evaluated well construction to determine aquifer intervals for approximately 577 final permits in the Southern High Plains Designated Ground Water Basin.

Denver Basin

- Denver Basin – The Geotechnical Services Branch remain involved with the Museum of Nature and Science concerning the depositional history of the Denver Basin and its relationship to the bedrock

aquifers. The branch continues to assist Mr. Bob Reynolds from the museum by providing water level information from the Denver Basin bedrock aquifers.

- The Branch has provided geophysical and water level information for several modeling efforts proposed for the Denver Basin. Ground water and subsurface modeling is currently being conducted by the USGS, Museum of Nature and Science, and the participants in the South Platte DSS effort.

Division Support

- Court actions were limited to general review of findings and performing geophysical log evaluations to provide site specific information for water court applications seeking final determinations of water rights.
- Well Permitting and Subdivision Review Assistance - work continues on a daily basis with these activities. The Geotechnical Services Branch routinely assists the permitting staff by reviewing the geology along the margins of the Denver Basin to determine aquifer boundaries.
- Michael Schaub will provide ground water hydrology expertise for the class for Well Tester Certification. The next class will be taught in conjunction with the participating Division offices in 2006.
- Michael Schaub and Elizabeth Pottorff have been the Division representatives to the Colorado Ground Water Protection Council.

Board of Examiners

- Complaint Investigations for Rules Enforcement - Dave McElhaney has spent much of his time working with the newly formed Well Inspection Group that is now receiving complaints and performing investigations to resolve complaints before the Board.
- Variances – Dave and Michael processed 178 requests for variance from the well construction rules during the year. In addition, the Branch performed several evaluations for proper well abandonment.

Well Inspection Program

The well inspection program was instituted for the protection of groundwater resources and public health through enforcement of the *Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation, and Monitoring and Observation Hole/Well Construction, 2 CCR 402-2*. Specific duties include inspection of water well construction and pump installation; monitoring/observation hole/well construction; well and hole plugging and abandonment; and to conduct complaint investigations; provide education and outreach; and general support of the State Engineer and Board of Examiners. The private well driller and private pump installer examinations formerly administered by the well inspectors in the Division offices were repealed from the statute upon adoption of SB 05-161.

Joe Bender resigned his position as Chief Well Inspector on March 1, 2005. Joe was instrumental in hiring and providing initial training and continued guidance to the well inspectors now located in Division 1-Denver (Tom Neefe), Division 3 (Larry Hakes), Division 5 (Doug Stevenson), and Division 7 (Doug Pickering). The well inspectors currently assigned to the field began their tenure with the Division in June and have rapidly become an irreplaceable asset to supporting the Board of Examiners. Mr. Nolan Lloyd was hired to fill the Chief Well Inspector position in late November 2005 and has rapidly advanced to become an integral part of the inspection and enforcement team. Nolan's vast experience and leadership in the program will become even more apparent in the following years.

A key focus of the well inspectors and the inspection program is to locate and initiate action against unlicensed contractors working illegally in the state. With regard to licensed contractors, the most frequent violation discovered by the well inspectors continues to be contractors drilling outside the distance limits allowed by the permit (usually 200 ft).

The Well Inspectors visited more than 2200 well sites during 2005. Nearly half of the inspections were conducted in Division 3 (943 inspections) which is fitting as the legislation that established funding and authority for the inspection program stemmed from the concerns of an individual who resides in the San Luis Valley. Well inspections were distributed across the state generally as follows:

Divisions 1, 2 and Designated Basins	370
Division 3	943
Divisions 4, 5 and 6	288
Division 7	606

Geotechnical Branch -Where We Are Going

- The Branch will continue cooperation with the the CGS mapping of parts of the Denver Basin and the Denver Basin bedrock aquifers ground water modeling effort by the USGS.
- Michael Schaub's will continue management responsibility of the water level monitoring programs and will begin modifying the programs as needed to replace monitoring sites that have been discontinued and to add new sites to provide better coverage.
- The Branch will continue to review and correct elevation and location discrepancies/anomalies in the geophysical log database and begin collecting specific well location information for many oil and gas wells that were included in the database during development of the Denver Basin Rules.

Hydrographic and Satellite Monitoring Branch

Introduction

The Hydrographic and Satellite Monitoring Branch provides accurate, high quality 'real time' stream flow data to support water rights administration. The Branch also develops historic streamflow records in coordination with other State and federal entities and the water user community. Hydrographers around the State operate and maintain a system of gaging stations on rivers, streams, canals, and reservoirs, perform streamflow measurements to maintain stage-discharge relationships at gaging stations, and maintain satellite monitoring equipment with goals of improving the quantity and quality of data used to manage and administer water throughout the State of Colorado.

The satellite-linked monitoring system (SMS) provides the Division of Water Resources, other State and federal entities, and the water user community with access to real-time streamflow data from gaging stations across the State of Colorado. These data and software systems provide for more effective and efficient water rights administration, water resource management, computerized hydrologic record development, and flood warning. The SMS allow the Division of Water Resources to collect, process, store, and distribute any kind of environmental data transmitted from remote locations. The data set of interest to the Division is the water level at rivers, streams, diversion structures, and reservoirs. The SMS converts these raw water level values into several "products" of use to various "clients." The "products" range from raw data passed on to other computer systems to the official Hydrographic Records of mean daily streamflows. "Users" include Division of Water Resources personnel and other water users wanting real-time flow data for water rights administration, computer systems performing other analyses, and the varied user community of State and federal agencies, municipalities, canal companies, attorneys, recreationists, and consulting engineers needing access to real-time stream flow data.

Staffing

Hydrographic staff are located in each of the 7 Division offices and in Denver. Denver staff include Tom Ley, Chief Hydrographer; Jana Ash, PE I, who provides Statewide hydrographic program support as well as operates and prepares streamflow records at several gages in Division 1; Dave Dzurovchin (retired in March 2005), and replaced by Patrick Tyler (hired in October 2005), Tech II, procures hydrographic equipment and supplies, repairs and maintains hydrographic equipment, helps compile the annual hydrographic streamflow record publication, and assists gaging station measurements and operation in the Denver area; and David Hutchens, Electronics Specialist III, who specifies and procures all electronic equipment for the satellite monitoring system, installs satellite monitoring equipment at gages, troubleshoots and diagnoses equipment problems, and performs electronic equipment repair (data collection platforms (DCP), transducers, shaft encoders, etc.) and maintenance. Hutchens provides technical support for the hydrographic staff, and conducts training on new and

existing equipment. Ten percent of his time is spent providing technical support to the USGS Lakewood field office, including training staff on new and existing equipment; bench repair of USGS-owned DCPs, shaft encoders, and water quality equipment; and troubleshooting problems at USGS streamgaging stations. This year he repaired 13 USGS stream gaging station sites and replaced 7 accubar sensors with accububblers. He also upgraded 3 USACE DCP's to high data rate.

