2015 Hydrographic and Satellite Monitoring Branch Annual Report

Introduction

The primary mission of the DWR Hydrographic and Satellite Monitoring Branch is to collect, analyze, and present accurate, high quality 'real time' flow and storage data in Colorado rivers, streams, creeks, canals, ditches and reservoirs to support the water rights administration mission of DWR. Hydrographers in each Division office around the State operate and maintain a system of over 530 gaging stations on these watercourses and water bodies; perform streamflow measurements to maintain stage-discharge relationships at gaging stations; and maintain satellite monitoring equipment with the goals of improving the quantity and quality of data used to manage and administer water throughout the State of Colorado. The Branch develops historic streamflow records at a subset of stream gage locations in coordination with other State and federal entities and the water user community.

The Satellite-linked Monitoring System (SMS) provides the Division of Water Resources, other State and federal entities, the water user community and the public at large with access to real-time streamflow and storage 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 high (flood) and low flow alerts. 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 users. 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 requiring 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

Matt Hardesty has been the Chief of the Hydrographic and Satellite Monitoring Branch since March 2, 2014. Hydrographic staff is located in each of the seven Division offices and in Denver. Statewide support positions include Scott Cuthbertson, Deputy State Engineer; Phil DeArcos, IT Professional (office in Montrose), who maintains all the computer applications for capturing, processing and presentation of satellite monitoring data, maintains the DWR Surface Water Conditions Web Site, develops and maintains hydrographic program software applications; and David Hutchens, Electronics Specialist IV (office in Lakewood), 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, and procures hydrographic equipment and supplies, and repairs and maintains hydrographic equipment. Hutchens provides lead technical support for the hydrographic staff in electronics and satellite monitoring equipment, and conducts training on new and existing equipment. He also has taken responsibility for maintenance of the conventional current meters and maintains and inventory of replacement meters and parts for use throughout the state.

The **Division 1** hydrographic unit is staffed with nine (9) hydrographers in 7.5 FTE positions: Russell Stroud (Lead, PSRS IV), Lee Cunning (PE I), Patrick Tyler (EPS Tech III), Tony Arnett (EPS Tech II), Matt Rusch (EPS Tech II), Michael Pockrus (EPS Tech II), Bob Erosky (EPS Tech II, Sterling, ½ FTE), Devin Ridnour (EPS Tech II, (Wray, ½ FTE) and Mike Wild (EPS Tech II, South Park, ½ FTE).

Mike Wild resigned in April of 2015. This position was subsequently filled by Jara Johnson who has a wealth of knowledge and experience including an MS in hydrology from the Colorado School of Mines. She has lived in the South Park Region almost all of her life. Her education as well as knowledge of the area will benefit the Division in numerous ways.

Division 1 did receive measurement and gage operation support from Cheston Hart (EIT 1) of Division 2 during the period between Mike's resignation and Jara's hiring. Cheston's assistance was greatly appreciated during this critical time as well as the ongoing support he provided Jara and Division 1 through the remainder of 2015.

Division 1's partial FTE Hydrographers' are full time employees who also have split duties as Deputy Water Commissioners, Lead Water Commissioners as well as Well Measurement Technicians. These positions receive technical supervision from the lead hydro, and personnel supervision from their Lead Water Commissioner or Assistant Division Engineer. The actual amount of hydro work varies for these individuals. The positions held by Mike Wild/Jara Johnson and Bob Erosky perform about 80% hydro work, while Devin Ridnour currently does about 50%. These individuals work from their homes or district offices and generally work independently in their assigned areas but they do make regular trips to the Division Office for meetings, training and supervision for their streamflow records responsibilities. Similarly, the supervising hydrographer and other hydrographic staff regularly travel to these areas to assist with field work and to oversee operation and maintenance of the streamgage network. In addition to regular hydrographers, Division 1 continued to receive discharge measurement assistance from Jean Leaver, deputy water commissioner in District 3.

