2016 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 579 gaging stations on these watercourses and diversion structures; 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 8.2 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, 0.80 FTE), Devin Ridnour (EPS Tech II, (Wray, 0.60 FTE) and Jara Johnson (EPS Tech II, South Park 0.80 FTE).

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 Jara Johnson and Bob Erosky perform about 80% hydro work, while Devin Ridnour currently does about 60%. 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.

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 2016, Division 2 was able to hire Donnie Jones as an intern. A series of injuries amongst the staff hampered field work efforts and resulted in a reduction of measurements for WY2016.

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. Lee Conner (EIT I) is in charge of repair and maintenance of hydrographic and construction equipment. Lanny McDonald (EPS Tech II) assists with construction project design and planning as well as manages our weed and pest control program. Geoff Warden (EPS Tech II) assists with technical issues and is becoming proficient in ADCP measurements.

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 Ullmann are equipped with measuring equipment and make measurements at stream gages and administrative gages in their Districts. James Holiman was selected for another position with Division 4 and will not be supporting the Hydrographic program in the future. Doug Wist a water commissioner in WD 40 who has had previous hydrographic training and experience will fill in for James. Phil DeArcos, IT Professional III is located in the Division 4 office.

The **Division 5** Hydrographic work was led by Craig Bruner (PE I) who serves as the Division's full-time hydrographer. Gaging station operation and streamflow measurement was supported by four commissioners trained in hydrographic methods/procedures. Neal Misbach performed gaging station work in district 51, Troy Wineland in district 36, Jake DeWolfe in district 38, and Corey Beaugh in district 72. The Hydrographic work group operated and maintained gaging stations, performed discharge measurements, and worked streamflow records in water year 2016.

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 2016. He was supported by Brian Leavesley (EIT II) half-time hydrographer/half-time augmentation plan coordinator along with the all the water commissioners within the division. The half-time EIT II position remained vacant in 2016. 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 1,286 discharge measurements, operated 189 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, 416 gage sites were reported on the Division 1 real-time streamflow webpage, a net gain of 14 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 (133); cooperatively operated (50), where the gage infrastructure is owned by another entity but the gage is operated by the CDWR; and data providers (233), 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.

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	WY2016
CDWR owned and operated	Colorado Division of Water Resources (CDWR), telemetered sites	118	121	123	129	133
	CDWR nontelemetered record sites	7	7	7	6	6
Cooperatively Operated	City of Aurora	20	22	22	22	22
	City of Colorado Springs	2	2	2	2	2
	Corps of Engineers	3	3	3	3	3
	NCWCD / Bureau of Reclamation	21	23	23	23	23
No. of gage sites operated by Division 1 Hydrographic Staff:		171	178	180	185	189
Data Providers	CDWR, NCWCD & LSPWCD Cooperative Program	52	52	54	54	56
	CDWR, NCWCD & SVLHWCD Cooperative Program	22	22	22	22	22
	CDWR, NCWCD Cooperative Program	23	23	27	45	47
	United States Geologic Survey (USGS)	44	44	44	48	49
	NCWCD	7	7	7	7	7
	Expanded Cooperative SDR Program	-	-	-	47	52
No. of gage sites operated by other entities in Division 1:		148	148	154	223	233
Total No. of gage sites displayed on Division 1 RT Streamflow page:		312	319	327	402	416

Division 1 Hydrographic staff again cooperatively made measurements at and assisted with instrumentation needs at several USGS streamgages in the 2016 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 253 gages reporting to the Division 2 Surface Water Condition web page in 2016. Division 2 hydrographers directly operated and maintained 140 (13% increase over 2015) of these gages on the SMS real-time network. The remaining 113 co-operator gages are owned by other agencies such as the USGS, City of Colorado Springs, City of Aurora, Upper Arkansas Conservancy District, 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. Division 2 provides technical support and measurement at several of these sites regardless of ownership. 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.

The **Division 3** Hydrographic Unit 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 engineering staff by providing services such as ditch measurements, seepage investigations, structure installations and other water-related consultations. The Division 3 hydrographers perform gage construction and maintenance, data acquisition system and telemetry installation and maintenance, streamflow measurements, development of stage-discharge ratings, and historic record production.