Division 1 has 5 full-time hydrographers and two half time hydrographers. They are: Lead Hydrographer Bob Cooper, PE II, Lee Cunning, PE I; Merlin Friedrichsen, Tech II; George Sievers, Tech II; Russell Stroud, Tech II; Garver Brown (1/2 FTE), Tech I; and Steve Barrett (1/2 FTE), Tech I. In anticipation of retirements in Division 1 in 2006, cross training was provided to a number of non-hydrographic DWR employees who may help operate some gages, and/or apply for hydro positions: Clayton Kimmi (Groundwater), Mark Simpson and Bob Erosky and Jack Davis (Deputy Water Commissioners). We have also provided training opportunities for Patrick Tyler in his new position as a hydrographic technician in Denver. Several water commissioners in Division 1 are equipped with measuring equipment and make administrative measurements in their Districts.

Assistant Division Engineer, Bill Tyner, PE III, provided overall program leadership of the Division 2 Hydrographic Program during 2005. Division 2 hydrographic staff are: Lead Hydrographer, Brian Boughton, PE I; Hydrographic Engineer, Lou Schultz, EIT II; Anthony Gutierrez, Tech II, and Adam Adame, Tech II.

The Hydrographic Branch in Division 3 is staffed by four hydrographers. Staff include Lead Hydrographer Craig Cotton, PE II, who is also the Staff Authority on cableway design and safety, Scott Veneman, Tech II, who provides satellite monitoring support in Division 3 as well as Divisions 4 and 7, Stan Ditmars, Tech II, and Lee Conner, EIT. With the retirement of the Division 3 Division Engineer Steve Vandiver in August 2005, the Division 3 hydro staff were given a number of additional duties.

Jerry Thrush, Tech II, manages the Division 4 hydrographic program. Several water commissioners in Division 4 are equipped with measuring equipment and make administrative measurements in their Districts. Water commissioners Steve Tuck and Doug Wist perform measurements and provide record development support.

George Wear, PE I, is the lead hydrographer for the hydrographic program in Division 5. Water commissioners in Div. 5 help with various satellite monitoring and gaging station maintenance duties, with one water commissioner working up one published record each year and performing occasional stream flow measurements. A new part-time hydrographer position has been approved for Division 5 and this PE I position should be filled in 2006.

The Division 6 hydrographic program consists of one part-time hydrographer, Erin Light, PE I, whose other duties are acting as the Assistant Division Engineer. Three water commissioners have hydrographic equipment however this equipment is not often used and commissioners often request that the hydrographer make measurements for them.

The Division 7 hydrographic program is lead by Scott Brinton, PE II, who is also reviews all western slope records for final signoff. A new position for an Engineer in Training for the Division 7 office was funded starting in the 2004-2005 budget. The position is to assist in numerous engineering tasks, including hydrographic duties, in the Division 7 office. Cheston Hart was hired for the position and

started his duties in the Division 7 office in May 2005. Several water commissioners in Division 7 are equipped with measuring equipment and make administrative measurements in their Districts.

Gaging Station and Hydrographic Operations

There are a total of 2 satellite monitoring gaging stations monitored by Division 1 hydrographic staff. DWR owns and operates the satellite and gaging equipment at 98 of the sites. Division 1 staff operate and maintain gages and DCPs at 22 sites where the DCP is owned by a cooperator. Division 1 staff operate and maintain gages at 39 sites where the DCP is owned and operated by a cooperator. This makes for a subtotal of 159 sites where Division 1 staff are responsible for measurements, rating maintenance and streamflow data. Division 1 staff perform monitoring only at 56 of the 215 total SMS sites.

There are a total of 165 satellite monitoring gaging stations monitored by Division 2 hydrographic staff. Of these, 86 sites are gaging stations where Division 2 hydrographic staff have operation and maintenance responsibility. Of the 86, streamflow records are prepared at 49 sites. The remaining 77 are sites operated and maintained by other agencies, primarily the USGS, where the Division 2 staff perform monitoring only, but are sites where, as needs arise, check measurements are performed.

In Division 3, 76 gages with satellite telemetry are maintained, which includes 52 stream-gage record stations, 6 stream-gage administrative stations, 11 stream-gage diversion stations, and 7 reservoir stations. One of the reservoir stations also transmits outflow data for 1 additional stream-gage administrative station. Of the 76 gages with satellite telemetry, 2 of them also have phone line telemetry. An additional stream-gage administrative station that doesn't use satellite telemetry, but is equipped with phone line telemetry is maintained. DWR owns the data logger / transmitter equipment at 65 of these stations.

Division 4 has 21 satellite gages. Streamflow records are prepared at 7 of these locations. Division 4 is closely associated and cooperates with the USGS at four additional gages. They have historically owned and maintained several DCPs in USGS gages. These have been taking less and less attention directly proportional to their administrative importance. Division 4 cooperates with the US BOR at three sites including two gages and one reservoir.

Division 5 operates and maintains 28 DWR satellite stations used for administrative and hydrographic record purposes, including 3 satellite monitoring streamflow stations for the Colorado Water Conservation Board. They also actively monitor 43 additional gage stations that are operated by other entities in Division 5.

Division 6 operates 12 active stream gage sites in the Yampa, White, and North Platte River basins. Of the twelve, ten are equipped with satellite monitoring. Of these, two transmit reservoir water surface elevation, six transmit stream flow gage height, and two transmit both parameters. The remaining two gages are equipped with chart recorders and/or a data collection platform (DCP) to record gage heights.

Division 7 operates 35 satellite gages, 19 of which have been upgraded to high data rate (hourly) transmissions. Streamflow records are prepared at 23 of these sites.

Streamflow Measurements

Hydrographers, water commissioner/hydrographers and water commissioners across the State made over 3390 measurements in 2005 in streams, rivers, canals and ditches (Table 1). These measurements were used to check and update stage-discharge relationships at gaging stations and in canals and ditches in support of real-time water administration decision-making and in support of historic streamflow record development.

Table 1. Streamflow measurements made in 2005.

Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7
1110	619	1100	140	103	109	209

Jerry Thrush in Division 4 was involved in a pilot acoustic Doppler current profiler (ADCP) program funded by the CWCB. They provided a 2 MHz StreamPro ADCP in April 2005. Jerry gained valuable experience in the field operation and office post-processing of data files. This device has proven to be a valuable tool. It has been found to increased ability to make additional canal measurements, and this has given better service to water commissioners. The number of administrative measurements on several local canals has more than doubled. The StreamPro has been upgraded to the deeper profiling mode and the section-by-section mode. The factory supplied slow and shallow mode has also been installed. The deeper profiling mode has been used and allows the deeper water at Redlands Canal to be measured by one person.

Jerry Thrush was also the recipient of a 1200 KHz Rio Grande Work Horse Acoustic Doppler Current Profiler (ADCP) purchased by the US BOR for use in flow measurement on Redlands Canal. This unit is capable of measuring swifter and deeper flows than the StreamPro.

Streamflow Records

A total of 231 streamflow records are being prepared for publication in WY2005 (Table 2). Of these, 35 records will be published by the USGS Colorado Water Science Center in their annual streamflow data report for WY05, and the New Mexico office of the USGS will publish four. Division 4, 5, 6 and 7 record checking and review is now conducted among those Division offices, under the leadership and final signoff authority of Scott Brinton, PE II, Division 7.

Beginning in 2006, two more seasonal records will be published in Division 5: a winter record for Snake River at Keystone and a summer record for West Divide Creek near Raven. The backlog of Division 5 gaging station discharge records was nearly completed in 2005, and will be wrapped up in 2006. Temporary employee Ed Wilson, Water Commissioner Steve Pope, and Chief Hydrographer Tom Ley deserve much of the credit for completing this project.

Table 2. Streamflow records for WY2005.

Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7
74	49	61	7	10	7	23

New Gaging Stations

Several new gaging stations were added to the satellite monitoring system in 2005. Typically new gages are added as the result of the identification of a critical water administration need. Existing gaging stations, not previously on the SMS, are also often candidates for adding satellite equipment where water administration needs have increased. Gage cooperators pay the capital costs associated with these new or upgraded stations. Annual maintenance agreements with cooperators on these gages are also entered into.

Division 1 established new gages at the following sites and for the purposes indicated:

- South Platte River at Atwood—SPDSS funded gage.
- Prewitt Reservoir Outlet sites (3 sites on same DCP)—to support water administration in District 1
- St. Vrain Creek near Hygiene—to support water administration District 5
- Guanella Reservoir Outflow and Stage (2 Sites on same DCP) to support water administration Dist. 5
- Guanella Reservoir Inflow—City of Golden water exchange
- Prewitt Reservoir Inlet— to support water administration in District 1, successful radio link test

Division 2 added the following new gages:

- Purgatoire River at Thatcher: The Army Corps of Engineers provided funding to the USGS for the operation of this gage, however, in 2005 the Corps was unable to fund the operation of the gage and the USGS had to drop it from their program. In April 2005 Division 2 took over the operation of the gaging station as required by decree. In October 2005 the USGS found a cooperator and resumed operating the gage.
- Huerfano River at Badito: In May 2005 Division 2 entered into an agreement with the Huerfano Water Conservancy District to gage stream flows on the Huerfano River at Badito.
- Buffalo Ditch: In May 2005 satellite-monitoring equipment was installed on Buffalo Ditch in an effort to ensure Colorado's compliance with the Colorado/Kansas compact.
- Center Farm Augmentation Station: Division 2 designed and provided construction oversight of the Center Farm Augmentation Station. Lower Arkansas Water Management Association (LAWMA) and the Colorado Division of Wildlife cooperated in the construction of the new 5-foot Parshall Flume and satellite monitoring equipment. The existing flume was abandoned as a measuring device and the new Parshall Flume will be used to measure and record augmentation water from the Lamar Canal and to ensure Colorado's compliance with the Colorado/Kansas compact.
- Cascade Creek near Cascade: In November 2005 Division 2 entered into an agreement the Cascade Metropolitan District to monitor stream flows through a 2 ft Parshall Flume on Cascade Creek.

There were no new gaging stations added to the satellite monitoring system in Division 3 in 2005.

There were no new gaging stations added to the satellite monitoring system in Division 4 in 2005. Division 4 staff have met with the Uncompahgre Valley Water Users Association and Tri-County Water Conservancy District to discuss installing and operating a gage on Cow Creek with them paying for the construction and satellite equipment. They have also met with the Colorado Division of Wildlife and a contractor. The contractor had submitted plans for a ramp flume to the two groups and we are waiting to conduct further negotiations.

Division 5 added a new satellite monitoring station at the Multa-Trina Ditch in District 45. In addition, a new staff gage station was added on the Crystal River at the DOW Hatchery for in-stream flow monitoring. In 2006, Division 5 will begin operating the West Divide Creek near Raven station, formerly operated by the USGS.

Division 6 re-installed a new gage station in mid-April of 2005 that was once operated and maintained by the USGS. The gage station is located on the Williams Fork River just upstream of its confluence with the Yampa River. The gage is located on Peabody Coal Property (Peabody) and an easement agreement was made with Peabody. The gage consists of an Accubar system connected to a high data rate Sutron SatLink2 Logger with satellite telemetry housed in a metal shelter. A Sutron shaft encoder and high data rate Sutron Satlink2 Logger with satellite telemetry were installed in mid-April 2005 at the Pot Creek at Stateline station. This equipment was installed for use as the primary data collection with the original paper recorder left at the site for backup.

There were no new gaging stations added to the satellite monitoring system in Division 7 in 2005.

Gage Refurbishment Projects

The Hydrographic Branch continues to refurbish and maintain our existing gaging sites that are not designated as critical flood sites, but are extremely important for our primary purpose of water administration. Gage refurbishment funds amounting to \$55,000 were received from CWCB for this purpose. These funds along with a portion of our General Fund appropriations were used to carry out several refurbishment projects.

In Division 1, the concrete control was extended 8 ft into the stream bank to prevent water from eroding the bank and causing the control to fail, and a bank-operated cableway was installed at the Bear Creek at Morrison gaging station. A bank-operated cableway was installed at the St. Vrain Creek at Lyons gaging station. The stilling well inlet pipes at the South Platte at Henderson gage were extended 40 ft into the channel to try and keep the stilling well from becoming isolated during periods of low flow. Satellite equipment was re-installed at the Berthoud Pass Ditch gaging station. A new shelter was constructed and installed at the St. Vrain Creek below Lyons gage. DWR paid to have the large Parshall flume from below Antero Reservoir moved to a storage location. This flume will be sandblasted, painted and re-installed, possibly on Tarryall Creek.

