



# Flood Hazard News

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## Big Dry Creek Trail Nears Completion "Backyard" Greenway to Form Part of a 14-Mile Loop in South Metro Area

By Robert Searns, AICP  
Development Consultant Greenway Team, Inc.

### Completing a Vital Link in the Regional System

With the forming and pouring of a very difficult section of pathway and retaining wall one of the most challenging segments of the Big Dry Creek Trail is now complete. This reach, extending from Broadway in Englewood to East Powers Avenue in Littleton, includes a 12'-wide concrete path, a retaining wall system to hold back steep unstable slopes, carefully placed boulders to prevent erosion, removal of unsightly concrete rubble and channel clean-up. The project also includes significant revegetation work consisting of carefully selected riparian tree and ground cover species. With the placement of this section of pathway, the Big Dry Creek Trail is now almost continuous from the Mary Carter Greenway (South Platte River) to Greenwood Village to access the High Line Canal Trail.

The 2008 effort will focus on closing the last short gap—less than ¼-mile from Lehow Street to Broadway. Once completed the Big Dry Creek Trail will form part of a new 14-mile loop that includes the High Line Trail, the Lee Gulch Trail and the Mary Carter Trail. It will both serve the South Metro area and form an integral part of the larger 600+ mile Metro Denver trails network with direct connections to Englewood, Littleton, Cherry Hills Village, Greenwood Village, Denver, Highlands Ranch, and Centennial.

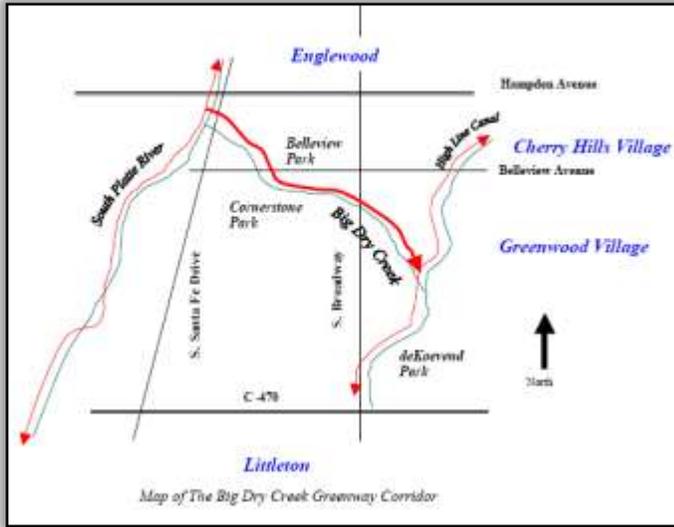
### A Multi-Objective Approach and Partnership

The Big Dry Creek effort represents a multi-objective approach to reclaiming a long-neglected urban stream corridor. Through a partnership of several South Metro cities, Arapahoe County, the South Suburban Parks and



Big Dry Creek Trail near South Santa Fe Drive

Recreation District, Urban Drainage and Flood Control District, the State Parks GOCO Trails program and the federal Transportation Enhancements program, the corridor is undergoing a dramatic transformation. A number of private donors also played a key role including property owners who contributed land for right-of-way.



The goals of the project are multi-faceted. The vision reflects a master plan authored jointly by Littleton, Englewood and the South Suburban Parks and Recreation District and a stormwater and erosion control plan prepared by the Urban Drainage and Flood Control District. The effort envisions creek corridor clean up and stabilization, habitat renovation, access to parks as well as wetland and riparian forest enhancements. A continuous paved shared-use hike/bike path will run the length of the 3.5 mile corridor providing access for recreation, bicycle commuting and stream channel and floodway maintenance.

**A Striking Transformation**

The transformation of a once-neglected segment of Big Dry Creek is striking. What was once a “jungle” of invasive plants, debris and steep slopes is now taking on a natural



**Rock Drop Structure near Broadway**

park-like character that will also be friendly to wildlife. With funding from Arapahoe County, South Suburban Parks and Recreation, Urban Drainage and others, the plan is to raise additional matching dollars and complete the last key link of the trail from Broadway to Progress Park (at Lehow Street) this coming year. Longer term, the plan is to promote the continued clean-up and rehabilitation of this important reach of urban riparian environment.

Running through a variety of settings that include industrial areas, parks, multi-family and single family residential areas, the Big Dry Creek project offers both challenges and opportunities. It has been referred to as a “backyard” greenway because much of the corridor is tightly confined by existing development. While narrow in many



**Big Dry Creek Trail Bridge at the Confluence with the South Platte River**

places the Big Dry Creek channel also includes open oxbows and meanders that offer great potential to enhance urban wildlife habitat with wetlands and forest cover.

**Urban Drainage Also a Vital Conservation Partner**

In addition to supporting the trail work, in two particular instances, Urban Drainage and Flood Control District has been a vital partner in these conservation efforts. One project involved the acquisition of a property adjacent to Prospect Park near South Broadway and Belleview. Along with constructing the trail, the work involved removal of fill that had been dumped in the creek channel over the years, and re-grading and creating an area where a healthier cottonwood/willow forest can thrive. With technical advice and funding from Urban Drainage this area is now returning to a more natural state while still meeting flood conveyance and erosion control objectives. Nearby, the District is helping with acquisition of an oxbow area where floodprone lands are being acquired and the stream is allowed to meander. This forested area will remain home to heron, fox, beaver, deer and other inhabitants.

Urban Drainage has also helped with other important stream upgrades and improvements including working cooperatively with Burt Automotive Group to replace a very unsightly drainage structure with a more natural appearing



#### **Before and after at Burt Automotive Group**

rock outfall and stabilization system, and providing rock rip-rap to replace dumped concrete debris at a number of streamside locations. The District also helped with the creation of new rock drop structures providing erosion control in the channel that prevents down cutting using carefully placed boulders. The rocks create an attractive waterfall effect and helps improve aquatic habitat by aerated the water and providing pools for small fish. The fish in turn provide a food source for Heron, Duck and other riparian species.

Another interesting element is the span constructed over a meander in the creek near Progress Park. A unique “canopy walk” passes over the dense vegetation rather than cutting through sensitive stream habitat. The deck affords a tree-branch-level perspective of the creek corridor adding interest to the trail experience that helps protect the resources below. Recently, Senator Ken Salazar joined hundreds of trail enthusiasts in cutting the ribbon on this completed segment and unique aspect of the Big Dry Creek Trail.

This year Urban Drainage has also been working with the other public and private sector partners to explore the utilization of excavated soil from another drainage project to cover barren rock slopes along the Big Dry Trail and allow new trees, shrubs and grasses to grow along the stream bank. Indeed, any time it was needed the advice and support of the Urban Drainage staff was there to help out in a true spirit of partnership and multi-objective greenway planning.

#### **Challenges and Lessons Learned**

The Big Dry Creek Greenway has been one of the more challenging projects in the creation of the Metro-wide greenway system. A tightly confined corridor, utility and railroad crossings, right of way acquisition and costs for bridges, retaining walls and other structures all contributed to the difficulty. Partnership-building and a strong interdisciplinary team of planners, engineers, and ecologists helped solve the problems. The project development team also left no stone unturned in raising money. For example, a substantial grant was secured from the Federal Transportation Enhancement program by fast-tracking a project that many thought was not feasible to win the dollars.

Right-of-way for the trail and related improvements was the other big challenge. Fortunately much of the right-of-way was made possible by generous donations from forward looking and public-spirited land owners including Carmel Properties and the late Kal Zeff, and the Silvercliffe Apartments and their owners. Individual owners and Xcel Energy and Southgate Water and Sanitation District also granted rights of way. Other owners were not supportive of the project concept and long negotiations have been



#### **Canopy Walk near Lehow Street**

required. Ultimately, though, all of the right-of-way will be secured and the project completed.

One key has been the appropriate combination of patience and persistence to get the job done. Part of the pathway to success was to build workable, usable segments of the trail that could stand on their own skirting around the challenging properties and to have contingency plans and alternative strategies to make vital trail connections. Taking this somewhat daring but carefully thought out approach rather than waiting to secure all of the right-of-way before building helped assure the success of the project. Now on the home stretch the project partners look forward to the completion of the final key link this winter and to cutting the ribbon on this important new trail and greenway this coming spring. We gratefully acknowledge the support of our many contributors and partners, the participating agency staff, the efforts of the South Suburban Park Foundation Board



The finished trail near Broadway

as well as our talented design and construction team! We also encourage you to get out on the trail and enjoy this exciting new greenway amenity!

*Robert Searns and his firm, The Greenway Team, Inc. serve as Project Development Consultant to the South Suburban Park Foundation, Inc. He is also Chairman of American Trails, a trails information and advocacy organization serving communities and trails enthusiasts across the U.S. and Canada ([www.americantrails.org](http://www.americantrails.org)).*

## South Platte River North Globeville Area Flood Control Project

By: Nancy Boudreau Love, CFM and David J. Love, P.E.  
Love & Associates, Inc.

The South Platte River project in North Denver (Globeville Area) is the single largest flood control project undertaken by either the Urban Drainage and Flood Control District (UDFCD) or the City and County of Denver. It represents state-of-the-art water resources engineering. When completed, it will



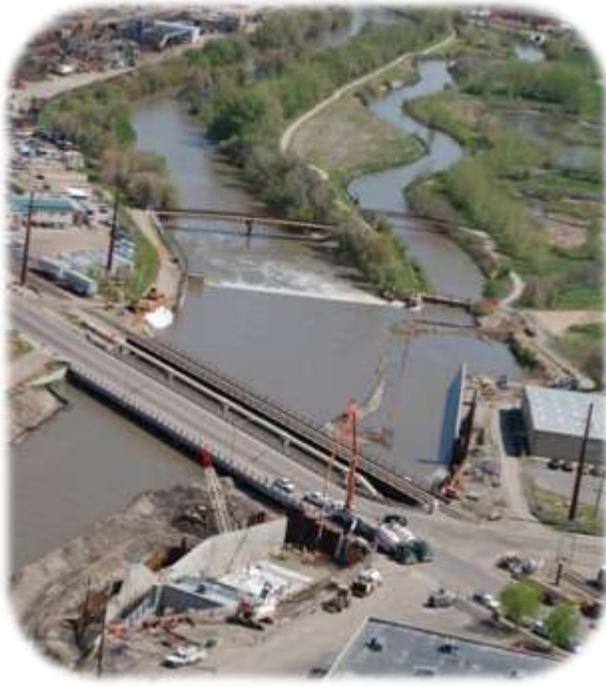
**An example of the obstructions the project had to deal with.**

remove over 300 acres of land in north Denver and south Adams County from the 100-year floodplain. It will also grade separate one of the two remaining at-grade street crossings of the South Platte River Greenway Trail, connecting Adams County and Denver trail systems with a new pedestrian bridge over the river and an underpass at Franklin Street

and the Denver Rock Island Railroad (DRIRR).

The full project was implemented in three separate phases. Phase I, completed in May 1997, consisted of 2,000 linear feet of channel improvements including levees, trails, bank stabilization, aquatic and wildlife habitat improvements, landscape plantings, and removal of a large abandoned sanitary sewer that crossed the river, thereby removing a major obstruction to flow. Phase II, completed in August 1998, included additional floodwalls and levees, bank stabilization, trails, aquatic and wildlife habitat, wetland creation and landscape plantings.

Phase III, the most challenging part of the total project, began construction in the fall of 2005 and will be completed by May of 2008. It includes the relocation of the Burlington Ditch diversion dam from downstream of Franklin Street to approximately 1,000 feet upstream. These ditch facilities irrigate over 100,000 acres of land and are the same facilities that fill Barr Lake and several other downstream reservoirs. The Farmers Reservoir and Irrigation Company (FRICO) has been an integral part of the project, insuring that the reconstructed facilities meet the needs and requirements of their water users. This required the construction of an open channel and 700 linear feet of a 40-foot wide by 7-foot high box culvert to convey the river flows to the FRICO head gate,



a

**An aerial view of the congested construction area.**

new diversion dam with fish and boater passage features, and boat landings upstream and downstream through this reach of the river, eliminating a major hazard to safety and a barrier to fish migration.

Also included in the total project are the construction of grade control weirs, removal and replacement of the (DRIRR) bridge downstream of Franklin Street, and removal and reconstruction of a 36-inch Denver Water Department suspended 'gray' water line which bridges the channel. In addition, this project incorporates construction of scour protection of the river bottom and banks, aquatic and wildlife habitat improvements, and a new and improved riparian corridor along the banks of the river. Obtaining a 404 Permit, other USFW&S regulatory permitting, and FEMA floodplain submittals have been key components of this project; as well as gaining approvals from all the adjacent landowners and the railroad, and water users. The total design-construction cost for all three phases will be just under \$25,000,000.

This project has faced significant challenges since its inception in 1995 when Love & Associates was contracted to provide an updated preliminary design and construction documents for this reach of the South Platte. To assure FRICO, UDFCD and Denver that the proposed system would work as well or better than the current water diversion system, the design was physically modeled twice at the Colorado State University Hydraulics Laboratory in Fort Collins. This verified that the improvements would not change the quantities of water being delivered to FRICO while containing the 100-year flood as designed. The first physical model was completed in 2001 and the second in 2003 with modifications and the addition of a closed box culvert system requested by FRICO.

Groundwater and river flows have caused a myriad of problems during construction, especially during Phase III. Despite these obstacles, the Phase III contractor, Lawrence Construction, maintained the projected completion date, dealing sometimes heroically with the 'water-water-everywhere' issues arising on a daily basis, and larger snowfall and colder winter temperatures than normal.

Love & Associates was the lead design engineer, supported by Bates Engineering for the design of structural components. Ben Urbonas of the UDFCD provided much technical and practical guidance to the design team. His



**Checking out the model at the Colorado State University Hydraulics Laboratory**

experience with working with riverine systems and the South Platte River system in particular provided insights into problems that needed to be anticipated and in how to deal with them in a practical, cost-effective, manner.

The City of Denver's Wastewater Management Division staff was very supportive of the design efforts and assisted the Love & Associates design team in obtaining the necessary permits. Most importantly they were able to secure the funding needed to complete this important flood control project on Denver's northern border that also provided an important link in the South Platte River greenway trail system with an underpass at the Franklin Street and the DRIRR bridges.

# Lloyd's Look

By Dave Lloyd

*Timely Comment from the District's Executive Director*

The last few weeks we've been working on putting together the agenda for our annual Update on Developments in Stormwater and Floodplain Management seminar to be held this coming February 26. Approximately 250 people attended the seminar this past year and every indication is that we will have similar attendance this coming year.

I was reminded of a presentation that was made at this year's conference by Ed Thomas, Esq., of Michael Baker Jr., Inc. Ed spoke to the attendees about the Legal Basis for Regulation of Floodplains and Natural Hazard Zones. In his presentation, he spoke about the responsibility of government and specifically local government. I would like to have Ed give the same presentation at the Colorado Municipal League annual conference this coming year as I felt that he was mainly preaching to the choir at our seminar and his talk would be more appropriate for locally elected officials, city managers, city attorneys, etc.

Ed was emphatic about the responsibility of local government in the area of public safety, specifically as it relates to the management of the nation's floodplains. I think most local governments take this responsibility seriously unless it stands in the way of generating sales tax revenue. With that said, I would hope that everyone in the field of stormwater and floodplain management would do everything they can to get the word out to their locally elected officials and managers that there is more to good governance than just getting a bigger piece of the sales tax revenue pie.

## **Organizational and Staff Changes**

This coming year will see some significant changes in the staff at the District. Two of our long time staff members have announced their retirements early in 2008.

Galene Bushor, Senior Administrative Assistant, has worked for the District for almost 27 years. Over the last few years, Galene has worked tirelessly in developing and implementing the District's Records Management Plan. We're going to miss her a great deal here at the District. Galene has always been that "go to" person when you wanted something done with accuracy and completeness. Not to mention the fact that she has had the unofficial title of "Office Mom" for several years.

Ben Urbonas, Manager of Master Planning, has also decided to retire early next year after 31 years with the District. Ben will leave a tremendous void as we've come to rely upon his technical expertise in the area of drainage and flood control a great deal. Besides his responsibilities in the area of drainage master planning, Ben has been instrumental

in keeping our Criteria Manual up to date as technology changes over time. Ben was also primarily responsible for the

development of our Volume 3, Best Management Practices Manual, one which has gained worldwide acceptance. Ben has been very active with the Water Environment Research Foundation and the National Association of Flood and Stormwater Management Agencies and I know they will miss his input and hard work on their behalf.

We wish both Galene and Ben the very best in their new adventures. We know that they'll both be forever busy with hopefully things more enjoyable to them.