The **Division 2** program was led by Steve Witte, PE IV, Division Engineer and Bill Tyner, PE III, Assistant Division Engineer for Engineering and Technical Support. The Lead Hydrographer was Joseph C. Talbott, Jr. (PSRS IV). The Hydrography Unit was fully staffed for the entire year with 3 staff hydrographers: Cheston Hart (EIT I), Anthony Gutierrez (EPST II), and Warren Gabbert (EPST II). Lori Lest (PEI) is in the Division's Hydrographic Engineer position. During the summer of 2015, Division 2 was able to hire Donnie Jones as an intern.

Division 2 hydrographers continued their assigned work tasks at specific gaging stations this water year. Typical work tasks included regular streamflow measurements, operation and maintenance of gaging station and satellite monitoring equipment as well as the analysis and computation of streamflow records at specific gaging stations. In addition to their regular workload, hydrographers responded to Division 2 administrative management requests for water measurements from water commissioners, surface water coordinators and compact administrators.

Division 3 is staffed by five hydrographers. Scott Veneman (PSRS IV) performs Lead Hydrographer duties while managing the satellite monitoring system for Division 3. Jesse Jaminet (PSRS II) performs senior hydrographer duties including assisting with coordination of record development and project management, manages survey and levels program, performs snow survey measurements, performs ADCP streamflow measurements, and cableway inspections. The Division 3 hydrographers perform streamflow measurements, gage and equipment maintenance, construction projects, record production, and assist with all hydrographic duties. Lee Conner (EIT I) is in charge of repair and maintenance of hydrographic and construction equipment. Lanny McDonald (EPS Tech II) transferred from the Well Measurement Unit in January to fill the position vacated by Andrea Taillacq in August 2014. Geoff Warden (EPS Tech II) transferred from the Well Measurement Unit in September to fill the position vacated by Stan Ditmars in May. The Hydrographic Unit in Division 3 has the responsibility of providing accurate 'real-time' stream flow data and historic record production for streams in and around the San Luis Valley of Colorado. This includes the Rio Grande and its tributaries, the Conejos River and its tributaries, and those streams tributary to the Closed Basin. The Hydrographic Unit also supports the water commissioners and other DWR personnel by providing services such as ditch measurements, seepage investigations, structure installations and other water-related consultations.

The **Division 4** Hydrographic work group is lead by Jerry Thrush (EPS Tech II). Several water commissioners in Division 4 including Steve Tuck, Paul Schmucker, James Holiman and Jason Ullman are equipped with measuring equipment and make measurements at stream gages and administrative gages in their Districts. Luke Reschke was selected for another position with Division 4 and will not be supporting the Hydrographic program in the future. Phil DeArcos, IT Professional III is located in the Division 4 office.

The **Division 5** Hydrographic work was led by Craig Bruner (EIT III) who serves as the Division's full-time hydrographer. Gaging station operation and streamflow measurement was supported by three commissioners trained in hydrographic methods/procedures during the second half of the water year. Neal Misbach performed gaging station work in district 51, Troy Wineland in district 36, and Jake DeWolfe in district 38. The Hydrographic work group operated and maintained gaging stations, performed discharge measurements, and worked streamflow records in water year 2015.

The **Division 6** Hydrographic program consists of one half-time Hydrographer, Dan Meyer, PE I, whose other duties as Assistant Division Engineer include providing support to the Division Engineer. Several Water Commissioners have hydrographic equipment; however, the Commissioners generally prefer that flow measurements be made by the Hydrographer.

Lead Hydrographer Brian Boughton (PE II) provided overall program leadership of the **Division 7** Hydrographic Program during 2015. He was supported by Brian Leavesley (EIT II) half-time hydrographer/half-time augmentation plan coordinator. The half-time EIT II position remained vacant in 2015. Each Division 7 hydrographer is assigned work with specific stream gage stations and geographic areas, but also provides support throughout the Division when needed. Hydrographer routine work includes responsibility for regular streamflow measurements, gaging station operation and maintenance, satellite monitoring equipment operation and maintenance, support water commissioners with flow measurements on ditches and the complete development and computation of streamflow records. Water commissioner routine work includes responsibility for regular streamflow measurements and gage station operation and maintenance. Brian Boughton also oversees streamflow record development in the four West Slope Divisions.