In Division 2, a new control, a compound Cipolletti/broad-crested weir, was installed at Horse Creek at Highway 194. The installation of satellite monitoring equipment at 8 sites over the winter 2004 and spring 2005 on Fountain Creek in District 10 was completed. Channel work to remove silt and vegetation around the stilling well at Muddy Creek below Muddy Creek Dam near Toonerville, CO was completed. Other refurbishment work included installation of handrails down the steps to the

Arkansas River at Granite gage shelter; replacing the satellite monitoring equipment shelter at Consolidated Ditch at Riverdale; work on the antenna mounting bracket for satellite monitoring equipment at Pueblo Reservoir; and putting a new coat of paint on several stream gage shelters.

In Division 3, Trinchera Creek above Turners Ranch gage was replaced this year. A new concrete well, inlets, and an exposed aggregate gage house were installed. The project also included the installation of a rock weir. The A-frames for the cableway at Rio Grande above the mouth of Trinchera Creek gage were replaced. A new rock weir was installed at the Wild Cherry Creek near Crestone, CO gage. New inlets were installed at Willow Creek near Crestone, CO and Spanish Creek near Crestone, CO. The existing control at Culebra Creek near Chama CO was rebuilt after some damage from high flows this spring. A new HDR data logger / transmitter system was installed at Sanchez Reservoir, where there was no previous satellite system. This system included an Accubar pressure transducer and nitrogen bubbler system to monitor the reservoir elevation.

In Division 4, the Redlands Canal Fish Screen Project necessitated moving the gage to a new site. The relocated gage went on line on April 1, 2005 when the canal came back on for the season. Under this project the BOR gave us a 1200 KHz Rio Grande Work Horse Acoustic Doppler Current Profiler (ADCP). This included a Trimble GPS unit and an Ocean Science Riverboat. They, also, supplied a Sutron AccuBubble at the gage. We cooperated with the USGS at this same site with a Son Tek Acoustic Doppler Velocity Meter (ADVM). The channel was dressed and smoothed of debris/large boulders, the shelter was designed, fabricated and installed. Three different water commissioners and a well commissioner were drafted into service, as well as USGS personnel and Redlands Canal staff and equipment at various times. We used an expanding compound to break a large boulder in the channel. Holes were drilled in a line along a fracture; the compound was mixed with water and poured into the holes. This produced a clean break without requiring use of explosives near a populated area.

The ramp flume at Muddy Creek below Paonia Reservoir received warranty repair to armor around the wing walls before last year's spring run off. High spring run off caused the ramp flume at Roubideau Creek to sustain cutting around the right wing wall. This is on the schedule to have repairs done before the next spring run off.

The orifice line at Vouga Reservoir had to be patched twice last year. The water level dropped enough to expose it to the atmosphere and some sort of varmint with sharp teeth chewed on it. It has been placed inside ¾-inch schedule 80 PVC conduit. There was a problem with the bubbler building pressure toward the end of the irrigation season. This may indicate that the end may have sunk into the mud. These two factors indicate a need to replace the orifice line and reposition the end next spring.

Vandalism occurred at Razor Creek above Vouga Reservoir and at Roubideau Creek at the Mouth near Delta. The solar panel and the GPS antenna were taken at RAZAVUCO. Scott Veneman helped with the replacement / repair on Razor Creek. The solar panel at ROUDELCO was shot to pieces.

In Division 5, a new low-flow control, a rock weir in the shape of a "W" was designed for the Snake River at Keystone station and constructed by Vail Associates, Inc. The purpose of the weir is to improve the sensitivity of the rating in the low-flow range, around 6 cfs, when minimum instream flow considerations arise.

In 2005, Division 6 requested and obtained four Sutron 8200 DCPs that were being replaced with high data rate DCPs. One of the four DCPs was installed in May 2005 at the Bear River below Bear Lake

station. The paper recorder once used at this site was removed. The program is planning on replacing the existing 12-inch stilling well below Steamboat Lake on Willow Creek. Presently, the well is hydraulically connected to the stream channel via a pea gravel layer extending from the well to the channel. The new well will be larger in size to better accommodate equipment (shaft encoder) and will have an intake pipe extending from the well to the channel.

Several gages in Division 7 were upgraded with new grounding systems during 2005.

High Data Rate Data Collection Platform Upgrade Project

The high data rate (HDR) data collection platform upgrade project continued this year. CWCB funding in the amount of \$248,000 was received in support of this ongoing activity. Included in this funding is the cost of the replacement data collection platforms plus upgraded shaft encoders and grounding systems. Often, gage power supply equipment (batteries, solar panels, charging regulators) and antennas also need upgrading along with the new DCP. A total of 65 State of Colorado DWR-owned data collection platforms were upgraded in 2005 from satellite transmissions once every 4 hours at 100 bps to hourly satellite transmissions at 300 bps. Currently 65 percent, or 260 out of 400 State of Colorado DWR data collection platforms, have been upgraded to high data rate.

In Division 1, 20 gaging stations were upgraded with DCPs having high data rate GOES radio transmitters (300 baud rate, hourly transmissions) in 2005.

During 2005, six gaging stations in Division 2 were upgraded with SatLink DCPs and high data rate GOES radio transmitters (300 baud rate, hourly transmissions). The upgrades at all of these sites required installation of SDI shaft encoders and upgraded grounding equipment.

In Division 3, seven stations were upgraded to high data rate transmitter/loggers this year. Three of these stations belong to Colorado Division of Wildlife, so DOW provided the HDR equipment. The other four belong to DWR. This brings the total number of DWR owned HDR systems in this division to 36. Since there are 65 stations with DWR owned satellite telemetry, the upgrade phase is over half complete. There are 11 stations with satellite telemetry owned by other entities. Only 3 of these have been upgraded to HDR.

In Division 4, HDR replacements for this year included four Sat Link Loggers and one 8210 for a total of five DCPs and six gages. David Hutchens spent three days on these and helped with trouble shooting at another site. This leaves only one low data rate DCP left in Div. 4. This is at Taylor Park Reservoir, where the equipment is owned by the BOR and DWR maintains it. This DCP is scheduled to be upgraded to HDR the third week of April 2006 with help from US BOR personnel. David Hutchens upgraded five SDI-12 shaft encoders last year. These were all installed before the irrigation season.