Taking Galene's place will be Patti Jefferson who comes to us with tremendous experience in the area of records management. We welcome Patti to the team. We hope to fill Ben's position internally by mid-February.



**Galene Bushor (r) training Patti Jefferson in the intricacies of the District's document retention plan.**

# Master Planning Program

Ben Urbonas, PE, Program Manager

After 31 years with the District and the Master Planning Program, I have decided to retire in 2008. My last day at the office will be in April. This will be the last time I will be writing this article for the *Flood Hazard News*. It has been a gift to have been given this outstanding opportunity to work at the District and to interact and work with so many talented individuals within the District and throughout Colorado, the United States and many countries around the world.

I have seen many changes in those years. Although we were already using calculators when I first joined the District (vs. slide rules), we proceeded to develop software and embrace the computer age over the years. It is hard to imagine and remember pouring over accounting sheets when doing CUHP and cost/benefit calculations in our master planning projects. It took hours to do what we can do in minutes now.

Many of the concepts and practices that we take for granted now were being scoffed at or just beginning to gain acceptance, such as the use of on-site detention, keeping waterways open, and considering landscaping, aesthetics, multi-uses and terrestrial and aquatic concerns in the design of waterways and detention facilities. The issue of considering water quality was only on the edges of our radar screen.

Today, in this region, we have an exemplary system of open green waterways and well functioning stormwater systems, one that has yet to be paralleled anywhere in the world. It still amazes me when I travel how many professionals in our field know of the District and, especially, it's *Urban Storm Drainage Criteria Manual*. I hope I contributed somewhat to all of this. Leaving the District stirs up feelings of sadness, but I leave with much pride in having had been a part of all the many changes and progress we have seen here in the last 30 years.

My special thanks go to Scott Tucker and David Lloyd for putting up with me for all these years and running cover whenever knowingly or unknowingly I stirred up things among our local governments, with the State and even with the Federal government. I will miss doing that a lot.

At this time David Lloyd has not announced who will replace me. I am confident that whoever he chooses will do a great job in continuing what was started and will advance it all to a new level. I wish him or her much luck and success

and offer the following advice: Approach the job with joy and with an attitude that you can make a difference. The rest will take care of itself; while the occasional bumps and bruises you get will quickly go away and be forgotten. Although I will no longer be with the District, Denver is home

STATUS OF PLANNING PROJECTS			
Project	Sponsor(s)	Consultant	Status
Big Dry Cr. (AdCo) North Tributaries Update	Thornton, Adams Co., Broomfield	Wright Water	Completed in 2007
Four Mile Canyon & Wonderland Cr. Updates	Boulder.	Love & Associates	65% Complete
Murphy Creek Update	Aurora	Moser Assoc.	85% Completed
Clear Creek Update	Wheat Ridge, Jefferson Co., Adams Co., Golden, Denver	Icon	95% Completed
Dutch Cr./Lilley G. Update	Jefferson Co., Denver, Lakewood	PBS&J	65% Completed
Hoffman Drainage	Adams Co. & Thornton	Moser Assoc.	75% Completed
Lena G. Update d/s of Maple Grove Reservoir	Wheat Ridge	GCC	95% Completed
First Creek (Upper) OSP	Aurora	Moser Assoc.	5% Completed
Westerly Creek d/s of dam	Denver, Aurora	Kiowa	5% Completed
Cottonwood Cr. - Lower	SEMSWA.	n/a	Consultant Selection
Hidden & Bates Lakes OSP	Adams Co, Arvada	n/a	Consultant Selection
Little Dry Cr & Greenwood Gulch u/s of Holly	Douglas Co. SEMSWA, Greenwood Village, Lone Tree, S. Suburban Parks	n/a	Consultant Selection
Lone Tree, Windmill, Dove Creeks MDP Update	SEMSWA, Douglas County	n/a	Mapping started, Engr. start in 2008
Baranmoor Ditch MDP	Aurora	n/a	Start in 2008
S. Boulder Cr. Update	City of Boulder	n/a	Start in 2008
Lafayette/Louisville Update	Lafayette & Louisville	n/a	Start in 2008
Lost Cr & Crooked Run	Aurora, Adams Co, SEMSWA	n/a	Start in 2008

for Irena and me. My grandchildren will see more of me, whether they want to or not. Also, some of you will probably see me through my association with the Urban Watersheds Research Institute and professional organizations, which I hope to maintain for the foreseeable future.

## Planning Projects

One planning project was completed in 2007; 9 projects were under way; and we hope to begin 5 new planning projects in 2008. We now have a total of over 135 completed watershed-level major drainageway and outfall system plans

in our inventory, including updates of master plans completed in the past.

### **Urban Storm Drainage Criteria Manual**

All three volumes of the *Urban Storm Drainage Criteria Manual* (USDCM) are posted on our web page, namely, [www.udfcd.org](http://www.udfcd.org) for you to download. If however, you would like to order a printed three-ring binder for Volumes 1 and 2 we still have a limited supply in our inventory. You can purchase them by contacting Margaret at our front office. Each posted chapter is marked with the revision date and I encourage you to check for latest updates.

This year we posted several corrections and an update of the Construction BMPs chapters of Volume 3. Most figures for that chapter are now in AutoCAD format for you to download and use. Do not forget to download the supporting spreadsheets that we have developed for many of the chapters of the USDCM.

In support of the update to the Construction BMPs chapter, UDFCD contracted with Scott Olson to develop a one-day training class on construction management when working in waterways (i.e., Waters of the State). These classes will be available to everyone starting in 2008 through the District. First priority will be to accommodate local government officials, but individuals in the private sector will also be accommodated. Initially we will try to schedule classes once a month for as long as there is demand and then we will cut back on the schedule. Our initial estimate is that we will charge \$100.00 to cover the cost of the instructor, lunch, coffee and tea breaks. Keep an eye out for notices from UDFCD and postings on our web site for the schedule of these classes.

### **Software and Criteria Manual Users Support Group**

I would like to remind everyone that we set up a user group titled "*UDFCD Computational Tools and USDCM Support Group*" with a website address: <http://groups.google.com/group/UDFCD-support>. It was done to help us at UDFCD support the Criteria Manual and software/spreadsheets and for you to share problems you have encountered, to raise questions and to discuss your thoughts about any of these products with others and us as well. We post messages through it whenever new versions of the spreadsheets, software or Manual updates are uploaded to the District's web site.

In other similar user support groups, many of the solutions and "fixes" are suggested by the users themselves. We will address all issues, questions and needed "fixes" if you let us know through that vehicle.

If you have not already done so, go to the above "groups" website and sign on. Check one of the options to receive one e-mails in order to receive notices and message we post.

### **District's Software**

You may download the District's CUHP and other software from our web site [www.udfcd.org](http://www.udfcd.org). Select "Downloads" followed by "Software". To download the companion EPA SWMM software go to the EPA's web page <http://www.epa.gov/ednrmrml/models/swmm/index.htm>. In addition to the above, new versions of UDPOND and UDSEWER that contain corrections and updates, including a profile plotter for the latter, are now available for downloading.

### **District's Annual Seminar**

At our February, of 2007 seminar we had over 250 registrants. The proceedings are available at: <http://udfcd.org/conferences/conferences.htm>

On February 26, 2008 we will have our next annual conference/seminar. The program is still in development, but we know that it will be at the Stapleton Doubletree Hotel and the registration fee will be \$50.00 to \$60.00. Register early and join us. We again promise you a diverse and timely program.



**Ben Urbonas describing how the Confluence Park boat chute works.**

# Floodplain Management Program

Bill DeGroot, PE, Program Manager

## Digital as Official

The Federal Emergency Management Agency (FEMA) has been preparing Digital Flood Insurance Rate Maps (DFIRM's) for several years and then converting them to paper panels. Converting to paper panels adds significant costs and 6-12 months to completion time of the panels before local governments, lenders and insurance agents can use them. In 2004 the Congress passed legislation which would allow FEMA to utilize digital products as the official Flood Insurance Rate Maps. The National Association of Flood and Stormwater Management Agencies (NAFSMA) and the Association of State Floodplain Managers (ASFPM) have been urging FEMA to take advantage of this opportunity to use digital products to save time and money in getting DFIRM's completed and distributed. Unfortunately, FEMA has yet to embrace this opportunity

Colorado has adopted the Uniform Electronic Transactions Act, which allows the District and local governments to use electronic documents as official documents. Meanwhile, our consultants have been preparing their work products for us in electronic form and then converting them to paper.

In September, the District's Board of Directors passed Resolution No. 68, Use and Reliance Upon Electronic Records, in order to position the District to better utilize the electronic documents our consultants are already preparing for us, as well as DFIRM data bases as they become available.

The resolution adopts an electronic records policy, authorizes the Executive Director to prepare and adopt a policy to implement the provisions of the resolution, and encourages all local governments within the District to adopt an electronic records policy in regard to digital floodplain maps similar to the one being adopted by the District. We are researching the best way to implement this resolution.

## District Levee Policy

Three fairly recent events brought home to us the need for a levee policy that discourages the use of levees for new development in the floodplain: The levee failures during Hurricane Katrina; California's realization that they need about \$10 billion to repair their levee systems; and FEMA's map modernization program in which FEMA is getting much tougher on which levees they will recognize and the burden they are putting on local governments to maintain and periodically recertify them.

As FEMA says in one of their levee fact sheets: *The fact is, levees can and do decay over time, and maintenance can become a serious challenge. When levees do fail, or are overtopped, they fail catastrophically. . .*

Fortunately we have very few levees in the District and we would like to keep it that way. In January the Board of Directors adopted a levee policy which discourages local governments from authorizing or permitting levees for new

development, and states that these levees would not be eligible for District maintenance assistance. It would allow the use of levees as a last resort to protect existing structures.

## Public Information Program

In 2006 we made a significant change in the format for the flood hazard information brochures we have been mailing to addresses located in or near 100-year floodplains delineated by the District. Each brochure is tailored to a small number of drainageways, and includes specific information about the drainageway(s), sources for the floodplain information, local government contacts and phone numbers, flood insurance, and information about flood warning plans if they exist for the drainageway.

This was the second year we mailed brochures with all of the same information described above. However, instead of a map of each drainageway we included instructions on how to access a floodplain map on our web site using an address search engine to show floodplains on a photo background and a star near the requested address. The floodplain map is a compilation of all of the digital floodplains developed for completed or nearly completed Digital Flood Insurance Rate Maps (DFIRM's) supplemented by additional floodplains mapped by the District.

Leonard Rice Engineers developed the process for us and hosts the map on their server. We have been working on using more recent photos that we have access to, and to speed up the download process. One problem we have yet to overcome is the need for an SVG enabled browser. Most libraries don't have SVG enabled browsers which shuts some people out of the process.

## Floodplain delineation

We completed three flood hazard area delineation (FHAD) studies this year: Clear Creek in Jefferson County, Hoffman Drain in Adams County and Thornton, and Lower Lena Gulch in Wheat Ridge and Lakewood.

We have FHADs underway for Dutch Creek and Tributaries in Jefferson County and First Creek in Denver and Aurora. We also have two "mini-FHAD's" underway to clean up portions of old FHAD's that we know have changed but the changes were never documented. These studies are for Greenwood Gulch in Greenwood Village and Centennial, and Little Dry Creek in Centennial.

All of these studies are prepared in digital form compatible with FEMA's DFIRM specifications, and have been or will be incorporated into the appropriate DFIRMs.

## DFIRM conversion projects

In 2004 we received FEMA DFIRM conversion grants of \$480,000 each for Adams County and Arapahoe County. The District has contributed \$70,000 for each county and the Colorado Water Conservation Board has contributed \$50,000 each.

Unfortunately, both projects have taken longer than anticipated, due primarily to the lack of backup data in the Michael Baker Jr., Inc. library. We have had to scramble to find other reliable sources and this delayed the process. This was particularly true for Arapahoe County, where we had the additional problem of integrating Aurora and Littleton into the map. The Adams County DFIRM is done, with an effective date of March 5, 2007. We are hopeful that Arapahoe County will go effective in late 2008.

In 2004, the District received a \$240,000 grant from FEMA, to be matched by \$30,000 each from the District and CWCB, to convert the Jefferson County DFIRM to the NAVD 88 datum. We are also adding several FHAD's (Ralston Creek, Leyden Creek, Massey Draw and North Tributary, SJCD (South) and Tributaries, Clear Creek, Lena Gulch and Dutch Creek and Tributaries) and about 50 new LOMR's to the database. The contractor is ICON Engineering.

When we are done with this project, now scheduled for March 31, 2008, we will have a very good database sitting on a FEMA server somewhere that no one can see or use, because we don't have enough money to complete all of the work necessary to publish new paper panels. To try to remedy this situation we have been asking FEMA to let us do a pilot project to adopt the digital maps as the official documents, thereby bypassing the need for large numbers of paper maps and the time and expense of getting them done. No luck so far, but we are continuing to push the idea.

The Boulder County DFIRM conversion project, which is being managed by the CWCB has also been delayed, but should go effective sometime in 2008.

### **Maintenance Eligibility**

Our maintenance eligibility program continues to flourish under David Mallory's direction. Also, I want to recognize him for spending several hours in a helicopter taking photos of District projects and maintenance eligible projects. See David's column elsewhere in this issue.

### **LOMC pilot project**

We have been reviewing requests for Letters of Map Change (LOMC) for FEMA since July 1, 2001. In the early days our work was subject to a fair amount of review by Michael Baker Jr. Engineers on FEMA's behalf. As we got more and more experience Baker's review times went down and we began to assume additional responsibilities. In 2007 we took over responsibility for all uploads to the Mapping Information Portal (MIP). We are pleased to have gotten to this point.

We have identified a number of advantages to the District being in the position of reviewing the LOMC requests at the local level. These are contained in our annual reports to FEMA that are posted on our website. We found this to be particularly advantageous with a very contentious CLOMR request this year. See David Mallory's column for a full account of this case.

### **Implementation efforts**

Implementation of portions of our master plans, particularly regional detention facilities, is always a challenge. We completed execution of an Intergovernmental Agreement (IGA) with Denver and the US Fish and Wildlife Service (USFWS) for the construction, operation and maintenance of a number of facilities in the Irondale Gulch watershed on the Rocky Mountain Arsenal Wildlife Refuge. Our next step will be to negotiate a companion IGA between the USFWS and the downstream Commerce City and Adams County.



**In the spirit of the holiday season, Randy Schnicker from Denver Public Works delivers fully executed copies of the Irondale IGA to Executive Director Dave Lloyd, with Bill DeGroot (l) and Dave Bennetts as witnesses.**

### **FasTracks Coordination**

We have continued to work with the Regional Transportation District (RTD), Denver, Lakewood, Golden and Jefferson County on RTD's West Corridor light rail project. We will have funds in three implementation projects on the South Platte River, Lakewood Gulch and Dry Gulch which will be constructed in conjunction with the light rail construction. We are also reviewing RTD's construction drawings for other drainage projects for District maintenance eligibility. We are also working with RTD and their consultants on environmental impact statements for four other transportation corridors.

### **Check these out on our website**

We have a photo album showing good examples for others to emulate. We also have an Activity Summary map that identifies all District studies completed or in progress that we update quarterly. It would be a good idea for anyone working on a drainage study in the District to check this map for existing or on-going studies that might affect their work.

All of our FHAD's (and master plans) are posted on our website under the Publications tab. You can save yourself some time and gasoline by looking there first rather than heading for our library, although the library is still open and fully stocked.

# Maintenance Eligibility Program

David Mallory, PE, Senior Project Engineer, Floodplain Management Program

## An Anniversary

This year marks the end of my first ten years at the District. My tenure here has been immensely rewarding and challenging. The District is a superb organization with a talented and dedicated staff. I have also enjoyed the interaction and project collaboration with local, state and federal officials, developers, consultants, and contractors. I am particularly indebted to Bill DeGroot for the opportunity and wise guidance in administering the District's Maintenance Eligibility Program. He is a gifted floodplain manager, and a great colleague.

## Construction Plan Reviews

The effects of the national mortgage crisis have become manifest in the Denver metropolitan market in several ways. We noticed a reduction in development submittals through the year, down by approximately one half over past years. We typically receive between 200 to 250 construction plan submittals each year from communities within the District. This last year we logged in 125 construction plan reviews. However, development remains robust in the southeastern Aurora, northern Douglas County, and the northern I-25 corridor areas for both commercial and residential projects. Terri Fead, PE, CFM continues to provide us with effective support in completing these reviews. She has also been very effective in the LOMC pilot project, DFIRM conversions, and FHAD reviews. I'm happy to announce that she will be part of the maintenance eligibility program again next year.