Gaging Station and Hydrographic Operations

Division 1 hydrographic staff are responsible for: designing, constructing, maintaining and operating streamgages, gage infrastructure, satellite monitoring equipment, conducting regular discharge measurement for the purposes of maintaining and developing stage-discharge and velocity indexed relations as well as working and publishing streamflow records. In addition to their regular workload, Division 1 hydrographers responded to administrative requests for water measurements from Water Commissioners, Division and State staff as well as measurement and rating requests from Ditch and Canal operators, cooperating entities and consulting engineering firms. This year Division 1 Hydrographers made 1,278 discharge measurements, operated 185 streamgage sites, and prepared 70 published streamflow records, 6 of which were from non-telemetered sites and 1 is physically located in Division 5.

By the end of the water year, 402 gage sites were reported on the Division 1 real-time streamflow webpage, a net gain of 75 sites from last year. Gages reporting to the real-time streamflow webpage fall into one of three categories: Colorado Division of Water Resources (CDWR) owned and operated (127); cooperatively operated (50), where the gage infrastructure is owned by another entity but the gage is operated by the CDWR; and data providers (225), where the CDWR does not own nor operate the streamgage. A summary of gage type, cooperators/data providers and number of gages in each category by year is detailed in Table 1 and Figure 1.

Table 1. Streamgages monitored on the Division One real-time streamflow webpage by gage type

Gage Type	Cooperator / Data Provider	No. of Gages			
		WY2011	WY2013	WY2014	WY2015
CDWR owned and operated	Colorado Division of Water Resources (CDWR), telemetered sites	118	121	123	129
	CDWR nontelemetered record sites	7	7	7	6
Cooperatively Operated	City of Aurora	20	22	22	22
	City of Colorado Springs	2	2	2	2
	Corps of Engineers	3	3	3	3
	NCWCD / Bureau of Reclamation	21	23	23	23
	No. of gage sites operated by Division 1 Hydrographic Staff:	**171**	**178**	**180**	**185**
Data Providers	CDWR, NCWCD & LSPWCD Cooperative Program	52	52	54	54
	CDWR, NCWCD & SVLHWCD Cooperative Program	22	22	22	22
	CDWR, NCWCD Cooperative Program	23	23	27	45
	United States Geologic Survey (USGS)	44	44	44	48
	NCWCD	7	7	7	7
	Expanded Cooperative SDR Program	-	-	-	47
	No. of gage sites operated by other entities in Division 1:	**148**	**148**	**154**	**223**
	Total No. of gage sites displayed on Division 1 RT Streamflow page:	**312**	**319**	**327**	**402**

Following the successes of the SDR/cellular telemetry network previously deployed in Districts 1, 2, 4, 5 and 64; this year's large increase in sites reporting to the Division 1 real-time streamflow webpage mainly came from an expansion of the CDWR cooperative SDR / cellular monitoring network (65). The CDWR applied for and received a Round Table grant for the purchase and placement of Sutron SDR units and cell phone telemetry at key administrative sites throughout Division 1. This effort expanded cellular monitoring of diversion, return and augmentation structures mainly in Districts 3, 7, 8 and 9.

Division 1 Hydrographic staff again cooperatively made measurements at and assisted with instrumentation needs at several USGS streamgages in the 2015 Water Year. Measurements made and assistance provided at USGS gages by Division 1 hydrographic staff are coordinated with USGS staff and done at critical gages under critical administrative criteria.