In Division 5, high data rate transmission upgrades were made to several satellite monitoring stations in 2005, including Vidler Tunnel and the West Divide Creek near Raven gaging stations. A stage-discharge recorder was installed at Chapman Gulch near Norrie as a backup logging device when a winter-long power outage compromised the USBR data logger.

Division 6 has four gage stations equipped with High Data Rate (HDR) equipment and has two gages scheduled for upgrade to HDR in the summer of 2006. Two HDR Sutron SatLink2 data loggers were

installed in 2005; one at the Williams Fork at mouth near Hamilton station and one at the Pot Creek at Stateline station.

In 2005, DCPs at fifteen gages in Division 7 were upgraded with high data rate radios that transmit on an hourly basis.

Flood Hardening Projects

Flood hardening of gaging stations, which might involve moving gages to higher ground, installing redundant gage height sensors, bank stabilization and protection, rating extensions, improved high flow measurement capability, or some other means of fortifying gage stations to enhance data collection and processing during flood events, continues to be one of our top priorities. The CWCB provided \$50,000.00 funding this year for the continuation of flood hardening projects.

In 2005, Division 1 worked on three gage flood hardening projects. Work was undertaken to replace the stilling well inlet pipes at the Big Thompson at the Canyon Mouth gage. During excavation a large void was found near the gaging station that extended under the highway shoulder. The project was terminated and the void was pumped full of concrete with the assistance of CDOT. A project to install satellite telemetry at Seaman Reservoir was completed. A new control was installed at the Bear Creek above Evergreen gaging station.

In Division 2, the refurbishment of the concrete control section and installation of a new gage shelter at the new location of the Lake Creek above Twin Lakes gaging station was completed using flood hardening funding in 2004. Satellite monitoring equipment was installed in the Spring of 2005 and the gage station at the old location removed. The new location has a bridge over the measuring section for high flow measurement that has been strengthened. A 4-wheel bridge crane was modified to fit the width of the bridge.

In Division 3, the gage for Alamosa Creek below Terrace Reservoir was replaced in March. Flood hardening monies were used to pay for the installation of a concrete well, all new inlets, and an exposed aggregate gage house. The cableway at this location was also replaced with a bank-operated cableway.

Division 4 was scheduled to install a bank-operated cableway at Surface Creek nr. Cedaredge in November 2005, as the final phase of the flood-hardening project, but snowfall prevented access for concrete trucks. This project is postpone until Summer 2006. The cableway apparatus has been purchased. Installation will include repair to the bridge abutment upstream of the gage due to really high spring (2005) runoff. The bank-operated cableway will be relocated upstream from the original planned location.

Divisions 5, 6, and 7 were not involved in any flood hardening projects in 2005.

Alert System

The DWR Flow Alert System was successfully upgraded in 2005. The system compares measured data (gage height, discharge, or any other parameter) from remote gaging sites against the alert criteria (threshold values) set up by DWR/CWCB users. Alert criteria choices include high flow alarm, low

flow alarm, or rate of change alarm. The system then contacts the users of a current alarm via e-mail, phone, or pager.

Upgrades that were added and have been in working order are:

- Allow handling of data from any source (DWR, USGS, NCWCD, and others)
- Allow use of self-timed or random data transmissions for alarm setup
- Remove the need to program the DCP's in the field unless desired
- Allow alarm for any station parameter (gage height, discharge, etc.)
- Provides automatic change of threshold values based on the time of the year (primarily for low flow alerts)
- Allows setting of threshold values using flow in addition to gage height
- As before, provides accurate data in near real time

The CWCB has added 167 new low flow alerts using numerous time frames and 149 new high flow alerts to their subscription. We are now up to 30 users, and users are very satisfied.

Training

Twenty-one DWR Hydrographers and Water Commissioners participated in a one-day Swiftwater First Responder training course on May 24, 2005 at the Arkansas Headwaters Recreation Area (AHRA) Visitor Center in Salida CO. The Swiftwater First Responder training course uses a curriculum developed by Rescue 3 International, a world leader in water and flood rescue. Rescue 3 International certified instructors for the course were Stew Pappenfort, AHRA Senior River Ranger, and Kevin Bird, Colorado Springs Fire Dept. This one-day class was designed to familiarize participants with the dangerous conditions that can exist while measuring streamflow, and the steps to be taken to keep oneself safe. The course was broken into two half-day sessions: the first four hours were spent in a classroom setting, while the second half was spent enjoying the 45-50 °F, 1520 cfs flow of the Arkansas River in downtown Salida.

The Annual Hydro Fall Training Meeting was held at the Hot Springs Lodge in Glenwood Springs, September 20-23, 2005. Twenty-seven DWR staff attended. Topics included updates on using Acoustic Doppler techniques and instrumentation for stream flow measurement, USGS methods for running levels at gaging stations, an overview of new satellite equipment (DCPs, shaft encoders, etc.), making cableway measurements, bank-operated cableways, and an update from IT on status and plans for hydro/satellite monitoring system upgrades. A half-day session concentrated on winter measurements and development of winter streamflow records. Safety training included a session on confined space hazards and working in stilling wells, and cableway safety and inspection.

Two DWR hydrographers, Jerry Thrush and Brian Boughton, attended a week-long USGS training on basic acoustic Doppler current profiler measurement methods (SW1321: Streamflow Measurements using ADCP's). Jerry made two required ADCP measurements after the class for review by the course instructors. He brought his StreamPro to Division 2 to help Brian Boughton make the two required measurements for the class. Both are now certified to make and check ADCP measurements for streamflow record purposes.

Jerry Thrush participated in about nine-one hour classes on ADCP measurements presented by RD Instruments *via* their interactive WebEx Internet presentations. The first of these started in February of 2005. Jerry received a day of personal training for the Rio Grande Workhorse ADCP on May 11, 2005 from Dave Dalkin of RD Instruments. He hosted training on the Stream Pro the next two days in Montrose by Dave Dalkin. Hydros from Div 1, 3, 4, 5, and 7 attended the StreamPro training.