## In the Field

We have not, however, seen a reduction in construction activities. So, the most exciting development in our field operations this year was the addition of Joanna Czarnecka to our staff. Joanna interned with the District while attending school. She has now returned on a part-time basis to take charge of the construction observation activities we perform as part of the District's Maintenance Eligibility Program. In



**Terri Fead (l) and Joanna Czarnecka provide valuable part-time help for the Floodplain Management Program.**

last year's article I discussed the cooperative effort with Douglas County to "catch up" legacy projects (pc for old and forgotten projects). Joanna has completed that effort with Brian Schultz of Douglas County. Arapahoe County, through SEMSWA has indicated a desire to do the same program for their legacy projects. We encourage other communities to review project status (posted weekly on our web site) and request reviews of legacy projects

The additional staff time available for construction site visits has afforded us the ability to be more proactive. In the past we have relied exclusively on others to keep us abreast of construction activities. We can now provide enhanced coverage for construction projects.

In summary, we completed final certificates for over 150 projects for inclusion in the Maintenance Eligibility program in 2007.

## How NAI Principals Guided Us through a Difficult CLOMR Review

NAI, or No Adverse Impact in floodplain management is a program promoted by ASFPM. The goal of NAI is to ensure that the actions of one property owner do not adversely affect the rights of other property owners in terms of increased flood risk and loss of development potential.

When a large retail developer submitted a request for a Conditional Letter of Map Revision (CLOMR) that proposed a significant floodway encroachment at arguably the highest flood risk area in the Denver Metropolitan Area, we were alarmed. Cherry Creek at Arapahoe Road has a 100-year peak discharge of nearly 50,000 cfs, the highest in the District. Arapahoe Road is a state highway with an inadequate bridge waterway opening, resulting in significant roadway overtopping. The development project proposed floodway encroachments in one community, while the adverse impacts would occur in adjacent communities. Our initial assessment was that this proposal should be denied. We entered into a unique review arrangement with Michael Baker Jr. (FEMA's National Service Provider) and ICON Engineering (our review consultant) to work through the denial process. Our legal counsel also recommended denial based on Colorado common law.

Midway through the review process several individuals working on the review attended an NAI Workshop sponsored by CASFM. As a result, we were able to formulate a way forward using NAI principals. We recommended to the development team a strategy that would significantly reduce adverse impacts to properties in adjacent communities, reduce the floodway encroachment, and gain support from all communities affected by the project. Faced with the prospect of denial, and a reasonable alternative, the developer entered into a constructive dialogue with the review team. The developer was tasked with securing approvals from each adversely impacted property owner as a

condition of adjacent community acknowledgement. All parties were eventually satisfied with the revised proposal and a CLOMR was issued.

The project was concurrently reviewed for inclusion in the District’s Maintenance Eligibility Program. A secondary benefit was the preservation of natural floodplain functions through a commonsense geomorphic-based approach to drainageway modification.

In the end, the project was significantly revised in order to render a smaller adverse impact, the project gained the support of adjacent communities, and natural and beneficial floodplain functions were preserved. More importantly, we set a precedent for enhanced floodplain management using NAI principals that go beyond NFIP minimum standards.

### Marketing Brochure Update

As reported last year, we have been working with many communities throughout the District to develop a “marketing brochure” for the development team to receive from the community early in the planning process. The brochure will advocate the concept of floodplain preservation. We believe there is a universal benefit in preserving natural floodplain functions. Channelizing major drainageways produces single purpose projects, namely flood conveyance, and contributes to the decline of stream corridors. We believe the first choice should be multi-function preservation and restoration projects that enhance natural stream corridor function. The multi-function approach works well with regional trail and open space goals, outdoor recreation, environmental preservation and of course flood control. Stream channelization should always be a second choice, and when necessary (to repair degraded streams for example) should replicate natural stream systems. Through thoughtful consideration early in the process, the developer can approach floodplains as amenities and position the project for maintenance eligibility from the District and 404 permit approvals from the ACOE.

In addition to completing community surveys, we identified a number of past projects that exemplified good floodplain preservation principals. These projects were photographed during the spring and summer using helicopter based aerial photography. I volunteered for the photo missions, completing 5 flights between May and October. For someone who avoids heights, the doors-off, low level

helicopter flights were a real white-knuckle adventure! However, the images are remarkably good and deliver a high impact. We collected nearly 2000 images of over 40



**Green Valley Ranch Golf Course and detention pond in Denver**

projects, including a number of District sponsored projects. The District project images were used in a presentation to our Board of Directors in the first annual “Virtual Bus Tour”. The images presented here give a taste of the photo record. The brochure and enclosed CD will include a full suite of images to showcase projects we feel exhibit floodplain preservation. We will also post example projects on our website. Look for the completed project early next year. In the meantime be good and stay out of the floodplain.



**The Rock Creek floodplain as it passes through the Rock Creek Ranch development in Superior. The open area at the top of the photo is Boulder County open space.**



**On a smaller scale, this developer stayed out of the floodplain, preserving trees, wetlands and a small stock pond.**

# Information Services and Flood Warning Program

Kevin Stewart, PE, Program Manager

## 2007 Flood Season Begins With Heartbreak

A sudden thunderstorm that struck Denver on May 14, 2007 resulted in the tragic loss of a 2-year-old boy when strong currents pulled young Jose Matthew Jauregul Jr. from his mother's arms while seeking shelter from rain and hail under the Decatur Street crossing of Lakewood Gulch.



Fast rising water less than two feet deep caused the horrific accident, preventing escape from the trail portion of a twin box culvert. The situation became even more dreadful when floodwaters carried Jose Matthew a short distance downstream to the swollen South Platte River where a 3-day recovery effort ensued. Local officials closed this section of the Lakewood Gulch trail the following day.

May 14 was one of 43 recognized flood threat days, making 2007 one of the busiest seasons for forecasters in the 29-year history of the District's local flood warning program. According to lightning strike statistics, the Denver region experienced at least 100 thunderstorm days during 2007. The 2002 Hayman fire burn area in Douglas County once again attracted more than its share of intense rain storms with 14 days setting off rainfall rate alarms. But unlike the prior year, the resulting floods and debris flows were far less damaging.

While heavy rains were also common in the District, fortunately property damage from flooding was low. One day does stand out as a notable "nearby hit" that warrants reflection. That day, August 2, and others are highlighted in the flood season recap section of this article.

## 43 Days with Flood Potential

April	24	1
May	1,14,17,29	4
June	3,12,26,27,28	5
July	3,4,8,10,11,12,19,21,25,26,27,28,29,30	14
August	1,2,3,4,5,6,7,10,14,15,17,18,23,24,28,29,31	17
September	5,24	2

The bolded dates denote days in which intense rainfall was measured by automated rain gages. Blue boxes designate NWS flash flood watch days and red boxes signify flash flood warnings.

## New Meteorological Support Service for 2007

The team of Genesis Weather Solutions and Skyview Weather was selected by the District to provide local governments with forecasts and notifications of potential and imminent flood threats during 2007. GWS is located in Highlands Ranch and was started in 2005 by Bryan Rappolt, a 13-year veteran of the District's long-running flash flood prediction program (a.k.a. F2P2). Skyview Weather is a Castle Rock-based company lead by Tim Tonge. Tim's group is familiar to a number of local jurisdictions in the Denver area, having provided them with year-round notifications of approaching storms and severe weather threats. The F2P2 operates from 15 April to 15 September and has been serving the District since 1979. Information about the F2P2 can be found at [f2p2.udfcd.org](http://f2p2.udfcd.org).

## Flood safety education remains a priority

The flood safety website [floodsafety.com/colorado](http://floodsafety.com/colorado) was initiated by the District and the City of Boulder in 2003. Jefferson County and others helped expand the informational coverage beyond Boulder in 2004. The following year Boulder and the District collaborated again to add more content specific to Colorado's highest flood risk community. As this phase nears completion, you can preview the latest at [floodsafety.com/boulderdemo](http://floodsafety.com/boulderdemo).

In 2007 the project also succeeded in producing a video that was aired multiple times by Cable Channel 8 in Boulder. The story featured an interview with Boulder Fire Chief Larry Donner. The producer, Marshall Frech, is hopeful that this work will eventually be broadcast by PBS.

## CoCoRaHS marks its tenth

The Community Collaborative Rain, Hail and Snow network observed its 10<sup>th</sup> birthday this past July while the City of Fort Collins remembered the devastating 1997 flash flood that claimed 5 lives and caused extensive damage to the community and campus of Colorado State University.



While the sad losses from this flood are still hurtful for many, it is reassuring to know that good can come out of a disaster and when good ideas get noticed, they sometimes spread like wildfire. CoCoRaHS is one of these wildfire examples. With Colorado's State Climatologist Nolan Doesken at the helm, this unique network of volunteer observers is currently active in 26 states with 7 more projected for 2008. At this rate CoCoRaHS expects to have 20,000 observers by the year 2010. Congratulations to Nolan, to his dedicated staff at CSU, and to all the volunteers that contribute so much to our understanding of precipitation and its impacts.

The District has been a CoCoRaHS sponsor since 2002 and makes routine use of this valuable information source. Be sure to read the article by Chad Kudym to see one creative way this data gets used. To learn more about CoCoRaHS visit [www.cocorahs.org](http://www.cocorahs.org) and consider becoming a volunteer.

#### EMWIN-Denver Update

The Emergency Managers Weather Information Network has a reputation in some communities like Houston, Texas as a one-stop shopping location for weather information. The system can filter information and “push” user-specified high priority products using short message service (SMS) emails to cell phones and pagers, or more detailed content if desired. EMWIN can also be used for interoperable communications between emergency managers concerning non-weather situations. The main selling point, aside from its low cost, is that local emergency managers and support organizations can tailor the system to best meet their specific needs.

The EMWIN project for the greater Denver area is driven by a steering committee that meets monthly. A message injector application recently passed IT security checks and is ready for operational testing. Thirty one receiver units have been distributed to 29 local governments, the Colorado Division of Emergency Management, the University of Colorado, Xcel Energy and the District. [ARES](#) Ham radio operators received necessary technical training in 2007 to assist their assigned jurisdictions. The 2008 goal will be to optimize utility, get feedback from users and make recommended changes. For more information about EMWIN visit [emwin.udfcd.org](http://emwin.udfcd.org).

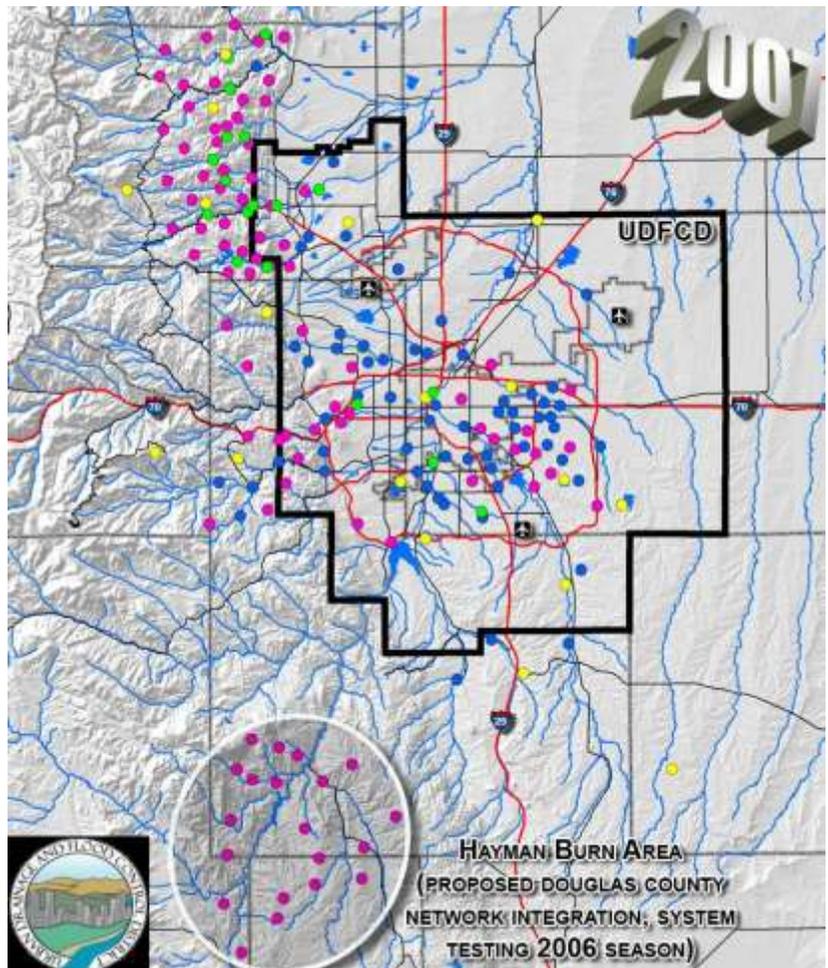
#### ALERT System News

With the introduction of the Hayman gages in 2006 via a new Douglas County repeater near West Creek, the District’s ALERT system now collects data from 196 stations that include 175 rain gages, 87 stream gages and 20 weather stations.

Seven new stations were added to the network in 2007. The City of Aurora Water Department installed two new hourly-reporting weather stations—one at Aurora City Hall and the other along Brighton Ditch in Weld County northwest of Brighton. Douglas County relocated four rain gages from the Hayman area to the upper Cherry Creek and Plum Creek basins south of Castle Rock (West Cherry Head, Spring Valley Road, Willow Creek and Tomah Road). A new stream gage was installed on Lakewood Gulch at 10<sup>th</sup> Avenue in Denver.

By spring of 2008, two new combination rain/stream gages will be operating on Piney Creek in Aurora. The Aurora Water Department will upgrade the equipment at the Quincy Reservoir weather station, which has been operating since January 8, 1989 and was the first ALERT weather station in the network. The Town of Parker is adding two rain/stream gages along Cherry Creek near Stroh Road and the Apache Plume confluence. The District will increase the number of rain gages from one to three at NCAR’s precipitation research

test site near Marshall. This is being done to evaluate how well various types of ALERT rain gages perform and to test a new multi-sensor weather instrument available from Vaisala that measures wind speed/direction, rain, barometric pressure, air temperature and relative humidity.



Two system expansion projects for Aurora and Douglas County are also slated for a 2008 start-up.

OneRain completed their 16<sup>th</sup> consecutive year of field maintenance services. Water and Earth Technologies (WET) provided the District with Year-2 of monthly system performance reports developed from a detailed evaluation of the District Base Station database and from a chronologic report log of all decoded ALERT messages, which includes the good, the bad and the ugly. Annual reports from OneRain and WET are available online at [alert.udfcd.org](http://alert.udfcd.org).

Leonard Rice Engineers (LRE) continued to support the District by web hosting real-time hydrologic models for Boulder Creek in Boulder County and Lena Gulch in Jefferson County. Two new models were developed this past year for Harvard Gulch and Goldsmith Gulch in Denver. The models activate automatically whenever flood threat notifications are issued by the F2P2 meteorologist. Basin average rainfall inputs are created from the ALERT database. In the future, the rain inputs may include quantitative precipitation estimates (QPE) from radar, and quantitative precipitation

forecasts (QPF) from storm track models and meteorologists. For more information about this procedure be sure to read the article by LRE's project manager Bruce Rindahl.

The ALERT system website evolution continues with improved graphics, floodplain mapping and pertinent links, photos of past floods taken at or near stream gages, descriptive metadata and other features that will draw your eye to the most important real-time decision-support data. Chad Kudym is the architect of these and other innovations as you will discover from his article on storm verifications.

### ALERT System Nearing Capacity

A recent study completed by Don Van Wie of Telos Services, formerly with OneRain, points to a growing concern that the District's ALERT system is nearing its capacity. Contention losses of 30% have already occurred for brief periods during intense storms. The findings suggest that a data loss rate of 63% will occur when the message rate reaches 2000 per hour. At 5400 messages per hour, the system will begin to collapse.

A simulated storm developed from an actual event was used to estimate a possible peak traffic load exceeding 7400 reports per hour from the existing gaging station network. The critical rate of 2000/hr was approached on May 14 of this year according to the data analysis performed by WET.

With more stations coming online, a redesign of the radio backbone will soon be needed. A number of options are available including adding additional radio frequencies to reduce traffic through existing repeaters. New protocols are being developed for ALERT data communications that hold great promise for more efficient use of the radio spectrum allocated to hydrologic uses. Given the current status of the District's ALERT system, the District may be a likely candidate for testing these new protocols and establishing national standards.