The **Division 2** Hydrography and Satellite Monitoring branch provided real-time gaging station data for streams, canals, and reservoirs throughout Division 2 and published stream flow data at specified gaging stations. Gaging station operation and maintenance continued to be a primary work task routinely performed during each site visit. There were 237 gages reporting to the Division 2 Surface Water Condition web page in 2015. Division 2 hydrographers directly operated and maintained 124 of these gages on the SMS real-time network. The remaining 113 gages are maintained by other agencies such as the USGS, City of Colorado Springs, City of Aurora, and US Bureau of Reclamation. Cooperator gages on the SMS real-time network in Division 2 require

some time commitment from the Division 2 Hydrographic staff. Hydrographers are often the liaison between Water Commissioners and gage cooperators when cooperator gages that are needed for water administration are not working or require updated measurements for calibration. Division 2 hydrographers often make supplemental hydrographic measurements at USGS gage sites such as the Arkansas River at Las Animas and the Purgatoire River at Las Animas, in order to satisfy Arkansas River Compact Administration requirements.

In **Division 3**, 83 gages with satellite telemetry are maintained, which includes 54 streamflow record gages, seven administrative gages, eleven diversions, four burn area monitoring gages, and seven reservoirs. There are currently five gages not on satellite telemetry, three of which are streamflow record gages and two of which are administrative gages. Division 3 operates and maintains 57 streamflow stations for which it produces historic streamflow records. In addition, the Hydrographic Branch in Division 3 cooperates with the Colorado Department of Health to produce and publish four other streamflow records for gaging stations in the Alamosa Creek drainage. The WY2014 records were submitted this year by the contractor for check and review. The WY2015 have not yet been submitted. Therefore, a total of 59 historic water year streamflow records were produced. There are 11 major diversions in the basin that the hydrographic staff assists in operation, calibration, and data collection of diversion data.

Division 4 operates and maintains 31 satellite monitoring stream gages. Streamflow records are prepared at 9 of these locations, 15 are used to produce diversion records and 7 are administrative only. Division 4 staff cooperates with the USGS, which operates 46 satellite gages in the Division, of which 25 are used for water administration. Division 4 cooperates with the US Bureau of Reclamation at four sites including three stream gages and one reservoir. There are another 20 non-satellite gages operated and maintained in Division 4 in support of water administration.

Division 5 operated and maintained 33 satellite monitoring stations in 2015. Six of these stations are associated the Fryingpan-Arkansas collection system. Streamflow records were published for 13 of the stations. The other gages were used for water administration and/or to develop diversion records.

Division 6 operates 16 active stream gage sites in the Yampa, White, and North Platte River Basins. Streamflow records are prepared at 9 of these locations. All 16 gages are equipped with satellite monitoring. Of these, three transmit reservoir water surface elevation, 12 transmit stream flow gage height, and one transmits both parameters.

Division 7 operates 72 active stream gage locations including 65 active satellite gages and seven non-satellite telemetry gages that utilize SDR and old 8200 units as data loggers. Streamflow records are prepared at 25 of these sites.

Streamflow Records

Based on a LEAN process review completed in July of 2015, significant improvements were made to the DWR hydrographic records working and documentation process. Those improvements included modifications and streamlining of the station analysis/description, creation of a shared Google sheet referred to as the Records Progress Tracking sheet and documentation of the process called "Streamflow Record Development in CoHMS" dated October 1, 2015. These improvements have already made improvements in efficiency and those gains should continue to be realized since there will be significantly less time spent training staff on the new system in the future.

The Hydrographic Branch prepared a total of 237 streamflow records for publication in the DWR Annual Streamflow Publication for WY2015 (Table 1). Of these, 14 records were reviewed and published by the USGS in their annual streamflow data report for WY2015. Divisions 1, 2, and 3 perform record development, checking, correction and final review within their respective Divisions. In Divisions 4, 5, 6 and 7 record checking and review is conducted among those Division offices. Brian Boughton had oversight responsibilities for hydrographic streamflow record preparation (scheduling, checking, final reviews) in the West Slope Divisions during the water year.

Table 1. Streamflow records for WY2014

Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7
70	52	59	9	13	9	25

Streamflow Measurements

Hydrographers and water commissioners across the State made 4,385 measurements in 2015 in streams, rivers, canals and ditches (Table 2). These measurements were made to calibrate stage-discharge relationships at streamgaging stations, in canals and ditches in support of real-time water administration decision-making and in support of historic streamflow record development.