Miscellaneous Activities

Streamgaging cost study: The Hydrographic Branch participated in a streamgaging cost study and comparison with the USGS Colorado Water Science Center. The average cost to operate and maintain DWR gaging stations was determined by dividing DWR total funding for the Hydro Branch by the number of gages and by use of a detailed cost spreadsheet developed by the USGS. An inventory of DWR satellite monitoring gages found 433 total streamflow and reservoir gages on the network (400 streamflow gages and 33 reservoir gages). Total State FY2005 funding to operate the 400-streamflow gage network was estimated at \$2,807,400. This includes costs of personal services for all field staff, supv./admin staff, and IT staff; vehicle O&M; vehicle lease cost; prorated office space costs; prorated office supplies costs; SM general fund allocation exclusive of personal services; SMS cash fund spending authority; CWCB DCP replacement and gage refurbishment allocation; and estimated IT infrastructure costs. The average cost per gage is \$7018.

Table 3 presents the streamgaging costs results based on the USGS detailed cost spreadsheet. Average cost per gage is given in several subcategories and in total. The total cost per gage of \$7231 compares reasonably well with the above amount. The primary differences between the two average per gage costs are attributed to:

- 1) the spreadsheet uses the average DWR field staff salary plus benefits to compute labor costs for field and office work. DWR field staff salary distribution is skewed, with more field staff salaries being less than the average. Thus, the spreadsheet estimates of labor costs are high.
- 2) DWR does not spend an average cost per year per gage of \$1150 x 400 = \$460,520. Actual gage expenses from the SM cash fund, general fund and CWCB construction fund were around \$403,800 in FY2005

Table 3. Annual DWR streamgaging cost per gage using USGS spreadsheet.

Cost Category	Cost/gage/yr (\$)
Administrative	575
Building and utilities	133
Field Equipment	1,151
Labor for field and office	4,566
Vehicles	311
Travel	54
Data Management and Delivery	440
One-time installation-decommission	0
<i>Total</i>	7,231

Div 1: Division 1 reached an agreement with the USBR concerning how to handle discrepancies in flow balances in the CBT system. The State provided a new rating on Olympus Tunnel. The USBR built a new measurement bridge on Adams Tunnel so that better measurement conditions exist for further study of that flume's operation. Flume inspection work resulted in complete reinstallation of poorly designed measurement devices on the Farmers Independent Ditch (by Central Water Conservancy District) and the Greeley No. 3 Ditch (By the City of Greeley and others). A design agreement was also reached on a new stilling basin for the flume below the Wray Fish Hatchery (CDOW). Greeley Hydrographers received training on the use of an Acoustic Doppler Current Profiler (ADCP) from Jerry Thrush of Montrose. An in-place ADCP was installed by CDOW as a primary measurement device for a submerged diversion point in District 1. We provided advise on its use and expect further requests in the future as it appears to be the only solution for measurement in flat ditches. Russell Stroud continues to provide support to water administration in the creation of discharge records from the many new data loggers that are being installed as part of the new SWSP's . He and Lee Cunning have developed new spreadsheet tools that facilitate this process.

Div 2: Inspections and flow measurement checks were made on several augmentation stations in Water Districts 11, 38, 17 and 67. Stream and reservoir gaging activities were routinely coordinated with the USGS Pueblo Subdistrict office, the US Bureau of Reclamation, and the US Army Corps of Engineers and other State and federal agencies during WY2005. Div 2 hydrographic staff have assisted in miscellaneous lysimeter construction activities at the CSU Rocky Ford Experiment station, and are actively performing maintenance of 7 CoAgMet weather stations in the lower Arkansas Valley. Several measurements were made at different gage heights to develop a new rating curve of an existing 8-foot Parshall Flume for the City of Colorado Springs sewer treatment plant. The National Weather Service has provided 13 tipping bucket rain gage sensors to Division 2 during the last two years. Seven were installed at existing steam gage locations in 2005. The remaining six will be installed in 2006.

Div 3: The National Weather Service provided four more tipping bucket rain gauges to be installed and interfaced to DWR data logger / transmitters at Division III gages this year. These rain gauges were installed at Conejos River near Mogote, La Jara Creek near Capulin, Ute Creek near Fort Garland, and La Garita Creek near La Garita, bringing the total number of rain gages at Division 3 gaging stations to eight.

Div 4: Jerry Thrush assisted the USGS in making two measurements with the Rio Grande ADCP during the spring runoff. This cooperation was coordinated to gain training and experience, as well as help the GS cover their responsibilities during a limited window of opportunity. During an attempt to make a third measurement the Riverboat No. 454 took a nosedive and went completely submerged. The frame on the tri hull boat failed and the equipment was lost. It lodged on a debris island about ½ mile down stream. A river guide to recover the equipment used a kayak. The Ocean Science Company replaced the boat with a strengthened frame and an equipment safety cable. Jerry also assisted the US BOR with a velocity study in and around the new fish screen on the Redlands Canal to study silt build up in their new structure. The Rio Grande ADCP was used and an additional six single point velocities were collected in addition to several partial flow measurements inside the screen and some full measurements above the shunt pipe.

Div 5: Transit loss analysis for several transdistrict and transbasin diversions into District 45 was conducted in 2005. This imported water has to travel many miles in sometimes dry natural channels before reaching the final diversion points on Divide Creek. Streamflow measurements were made in

order to estimate transit losses for these imports. Several new satellite monitoring contracts with water users were signed in 2005, including contracts for the City of Golden (Vidler Tunnel) and the Multa-Trina Ditch Company (several stations in District 45). Two more cooperators have promised to contribute to the operation of the Snake River at Keystone station for 2006.

Div 6: Erin Light made a number of discharge measurements were for a stream flow gain/loss investigation that Division 6 is conducting on Elkhead Creek between its confluence with the Yampa River upstream to Elkhead Reservoir.

Div 7: A large number of measurements were made to calibrate the ramp flume constructed on the La Plata River at Hesperus several years ago in an effort to redefine the upper end of the rating table. The effort was not very successful due to the extremely high flows encountered. Trash and debris on and below the ramp flume control and the high velocity of the flow below the flume impeded any accurate measurements.

Board of Examiners for Water Well Construction and Pump Installation Contractors

n Article 91 of Title 37, the Colorado legislature created the State Board of Examiners of Water Well Construction and Pump Installation Contractors under the Division of Water Resources in the Department of Natural Resources. The Board consists of five members, one of which is the State Engineer who has historically provided staff to support the activities of the Board and to assist the Board in the efficient and effective discharge of its duties and responsibilities. In 2003, the legislature passed Senate Bill 03-45 authorizing an increase in well permit fees and authorizing the creation of a well inspectors program (section 37-91-113, C.R.S.). During 2004, the State Engineer hired a Chief Well Inspector and four Well Inspectors to monitor compliance with applicable statutes and the Water Well Construction Rules adopted by the Board. In addition to the Well Inspectors, several DWR employees in Denver, as well as Water Commissioners and Division office staff, contribute to supporting the activities of the Board.