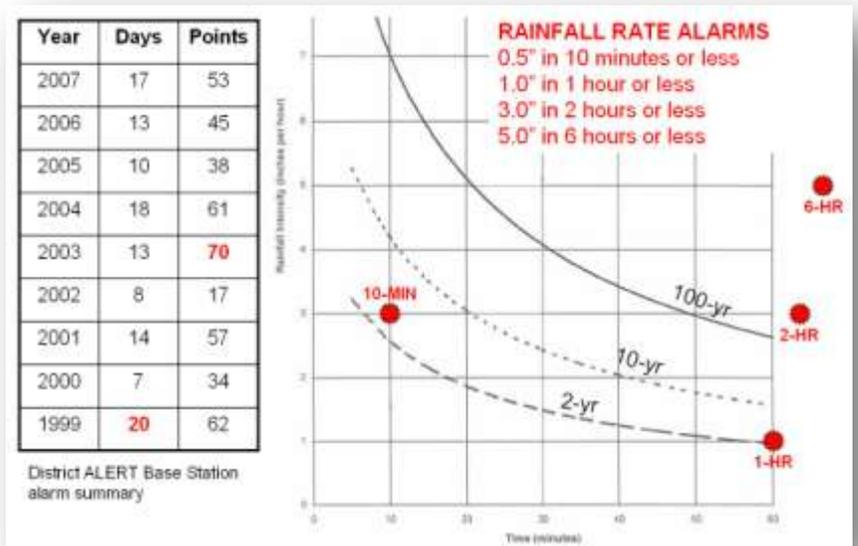
### Understanding Extremes

It seems like every time a heavy downpour results in flooding, inquiring minds want to know how big the flood was in terms of its frequency or its likelihood of happening again. Most floods that we experience on an annual basis are relatively small in magnitude, as compared to the 100-year (1% annual chance) flood that most people relate to and believe they understand.

The news media frequently looks for some authority to confirm that a flood or rainstorm was a 2, 5, 10, 50, 100, or 500-year event, or an anomaly of greater magnitude. Since rainfall data is more readily available than streamflow, these measurements are commonly used to estimate a return period that news reporters convey to the public. For example, one TV news report about the May 14 "flash flood" on Lakewood Gulch stated that this event was a 50-year flood. If the truth be told, it wasn't even close. However, a

nearby ALERT rain gage did measure a very short intense burst that approached the 50-year (2% annual chance) magnitude. To equate this to a 50-year flood on Lakewood Gulch is completely misleading, but it happens all too often. By the end of 2007, the Lakewood Gulch stream gage at 10<sup>th</sup> Avenue in Denver measured three other events of equal magnitude.

Another common misunderstanding is the likelihood of experiencing a so-called "rare" rainfall event. When return periods are used to describe large rainstorms, it leaves the impression that such events happen infrequently. But the truth is, big rains happen every year in a region as large as the District, even events as "unusual" as the 100-year. This defies rational thinking for most people and consequently, trying to explain this to a news reporter may not have the desired outcome. How is it possible that a rainfall event that only has



a 1% annual chance of occurring in your neighborhood is almost certain to happen every year somewhere in or near the community in which you live? In attempting to answer this challenging question, consider the following:

Colorado's State Climatologist has stated that in a typical year, it is not unusual for Colorado to experience between 100 and 150 precipitation events that exceed the 100-year mark. The above figure supports this statement with a look at nine years of rainfall alarms from the District's ALERT system. The table shows that 2003 had the largest number of gage point alarms (70) while 1999 had the greatest number of alarm days (20). The graph shows the corresponding return periods for the rainfall rate alarm thresholds used by the District. At the very least, an alarm indicates that a 2-year rainfall event has been exceeded. A closer inspection of the data reveals that a majority of these storms actually exceeded the 5-year threshold, suggesting that the metro Denver region averages between 10 and 15 days a year of intense rainfall capable of at least causing minor flooding. Experience has also shown that significant flooding occurs every year

from one or more of these events while disastrous floods are, fortunately, few and far between.

So, how can this information help us begin to correct some of the continuing myths about extreme events? Here are some suggestions:

1. When describing flood magnitudes to the public, relate the subject event to a past flood whenever possible.
2. Use terms most people can correctly relate to like *“the floodwaters rose 3 feet in less than 10 minutes”* or *“the roadway was overtopping by 2 feet of water.”*
3. Avoid mentioning peak discharge. Lay people seldom understand flow rate units of CFS, CMS or GPM.
4. When pressed to estimate a return period, consider relating the event in question to the 100-year flood as a fraction or multiple, or state that the water level rose to within 4 feet of the 100-year flood or exceeded the 100-year flood by some known amount at a specific location.
5. Never equate flood frequency with an observed rainfall intensity and corresponding return period, unless you are talking about a flood that occurred in a parking lot with a person that understands exactly what you are talking about.

Events like Hurricane Katrina and worldwide debates over climate change have made us all very sensitive to weather extremes and their potential catastrophic impacts. As engineers and subject experts on floods, we should first educate ourselves about extreme events and then work with communication professionals to more effectively educate others about the true risk of flooding and what individuals and families can do to protect themselves.

### 2007 flood season recap

April precipitation made for an early start to the flood season, causing notable rises in flood control reservoir levels well before the normal snowmelt runoff period in May and June. The April 23-24 storm system that delivered between 2 and 3 inches of rain over a large portion of the District prompted forecasters to issue the first messages of the year. While April is not considered a high streamflow producer for the District, a remarkable number of gaging stations recorded annual peaks that month.

The table lists 28 days that caused ALERT rainfall rate alarms in 2007. The 11 red dates represent intense rainfall in the Hayman fire burn area of Douglas County that did not affect the District. The alarm thresholds were set slightly lower for this area at the request of Douglas County and NWS officials. The following briefly describes some of the more notable events:

May	14,29
June	24
July	3,4,5,10,19,21,25,26,27,29,30
Aug	2,5,6,7,13,14,15,17,18,23,24,29
Sept.	5,24

#### Monday-Wednesday, April 23-25

With CoCoRaHS distinguishing the 24-hour rainfall period ending April 25 at 7 AM as the wettest day in their short history from a national perspective, volunteer observers from

within the District contributed their fair share with many reports exceeding 2 inches.

The first incident of flooding reported to the District occurred during the evening hours of April 24 sometime after the newly rehabilitated Leyden Dam in Jefferson County began releasing flows from its principle outlet. Immediately downstream of the dam Colorado Highway 72 (Indiana Street) was overtopped by less than a foot of water. Law enforcement officers were on scene early to slow motorists.

The rainfall was not intense, but the large amount of rain combined with snow from elevations above 6,000 feet produced significant runoff District-wide with annual peaks occurring at many locations including Ralston, Leyden and Van Bibber Creeks in Arvada and Jefferson County; Lakewood Gulch in Denver; Westerly Creek and Granby Ditch in Aurora; Englewood Dam and Holly Dam in Arapahoe County; Slaughterhouse Gulch in Littleton; Cherry Creek in Denver; Sand Creek in Commerce City; and the South Platte River in Adams County. Flows on Cherry Creek and Plum Creek in Douglas County were also well above normal.

#### Monday, May 14

This day ended in tragedy with the loss of a 2-year-old boy that became trapped with his mother under the Decatur Street crossing of Lakewood Gulch in Denver. Earlier in the day the NWS had issued severe weather watches and warnings that included the possibility of heavy rainfall. Most of the storms that day were moving too quickly to cause much concern by way of flooding. The intense storm that developed suddenly over downtown Denver around 7 PM produced very heavy rain and hail. The rain gauge at Denver Wastewater Management (2000 W. 3<sup>rd</sup> Ave.) measured an inch in just 12 minutes.

Elsewhere, flooding along Goldsmith Gulch near Bible Park resulted in a failed rescue attempt of a teenage boy by Denver Police. The boy was not found and was assumed to have escaped the floodwaters somewhere between Yale and Iliff Avenues. A police officer was pulled from the strong current by fellow rescuers and was treated for hypothermia. Media coverage of both incidents was extensive.

Annual flood peaks were measured along Harvard Gulch and Goldsmith Gulch in Denver; Westerly Creek in Denver; Sable Ditch in Aurora; Bear Creek in Sheridan; and the South Platte River in Denver. Lakewood Gulch at 10<sup>th</sup> Ave in Denver rose approximately 3 feet between 8:00 and 8:15 PM hitting a peak gage height of 4.18 feet. This new stream gage recorded nearly

identical water levels on three other days in 2007—April 24, May 1, and August 3.

Peak flow estimates at Decatur Street made by Leonard



Rice Engineers and the U.S. Geological Survey ranged from 400 to 550 cfs. To put these numbers in perspective, a master planning study completed in 1979 estimated a 2-year (50% annual chance) discharge of 800 cfs that would increase to 1,900 cfs with a fully developed drainage basin. Design flow rates of 7,200 and 11,400 cfs were calculated for the 10 and 100-year events. Between 1981 and 2007, annual peaks for Lakewood Gulch ranged from 300 to 1,200 cfs according to data from a USGS crest stage indicator gage.

The fact that floods like the May 14 event on Lakewood Gulch happen almost every year does not lessen the danger posed by fast moving water. Although the water depth on the trail was less than two feet, the quick rising floodwaters and high flow velocities of 10 to 12 feet per second made escape impossible for a mother and her child on this particular day. This tragic accident will not soon be forgotten and will hopefully serve to remind others that gently flowing streams can turn deadly with little or no warning.

Wednesday, July 4

Celebratory fireworks are always a most welcome and anticipated Independence Day highlight, but in the District the 4<sup>th</sup> of July would not seem complete without a grand finale lightning show accompanied by localized flooding. This year the T-storm arrived in Denver shortly after the pyrotechnics ended with the Cherry Creek at Steele Street rain gage setting off a half-inch in 10 minute rate alarm at 10:13 PM. A maximum rainfall total of 1.4 inches was reported by a CoCoRaHS observer.

Saturday, July 21

A line of strong thunderstorms extending from the Hayman burn area in southwest Douglas County to Aurora dumped between 2 and 2.5 inches of rain at a number of locations prompting the NWS to issue a flash flood warning for Aurora. The largest rainfall measurement of 1.93” occurred at the Murphy Creek Golf Course ALERT gage where the stream gage also recorded its annual peak. The late afternoon storm lasted approximately 90 minutes.

Friday, July 27

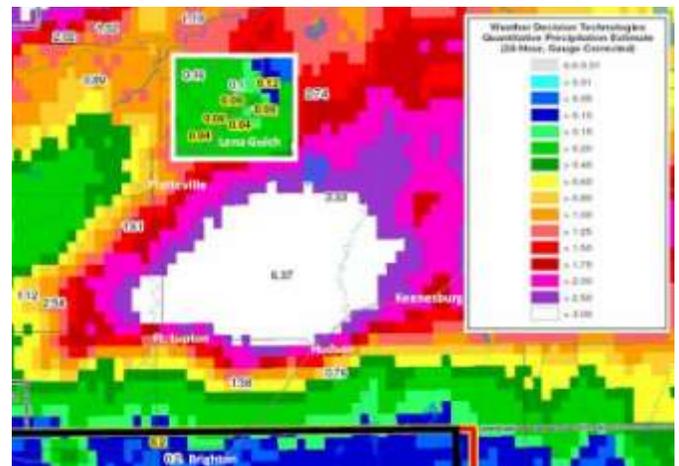
It’s a rare day when District staff gets a phone call from a NWS forecaster at 3:45 AM concerning the potential for flash flooding from a deep warm layer with surface dewpoints in the 60’s. That forecast sounded familiar to a day exactly 10 years earlier when a flash flood in Fort Collins claimed 5-lives and resulted in a presidential disaster declaration. A subsequent flash flood watch was issued for the entire District and the anticipated storms arrived in time for the late afternoon rush hour. The storms formed over the southern portion of the District and moved very slowly to the north producing heavy rainfall of 1.5 to 2.5 inches in 30-60 minutes and triggering alarms at five ALERT gages between Littleton and Adams County. The most intense rainfall measured at the District’s Diamond Hill office set off four alarms between 5:47 and 5:54 PM. This storm activity prompted the NWS to issue flash flood warnings for Denver, Arapahoe and Adams counties. While traffic disruptions were common, flood losses appeared minimal according to news reports. A man

was killed by lightning on a park trail in Jefferson County north of Morrison.

Thursday, August 2

This day had the potential of being the biggest flood day of 2007 for the District. Once again, luck favored the District with storms that caused only minor street flooding. An area northeast of Brighton was not as fortunate, however, being hit by rainfall that warrants reflection. August 2 also brought Fort Collins a near repeat of the 1997 flood when the southern portion of the city was hit by a heavy rainstorm that dumped over 5 inches in 3 hours.

District rainfall was relatively light in comparison to nearby storms with the largest reported amounts being just over an inch. Heavy rainfall in Denver and Aurora caused some nuisance street flooding and set off gage alarms near Stapleton and Buckley Air Force Base. A large rainstorm northeast of Brighton went relatively unnoticed while media reports focused on the flooding situation in Fort Collins. The monster storm in Weld County (see figure) was far more impressive than the Fort Collins event covering a much larger area and producing more than 6 inches of rain at its core with a sizable area receiving over 3 inches. Interesting also is how this storm centered itself almost perfectly between the rural towns of Ft. Lupton, Hudson, Keenesburg and Platteville.



**Large rainstorm of August 2, 2007 northeast of Brighton**

The numbers represent storm rainfall totals in inches. The yellow highlighted amounts are ALERT gage measurements and the white highlighted amounts were reported by CoCoRaHS observers. The colored pixels represent radar estimated amounts.

To emphasize the hydrologic significance of this event, the figure includes an inset map of equal scale depicting the 14 square mile Lena Gulch basin in Jefferson County. A recently completed master plan update for Lena Gulch shows that a very damaging 500-year flood would result from a 2-hour basin average rainfall of just 3.8 inches. Had this Weld County storm occurred over Lena Gulch or any other developed portion of the District, breaking news stories that day would have certainly included metro Denver. Hopefully events like these can serve as a reminder that “unusual” rainstorms are not all that rare and we should remain diligent in anticipating the next one.

Wednesday, August 15



#### **Bear Canyon Creek along Table Mesa Drive in Boulder**

Photo source: KCNC News4 website ...[cbs4denver.com](http://cbs4denver.com)

This sudden storm hit the southern part of Boulder producing upwards of 1.5 inches of rain between 5:00 and 5:30 PM, and causing alarming water levels on



Bear Canyon Creek. The small stream runs between the east and westbound lanes of Table Mesa Drive west of Broadway (Colorado Highway 93). The above photo shows that roadway culverts had reached their capacity. Another inch of rain could have resulted in flood damages to adjacent properties as shown by the aerial photo depicting the extents of the 100-year floodplain. The intersection of Table Mesa Drive and Broadway is in the upper right corner.

#### Friday, August 24

Every year the District experiences at least one nocturnal boomer. This one happened unexpectedly just after midnight waking residents in Broomfield, Boulder and Jefferson counties. The ALERT repeater station on Blue Mountain was severely damaged by lightning. Radar precipitation estimates of 1.5 inches were confirmed by surface measurements.

#### Monday, September 24 (post-season)

The rainmaker apparently did not get the memo because this event happened nine days after F2P2 forecast services ended for the year. Portions of northeast Boulder received more than two inches of rain from this late season finale. According to radar precipitation estimates, the Town of Superior may have experienced equally as much. The intense downpour in the Gunbarrel area set off an ALERT rainfall alarm at 7:26 AM and the water level in the detention basin there rose 1.7 feet. Intense rainfall was also measured at

Leyden Lake in Jefferson County between 9 and 9:30 AM, ending the season at the same location where the action began precisely 5 months earlier on April 24.

#### **2007 High Water Marks**

Past issues of *Flood Hazard News* contain tables that list annual peak flows and maximum gage heights recorded by the ALERT system for each respective year. New record high water measurements are also identified in those tables. With some gage records now exceeding 20 years in length, the historic data is becoming increasingly significant while the stream gauging network continues to expand.

Consequently, the past practice of publishing a peak flow table in this newsletter has been replaced by making available a more complete online version of peak flow/high water records from 1986 to present at [alert.udfcd.org](http://alert.udfcd.org). This is a work in progress, so please be patient and send us your suggestions. Some of the older records are the most difficult to compile. The District recognizes the efforts of IS/FWP student intern Stephanie LaCrue in compiling this important historic record.

Readers wanting more information about past storms and floods in the Denver region should visit the [Flood Warning Program Bulletin Board](#) webpage.