Table 2. Discharge measurements made in 2015

Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7
1278	652	1361	219	149	70	393

Hydrographic Tools

The DWR State of Colorado Surface Water Conditions website:

http://www.dwr.state.co.us/SurfaceWater/default.aspx

continued in operation, with key maintenance support provided by Phil DeArcos. Phil DeArcos is responsible for the day to day management of the retrieval, decoding, processing, posting, and archival of all data collected on the DWR computer-based surface water monitoring system. This includes adding new gages, changing decoding based on DCP upgrades and/or sensor upgrades/additions, retrieval of data from outside data providers (USGS, NCWCD, and UAWCD).

In 2015, Phil DeArcos and other OIT staff in conjunction with Hydrography and the DWR Water Information Team were able to implement cellular decoding capabilities for use in the administrative flow network. This was in support of a grant from the South Platte and Metro Roundtables that provided funds for installation of cellular telemetry equipment in several sub-basins within the South Platte. In the coming year, the Hydrography Branch and Water Information Team will also work on making improvements to the Surface Water Conditions Website and consider additional telemetry system improvements to allow handling of generic data files such as those provided by SCADA systems.

Satellite Monitoring Station Upgrades, Refurbishments and New Gages

All satellite monitoring system DCP's have been upgraded with Satlink 2 DCPs. All new Satlink 2 DCPs are equipped with version 2 (or narrow band protocol) GOES transmitters. Approximately 50 DCPs are replaced annually assuming the equipment has about a 10 year life. This annual replacement rate represents about 10-12% of the current SM network each year. David Hutchens manages the satellite monitoring equipment inventory and coordinates with the Lead Hydrographer in each Division to perform equipment upgrades.

The Hydrographic Branch continues to refurbish and maintain existing streamgages. Gage maintenance and refurbishment funds amounting to $55,000 were received from CWCB for this purpose. These funds along with cooperator funds were used to carry out several refurbishment projects.

Division 1

Numerous new streamgage requests continue to be made each year to facilitate administration of continually tightening uses of Colorado's water systems. Analyses of the Division 1's streamgage inventory and staff workloads are regularly done to determine if new streamgage requests can be accommodated and to prioritize streamgaging operations.

Division 1 maintains numerous contracts with entities for the operation of streamgage facilities and development and publication of streamflow records throughout the Division. All contracts previously in place were either maintained or renewed this year with the addition of four new contracted streamgage sites: Clear Creek Above Georgetown Lake (CLEGLKCO), Georgetown Lake (GEOLAKCO), Idaho Springs

Reservoir (IDSRESCO) and Chicago Creek below Idaho Springs Reservoir (CHIIDSCO). All of these sites were installed with operations beginning in the 2015 Water Year with exception of the IDSRESCO site which could not be brought online due to dam repair activities extending in to the winter.

The Boulder Creek at Boulder, CO (BOCOBOCO) site which had suffered significant damage as a result of the 2013 flood event was decommissioned by Division 1 hydrographic staff this spring. After consultation with the District 6 Water Commissioner this site was identified as providing little administrative benefit or importance to the overall administration of District 6. Much of the installation was subsequently placed following construction of the Boulder Creek at 109th St. (BOC109CO) streamgage site later in the summer. This location was identified by the Water Commissioner as being critical to the administration of the Boulder Creek system. Additionally this location had a cross-vane and W-vane grade control structures originally constructed by the Urban Drainage and Flood Control District which the CDWR was able to rehabilitate and use for water resource investigations.

Similarly the Big Dry Creek near Ft. Lupton (BIGDAFCO) streamgage site was decommissioned and reestablished at a downstream location. These efforts were done to address operational issues with the old streamgage site as well as to provide better resolution in the stage-discharge relation needed due to administrative changes in the drainage.

