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COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

StreamLines

Quarterly Newsletter of the Office of the State Engineer

Dam Safety Engineers Attend "Seepage for Earth Dams" Training

Garrett Jackson and Dennis Miller, Dam Safety Engineers

A seminar was presented on October 28-30, 2003 on the campus of the University of Colorado in Boulder, a component of the Association of State Dam Safety Officials (ASDSO) advanced technical program of study. Instructors included Keith Ferguson, Steve Poulos, and Jim Talbot (from GEI Consultants, Inc.), and Alfredo Urzua (Boston College and Prototype Engineering), who presented a concise, thought-provoking program throughout the three-day course. The 67 attendees, from twenty different states and Puerto Rico, represented a broad range of perspectives and included representatives from state regulatory agencies, the federal government, private consultants, and dam owners. Not surprisingly, most attendees were from Colorado and nearby western states, but the seminar also drew participants from as far away as Florida, Georgia, Maryland and Mississippi, as well as a group of three from Puerto Rico. Their efforts to attend and participate were particularly welcome.

The seminar topics included general and technical discussions of the principles of seepage through porous media (specifically earth dams and their earth and rock foundations), field and laboratory investigations of permeability, seepage analyses using both flow nets and numerical models, the fundamentals of seepage control using natural and synthetic materials, design criteria for filters and drains in dams and foundations, and quality control in construction of seepage control systems. Many insightful case histories of both successful and unsuccessful seepage control designs were reviewed to illustrate the points of the discussions. The case histories covered a wide range of relevant topics including:

- discussions of drain capacity vs. filter criteria in design and construction of a seepage control system;
- development and effects of piping;
- Karst and solution-prone materials;
- dewatering for stability and control of seepage;
- effects of seepage on dispersive soils;
- seepage control and seismic concerns;
- effects of dam penetrations, such as outlet conduits, on seepage development;
- concrete facing as a seepage barrier; and
- instrumentation systems for existing dams.

The instructors demonstrated their considerable experience in, and knowledge of, the field of seepage and its effect on earth dams. The attendees were able to discuss many of their specific questions with the presenters and other attendees in an open exchange of ideas and experience.

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COLORADO DEPARTMENT OF NATURAL RESOURCES

Dam Safety Engineers Attend "Seepage for Earth Dams" Training (cont.)

A comprehensive and detailed bound set of course notes covering all of the discussion topics and case histories presented, including photos, graphs, charts and illustrations, was provided to all attendees and should prove a valuable addition to the professional libraries of all who attended. Going far beyond the mere listing of significant technical references typically provided at technical seminars, the instructors assembled and provided to the attendees, in a separate volume, a complete and readily-usable set of some of the more significant technical references in the field of earth dam seepage. The references ranged from an excerpt of Henri Darcy's classic 1856 book describing his derivation of his now-famous law defining seepage flow through porous media, to Arthur Casagrande's classic 1930's vintage papers and Harvard class notes on embankment dam seepage, to mid-1990's reference describing the current state of practice for filter design.

Overall, the course appeared to be well received by the attendees, with the general consensus that the information and knowledge passed along by the instructors would prove useful in the evaluation of embankment dam safety.

U.S. Department of Interior Signs Historic Agreement

Wayne Schieldt, Assistant Division Engineer, Division 4

On April 2, 2003, a historic agreement was signed with the U.S. Department of Interior to settle the most controversial Water Court application in Division 4 history. The agreement secured a federal reserved water right for the Gunnison River of 300 cfs in Black Canyon National Park. Those signing the agreement were Commissioner John Keyes of the Bureau of Reclamation, Randy Jones of the National Park Service, Steve Williams, Director of the U.S. Fish and Wildlife Service, Colorado Attorney General Ken Salazar, and Greg Walcher, former Executive Director of the Colorado Department of Natural Resources.

The agreement stated that the Colorado Water Conservation Board (CWCB) would file for an instream flow water right under Colorado law for "water beyond that which satisfies present and future obligations of the authorized purposes of the Aspinall Unit." The CWCB water right would have a 2003 priority date. This created quite a challenge for CWCB personnel since they usually file for water rights for "minimum stream flows… to preserve the natural environment to a reasonable degree."

The reach of the water right would be from the U. S. Geological Survey (USGS) gage immediately downstream of the Gunnison Tunnel diversion (where the river enters the Black Canyon National Park), downstream to the confluence with the North Fork of the Gunnison River.