#### **Information Services on the Rise**



The District continues to expand services to local governments, engineering consultants, contractors and the public through its development of GIS-based information and web services. E-Library enhancements will be a continued focus through 2008 and beyond. Much is already available from the District's website, which is enthusiastically administered by our IT consultant Derrick Schauer. Nearly all District studies and reports can be downloaded from our website by clicking on the publications tab and making your selection.

Future plans include developing better map-driven "drill down" interfaces that allow users to more easily locate and download District publications, construction as-built drawings, floodplain maps, project status reports, historical flood information, hydrologic and hydraulic models (H&H), maintenance eligibility status, monument surveys, and other useful products.

The District's IT infrastructure is keeping pace with these needs thanks to Derrick's near full-time efforts. His support of the District LAN and centralized file servers, combined with his Internet talents have been recognized by the District and with those needs continuing to grow, the District has established a permanent staff position to be filled by Derrick in 2008. Congratulations Derrick and welcome to the staff of the Urban Drainage and Flood Control District.

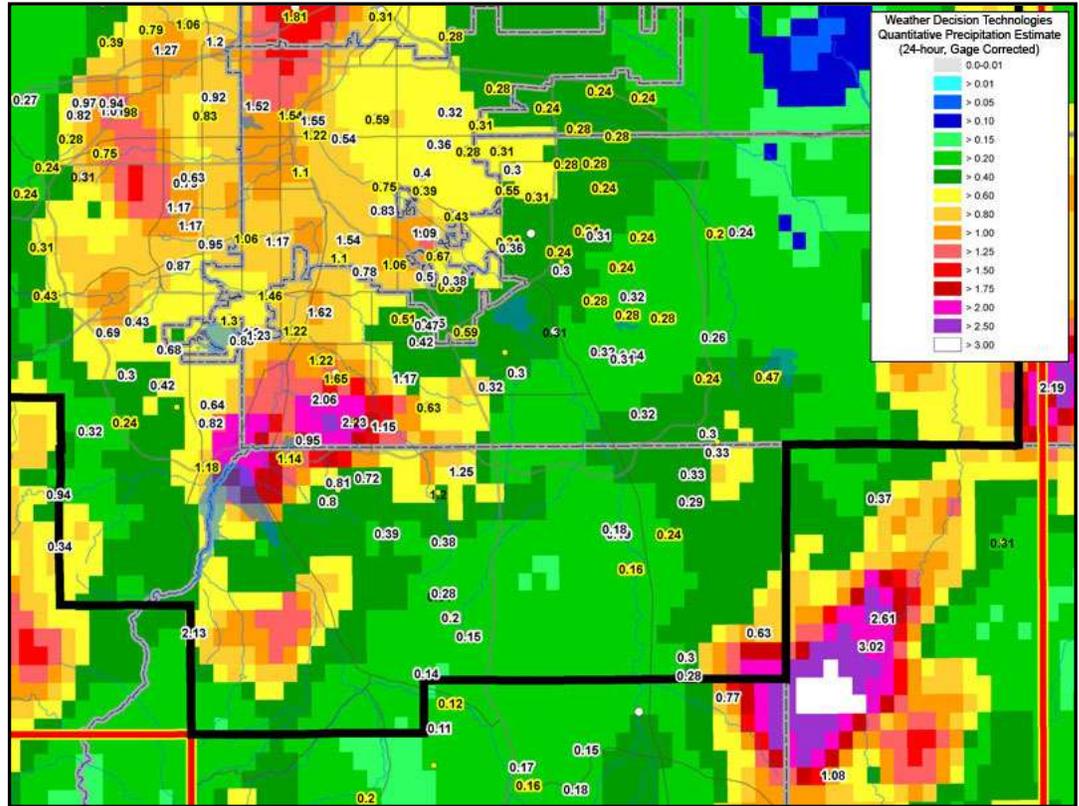
# Radar-based Message Day Verification

Chad A. Kudym, GIS Administrator, Information Services and Flood Warning Program

The Information Services and Flood Warning Program staff worked with their weather data vendor, Weather Decision Technologies (WDT), to test gage-corrected quantitative precipitation estimates (QPE\_GC). The District's goal was to assess the value of QPE\_GC for the Flash Flood Prediction Program (F2P2) both in real-time and for verifying message-level rainfall on a daily basis.

The District's automated local evaluation in real-time (ALERT) rain gage network was used to adjust radar-derived rainfall estimates in real-time (every 15 minutes). WDT's resulting QPE\_GC product was provided in Geographic Information System (GIS) format with 1-km resolution as a running total for the previous 1, 3, 6, 12 and 24-hours.

The Community Collaborative Rain, Hail and Snow (CoCoRaHS) volunteer observer network data were used for



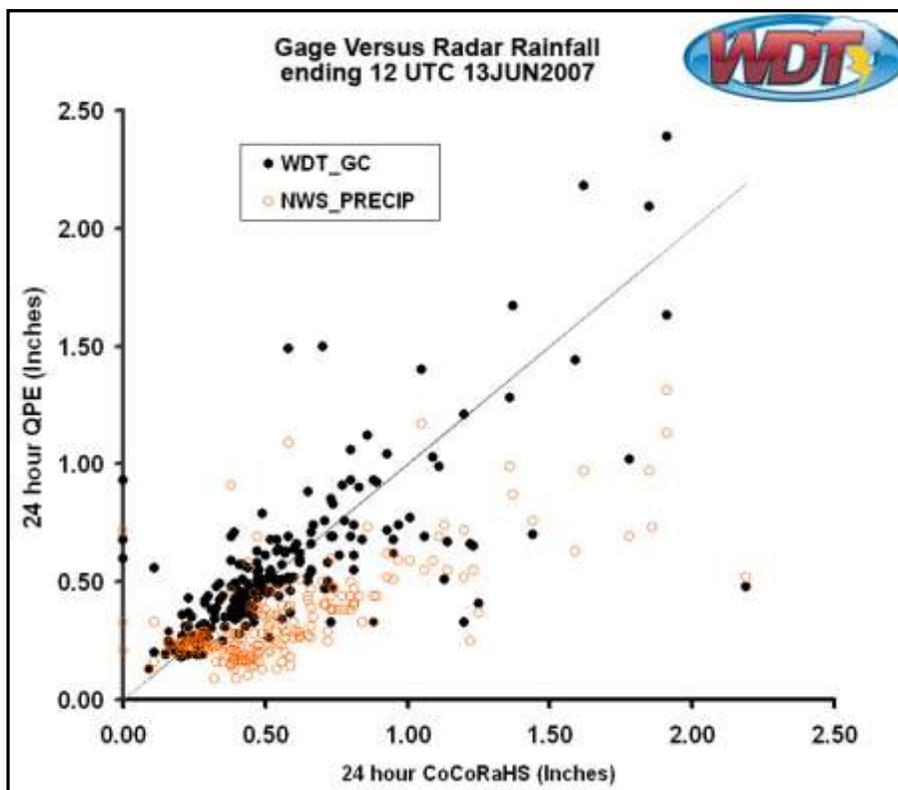
statistical analysis to independently verify QPE\_GC estimates.

The map above illustrates the combined display from integrating 24-hour precipitation estimates in inches from CoCoRaHS (white), District ALERT gages (yellow) and QPE\_GC.

Such maps were used by District staff to assemble statistics for the F2P2 on days in which flood threat messages were issued to local jurisdictions.

In 2008 the District will be working with WDT to assess the value of basin-averaged QPE\_GC for flash flood prediction. The basin average product should help local officials compare real-time radar precipitation estimates with flash flood guidance tables and other threshold criteria set forth in basin-specific flood warning plans. The WDT products may also be used to drive real-time runoff models and inundation mapping.

The graphic to the left represents work WDT is performing with help from the District to assess the overall accuracy of the QPE\_GC product in comparison to standard NWS radar-derived precipitation estimates. District staff will be presenting the results of this study with WDT at the American Meteorological Society Annual Conference in New Orleans in January 2008.



# Maintenance Program

Mark Hunter, PE, Program Manager

The Urban Drainage and Flood Control District Maintenance Program budgeted a total of \$7.4 million in 2007 to maintaining publicly-held drainageways in the Denver metropolitan area. Our maintenance work covers the spectrum of drainageway work. It includes debris pick-up and mowing, localized repair to damaged and eroded channels or detention facilities, and consultant-designed reconstruction of long reaches of deteriorated drainageways.

Most of our work involves publicly-owned open channel drainageways that have been improved in the past as part of a capital improvement project or a subdivision development. These open channels typically have native-grass-lined banks, riprap or vegetative erosion protection, and rock or concrete grade control structures.

## Mowing and Debris Pick-up

For the year 2007 we awarded eight contracts for debris pickups and native-grass mowing under our routine maintenance program. Six of those contracts were awarded as renewals of the prior year contract. The value of each of these renewed contracts was adjusted to match the change in the regional Consumer Price Index over the prior year. The remaining two contracts were awarded through a competitive bid process in March.

Mowing and debris pick-up work was done on 294 different sections of urban native-grass-lined drainageways within the District's boundaries. The contractual value of the work through October of the year was \$825,370. The table below summarizes the miles of drainageways within each county in the District on which we performed regularly scheduled mowing and/or debris pickup maintenance.

## 2007 Routine Maintenance Summary

Adams County	21.2 miles
Arapahoe County	43.0 miles
Boulder County	18.9 miles
Broomfield County	0.2 miles
Denver County	44.7 miles
Douglas County	13.8 miles
Jefferson County	34.3 miles
TOTAL	176.1 miles

## Construction Activities

Through October of 2007, \$4.8 million of maintenance work has been performed under our various construction contracts. For that group of localized drainage repairs where the estimate of construction cost is less than \$400,000 the smaller activities are directly awarded to individual

contractors while the larger projects are bid among our group of eleven private "Drainageway Contractors" who have qualified for open-ended contracts with the District. A major advantage of work under the open-ended contracts is the ability to use them to react quickly to local drainage needs.

When project construction will cost more than \$400,000 the work is designed by a private consultant and then put out for public bid to be built by a private contractor. These larger projects typically address severe problems that have occurred on previously improved urban drainageways.

Through the first 10 months of the year 114 individual activities have been completed, are under contract, or are being designed. Our major projects for the year are summarized in the accompanying table titled "Status of Major Maintenance Projects for 2007."

## Channel Repairs

Southeast of Orchard Road and Monaco Way construction is underway on Greenwood Gulch to stop the vertical and lateral erosion. The project includes low flow drop structures to reduce the erosive power of the creek by reducing the longitudinal gradient of the channel. The neighborhood and vegetation are mature so the drainageway corridor is confined. As a result there was no room to build 100-year capacity drop structures.

High water on Massey Draw in 2004 caused flooding damage near Kipling Street. It also caused erosion damage to an unimproved portion of the channel near Wadsworth Boulevard well downstream of the area that experienced the flooding conditions. In between the two damaged areas the



This view of Massey Draw shows the tight corridor in which the boulder walls and drop structures were built

channel had been improved in the past and therefore received little damage. We have now repaired the downstream erosion damage using boulders for bank protection and drop structures to reduce the creek gradient.

In last year's *Flood Hazard News* we detailed the succession of construction and erosion that has occurred on **Goldsmith Gulch** between Iliff Avenue and Yale Avenue over the last 25 years. The longitudinal grade appears to be flat enough, yet the stream has been prone to flash flooding with resulting erosion and formation of secondary channels. The recently completed rehabilitation provided a low flow channel that was reinforced for its full width with boulders or riprap. Overbank erosion protection along this narrow corridor was established through the use of rolled erosion control materials and natural vegetation. The parallel regional trail was also rebuilt.



**Goldsmith Gulch before and after.**



**Multi-purpose Projects**

We continue to cooperate with local governments to fund multi-purpose projects. Since drainageways and parks often share the same corridor the repair of damage can be a combined effort.

**Grange Hall Creek** in Thornton, Northglenn, and Adams County has received much attention over the years. Thornton is enhancing its recreation center northwest of 108<sup>th</sup> Avenue and

**Status of Major Maintenance Projects for 2007**

Project	Jurisdiction	Cost	Status
<b>ADAMS COUNTY</b>			
Big Dry Ck, Cozy Crnr Trib – 116 <sup>th</sup> Av. & Sheridan. Repair channel and pond	Westminster partic.w/ Westy	Design	local gov 100%
		Const	next year 0%
Grange Hall Creek – NW.of Colo. Blvd & 108 <sup>th</sup> . Drops and channel work at Rec ctr.	Thornton partic. w/ Thornton	Design	local gov 100%
		Const	next year 0%
Line B – S. Platte River to Southern St. Build drop, remove substantial sediment	Brighton partic.w/ Brighton	Design	31,385 100%
		Const	35,594 100%
Little Dry Creek – West of Federal Blvd. Utility work and channel regrading	Westminster partic.w/ Westy	Design	58,585 100%
		Const	276,973 100%
<b>ARAPAHOE COUNTY</b>			
Greenwood Gulch – E.of Monaco/Orchard Build drop structures and repair erosion	Centennial	Design	50,000 100%
		Const	299,120 50%
Lee Gulch – E. of Prince at Hill St. ext. Local channel repair and regrading.	Littleton	Design	26,531 100%
		Const	36,786 100%
Little Dry Creek – East of Colorado Blvd. Local small drops and channel repair	Centennial	Design	75,592 100%
		Const	263,016 100%
Westerly Creek – S.of Kentucky Ave. Ongoing repair of drop structures	Aurora	Design	26,707 100%
		Const	100,000 70%
Windmill Creek – SW of Bronco Parkway Study of preventive maintenance	Arapahoe County	Design	39,181 100%
		Const	40,000 50%
<b>BOULDER COUNTY</b>			
Boulder Crk – NW of Hwy 287 & Jasper Repairs to 1999 realignment project	Boulder County	Design	6,000 100%
		Const	34,345 100%
Coal Creek – Bldr. Crk. S.to Kenosha Rd Rebuild large drops and do erosion repair	Boulder County	Design	35,790 100%
		Const	next year 0%
Coal Creek – S. Public Rd to W. of 287. Install small drops and repair erosion	Lafayette	Design	47,621 60%
		Const	next year 0%
Fourmile Cnyn Crk – E.of 28 <sup>th</sup> to E.of 30 <sup>th</sup> Repair small drops and channel erosion	Boulder	Design	28,910 50%
		Const	next year 0%
<b>BROOMFIELD COUNTY</b>			
City Park D'way – W. of 287 to Burbank Utility conflict and repair local erosion	Broomfield	Design	24,325 70%
		Const	next year 0%
<b>DENVER COUNTY</b>			
Cherry Creek – University south of 1 <sup>st</sup> Av. Rebuild drop #1 and improve trail	Denver partic. w/ Denver	Design	100,465 100%
		Const	next year 0%
Cherry Creek – U/s Havana & Hampden. Rebuild large drop structure #27	Denver partic. w/ Denver	Design	69,030 80%
		Const	next year 0%
Goldsmith Gulch – Iliff to Yale at Monaco Repair narrow channel and trail	Denver	Design	95,207 100%
		Const	528,724 100%
Irontale Gulch – Andrews Dr. at Tulsa Ct On-going rebuild of concrete channels	Denver	Design	previous 100%
		Const	315,425 100%
Irontale G, Tower Outfall – SE of 56 <sup>th</sup> & Chambers. Maint.access at Parkfield Lake	Denver partic. w/ Denver	Design	local gov 100%
		Const	361,221 100%
West Harvard Gulch – Platte R to Railroad Drops, channel repair, and trails	Denver partic. w/ Denver	Design	200,817 95%
		Const	next year 0%
<b>DOUGLAS COUNTY</b>			
East Dad Clark G – N. of Venneford Rd Bank protection and erosion repair	Douglas County part. w/Cap.& H.R.	Design	32,150 100%
		Const	281,455 80%
Marcy Gulch – S. of Town Center Drive Add drop structures and bank protection	Douglas County	Design	89,372 100%
		Const	419,669 100%
<b>JEFFERSON COUNTY</b>			
Kenney's Run – Along Johnson Road Repair small drops and regrade banks	Golden partic. w/ Golden	Design	81,200 75%
		Const	next year 0%
Lakewood Gulch – W.of Dudley at 8 <sup>th</sup> Ave Drops and repair channel	Lakewood	Design	59,610 60%
		Const	next year 0%
Massey Draw – NW Wadsworth & C470 Drops and channel repair	Jefferson County	Design	86,557 100%
		Const	435,911 100%
Ralston Creek – Taft St. to Urban St. Repair channel and utility crossings	Arvada partic. w/ Arvada	Design	20,000 50%
		Const	next year 0%
SJCD South – Kendall to East of Pierce Repair old project and eroded channel	Jefferson County	Design	65,000 90%
		Const	next year 0%
SJCD South – SW of Carr St & Ken Caryl Repair eroded channel	Jefferson County	Design	43,595 80%
		Const	next year 0%

Colorado Boulevard and we are coordinating with them to add needed drop structures to the creek.