Entry of data from well construction reports, pump installation reports, and well abandonment reports required by the Board continues to be accomplished by Jessie Dunbar who also shares his time supporting the permitting section. Data entry of well construction, pump installation, and well abandonment information continues to be kept current by Mr. Dunbar's efforts. Mr. Dunbar also identifies potential well construction and/or pump installation deficiencies and forwards the information to the Well Inspection Branch for further investigation.

General Support

Activities of the support staff are focused in three general areas: complaint/enforcement actions, variances from the requirements of the Water Well Construction Rules, and licensing of well construction and pump installation contractors. In addition to these functions, the Staff provides technical and professional assistance to the Board in the development of its administration rules, construction rules and associated Board policies. The Staff also reviews and presents to the Board new technology developed in the well construction industry, coordinates the activities of the Board with the objectives and requirements of the Division of Water Resources and other agencies, disseminates information to contractors, and provides education and general information concerning the Board's activities in a variety of public forums.

License renewal for 2006 will mark the first year that each contractor licensed by the Board of Examiners will be required to submit a Certificate of Completion listing the accredited continuing education (CE) courses or programs attended by the contractor between June 2004 and January 2006. The staff is active in reviewing and recommending accreditation of proposed CE courses for contractor's compliance with section 37-91-105(7), C.R.S. Criteria for accreditation were determined in conjunction with the Colorado Water Well Contractors Association (CWWCA). The Board established an accreditation committee composed of staff, a CWWCA representative, and a Board member to ensure the timely review of applications for course accreditation. Thirty-seven courses were accepted for a total of 198½ accredited hours of continuing education during the initial CE period.

Complaints and Enforcement Actions

The State Engineer's Well Inspectors and Staff supporting the Board of Examiners are responsible for the investigation of complaints that allege well construction or pump installation that violates the provisions of Article 91 of Title 37, C.R.S., and/or the Water Well Construction Rules. The investigations often result in bringing the issues before the Board of Examiners for resolution, while staff actions authorized by the Board resolves other issues. The well inspectors and staff also conduct "follow-up" actions to ensure that contractors and well owners are complying with Orders of the Board, including pursuing a judicial remedy if necessary. The staff works closely with the Attorney Generals Office to accomplish these tasks. Credit for successful resolution of issues in the judicial arena goes to Amy Stengel of the Attorney General's office.

The following is a summary of complaint/enforcement actions brought before the Board or resolved by the Board or support staff during calendar year 2004.

New Complaints Investigated.....	82
Complaint Type: Construction violation.....	22
Permit violation.....	33
Unlicensed contractor.....	22
Illegal use of license.....	3
Order to Fix or Plug.....	2
Complaints Resolved.....	67
2003/2004 complaints resolved in 2005.....	22
2005 complaints resolved	45
Resolution/Action: Dismissed, withdrawn, discontinued, or otherwise resolved.....	24
Complied with Order.....	4
Fines.....	36
Letter of admonition/reprimand/fine.....	1
Suspension or revocation.....	2

In addition, the staff processed 178 requests for variance and infiltration gallery plans. The staff reviewed 7458 completion reports, 4067 pump installation reports, 2033 abandonment reports, and more than 2000 well owner completion notices.

Licensing

The Board licensed a total of 309 contractors in 2005, including 12 new contractors. Gina DeArcos coordinates the licensing activity of the Board by scheduling and administering written examinations, assembling test scores, and scheduling oral examinations before the Board. Gina is responsible for providing licensing information to persons interested in obtaining a contractors license and assembling, mailing and subsequently processing more than 300 packets of information annually for renewal of contractor licenses.

License renewal for 2006 marks the first year that each contractor is required to obtain a minimum of eight hours of continuing education (CE) for license renewal. Gina has been instrumental in tracking and providing information concerning the CE programs accredited by the Board and available to the contractors for meeting the CE requirement.

Education and Outreach

The staff continues to work with the Colorado Water Well Contractors Association (CWWCA) to provide information to the licensed contractors. This is accomplished by individual outreach through mailings, CWWCA newsletter articles and examination preparation workshops. Staff participates at the annual conference of the CWWCA and is available for discussion and instruction on permitting issues and construction standards at the conference.