The new CWCB right would attempt to meet the following needs:

- the release, timing, magnitude and duration of these flows shall be worked out cooperatively each year based on the hydrology in the basin;
- the flows will accomplish environmental purposes while protecting existing water rights and future uses in the basin that are protected by the Subordination Contract;
- the protection of Gold Medal trout water, power productions, irrigation, and recreation;
- the protection of downstream communities from flooding, mainly Delta and Grand Junction; and
- provide an opportunity to work cooperatively with federal agencies.

The amount of flow available for the filing has been difficult to determine, but has been quantified with a formula that is contained in the proposed application. The formula uses the forecasted May 1 to July 31 unregulated inflow to the Aspinall Unit minus the amount necessary to fill the existing decrees, both flow and storage, and minus the amount necessary to satisfy development of the 60,000 acre-feet depletion allowance under the Subordination Contract. Based on an analysis done for years 1975 to 2000, there was

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water available for the CWCB right in 73 percent of the years.

Another issue to be worked out was the maximum amount for the filing. The main concern was to avoid flooding the City of Delta. In 1995, substantial flows were released out of the Aspinall Unit to avoid an uncontrolled spill. The resultant flows of 14,900 cfs in the Gunnison River at Delta caused flooding damage, but the adverse impacts occurred at flows above 10,000 cfs. Consequently, the CWCB filing will request flows up to 14,500 cfs (May 1 through July 31), but will not be exercised to exceed 10,000 cfs at the Gunnison River below the Gunnison Tunnel Gage, or at the Delta Gage until improvements are made in the floodplain area surrounding Delta.

CWCB personnel and representatives from the Attorney General's office worked diligently to complete the application and present it to the CWCB board for approval and filing. The filing was presented to the Division 4 Water Court in December of 2003. Only ten statements of opposition were filed, and it is hoped that many of the issues can be resolved through the CWCB public hearing process.

Boyle Engineering Receives Award for Monument Lake Dam Rehabilitation

Doug Boyer, Chief of Dam Safety Branch

Boyle Engineering Corporation of Lakewood, Colorado was awarded the 2003 National Rehabilitation Project of the Year by the Association of State Dam Safety Officials (ASDSO). This annual award recognizes a unique remedial design that advances the state-of-the-art in the field of dam safety, and exemplifies the high professional engineering standards that dam safety requires. The rehabilitation of Monument Lake Dam, located southwest of the town of Monument, Colorado, was selected for the award from a highly competitive list of dam rehabilitation projects.

Boyle Engineering Corporation dealt with many technical challenges and unusual environmental issues in its rehabilitation of 110-year-old Monument Lake Dam. The Class II, 40-foot high, 840-foot long, zoned embankment dam is jointly owned and operated by El Paso County and the town of Monument. The reservoir provides a scenic backdrop for the town of Monument, and has been providing irrigation water and flood control along Fountain Creek for more than 100 years.

In 1998, the Colorado State Engineer's office recommended a zero-storage restriction due to the dam's poor condition. The deficiencies included:

- trees up to four feet in diameter along the toe, downstream slope, crest, and upstream slope of the dam;
- surface erosion channels up to three feet deep on the crest, downstream slope, and right abutment;
- a failed valve on twin 16-inch diameter cast-iron outlet pipes;
- inadequate spillway capacity; and
- erosion and collapsed gabion walls along the downstream spillway channel.

By using a two-dimensional incremental damage analysis, compared to a one-dimensional model, Boyle Engineering justified a 100-year spillway capacity instead of the 50 percent probable maximum precipitation spillway capacity normally required by the state. The downstream floodplain is wide and diverging, which would cause a flood to spread out in several directions. Boyle discovered that the one-dimensional models would over-estimate downstream impacts, which would require a larger, more costly spillway. The project sponsors realized an approximate savings of $2 million in spillway construction costs through the use of the two-dimensional incremental damage analysis.

The technical aspects of the project were complicated by the presence of the Preble's Meadow Jumping Mouse. Obtaining a Corps of Engineers permit required consulting with the U.S. Fish and Wildlife Service regarding the protected species. Boyle Engineering designed a 60-foot wide "mouse

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Boyle Engineering Receives Award for Monument Lake Dam Rehabilitation (cont.)

highway," to connect downstream and upstream Preble's habitats. The corridor is complete with shrubs, grasses, and an irrigation system.

Reservoir sediment potentially contaminated by whirling disease spores caused further complications. In order to avoid spreading the whirling disease, the dredged sediment was wasted on site, as per state requirements. The construction cost for rehabilitating the dam and dredging the reservoir was $3.2 million.

Beaver Dam Action

Ken Beegles, Division Engineer, Division 7

[Editor's note: In the last issue of *StreamLines*, an article was written entitled, "Beavers and Water Rights," that addressed how beaver dams are dealt with in Division 2. This article discusses how a beaver dam was handled in Division 7.]