The linear corridors provided by drainageways are ideal avenues for neighborhood parks and trails. East of Ward Road in Arvada **Ralston Creek** slices through a park where erosion by the creek has exposed utilities and threatened the trail. Our design is underway to regain the natural banks and meanders of the creek and to protect the utilities and trail.

A patch of indigenous prairie grasses and shrubs adjoins the proposed channel and trail work on **West Harvard Gulch** west of the South Platte River near the Yale Avenue alignment. While we have been slowly moving forward with the right-of-way acquisition and final funding arrangements we have been able to protect the legacy vegetation area from the churning wheels of dirt-bikes. The proposed project will restore and protect the currently entrenched channel and will provide a highly desirable trail link to the **South Platte River** corridor for the neighborhoods to the west.

A major purpose of drainageway maintenance is to reduce large unexpected expenditures in the future by taking care of small problems while they are still small. Toward that goal we have developed some simple low cost erosion control techniques with the intent of controlling erosion in the short-term so thorough study and design can be completed for long-term regional solutions. These ideas are being tried on **Windmill Creek** northeast of Centennial Airport. We will report on this effort in the future.

#### Detention Ponds and Sediment Control

The City of Brighton has relatively flat topography, but as urbanization occurs sediment is still generated and carried by **South Urban Channel (Line B)**. At its confluence with the South Platte River the grade is even flatter and the sediment is deposited. Recent sediment removal and channel regrading has established a more efficient low flow channel to carry the material. The nearby trail, which was often under water and mud, was also improved to make it a more all-weather corridor.

Our successful sediment removal and vegetation thinning last year on a flat reach of **Coal Creek** near Centaur Village in Lafayette has expanded downstream. The additional work involves more removal of excess material, but will also include the installation of three or four grade control structures to manage lateral erosion.

Since the completion in the late 1990s of the sediment trap on **Willow Creek** south of Dry Creek Road in Centennial we have removed about 1000 cubic yards of material at least once each year. We realize the sediment capture volume for this facility is undersized for the basin, yet it is capturing the large grained material which would otherwise be deposited under the nearby Dry Creek Road Bridge or in the flood pool behind Englewood Dam.

#### Grade Control

The design is nearly complete for the rehabilitation of the 18-foot tall drop structure on **Cherry Creek** upstream of Hampden Avenue and Havana Street. The design has been

expanded to include recent downstream erosion that is migrating toward the structure. The new drop structure will accommodate the deeper downstream channel as well as the design discharge from Cherry Creek Reservoir.

Seven miles downstream from the above drop structure is another high priority structure on **Cherry Creek** that is being rebuilt. Immediately west of University Boulevard is an old 4-



South Urban Channel before and after



foot tall timber and steel H-pile drop structure. It is being rebuilt as a sheet pile and grouted boulder facility. The work includes re-setting the Cherry Creek trail under University to accommodate a 90-degree bend in the alignment. The design phase, including easement acquisition by Denver, is done and construction is planned in 2008.

Open channel drainageways are sometimes in the form of a concrete-lined trough in order to narrow the footprint of the facility. Through some public areas south of Kentucky Avenue in Aurora **Westerly Creek** is held in a concrete-lined channel. We have coordinated with Aurora over the last few years in the difficult reconstruction of four drop structures in this channel. Each drop is a cast-in-place concrete foundation and wall with the wall extending well below the grade of the concrete channel.

# South Platte River Program

Bryan Kohlenberg, P.E., Senior Project Engineer

The South Platte River section within the Design, Construction and Maintenance Program, consists of a senior project engineer, a construction manager, and a student intern assigned to the 41 miles of the South Platte River from Chatfield Reservoir downstream to the Adams/Weld County line at 168<sup>th</sup> Avenue.

For over 20 years we have worked with cities, counties, special districts, utility owners, and property owners along the South Platte River to help preserve the corridor, improve conditions and habitat of the river, and assist with the maintenance of this valuable natural resource within the Denver Metropolitan area. In 2007 we participated in the following:

## SPR Capital Projects

### Globeville Project

The final construction phase of Denver's Globeville channelization project continues along the South Platte River at Franklin Street. The project includes a new water diversion structure for the Burlington canal, new trail improvements under Franklin Street, a new pedestrian bridge across the river, and a new grade control with boat chute/fish ladder. This project will remove approximately 200 acres of highly urbanized lands in north Denver from the 100-year floodplain. Construction is expected to be complete in the spring of 2008. Also, see the article earlier in this issue regarding this project.



Channel Construction in Globeville at Franklin Street

### Zuni/Sun Valley Reach Project

This year Edge Construction was awarded the first phase of channel utility relocations adjacent to Xcel's Zuni power plant just downstream of 13<sup>th</sup> Avenue. A large electrical distribution duct is being lowered and a shallow depth 115kV transmission line is being protected with concrete encasement in order to allow for the Zuni/Sun Valley channel lowering/widening project between 8<sup>th</sup> Avenue and Lower Colfax Avenue.

This phase also includes demolition of the old elevated concrete trail along the west bank. A temporary asphalt trail will be provided through this reach. Ultimately a new trail underpass will be constructed at 13<sup>th</sup> Avenue. At a cost of over \$850,000 this first phase of the Zuni/Sun Valley reach project should be completed by April 2008.

The design team, including the District, City and County of Denver, Matrix Design Group, and Xcel Energy continue to actively pursue project real estate, additional utility relocation needs, and funding (approx. \$30M) for the Zuni/Sun Valley reach of the South Platte River.

## SPR Maintenance Activities

### Routine Maintenance

In 2007, South Platte River routine maintenance efforts included:

- 244 river miles (equivalent) of trash and debris pickup and removal
- 3.3 acres of string-trim mowing at access ramps and rest areas
- 74 miles (equivalent) of recreation/maintenance trail edge mowing
- 2.6 miles (equivalent) of tree pruning and trimming along the trail
- Clearing of excess vegetation from the river channel
- Removal of dead, non-native and invasive trees, such as Tamarisk (a.k.a. salt cedar), Russian Olive, and Chinese/Siberian Elms
- Planting of various native trees, shrubs and native dry land grasses to provide erosion control and wildlife habitat
- Helping control many varieties of invasive weeds such as Purple Loosestrife, Thistle, and Knapweed
- Participation in annual NIMBY ("Not In My Backyard") FEST volunteer trash cleanup event



Zuni/Sun Valley Reach - Utility Work Downstream of 13<sup>th</sup> Avenue

This year over \$300,000 was spent to perform these services along the 41 miles of the river. Colorado Total Maintenance (CTM), Inc. was once again selected to perform these services.

### Restoration Maintenance

In 2007, the following restoration maintenance projects were completed:

- Emergency repair of severely eroded east bank near 124<sup>th</sup> Avenue in Adams County during high spring runoff.
- Completed additional bank restoration/stabilization project along west riverbank at the new Elaine Valente Open Space just north of 104th Avenue in Adams County.
- Restored eroded east bank adjacent to Erger's Pond sand and gravel mine near 155<sup>th</sup> Avenue extended.
- Repaired failing outfall structure at Little's Creek confluence with the river.
- Participated in design of replacement wall for 650 feet of badly deteriorated wooden retaining wall along South Platte River Drive downstream of Mississippi Avenue in Denver.
- Replaced severely cracked or heaved concrete recreation/maintenance trail sections in Denver.
- Repair of habitat rock weir structure within South Platte Park in Littleton.

Several restorative maintenance projects that are planned for construction next year include:

- Repair of several riverbank stabilization and wildlife habitat structures within South Platte Park in Littleton.
- Repair or replace badly deteriorated wooden retaining walls and wooden bridges along the South Platte River trail within Denver.
- Construction of at least two bank stabilization/restoration projects adjacent to existing sand and gravel mines in Adams County.

### SPR Cooperative Projects

Cooperative projects are constructed on flowage and maintenance access easements dedicated to the District by private property owners adjacent to the river in exchange for river restoration work. The District can participate financially up to 75 percent of the total project cost. To date over 740 acres of such easements have been dedicated, resulting in over 36 bank stabilization and/or river grade control and riparian revegetation projects since 1987.

One new cooperative project was completed and two new projects were begun this year:

Worthing Pit Coop – Left Hand Excavating completed over 1000 feet of east riverbank restoration/stabilization on property owned by Henderson Aggregates Inc. (Albert Frei and Sons) south of 132nd Avenue extended.

Hazeltine Reservoir Coop – Naranjo Civil Constructors started construction of 800 feet of east riverbank restoration/stabilization adjacent to a sand and gravel mine just north of 104th Avenue on property owned by Aggregate Industries.

Brighton Mine Coop – Kemp and Hoffman, Inc. started construction of west riverbank restoration/stabilization adjacent to a sand and gravel mine north of E-470 on property owned by Aggregate Industries.



Worthing Pit Coop - During and After Construction



This is called "Filler"

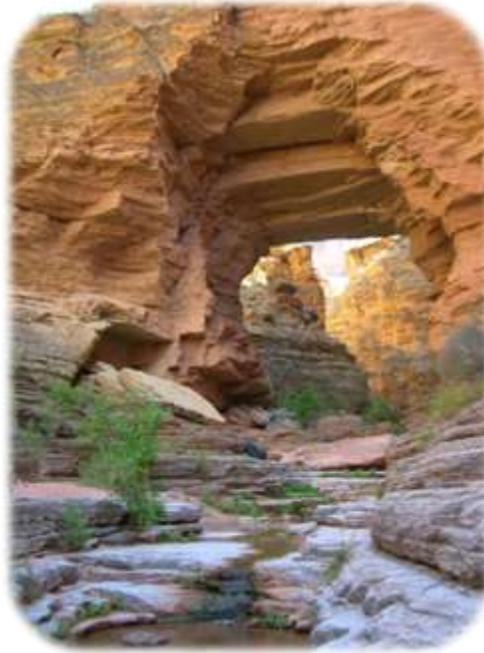
# Design and Construction Program

Paul Hindman, PE, Program Manager

In 2007, the Design and Construction program continued to assist local governments in designing and building many major flood control projects. The reorganization we did last year appears to be beneficial to both our clients (local governments) and our internal staff. We have had only one small change, Richard Borchardt is now in charge of Arapahoe County and Cindy Thrush is in charge of Boulder and Broomfield Counties.

Throughout the entire program, in 2007, we committed \$11.6 million to projects. As shown in the attached table, the Design and Construction Program continues to manage over 100 projects. Some have been ongoing for many years with multiple phases while others are just getting started.

For all of our construction projects we are continually striving to have the flood control improvements to be in context with their surroundings. Below are a few pictures of where we have gotten close to that goal.



**Royal Arch Creek-Grand Canyon, Arizona. We didn't build this (really?), but this is what we are trying to mimic with our sculpted drops like the one below on Sulphur Gulch in the Town of Parker.**



**Cottonwood Creek at Peoria Street, a water quality pond which doubles as a wildlife sanctuary. The bird houses on poles are actually indicators of the sediment level in the pond and outline the hidden maintenance access road.**



**Flooding along Tributary CC-10-in Erie.**



**Channel constructed to control flooding shown at left.**

## Status of Current District Design and Construction Projects

Project Name	Participating Jurisdiction(s)	Design Status % complete	Construction Status % complete	Construction Cost (X \$1000)
<b>Adams County</b>				
Brantner Gulch	Adams	20	0	
Cozy Corner	Westminster	2	0	
Dahlia/Kenwood Outfall	Adams	40	0	
Globeville Outfall	Adams	50	0	
Grange Hall Creek	Thornton	2	0	
Hoffman Drainageway	Adams	30	0	
McKay Pond	Adams	100	0	
McKay Pond: Outfall	Adams	100	0	
Niver-Trib L @ Pecos St.	Federal Heights	100	100	237
North Outfall - Baseline Road	Brighton	90	0	
Park Hill Outfall	Denver/Commerce City	25	0	
Quail Creek	Westminster	10	0	
Silverado II Detention Pond	Aurora/Denver	100	100	906
Shaw Heights Trib.	Westminster	20	0	
South Outfall	Brighton	20	0	
Triangle Point	Adams	10	0	
<b>Arapahoe County</b>				
Big Dry Creek: Allen WTP LOMR	Englewood	95	NA	
Big Dry Creek Maintenance Trail	Englewood	50	0	
Cherry Creek: Drops #20 & #21	Arapahoe County	100	10	920
Cherry Creek Open Space	Arapahoe County	100	100	1,020
Cherry Crest West-Retrofit	Centennial	100	0	0
Goldsmith Gulch at Berry	Greenwood Village	20	0	
Granby Ditch Inlet	Aurora	100	50	
Holly Hills Detention	Arapco.	100	25	
Little Dry Creek at Arapahoe Road	Centennial	95	0	
Normandy Gulch	Columbine Valley	25	0	
Piney Creek: u/s of E-470 (Sampson Gulch)	Aurora	95	0	
Quebec / Iliff Outfall	Arapco	100	60	
Quincy Reservoir Drainage	Aurora	100	5	1,054
Sable Detention	Aurora	10	0	
Sand Creek	Aurora	100	99	4,100
Southwood Village Outfall	Centennial	90	0	
Utah Park	Aurora	100	15	
<b>Boulder County</b>				
Drainageway G-Phase 2	Louisville	90	0	
Detention Facility No. 1026	Erie	90	0	
Detention Facility No. 1045	Erie	100	40	
Elmer's Two Mile Greenway Project Phase I	Boulder	50	0	
Reach BP20	Erie	90	0	
Valmont Bridge on South Boulder Creek	Boulder County	100	100	1,591
Wonderland Cr.-Boulder White Rock	Boulder	30	0	
Wonderland Creek Diagonal Hwy	Boulder	100	50	
<b>Broomfield County</b>				
City Park Drainage	Broomfield/Westminster	15	0	
<b>Denver County</b>				
30th & Magnolia Phase II	Denver	100	25	
Cherry Creek: Drop No. 24	Denver	100	100	360

Project Name	Participating Jurisdiction(s)	Design Status % complete	Construction Status % complete	Construction Cost (X \$1000)
Globeville / Utah Junction-Phase 1	Denver	100	0	
Goldsmith Gulch Retrofit	Denver	75	0	
Harvard Gulch/University-Hills-Phase 1	Denver	75	0	
Fastracks-Denver	Denver	65	0	
Lakewood Gulch: 10th Ave. bridge retrofit	Denver	100	100	275
Lakewood Gulch: Tennyson - Sheridan	Denver	50	0	
Lakewood Gulch: Wolff Bridge	Denver	75	0	
Montclair OSP	Denver	75	0	
Park Hill Phase III	Denver	100	50	
<b>Douglas County</b>				
Cherry Creek: Apache Plume	Parker	100	100	908
Cherry Creek: Stroh Ranch	Parker	100	0	
Happy Canyon Creek-Phase 2	Douglas County	90	0	
Newlin Gulch @ W. Parker Rd.	Douglas County	100	25	
<b>Jefferson County</b>				
Arvada Channel	Arvada	100	0	
Coyote Gulch	Lakewood / Jeffco	50	0	
Drainageway B	Lakewood	100	80	1,670
Drainageway G	Jefferson	10	0	
Fastracks-Lakewood	Lakewood	40	0	
Hays Lake Outfall	Arvada	100	100	118
Kenney's Run	Golden	100	100	2,000
Lakewood Gulch-Welchster Park	Jeffco	100	0	
Lena Gulch: 10th Ave. through Orion St.	Jefferson County	100	100	982
Lena Gulch-Isabell	Jeffco	95	0	
Raccoon Creek	Jeffco	95	0	
South Lakewood Gulch: CCU Detention Pond	Lakewood	100	100	1,140
Van Bibber	Arvada	100	95	9,174
<b>Other Projects</b>				
Storm Sewer Inlet Study	All	80	NA	



Rebuilding Utah Park, including stormwater detention in the park, is one of the projects the District is participating in.

# Simplified Real-Time Hydromodels Using Spreadsheets

By Bruce Rindahl, Leonard Rice Engineers

As the hydrologic and hydraulic simulation programs available to engineers become more sophisticated and faster on today's computers, the models themselves are becoming more detailed and complex. The basic hydrologic and hydraulic equations, however, have remained relatively unchanged (e.g. Horton's equation, Manning's equation, etc.). In 2006, Urban Drainage Flood Control District (District) began investigating the use of simplified hydrologic and hydraulic models for use in real-time flood prediction. The use of spreadsheets and internet technology provided for an automated method of running the models utilizing the District's ALERT rainfall as real-time input and permitted the posting of the results to a web interface.