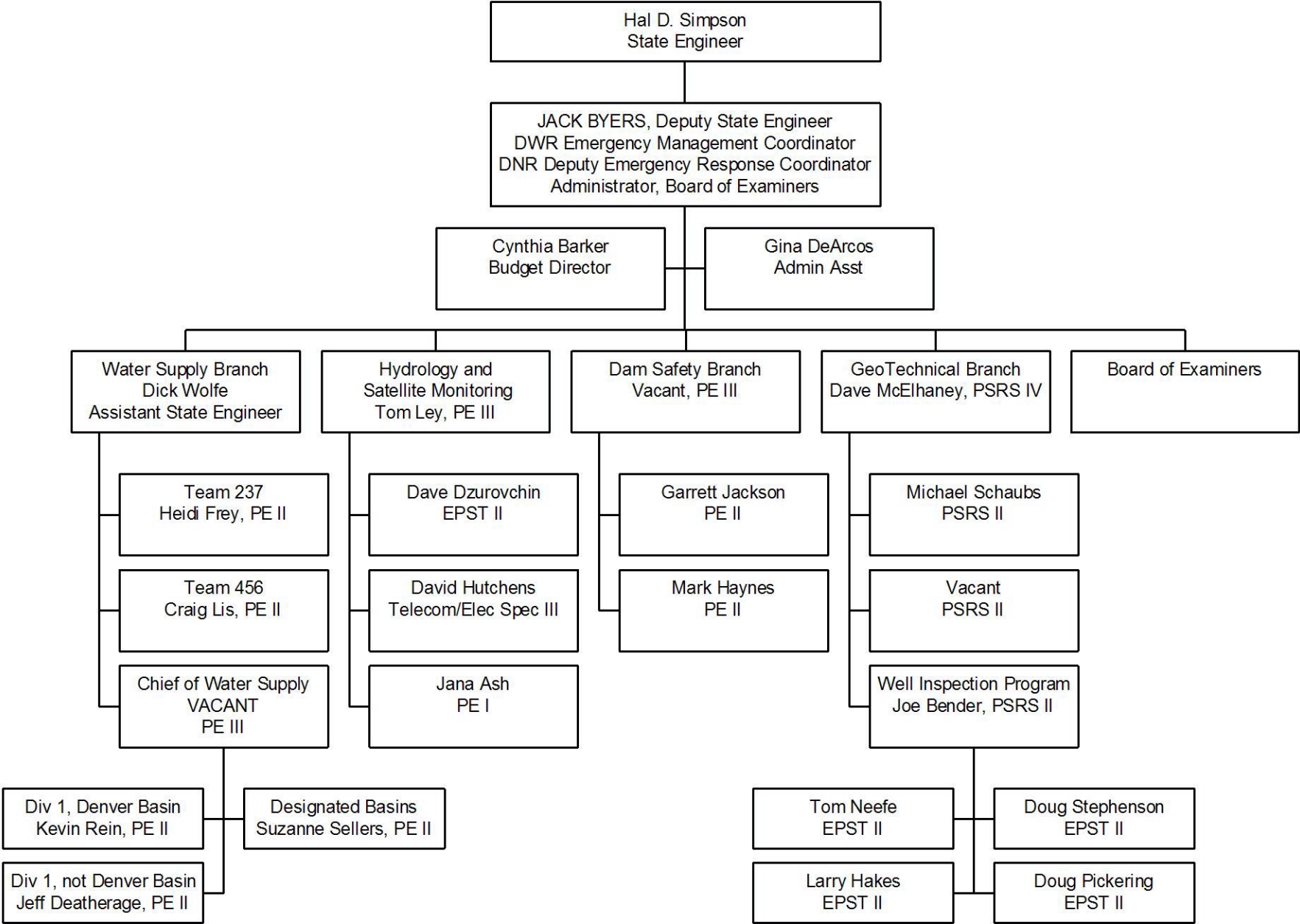
Well Inspection Program

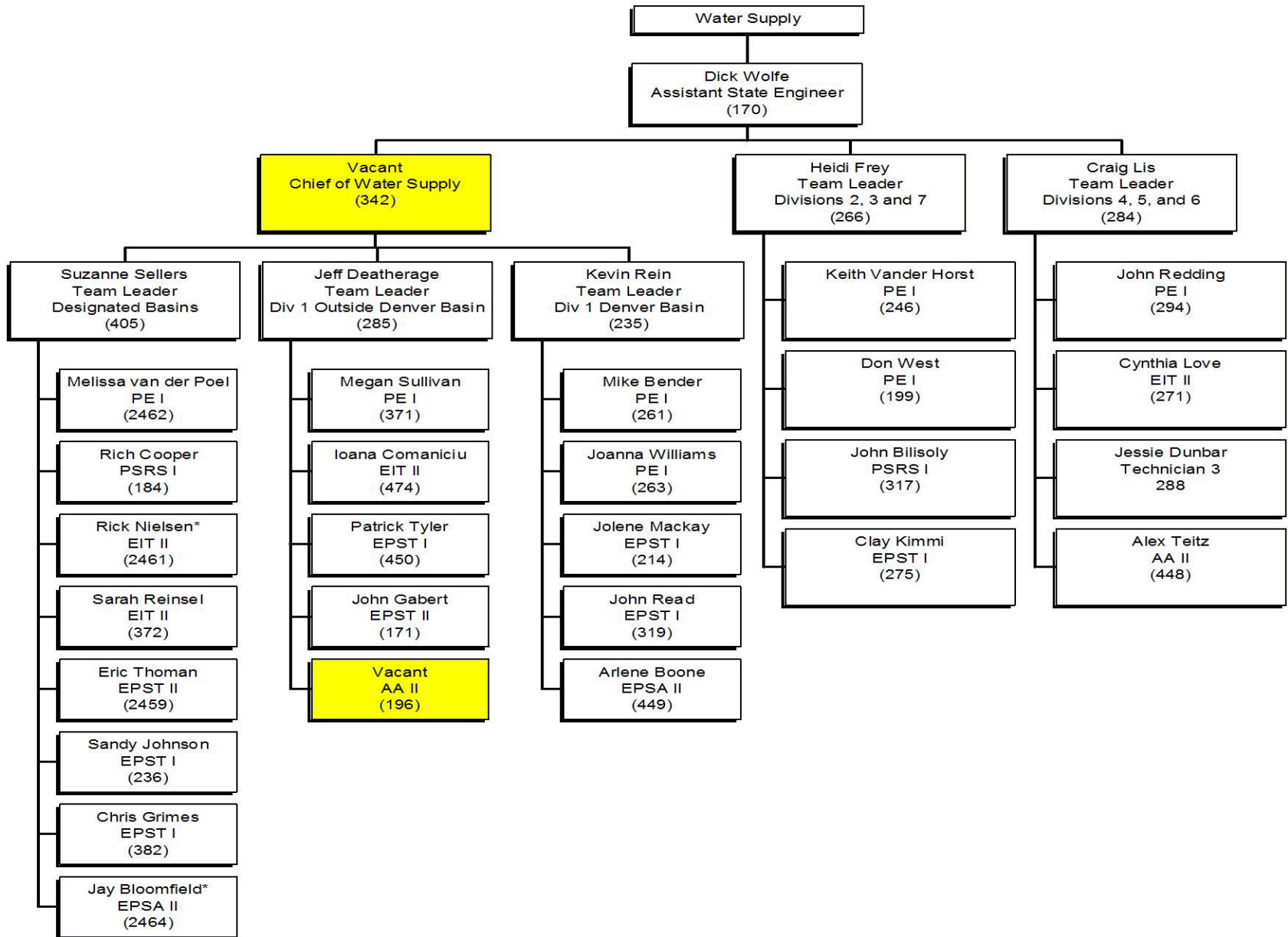
The Chief Well Inspector resigned in March 2005 and a new Chief assumed supervision of the Program in December 2005. The Chief Well Inspector is based in Denver along with one Well Inspector that covers the northeast and central plains. The remaining Well Inspectors are located in Alamosa, covering the south central and southeast; Glenwood Springs, covering the northwest; and Durango, covering the southwest. The well inspection program is proving to be a tremendous asset to the Board of Examiners' enforcement activities. The well inspectors are doing an outstanding job as is described in the Geotechnical Services Branch section of this report.

It is anticipated that, as the program continues to develop, the proportion of violations discovered as a result of the inspection program will decrease. Since inception of the inspection program, it is evident that many licensed contractors are refining their well location and construction practices to ensure full compliance with the Board's Rules.

Organizational Charts

DEPUTY STATE ENGINEER





*Approved in 1998 for final permits; expire July 1, 2007.

Updated March 16, 2005