Numerous instrumentation and streamgage infrastructure upgrade projects were conducted by Division 1 hydrographic staff this year as well. Some of these projects include, extension of the cantilever boom at the South Platte River at Henderson, CO (PLAHENCO) site to accommodate placement of a radar sensor, placement of a cantilever boom and radar apparatus at the Bear Creek at Morrison, CO (BCRMORCO) site to address broken intakes and placement of radar instrumentation at the Bear Creek at Sheridan, CO (BCRSHECO) site to address significant draw-down conditions.

Finally, satellite telemetry was added to installation at the Straight Creek Tunnel at Eisenhower / Johnson Tunnel (STCTUNCO) streamgage site this year. This site had be a non-telemetered transbasin streamflow record for years and infrastructure limitations of the tunnel facilities had previously prohibited installation of any sort of telemetry instrumentation from this site. However, this year's infrastructure improvements to the facility by CDOT allowed for inclusion of components needed to facilitate GOES telemetry from this site. The addition of the site on the real-time streamflow network

will greatly improve the administration of this transmountain diversion in Division's 1 and 5 as well as CDOT's water treatment and water quality monitoring activities.

Division 1 hydrographic staff continue to be engaged in and focesed on recovery and reconstrcution efforts steaming from the September 2013 flood event. Recovery and reconstruction efforts span the continumim, from total reconstruction to moderiate repairs to infrastructure. Gage projects still in the planning phase or in process of rehabilitation include: North Fork Big Thompson River at Drake, CO (BTNFDRCO), Dille Tunnel Diversion near Drake, CO (DILTUNCO), Big Thompson River at Canyon Mouth near Drake, CO (BTCANYCO), Big Thompson River at Mouth near LaSalle, CO (BIGLASCO) and Saint Vrain Creek at Lyons, CO (SVCLYOCO). Many if not all of these projects will be completed in the 2016 Water Year.

Division 2

In Division 2, the Granada Irrigation canal Augmentation Station East and West, Gomez Ditch, Gomez Ditch City Return Flow, La Veta #1 Return Flow, and Pine Creek at Mouth were added to the SMS network for water administration purposes.

In addition to satellite monitoring equipment upgrades being completed at various gages, the following notable projects were completed:

- A radar level sensor was installed at Arkansas River at Catlin Dam (ARKCATCO) to relocate the gaging structure to a more stable control location and replace the lost gaging site due to run-off high flows. This included the design and construction; overseeing the fabrication; and installing a simple supported beam for mounting the sensor. A wire weight gage was installed as the new primary reference gage.
- The weir pool at Greenhork Creek Above Rye Colorado (GRECRKCO) had significantly filled in during WY2014 hydrologic events. A project was understaken to clean out the weir pool and shape the channel upstream of the exisitng two stage weir structure. An effort to use exisiting materials to develop hardened banks was undertaken as well as building a three stepped pool and A-shaped weir structure upstream to help with energy dissapation.
- The weir pool at Horse Creek at Hwy 194 (HRC194CO) was cleaned out to improve flow conditions at the weir.
- The weir pool at Cottonwood Creek below Buena Vista (COCRBVCO) was cleaned out to improve flow conditions at the weir.
- A radar level sensor was installed at Rule Creek at HWY 101 near Toonerville (RULTOOCO) to replace the problematic constant flow bubbler.
- In conjunction with CWCB, and new gaging site at Pine Creek at Mouth (PINMOUCO) was installed to measure an in-stream water right.

Greenhorn Creek Above Rye Colorado

Arkansas River at Catlin Dam

Division 3

In addition to satellite monitoring equipment upgrades being completed at several gages, the following notable projects were completed:

- A radar sensor and wire weight gage were installed at North Channel Conejos River near La Sauses.
- The gage-pools were cleaned and reshaped and upper inlets were installed at Wild Cherry Creek near Crestone, Cotton Creek near Mineral Hot Springs, and San Isabel Creek near Crestone.
- The gage-pools were cleaned at North Crestone Creek near Crestone, South Crestone Creek near Crestone, Willow Creek near Crestone, and Deadman Creek at Mouth near Crestone.
- Timbers were installed above the flume at Cottonwood Creek near Crestone to prevent erosion and keep water in the channel.
- The weir plate was re-attached to flume and reinforced at Spanish Creek near Crestone.