A spreadsheet template was created in Excel to compute basin runoff based on the current design standards of the District's Drainage Criteria Manual. Real-time rainfall in the template is computed from weighted ALERT rain gages instead of a design storm. ALERT raingage data is obtained using Excel's built-in Web Query capability. The Web Query interface also allows the user to specify a time to automatically refresh the data to assure the model is reflecting current rainfall estimates. One Excel worksheet is assigned for each basin in the model.

Another template was created in the Excel spreadsheet to simplify channel routing by approximating more detailed routing techniques. Values from the basin runoff worksheets are linked to the routing worksheets and a full networked model is created. One Excel worksheet is assigned to this routing analysis.

The first basin to be tested as a proof of concept was a HEC-1 model for Boulder Creek. This model used the SCS Curve Number methodology and the Muskingum routing method for the calculations. Since these methods could be accurately reproduced in the spreadsheet version, the two models gave identical results for the same design storm. This model has been running during flood potential days in real-time for the 2006 and 2007 flood seasons.

Based on the success of the methods developed for Boulder Creek, the next step was to utilize existing detailed studies to develop simplified models for real-time analysis. The question we were seeking to answer was, "How detailed of a model do you need for real-time flood warning?". The test model to answer this question was Harvard Gulch, located in Denver.

Ben Urbonas of the District had previously developed a SWMM model for the Harvard Gulch basin using 59 basins and approximately 26 junctions and routing structures. In order to simplify the model, three design points were selected at critical points and the tributary sub-basins were assigned a single raingage for analysis. This resulted in a simplified model with three 'aggregated' basins.

The unit hydrographs for each basin were developed by adjusting the raingage data in the first time step to produce exactly one inch of runoff volume from the entire aggregated basin. The model computed runoff from this slug of rainfall for each individual sub-basin and routed it through the model to the selected design points. Since the definition of a unit hydrograph is the hydrograph produced by one inch of runoff, the model results at the various design points became the unit hydrograph for that basin.

The routing worksheet used Muskingum routing techniques to route the runoff hydrographs downstream. Calibration was performed by comparing the results of the detailed SWMM model at downstream design points. The Muskingum parameters were then optimized in the Excel worksheet to match the SWMM output. At this point the simplified Excel model now mirrors the results from the detailed SWMM model. To test these results a standard 100 year design storm was input for both models and the results compared. Figure 1 shows the results of this analysis.

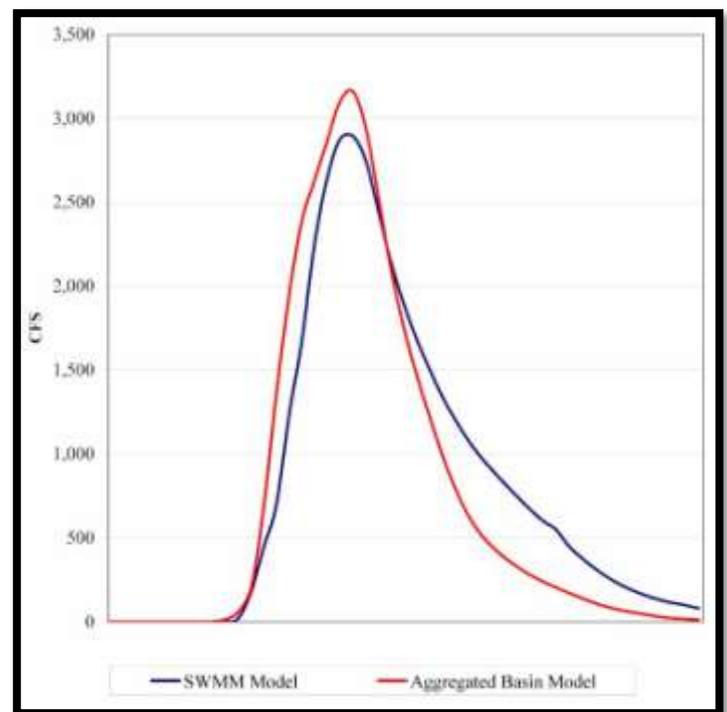
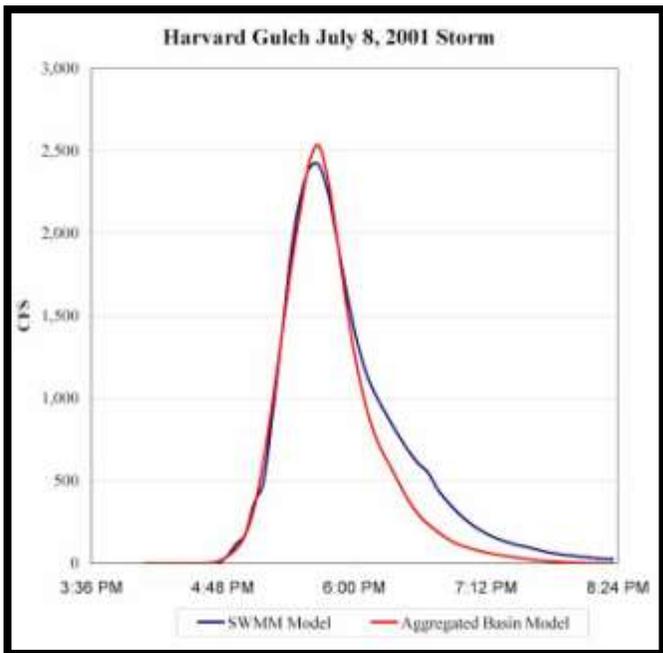


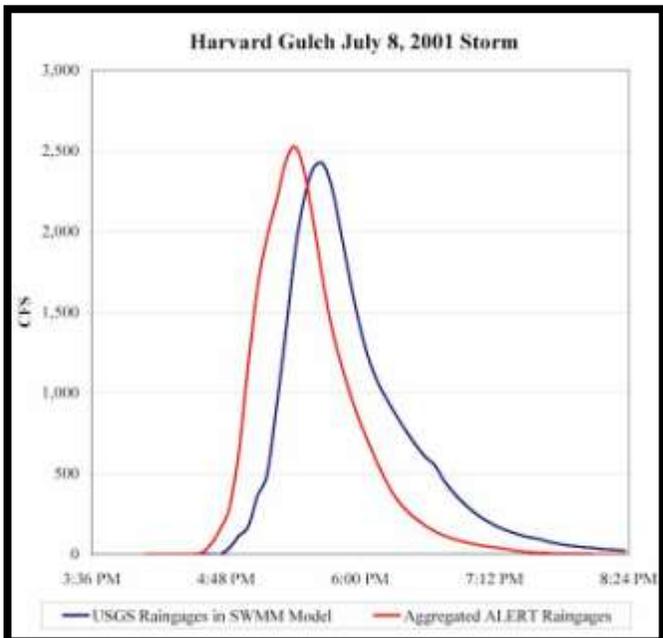
Figure 1: Harvard Gulch 100-year design storm

As shown in Figure 1, the resulting peak flow between the two models is within 10% and the time to peak is identical. Based on the excellent results of this calibration, a further analysis was performed to compare the two models using actual storm data. The date selected was July 8, 2001 where up to 3.55 inches of rain fell in a 90 minute period. Five USGS rain gages were available during this storm for analysis. The identical rainfall patterns were input to the two models and the results compared. Figure 2 shows the results of this analysis.



**Figure 2: Comparison of the models using the 7/8/2001 USGS rainfall data**

The July 8, 2001 storm results showed better correlation between the two models than in the 100 year calibration run. The SWMM run was calibrated to this particular storm which had an estimated peak flow of 2080 cfs (at the downstream end of Harvard Gulch Park) as determined by direct measurement of high water levels (Source: *Flood Hazard News*, Vol. 13, No. 1, December, 2001). This peak flow compares favorably with the model considering the attenuation and flow-splitting characteristics of the park.



**Figure 3: Comparison of USGS rainfall data with ALERT rainfall data**

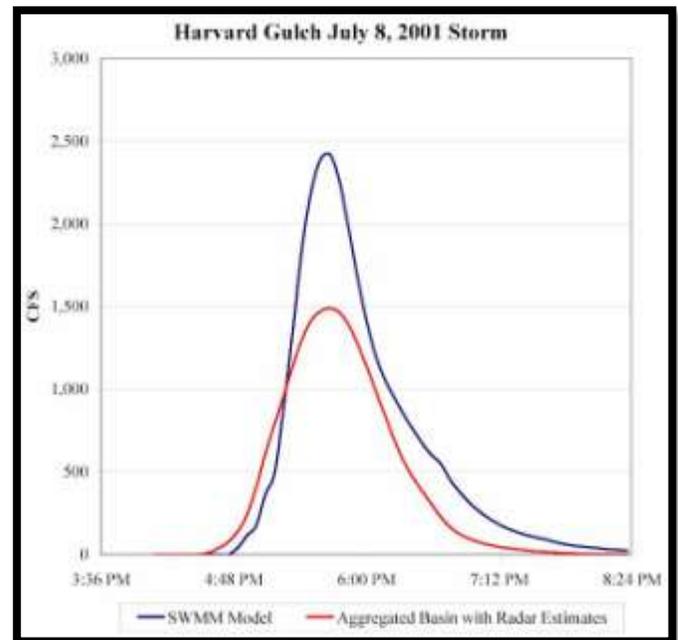
Several District rain gages also recorded rainfall during this storm and a comparison run was made using the ALERT

data versus the USGS rainfall data. This allows a glimpse into what the model would have shown in real-time operation. The result of this analysis is shown in Figure 3.

The comparison of the USGS rainfall data with the ALERT data also shows good results between the two models. The peak flow value occurred 15 minutes sooner with the ALERT data than the USGS data. This can be explained by the location of the rain gages. The ALERT gages used in this analysis are generally located west of the USGS gages and the storm of July 8, 2001 moved from west to east. Thus the ALERT gages measured the rainfall before the USGS gages as the storm center moved through the area.

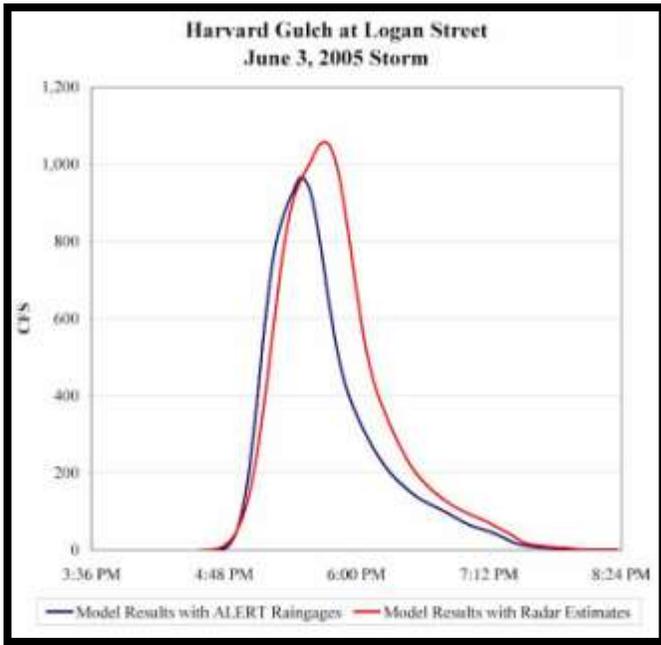
Radar estimates of the rainfall from this storm were also developed by Vieux and Associates for each aggregated basin in the model. Meteorological radar analysis of the storm cell provides estimates of the uniform spatial distribution of rainfall over a specified basin. The benefit of radar estimates is the ability to estimate rainfall in basin locations where rainfall gages do not exist. A comparison of radar estimated rainfall to raingage data is useful in determining how closely radar estimates match real-time data.

The radar estimates were compared to raingage data to show the difference between the two rainfall estimates during the July 8, 2001 Harvard Gulch storm. The result of this comparison is shown in Figure 4.



**Figure 4: Comparison of Radar rainfall estimates with raingage estimates**

Interestingly, the radar estimates reflected a lower peak and volume for the July 8, 2001 storm than the ALERT raingage data. Two explanations are possible for this. First the most intense part of the storm appears to have passed directly over some of the ALERT and USGS rain gages (for some reason, rainfall events normally seem to deliberately avoid existing gage locations) and thus the raingage location measured the most intense rainfall



**Figure 5: Comparison of Radar rainfall estimates with rain gage estimates for the June 3, 2005 Storm**

amounts. In addition, some data loss of the radar information occurred during part of the storm which was filled by using a mosaic of adjacent radar data streams. Different historic storms were analyzed using these methods and the radar estimates showed a better correlation with raingage data.

An additional comparison of radar estimates and ALERT raingage data was performed for the June 3, 2005 Harvard Gulch at Logan Street storm to better determine how closely the two rainfall estimates match. This rainfall event was not as large as the July 8, 2001 storm, so the resulting flow in Harvard Gulch is smaller. The results of the comparison are shown in Figure 5 and indicate the two rainfall estimates provide similar flows.

In conclusion, the simplified spreadsheet approach shows promise as a tool to accurately predict potential flooding in real-time conditions. Several models were run during the 2007 flood season and additional models are currently under development. New features to the interface are planned for better display of flooding estimates via a web interface in real-time.

## Dr. James C.Y. Guo Receives First Friend of UDFCD Award

In 2007 the District initiated the Friend of UDFCD award with the intent to recognize individuals that have significantly and selflessly contributed to the field of stormwater and flood management and its technology in the Denver Region and within the State of Colorado

In February, 2007, the recipient of the first Friend of the UDFCD Award was Prof. James C.Y. Guo, Ph.D., P.E. He has contributed his professional time and energies for over 20 years to advance the technology and its transfer within Colorado to others in the fields of hydrology, hydraulics and urban storm drainage system design and analysis. In addition, he developed software for the District for the analysis and design of open channels, storm sewers, and detention basins. He also developed the initial early spreadsheets for the analysis of open channels, detention basin and culverts.

To foster technology transfer, Dr. Guo conducted much needed continuing education and training of professionals in our field. He also collaborated with the District in analysis of long term rainfall and runoff records that led to the development of cost effective and technically defensible sizing of the water quality capture volume, a leading work in the world and not only in Colorado. This work was peer

reviewed and published in technical journals in the United States and internationally.

For all of the above-mentioned contributions Dr. Guo received little or no compensation from the District or others.



**Dr. Guo receives a plaque and congratulations from District Board Chair and Broomfield Mayor Karen Stuart as Dave Lloyd looks on.**

# Stormwater Quality & Permitting Support Activities

Ken MacKenzie, Senior Project Engineer, Master Planning Program

UDFCD continued to be active in the stormwater quality arena in 2008, with commitments to the following organizations and activities:

**Colorado Stormwater Council (CSC):** The CSC celebrated its one-year anniversary as a Colorado non-profit corporation in October 2007. The CSC is an organization for Colorado MS4 permit holders. It acts as a forum for municipalities and municipal permit holders; enables exchange of technical information regarding stormwater regulations and compliance with permits; serves as a voice for its members at regulatory hearings or meetings; educates members; and aids in the development and implementation of stormwater programs at local and regional levels. I am proud to serve on the Administrative Committee and chair the Technical Review and Advisory Committee for this fine organization. If your organization holds a Colorado MS4 permit, I urge you to become a dues-paying member of the CSC. For more information, visit their website at [www.coloradostormwatercouncil.org](http://www.coloradostormwatercouncil.org).

**Colorado MS4 Stormwater Group:** The District continued to host quarterly meetings to discuss stormwater issues in 2007. These meetings were open to all Colorado communities affected by the Clean Water Act, which requires permits for municipal separate storm sewer system (MS4) discharges. These meetings served as a forum to exchange ideas and experiences, set up workgroups, and report on accomplishments. In 2008 I will merge these meetings into a quarterly "special session" of the CSC monthly meeting, possibly as a catered luncheon.

**Structural BMP Testing:** The District's program to monitor and test structural BMPs continued in 2007. We completed construction of a new open-bed sand filter BMP at

the Lakewood city shops, an industrial setting where the District has put many BMPs to the test over the past twelve years. We were able to sample water quality through this BMP for a few storms in 2008 and will continue monitoring stormwater quality for this, for an adjacent porous-concrete pavement site, and for an extended-detention basin at Grant Ranch in south Denver for several years. Additionally, we hope to construct a side-by-side porous asphalt and modular block pavement test site in 2008 at the Denver wastewater building, if we can get required assistance from the Colorado Asphalt Paving Association to build it.