When does a beaver dam become a problem for stream administration? In Division 7 last year, one created a challenge for area water users. A private property located just upstream of the town of Mancos, Colorado, became a home to at least two beavers. This property had previously been recognized by the governor for the wetlands enhancements that were created off channel. But during the 2002 drought, the Mancos River flow reduced to a trickle and the beavers went to work. By March 2003, there was a six to eight-foot high dam, 250 feet long, holding water back. The dam was being enlarged daily. The potential break on the right side would have flooded a neighboring property. Also, downstream irrigators were complaining because of fears that the obstruction in the stream would delay river and reservoir releases from upstream to feed their senior ditches. The backup created a pool estimated at three to five acres and was spread into the backwater shallows with many willows and floodplain vegetation, so there would be evaporative losses as well as transpiration from the plants.

Redwood Beaver Dam on the main channel of the Mancos River

Efforts to secure cooperation from the landowners proved futile at this time. Assistance from the Attorney General was requested and orders for removal were issued. After considerable delay in contacting the defendant and time spent waiting for promised action to remedy the situation, a Water Court filing for enforcement was made. The ditches were receiving water, but reservoir releases were delayed, and there was considerable difficulty in the administration of priorities on the stream. The Mancos Water Conservancy District took an interest at this point. The applicant had attempted to find an alternative solution either through regulatory requirements from the Army Corps of Engineers, or by constructing an overflow on the dam. A field meeting held in June established some ideas; however, major modifications would have needed to be carried out at the dam site to install a controlled release structure, which would have had to pass through 40 cfs at times.

Since no solution was proposed, the matter was scheduled for trial on July 10, 2003. The applicant responded and finally decided to sign a stipulation agreeing that she had failed to comply with orders to remove the obstruction and also

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Beaver Dam Action (cont.)

agreed to remove it, keeping the stream free to flow through the property for downstream demand. The following week, water was released and the normal flow of the Mancos River returned to its previous channel.

State water managers are still concerned about this issue as they have little authority to order removal of the beavers themselves. The dams may continue to be a problem as the beavers are moving or being encouraged to move to downstream locations within stream administration reaches. However, for the moment, the matter on the Mancos River has been resolved relatively amicably, avoiding the necessity for a court trial.

CWCB Grants $11 Million Loan for Elkhead Reservoir Expansion

Robert Plaska, Division Engineer, Division 6

In a move that brings the expansion of Elkhead Reservoir one step closer to reality, the Colorado Water Conservation Board approved an $11 million loan to the Colorado River Water Conservation District (District) at their November meeting. The District is undertaking the expansion of Elkhead Reservoir in conjunction with the Upper Colorado Endangered Fishes Recovery Program. The reservoir will be enlarged by 12,000 acre-feet at an estimated cost of $19.5 million. The District will be responsible for $10.8 million, with the recovery program responsible for $8.7 million.

The expansion will provide a dedicated pool of 5,000 acre-feet for release for protection of the endangered fish species within the critical habitat on the Yampa River. In addition, the remaining 7,000 acre-feet of storage will be available to satisfy existing and future needs in the Yampa River drainage. The enlargement of Elkhead Reservoir was the preferred alternative in the environmental assessment for the Management Plan for Endangered Fishes in the Yampa River Basin. The U.S. Fish and Wildlife Service is currently reviewing this environmental assessment and will soon determine if the preferred alternative will form the basis for a Programmatic Biologic Opinion for the Yampa River. That decision was expected late last year or early this year.

While construction of the enlargement could begin as early as the summer of 2004, there are still a number of steps that must be taken prior to construction. Permits from the U.S. Army Corps of Engineers must be obtained, the State Engineer's Office must approve plans and specifications for the enlargement of the dam, and agreements with the city of Craig and the federal government must be finalized, among others. However, the District is confident that these will soon be resolved.

When completed, the current storage capacity of Elkhead Reservoir will be increased from 13,800 to 25,800 acre-feet. Construction is expected to last two to three years. The District recently filed an application in the Division 6 Water Court for a new storage decree to fill the enlargement.