Currently 93 stations with satellite telemetry are maintained, which includes 56 streamflow record gages, eleven administrative gages, thirteen diversion gages, four burn area monitoring gages, and nine reservoirs. There are currently four gages not on satellite telemetry, one is a streamflow record gage and three are administrative gages. In addition to producing and publishing 59 historic streamflow records, the Hydrographic Unit cooperates with the Colorado Department of Health to produce and publish four additional streamflow records for gaging stations in the Alamosa Creek drainage.

Division 4 operates and maintains 36 satellite monitoring stream gages. Streamflow records are prepared at 9 of these locations, 20 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 2016. 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 WY2016

Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7
70	49	59	9	13	9	25

Streamflow Measurements

Hydrographers and water commissioners across the State made 3,992 measurements in Water Year 2016 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 2016

Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7
1287	610	1374	133	184	80	324

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.

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.

This year, the Big Thompson, North Fork Near Drake, CO (BTNFDRCO) was reactivated on September 14, 2016, three years and 1 day after the flood event following repairs made to the stream and adjacent infrastructure by Larimer County. Additionally, the United States Bureau of Reclimation also completed repairs to their Dille Tunnel Diversion (DILTUNCO) site and were able to divert water into and through the C-BT system this year.

Flood related gage projects still in the planning phase or in the process of rehabilitation include: 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). All of these projects are expected to be completed in the 2017 Water Year.

Numerous instrumentation and streamgage infrastructure upgrade projects were conducted by Division 1 hydrographic staff this year as well. Some of these projects include: Bridge replacement at So. Platte River Above Elevenmile Reservoir (PLAHARCO), radar placement at 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.

Jara Johnson has brought a wealth of knowledge and experience to the Hydrographic branch in stream restoration and boulder cross-vane design. This year she traveled to and provided design assistance as well as future project scoping advice in Division's 1, 3 and 4. This year Division 3 constructed a cross-vane structure at their 30-mile streamgage (RIOMILCO) facility which was principally designed by Jara with Jesse Jaminet leading, and coordinating the construction effort. Additional construction support was provided by Russell Stroud.

Division 2

In Division 2, Victor Bison Park Reservoir, Victor Reservoir No 2, Mexican Ditch, 8 Arkansas River Farms gages, Lake Isabel, and the Holbrook Inflow, Outflow and Reservoir gages 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:

- The rock weir control was reconstructed at Huerfano River at Redwing (HURREDCO). The previous control had collapsed over time and shifts to the rating showed that there had been a decreasing trend in the reliability of the control. Using larger boulders nearby, a heavier duty control was constructed trying to implement a "cross vane weir" type configuration with a better armored scour pool to prevent scour related erosion and collapse of the new weir. A radar level sensor was also installed to replace the failing stilling well. Construction efforts and spring run-off compromised the reliability of the stilling well. Efforts to repair the stilling well failed, so installing a non-contact level sensor seemed appropriate. Division 2 staff undertook the design and construction, oversight and construction management for the weir as well as the mount for the radar. A levels survey is required spring of 2017 to determine ice affect damage from the winter.
- The exisiting compound weir at Horse Creek at Hwy 194 (HRC194CO) was allowing water to pass by the weir in higher flows due to a gradual shift in the channel. Upon analysis of satellite photography, it was determined that the channel shifted due to increased growth of aquatic vegetation in the weir pool and along the channel. The weir walls were extended approximately 15-20 feet on either side of the weir using sheet pile. The channel was reshaped, cleaned out and armored with rip-rap. The approach to the weir was cleaned out and the banks re-armored to protect the new sheet pile weir. This site had also had a failing CFB line. Due to the warm water and availability of bionutrients, algal growth would occur on and in the CFB. The CFB was replaced with a radar level sensor attached to a steel I-beam driven 8 feet into the upstream weir pool. Data quality has been excellent at this site after the upgrade. Division 2 staff undertook the design and managed the contstruction. Gracious support was provided by the Fort Lyon Canal Company, who has an interest in this gaging site.
- The CFB line was relocated downstream of the bridge at Purgatoire River at Fisher's Crossing (PURFICCO). Under high flow conditions, the bridge acted as

a control at the site, backing water upstream and allowing it to go into the flood plain. The rating was poor during these times. Moving the CFB line downstream allows the bridge to act as a reservoir and feed water during periods of high flow for more stable record. A downstream riffle is the control at lower stage. Division 2 assisted with the construction and performed construction management of the project.