**New open-bed sand filter test site. This BMP may offer an economical solution for ultra-urban stormwater quality treatment**

## Random Notes from Your Humble Editor

Bill DeGroot

First of all, thanks to all of the contributors to this edition of *Flood Hazard News*, especially our outside contributors Bob Searns, Nancy Love and David Love, and Bruce Rindahl (District staff members were ordered by the boss to deliver).

I became editor in 1974 and have been at it ever since. It's a nice break for me to do something different like this once a year. In the early days we would provide typed copy to the printer who would set it in the proper font, and provide galleries to us to proof and to lay out the way we wanted the newsletter to look. Now our contributors give me .doc and .jpg files that I proof, organize and try to make look attractive. I like this way better.

In recent years we have been printing and mailing close to 2000 copies of FHN. In 2006 and again this year we posted the FHN in .pdf on our website and sent post cards to our subscribers notifying them it was available. This year we are transitioning to email notification but still using post cards when an email address is not available. Next year, if we don't have your email address you won't be notified. If you received a post card this year, or found this issue through other means, and want future notifications, send an email to [udfcd@udfcd.org](mailto:udfcd@udfcd.org) and put *Flood Hazard News* in the subject line.

# Cherry Creek Project Wins CASFM Grand Award

The Cherry Creek Open Space Project, funded by Arapahoe County and UDFCD, won the Grand Award at this year's Colorado Association of State Floodplain Managers conference held in Breckenridge, Colorado. The project was managed by **Paul Hindman** and **Lanae Raymond** from Arapahoe County, currently the South East Metropolitan Storm Water Authority. **Glenn Hamilton** with Muller Engineering Company, Inc. designed the project and L&M Enterprises constructed the improvements.

The project was initiated because of upstream development within the watershed and the sandy nature of the Cherry Creek streambed caused the channel to become incised, with down cutting of 3-5 feet on average throughout the project reach. This condition had lowered the groundwater table, and had begun to compromise the surrounding vegetation as the channel bed became progressively disconnected from its overbanks. Channel incision also resulted in steep, unstable banks in places, causing an increase in sediment load conveyance towards Cherry Creek Reservoir. In an effort to improve and protect the water quality of the Reservoir, stream stabilization projects such as this have begun to take on increasingly greater importance.

Stabilization components of the project designed to address the down-cutting channel included seven riffle drop



**Wagon rides from the 17-Mile House to the project site at the grand opening**

structures, a 3-foot high vertical tie-in drop, a 2.2-foot high sloping riffle rundown at the secondary channel confluence, and two sheet pile cutoff walls integrated into pedestrian creek crossings at the two ends of the project. Restoration of the project area's ecology and vegetation were addressed by raising the channel bed and associated groundwater table back up to its pre-incised condition, and by more frequent conveyance of Cherry Creek flows into a newly contoured secondary channel along the inside of the bend. Other



**Secondary wetland channel**

components of the project further enhanced the area by providing educational and recreational amenities that capitalized on the historic context of the region.

## Cherry Creek Project Enhancements

- ✚ 7 low-height riffle (rock-cobble) drops
- ✚ 3' high vertical tie-in drop (with sheet pile)
- ✚ 2.2' high sloping riffle rundown drop
- ✚ 3 weathered steel bridge crossings
- ✚ 1 box culvert adjustable weir crossing
- ✚ 2 runs of sheet pile grade control (d=20')
- ✚ 7 "Big Dipper" boulder clusters
- ✚ 2 educational gathering areas
- ✚ 17-Mile House Wagon trail loop
- ✚ 2 neighborhood bike path connections

The 17-Mile House & Barn retained their historical and architectural history, appearing much as they did during the late 1800's when they provided travelers a resting place. The



**Main channel with low flow crossing and riffle drop**

rich historical context of the property was key during the design process, focusing the project team on coming up with a context-sensitive design for the Cherry Creek floodplain at this location. This project became the “public’s”, not only because the team was committed to making sure it was a

community amenity, but also because of its connection to the historic site that the community had embraced as a valuable remnant of the past. The goal was to restore the natural setting to match the context of the historic mile house and barn. As shown in the following pictures, this was achieved.



An overview of the project area, showing the two channels and the trail system



The Association of State Floodplain Managers (ASFPM) Foundation recognized the Colorado Association of Stormwater and Floodplain Managers (CASFM) for its contribution to the Foundation at ASFPM’s annual conference. From left to right are David Mallory, CASFM treasurer, Brad Anderson, CASFM chair, Larry Olinger, Foundation president, Bill DeGroot, freeloader and Dale Lehman, a Trustee on the Foundation Board.

# 2007 Professional Activities of District Staff

## **Dave Lloyd, Executive Director**

- \*Chairman, Board of Advisors, Urban Watersheds Research Institute
- \*Attended Colorado Public Pension Coalition Annual Conference in Winter Park in September
- \*Attended National Association of Flood and Stormwater Management Agencies (NAFSMA) Annual Conference in Newport, RI in October
- \*Member of Governing Board, Colorado County Officials and Employees Retirement Association (CCOERA)
- \*Member of Douglas County Stormwater Working Group
- \*Member of American Public Works Association (APWA) and Colorado Association of Stormwater and Floodplain Managers (CASFM)

## **Bill DeGroot, Manager, Floodplain Management Program**

- \*Treasurer of the Board of Directors and Chair of the Floodplain Management Committee of the National Association of Flood and Stormwater Management Agencies (NAFSMA).
- \*Attended NAFSMA's annual meeting in Newport, RI in October. Chaired the Floodplain Management Committee meeting, and gave a progress report to a plenary session.
- \*Attended the Association of State Floodplain Managers annual conference in Norfolk, VA in June.
- \*Attended the annual meeting of the Colorado Association of Stormwater and Floodplain Managers in Breckenridge in September.
- \*Member of Association of State Floodplain Managers (ASFPM), American Society of Civil Engineers (ASCE), and Colorado Association of Stormwater and Floodplain Managers (CASFM).

## **Kevin Stewart, Manager, Information Services and Flood Warning Program**

- \*President of the National Hydrologic Warning Council (NHWC).
- \*Member of the U.S. Department of the Interior's Advisory Committee on Water Information, Subcommittee on Hydrology.
- \*Steering Committee Member of the American Meteorological Society (AMS) Commission on the Weather and Climate Enterprise.
- \*Chair of the EMWIN-Denver Steering Committee.
- \*Member of ASCE, APWA, ASFPM, CASFM and the Colorado Emergency Managers Association.
- \*Speaker at AMS Corporate Forum in Washington, DC in March.
- \*Speaker at NHWC Conference and Exposition in Savannah, GA in June.
- \*Speaker at NOAA/NWS National Hydrologic Program Managers Conference in Kansas City, MO in July.

## **Ben Urbonas, Manager, Master Planning Program**

- \*Gave a talk at the District's February 28th seminar on updates to the *Urban Storm Drainage Criteria Manual (USDCM)*.
- \*Continued to serve on the Board of Directors of the Cherry Creek Basin Water Quality Authority.
- \*Continued to serve on the Water Environment Research Foundation's (WERF) Research Council.
- \*Continued to serve as Chairman on two of WERF's Project Steering Committees for research projects on *Quantification of Solids in Stormwater* and the development and maintenance of the *International BMP Database*.
- \*Was one of three instructors at a training workshops in July on *EPA's SWMM 5.0 Software and CUHP Interface*, an assistant instructor at a training class on *Use of SWMM in Planning and Design* thought by Dr. Guo in December, and was the lead instructor for a class on *BMP Selection and Design* in October.
- \*Continues to serve on the External Advisory Board for the Civil Engineering Department of Colorado State University.
- \*Attended the National Association of Flood and Stormwater Management Agencies (NAFSMA) annual meeting in Newport, RI and continued to serve as a co-chair of its Stormwater Management Committee.
- \*Attended the EWRI's World Environment and Water Congress 2007 in May in Tampa, FL where he gave a keynote talk at the *4th Urban Watershed Management Symposium*.
- \*Attended Novatech 2007 International Stormwater Conference in June, 2007 in Lyon, France where he presented a paper co-authored with Jim Wulliman on the topic of *Full Spectrum Detention*.
- \*Gave the opening Keynote Address in July 2007 at the Engineering Conferences International conference on the topic of *Stormwater Computer Modeling* at the Humboldt State University in Arcata, CA. The paper summarizing this talk is available at the UWRI web site under "Downloads" > "Technical Papers".
- \*Gave a talk on updates to the *Construction BMPs* chapter of the USDCM updates at the Cherry Creek Stewardship Partners' annual conference in November, 2007

## **Paul Hindman, Manager, Design and Construction & Maintenance Program**

- \*Chair of the 2011 Denver Site Committee for the American Public Works Association (APWA) International Public Works Congress and Exposition.
- \*Chapter Delegate, APWA Colorado Chapter
- \*Randolph Jennings Recipient. Toured flood control facilities in Czech and Slovak Republics.
- \*Presented "Designing Multipurpose Uses into Waterway Facilities", Czech/Slovak Public Works Association Annual Conference, Trencianske Teplice, Slovakia.
- \*Planned and facilitated "2011 Pie Eating Contest", Western Snow and Ice Conference. Estes Park, Colorado
- \*Co-Chair of Cherry Creek Stewardship Partners Annual Conference. Lone Tree, Colorado.

## **Chad Kudym, GIS Administrator, Information Services and Flood Warning Program**

- \*Elected to Colorado Association of Stormwater and Floodplain Managers Board as Treasurer
- \*Member of the EMWIN-Denver Steering Committee
- \*Speaker at Seventh Biennial Conference and Exposition National Hydrologic Warning Council in Savannah, GA in June
- \*Speaker at Arid Regions Conference in Breckenridge, CO in September
- \*Appointed as Conference Chairperson for the 2009, Eighth Biennial National Hydrologic Warning Council Conference in Vail, CO
- Cindy Thrush, Senior Project Engineer, Design, Construction & Maintenance Program
- \*Presented "Maintaining Regional Water Quality BMPs" at the Cherry Creek Stewardship Partners Specialty Conference in May 2007.
- \*Co-presented with US Army Corp of Engineers, on "Understanding Section 404 Permit Requirements for Development in Floodplains" at the September 2007 Colorado Association of Stormwater and Floodplain Managers Conference in Breckenridge.
- \*Member of American Society of Civil Engineers (ASCE), Society of Woman Engineers (SWE), and Colorado Association of Stormwater and Floodplain Managers.

## **Bryan Kohlenberg, Senior Project Engineer, South Platte River – Design, Construction & Maintenance Program**

- \*Instructor at Urban Watersheds Research Institute training workshop on "Stream Stability Design and Rehabilitation," in Aurora, CO in August, 2007.
- \*Continued as National Society of Professional Engineers' scoring coordinator for the Jefferson, North Metro and Colorado State MATHCOUNTS competitions for 7<sup>th</sup> and 8<sup>th</sup> graders.
- \*Member of American Society of Civil Engineers, Colorado Association of Stormwater and Floodplain Managers and American Public Works Association.

### **Mark Hunter, Manager, Design, Construction & Maintenance Program**

- \*Serves on the Board of Directors and on the Operations Committee and Manager Selection Committee of the Metro Wastewater Reclamation District.
- \*Serves on the Board of Directors of the International Erosion Control Association (IECA).
- \*Co-Chairman of the IECA Foundation Committee.
- \*Member of IECA Awards Committee and the Stream Restoration Technology Section.
- \*Member of the Mountain States Chapter of IECA.
- \*Member of APWA and CASFM.

### **David Mallory, Senior Project Engineer, Floodplain Management Program**

- \*Presented "Floodplain Preservation / Marketing Brochure" with Michelle Leach at the February UDFCD Annual Seminar.
- \*Attended the Colorado Association of Stormwater and Floodplain Managers (CASFM) No Adverse Impact February Workshop.
- \*Presented "Introduction to CASFM" with Tom Browning at the May National Flood Conference in Denver
- \*Attended the Association of State Floodplain Managers (ASFPM) June Conference in Norfolk, Virginia.
- \*Moderated a No Adverse Impact Workshop at the ASFPM Arid Regions / CASFM September Conference in Breckenridge.
- \*Serves on the CASFM Board of Directors as immediate past Treasurer and current Vice Chair.
- \*Member of CASFM and ASFPM.

### **David Bennetts, Senior Project Engineer, Design, Construction & Maintenance Program**

- \*Program Chair for the Arid Regions 11<sup>th</sup> Triennial Conference in Breckenridge in September
- \*Co-presented with David Mallory "Constructing Grouted Boulder & Sculpted Concrete Drop Structures" at the District's Annual Seminar in February
- \*Council Member, CU Denver Engineering Leadership Council
- \*Committee Member, Urban Infrastructure Committee, CU Denver
- \*Member of ASCE, APWA, and CASFM

### **Ken MacKenzie, Senior Project Engineer, Master Planning Program**

- \*Presented "Simplified Hydrologic and Hydraulic Design Methods using Microsoft Excel Based Workbooks with Visual Basic Programming Techniques" at the Engineering Conferences International Conference in Arcata, California in July.
- \*Served on ASCE's Urban Water Resources Research Council.
- \*Chaired the Colorado Stormwater Council technical review and advisory committee.
- \*Served on the Colorado Stormwater Council administrative committee.
- \*Served on the Water Environment Research Foundation (WERF) Panel to study "Linking BMP Performance to Receiving Water Protection to Improve BMP Selection and Design".
- \*Served on the Denver Regional Council of Governments water and environment planning committee.
- \*Served on the board of directors of the Urban Watershed Research Institute.
- \*Taught courses on open channel and storm sewer design.
- \*Member of ASCE and CASFM.

### **Laura Kroeger, Sr. Project Engineer, Design, Construction and Maintenance Program**

- \*Chair of the Scholarship Committee for the Colorado Chapter of the American Public Works Association (APWA).
- \*Selected for the inaugural class of the Emerging Leaders Academy. American Public Works Association (APWA).
- \*Produced and delivered on time, Adam Lewis Kroeger, May 2, 2007.

### **Mike Sarmento, Senior Construction Manager, Design, Construction & Maintenance Program**

- \*Received OSHA 40 hour HAZWOPER certification in September.

### **Steve Materkowski, Senior Construction Manager, Design, Construction and Maintenance Program**

- \*Attended APWA 2007 Inspectors Conference
- \*Attended APWA 2007 Management Conference
- \*Graduated Top Cadet from Highlands Ranch Public Safety Training Institute, Law Enforcement Academy. June 1, 2007.
- \*Passed Colorado POST exam. June 1, 2007.

### **Jeff Fisher, Sr. Construction Manager, Design, Construction and Maintenance Program**

- \*Assisted with Colorado Chapter APWA 2007 Inspectors Conference
- \*Assisted with production and delivery of Adele Rose Fisher, November 1, 2007

### **Darren Bradshaw, Construction Manager, South Platte River – Design, Construction & Maintenance Program**

- \*Completed training in Stormwater Management and Erosion Control Construction Course at Red Rocks Community College, February 2007.
- \*Received training in Civil 3D (AutoCAD) at CAD-1's training facility, June 2007.
- \*Attended one day seminar on Construction Law for Colorado Architects, Engineers, and Contractors, November 2007.

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## **DISTRICT STAFF**

### **Dave Lloyd, Executive Director**

#### **Floodplain Management Program**

Bill DeGroot, Manager

David Mallory, Sr. Project Engineer

#### **Information Systems and Flood Warning Program**

Kevin Stewart, Manager

Chad Kudym, Project Engineer

Derrick Schauer, Information Systems Technician

#### **Master Planning Program**

Ben Urbonas, Manager

Ken MacKenzie; Sr. Project Engineer

### **Design, Construction & Maintenance Program**

Paul Hindman, Manager

Mark Hunter, Manager

Dave Bennetts, Sr. Project Engineer

Cindy Thrush, Sr. Project Engineer

Laura Kroeger, Project Engineer

Rich Borchardt, Project Engineer

Jeff Fisher, Sr. Construction Manager

Steve Materkowski, Sr. Construction Manager

Mike Sarmento, Sr. Construction Manager

Joe Williams, Construction Manager

### **South Platte River Program**

Bryan Kohlenberg, Sr. Project Engineer

Darren Bradshaw, Construction Manager

#### **Finance and Accounting**

Frank Dobbins, Manager

#### **Administrative Services**

Sandy Gonzalez, Manager

Galene Bushor, Sr. Admin. Asst.

Margaret Corkery, Admin. Asst.

Patti Jefferson, Admin. Asst.

Geanesia Hinton, Receptionist