Annual Meeting of the Colorado Water Officials Association

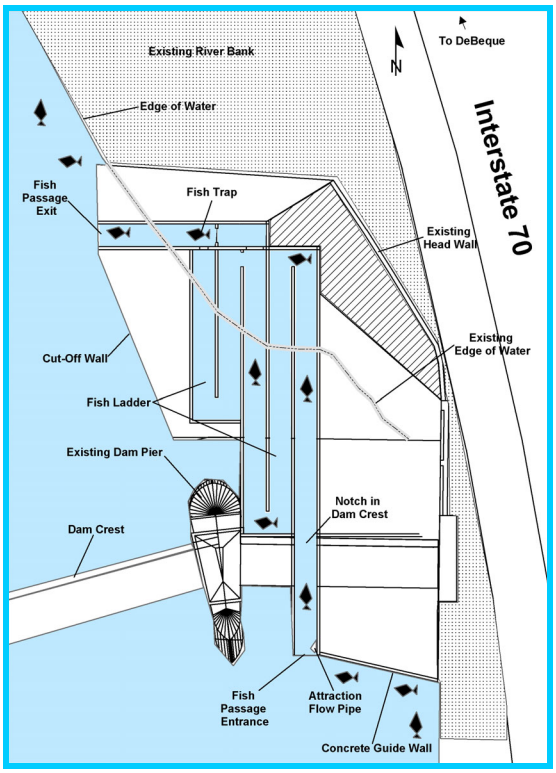
The annual Colorado Water Officials Association (CWOA) meeting was hosted by the Division 3 members on October 2-3, 2003. The unique and rustic setting of the Beaver Creek Youth Camp welcomed over 50 attendees from all over the state. The conference was preceded by a golf tournament at the Rio Grande Club. The competitors generously donated to the "mulligan" pot, which was passed on to the Division 7 scholarship fund. During the conference, several speakers informed the audience about the history and issues of priority administration in Colorado and particularly, the San Luis Valley. Featured speakers were Steve Vandiver, Bill Paddock, Ed Quillen, Dick Stenzel and David Robbins. Plans are already in the works for the 2004 Conference and Water Rodeo to be held in Division 4.

Grand Valley Project's Fish Passage

John Sikora, Assistant Division Engineer, Division 5, and Justyn Hock, USBR, Grand Junction

Federal and state agencies, water users and environmental interests have been cooperating in the Upper Colorado River Endangered Fish Recovery Program since 1987. The species of concern are the Colorado pikeminnow, razorback sucker, and bonytail chub. The recovery program affects all of the tributaries of the Colorado River, but the focus of this article is on the 15-Mile Reach of the Colorado River above the Gunnison River near Grand Junction. On December 20, 1999, the U.S. Fish and Wildlife Service (USFWS) issued a final programmatic biological opinion (PBO) on the 15-Mile Reach. This opinion provides Endangered Species Act compliance for approximately one million acre-feet of existing depletions and 120,000 acre-feet of new depletions above the 15-Mile Reach on the Colorado River. Failure to comply with the terms of the PBO or exceeding the limit of new depletions would trigger reinstating of consultation with the USFWS.

Loss of habitat is one factor that is believed to have led to the decline of these endangered species. The Grand Valley Irrigation Company (GVIC), Price-Stubbs and the Government Highland Canal (GHC) diversion dams in this reach of stream are obstructions to the movement of endangered species. Once the endangered fish can navigate these structures, the fish will have access to over 50 miles more of habitat. The U.S. Bureau of Reclamation (BOR) in Grand Junction is responsible for the planning, design and construction of fish passage and screens on the GVIC and the GHC diversions and the fish passage structure on the Price-Stubbs on the Colorado River.



The GVIC diversion rights are 640 cfs and it is the farthest downstream diversion on the Colorado River in the 15-Mile Reach. A fish passage structure was completed on the GVIC diversion in 1998 and a fish screen was completed in 2001.

In August of this year, a $4.5 million contract was awarded for the construction of a fish passage structure on the GHC. In July 2004, the endangered fish will have access through a fish ladder to critical habitat blocked by the GHC diversion dam since 1917.

The fish ladder is being constructed through the left roller bay of the diversion dam and includes the ladder, passage, trap, and attraction flow pipe (see diagram). The fish ladder will use a maximum of 135 cfs of Colorado River flow to operate the passage. The fish trap at the fish passage exit will provide selective passage, preventing non-native fish from moving upstream.

Construction of a fish screen will begin in the winter of 2004. The fish screen will be located one mile downstream of the diversion dam. The fish screen's return pipeline will use approximately 50 cfs and will return fish and debris to the Colorado River. This 50 cfs would be diverted at the diversion dam in addition to the normal 1,620 cfs summer and 800 cfs winter diversions.

The water supply for both of these facilities will be supported by releases from upstream reservoirs (Ruedi, Green Mountain, Williams Fork and Wolford Mountain) during periods of time when the river is under administration and insufficient natural flow water is available for diversion. These reservoirs have dedicated pools to aid in the recovery of endangered fish.