- Repairs were made with Division 2 staff oversight, hands on and consultation on both the Mt Pisgah and Skaguay reservoirs. The gate controls were being modified at Mt Pisgah. Division staff provided technical guidance on the relocation of the CFB line. After the construction company accidently cut the CFB line, Division staff assisted with reinstalling the line. At Skaguay reservoir, extreme temperature conditions had pulled the bubbler conduit off the face of the dam (rupturing the dam, fortunately, it was fixed with no losses), Division staff consulted on repairs and assisted with repairs.
- The weir pool at Chalk Creek near Nathrop (CHCRNACO) had significantly filled in and was starting to erode downstream of the control. A project was understaken to clean out the weir pool and shape the channel downstream of the exisitng of the existing control. An effort to use exisiting materials to develop hardened banks was undertaken as well. The old stilling well was also removed from service and a radar level sensor was installed. Divisiont 2 oversaw and assisted with the construction as well as performed construction management.

Horse Creek at Hwy 194 Before and After

Huerfano River near Redwing (HURREDCO)

Chalk Creek at Nathrop (CHCRNACO) Weir C/O, SDR "rocket ship"; new Primary

Division 3

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

- A new rock with concrete grout weir control structure was constructed at San Antonio River at Ortiz.
- A new Rosgen style rock weir was constructed at Rio Grande River at Thirty Mile Bridge near Creede. Invaluable design and construction assistance was provided by Jara Johnson and Russell Stroud from Division 1. A radar level sensor and wire weight gage mounted on a cantilever was also installed at this site with technical guidance and assistance provided by David Hutchens.
- The steel sheet piling weir was repaired and welded at South Channel Conejos River near La Sauses. A steel plate measuring section was also constructed in an attempt to improve measurement quality.
- A large island that had formed below the bridge peir and was affecting the stage-discharge relationship at Rio Grande River near Monte Vista was removed by a contractor.

- The retired gage shelters and stilling wells were removed at Trinchera Creek above Turner's Ranch and Rio Grande River at County Line.
- A temporary bank-operated ADCP pulley sytem was installed at North Crestone Creek near Crestone to be used for high water measurements.
- A Stage-Discharge Recorder and satellite telemetry was installed at Trinchera Creek at Seyfried Splitter near Blanca.
- A Stage-Discharge Recorder and satellite telemetry was installed at the Alamosa Creek Canal diversion gage.
- A Stage-Discharge Recorder and satellite telemetry was installed at the Terrace Main Canal diversion gage.
- A Constant-Flow Bubbler and satellite telemetry was installed at La Jara Reservoir.
- A Constant-Flow Bubbler and satellite telemetry was installed at Santa Maria Reservoir.

Division 4

During 2016, the following gage upgrade projects were undertaken:

- New Gaging Station the Overland Ditch at Oak Mesa. This helps three Water Commissioners to save time and mileage in their administration.
  The Uncompahgre Valley Water Users Association became cooperators to install SMS on six of their main diversions from the Uncompahgre River to help with their efficiency in operating flows from the Gunnison Tunnel. These installations were accomplished by David Hutchens in three phases and the UVWUA has been very pleased with the results.
  - The Montrose and Delta Canal
  - The Selig Canal
  - The East Canal
  - The Loutsenhiser Canal
  - The Garnet Ditch
  - The West Canal Tunnel

New SMS on the M&D Canal

New SMS on the Selig Canal

New SMS on the East Canal

New SMS on the Loutsenhiser Canal

New SMS on the Garnet Ditch

New SMS & Radar West Canal Tunnel

- New Gaging Station at Kiser Creek above the Big Ditch head gate. This was done in cooperation with the Big Ditch Water Users who supplied a backhoe and the bulk of the conduit. About 300 feet of data wire was extended form BIGMONCO to communicate with a SDR located at a Parshall flume. This allows the Water district 40 field office in Cedaredge and those Water Commissioners to track reservoir releases and with the data from the Big Ditch to know how much water is going on down Kiser Creek
- The radar water level sensor and the wire weight gage were moved at UNCBRGCO. The high water altered the approach into the bridge and a gravel / cobble bar deposited directly under these devices, and they became isolated during lower flows.
- A new cantilevered radar water level sensor and wire weight gage was installed at Muddy Creek above Paonia Reservoir. The stilling well inlets were continually silting in and experienced varying degrees of drawdown during higher flow regimes. This upgrade has increased efficiency and accuracy at MUDAPRCO.
- An existing cantilevered wire weight gage was modified to accept a radar water level sensor at Cow Creek nr. Ridgway Reservoir. This alleviates problems with the bubbler orifice end being buried during flash rain events and spring runoff.
- The two track access road into the Uncompahgre River nr. Olathe runs through an over mature grove of cotton wood trees. There were two occasions when blow down had to be cleared to gain access to the gage.