Division 4

During 2014, the following gage upgrade projects were untertaken:

- New Gaging Station at Ironstone Canal Near Olathe: The Ironstone Canal has had a history of problems with the stilling well silting in and having plugged inlets. The bottom inlet became buried and water trapped in the flush risers froze. The only one good inlet couldn't be flushed properly. The solution was a radar gage. David Hutchens installed a radar unit to fix a problem stilling well/inlet gage that was costing an inordinate amount of Water Commissioner and hydrographer time and to improve the quality of the data.
- Installed a new Radar Water Level Sensor at ABCLATCO.
- Installed a new Radar Water Level Sensor at FAIRVWCO.

- Installed a new orifice end at COWCRKCO.

New Ironstone Canal Radar Gage

New AB Lateral Radar

New Fairview Diversion Radar

Division 5

During 2015, Division 5 installed a second gage on the Orchard Mesa Irrigation Canal (ORCHIDCO), consisting of a new transmission platform, radar sensor and semi-permanent bank-operated cableway to facilitate ADCP measurement. This site will replace the existing gage.

Division 6

During 2015, Division 6 installed a new permanent gage at MICWLDCO replacing both the temporary gage (MICTMPCO) and previous permanent gage also known as MICWLDCO. The reason for the replacement was the removal of a downstream bridge that was replaced by a triple box culvert.

Division 7

No upgrades or additions were made to the system.

Alert System

The DWR Flow Alert System compares measured data (gage height, discharge, or any other parameter) from remote gaging sites against 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 can be configured by user preferences to contact the user of a current alarm via e-mail. There are currently over 50 users with 460 different alert criteria programmed. Users continue to be satisfied with the system and its functionalities. Upcoming improvement to the alert system will include the ability for users to create and save custom alert criteria. This will allow users to define alert levels to individual needs instead of being limited to a preconfigured alert.

Training

The annual Hydrographic Branch conference was held in Glenwood Springs on October 14-15, 2015.

Twelve DWR staff members from around the State attended a Swiftwater awareness training program in Salida on May 13, 2015.
Hardesty/Jaminet Snow Science training in Silverton

Division 2

Johnson attended ADCP training with the USGS (SW1321) in Orlando, Florida on March 21-25, 2016.

Division 2

Joe Talbott attended ADCP training with the USGS (SW132) in Orlando, Florida on March 9-15, 2015.

Division 3

Jesse Jaminet, Scott Veneman, and Matt Hardesty attended an Indirect Peak Flow Measurement Course on August 27, 2015. This one day field training taught how to make indirect peak flow stream measurements using the critical depth method. Bob Jarrett, a retired USGS flood chaser and researcher, taught the class.

Jesse Jaminet and Lanny McDonald attended a two day Snow Survey Refresher Course on Nov 18-19, 2015.

Jesse Jaminet and Matt Hardesty attended a two-day snow science course in Silverton, CO on February 10-12, 2016 taught by Center for Snow and Avalanche Studies.

Coordination with Federal, State and Local Agencies

The Hydrographic and Satellite Monitoring Branch continued coordination of streamgaging activities with the USGS Colorado Water Science Center and the CWCB.

Coordination meetings with USGS and CWCB were held on October 13, 2015 in Glenwood Springs, CO in conjunction with the Annual Hydro group conference.

Hydrographic staff around the State coordinate multiple activities with the USBR, including stream gage operation and maintenance on the Colorado Big Thompson Project (Div 1 and Div 5), the Fryingpan-Arkansas Project (Div 2 and Div 5), the Closed Basin Project (Div 3), and the San Juan-Chama Project (Div 7), and gages in the Colorado River Basin (Div 4, 5).