After the construction of the fish passage and screen at the GHC is completed, the last remaining obstacle for preventing migration is the Price-Stubbs diversion dam.

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Grand Valley Project's Fish Passage (cont.)

The irrigation water rights for this structure were transferred to the GHC. In 1980, Hydro-West filed on a 2,077 cfs conditional hydroelectric water right at this location. Construction is planned for a fish passage at this diversion dam in the Winter of 2004 or 2005. This construction will remove the last of the obstacles for fish migration in the 15-Mile Reach.

Rio Grande Compact Issues

Steve Vandiver, Division Engineer, Division 3

The Rio Grande Compact was not a significant issue in 2003. Because of the low flows in the Rio Grande and Conejos River, the obligation was relatively low for both rivers. The low obligation, along with the fact that both rivers were in a credit status under compact accounting, allowed Colorado to under-deliver on this year's obligation in order to utilize that credit. This situation allowed Colorado to divert more of the natural stream flow than would have been possible if we had not been in credit status. While we never intentionally build up a credit account, the fact that it was available in this type of year was a great benefit to the users on both rivers. Colorado will likely end the year with an accrued credit of between 7,000 and 10,000 acre-feet. There is also disappointment in the fact that the Closed Basin Project only yielded approximately 13,000 acre-feet in 2003, not providing a lot of help on compact deliveries. It is hoped that the U. S. Bureau of Reclamation and the Rio Grande Water Conservation District can rehabilitate this well field and increase the production to a level that is a significant help in our Compact administration situation.

Human Resources

New Employees

Roberta Barella started on March 8 as a Program Assistant in Division 3 and was the outstanding candidate from over 80 applicants for the position. Roberta is from Antonito, Colorado, and has a background in early childhood education and office management. She brings experience in working with many of the programs used by the Division as well as a very pleasant demeanor and a hard work ethic. Division 3 is pleased to have Roberta in their office and looks forward to working with her.

Retirements

Robert Klenda retired on February 1, 2004 after 21 years of service as a Water Commissioner in Division 5. Bob began his career in 1983 as a permanent part-time employee administering water rights in the Collbran area of WD72 in Mesa County; he moved to WD45 in 1985 covering the water rights south of the Colorado River from near DeBeque to just west of Glenwood Springs; and retired as lead Water Commissioner in WD45. Bob's consistent outstanding qualities of accuracy, timeliness, detailed research in gathering records, resolving disputes among water users, training employees, and public servant attitude earned him the respect and trust of the water-using public in his districts and inspired confidence in his fellow employees. He received the Water Commissioner of the Year award in 1987 and 2001. In his "spare" time, Bob was a master saddle maker, earning various awards. Most recently, Bob was invited to participate in the Colorado Saddle Maker Association's Pro Rodeo Hall of Fame, "Art of the Saddlemaker," exhibition held in Colorado Springs in September-October 2003. Bob was also active in teaching leathercraft to 4-H'ers who often won awards at local county fairs for their projects. He looks forward to spending more time "on the range" and with his growing family.

James T. "Jim" Hanrahan retired on February 27 after working for the Division of Water Resources for 25 years. Jim started as a Water Commissioner on the Grand Mesa in 1979. He moved to the Division 1 office in Greeley in 1983 to become a "1042" well commissioner. He then moved to Wray in 1987 to become the Water Commissioner for Water Districts 65 and 49 as well as work for the Colorado Ground Water Commission. Finally, Jim moved to Sterling in 1991 to become the lead Water Commissioner for Water District 64. Jim was named Water Commissioner of the Year for Division 1 in both 1992 and 2001. Jim's knowledge of District 64 and his ability to anticipate and deal with problems effectively will be sorely missed.

CALENDAR OF EVENTS

March 16-17	Colorado Water Conservation Board Meeting, Denver, Colorado; for more information, contact Catherine Gonzales at 303-866-3441
April 6	Colorado Board of Examiners of Water Well Construction and Pump Installation Contractors Meeting, Denver, Colorado; for more information, contact Gina DeArcos at 303-866-3581
May 21	Colorado Ground Water Commission Meeting, Denver, Colorado; for more information, contact Marta Ahrens at 303-866-3581
May 25-27	Colorado Water Conservation Board Meeting, Alamosa, Colorado; for more information, contact Catherine Gonzales at 303-866-3441
June 1	Colorado Board of Examiners of Water Well Construction and Pump Installation Contractors Meeting, Denver, Colorado; for more information, contact Gina DeArcos at 303-866-3581

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