- The radar unit at the Fairview Diversion was vandalized. Project 7, the domestic water supplier for much of the area, cooperated in fabricating a security plate.

New Radar and Wire Weight Gage at MUDAPRCO

New Radar on an existing cantilever at Cow Creek nr Ridgway Reservoir.

Uncompahgre River near Olathe access road blow down before and after.

Fairview Diversion security plate.

The RioPro at the Ironstone Canal

The Rio Grande Workhorse which had been in service in Division 4 since 2005 was upgraded to a Rio Pro which entailed new electronics. The ability to measure even more shallow depth allowed one ADCP instrument to be used in a wider range of deployments. This allowed the Stream Pro in use since 2005 in Division 4 to be redeployed to Division 3 in Alamosa.

Division 5

During 2016, Division 5 developed flow rating and initiated transmission from the new gage site installed during WY15 at the Orchard Mesa Irrigation Canal (ORCHIDCO). Permanent bank-operated cableway mechanisms were installed at this site, along with the Grand Valley Canal (GRDVALCO) gage to better facilitate ADCP measurements.

Division 6

No modifications or additions made to the system.

Division 7

- Upgraded the Jackson Canal (JACCANCO) to a radar water level sensor.
- Division 7 installed a new radar gage on the Mancos River at CJ"s Bridge (MANCHICO) which is located approximately 2,300 feet below Chicken Creek. The new gage was installed to provide administrative support for the Mancos water commissioner in district 34.

MANCHICO

No modifications 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 Fort Collins on October 26-28, 2015.

Lee Cunning attended HEC-RAS training in Denver with the Dam Safety Branch on May 9-10, 2016.

Jara Johnson attended USGS SW1312 Hydroacoustics training in Orlando, FL from March 21 – 25, 2016.

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 USGS and CWCB was accomplished via a Directors Meeting held on April 3, 2017 at 1313 Sherman St. in Denver, CO.

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.

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.

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.
- Consulted and advised on the installation of gages for diversion records including Arkansas River Farms sites at LAWMA, San Isabel Reservoir, City of Victor Reservoirs, Holbrook Canal Company, Skaguay Reservoir Outlet, Buffalo Ditch, Muddy Creek control project, Hayden Ditch in Colorado City, and 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.

Division 4

- The Division 4 Engineer Bob Hurford, Assistant Division Engineer Jason Ullmann and Hydrographer Jerry Thrush attended a board meeting of the Overland Ditch Company and presented the cost for a satellite gage at the Overland Ditch at Oak Mesa. The Board voted to accept the terms. This agreement extends their cooperator status from one gage to two.
- Jason Ullmann, Division 4 Assistant Engineer and Jerry Thrush, Div 4 Hydrographer attended a meeting between the Colorado Water Conservancy staff and the Uncompahgre Valley Water Users Association. The six new gages were discussed and the CWC staff committed to help draft a grant application to the

BOR. This collaboration resulted in the UVWUA becoming formal cooperators supporting these six new SMS gages.

Division 5

- Stilling well intake reconstruction/reconfiguration will be performed at the Roaring Fork River below Maroon Creek (ROABMCCO) gage to improve gage height data during low flows. High flow operation (May through July) was discontinued and record development period reduced in accordance with fulfilled high flow monitoring requirements associated with the Aspen Consolidated Sanitation District discharge permit.
- Reduced period of operation and record development from 12 to 6 months initiated in WY2016 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).
- The period of operation and record development will be extended from 4 to 12 months at the Crystal River above Carbondale (CRYDOWCO) to provide U/S monitoring requirements associated with CPW fish hatchery permitting renewal.

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 Lone Pine Canal. The measurements were used to estimate transit loss from McPhee Reservoir to Narraguinnep Reservoir.