The Hydrographic Branch in Division 3 is charged with fulfilling the terms and conditions of a contract between the State of Colorado and the USBR. This contract provides for streamflow measurement and data collection on the Closed Basin Project. It is the responsibility of the Hydrographic Branch to measure, record, and disseminate flow information to the USBR and to other public entities. In addition, the hydrographers are consulted on certain areas of concern regarding streamflow and measurement within the Project. Specifically, the Division of Water Resources is responsible for the operation of the gaging station on the Closed Basin Canal, and the development of monthly and yearly streamflow records for this location. In addition, there are at least nine other locations on the Closed Basin Project area that are to be measured when the need arises. The current 5-year contract agreement between the State of Colorado and the USBR regarding the Closed Basin Project went into effect in April of 2010.

Division 7 hydrographic staff operate several gages in support of USBR San Juan Chama Project operations. They continued to operate and prepare a streamflow record for the Azotea Tunnel Outlet near Chama NM gage. This gage is the common discharge point of the three San Juan-Chama diversions in Colorado. Measurements were undertaken to check the Azotea Tunnel outlet rating and improve the mass balance between the three diversions and the common outlet.

DWR hydrographic and water commissioner staff continued to conduct snow surveys around the State in support of the NRCS (Natural Resource Conservation Service) and other agencies. The sites generally are surveyed the last day of each month from January through April. The data are collected and disseminated by NRCS and published on their website for water users. DWR staff currently measure 16 sites across the State.

Miscellaneous Activities and Notes

Division 2

- Provided support to the Winter Water Storage Program by measuring the Fort Lyon Storage Canal and working record on a bi-weekly basis and making measurements at the Arkansas at Las Animas and Purgatoire at Las Animas gages.
- Provided winter flow measurements for Lake Creek above Twin Lakes to the Bureau of Reclamation.
- Made grounds maintenance and equipment checks at CoAgMet weather stations.

- Consulted and advised on the installation of gages for diversion records including Granada sites at LAWMA, San Isabel Reservoir, Muddy Creek control project, multiple ARKDSS projects on the Cucharas and Huerfano Rivers and the Catlin Canal Company.

Division 3

- Hydrographers supported the water commissioners and other DWR personnel by providing services such as ditch measurements, seepage investigations, structure installations, water-related consultations, etc.
- Hydrographers were trained by Bob Jarrett to perform indirect peak discharge measurements using his critical depth method. These measurements were used to define the upper portion of stage-discharge ratings at North Crestone Creek near Crestone, San Isabel Creek near Crestone, and Willow Creek near Crestone.

Division 4

- A MOU was reached with the US Bureau of Reclamation concerning ownership and access at the Muddy Creek gages above and below Paonia Reservoir.
- An informal training session was conducted at the Cedaredge Office with 6 water commissioners concerning communication with DCPs and field procedures on January 15, 2015. A field visit to BIGMONCO demonstrated real conditions.
- Met with the Bowie Coal Mine concerning four abandoned USGS stream gages on the North Fork of the Gunnison River.
- A day was spent in the Upper Gunnison WD 59 in cooperation with Div III hydrographer Jesse Jaminet to help troubleshoot his SX Blue II GPS unit using both of our Stream Pros.

Division 5

- A cantilever gage and secondary radar sensor will be proposed at the Roaring Fork River below Maroon Creek near Aspen to provide improved gage height data during low flows due to problematic stilling well intakes.
- A reduced period of operation and record development from 12 to 6 months will be proposed to the USBR for three of the minimum index flow gages associated with the Fryingpan-Arkansas collection system. The gages are the Fryingpan River near Ivanhoe Lake (FRYIVLCO), the South Fork Fryingpan at Upper Station near Norrie (FRYSFUCO), and Ivanhoe Creek near Nast (IVCRNACO).

Division 6

The Division 6 Hydrographic program plans to complete the following projects during WY 2016:

- Bear River below Bear Lake: Re-paint shelter.

- Walton Creek: Replace sign on outside door, install an electronic tape gage and external staff gage.
- Yampa River above Lake Catamount: Install an electronic tape gage.

Division 7

- Division 7 staff made discharge measurements at a couple points on the La Plata River between Long Hollow and the New Mexico Stateline. The measurements were used to estimate transit loss of water released from Long Hollow Reservoir.