URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

Flood Hazard News

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Cooperating Technical Partner Program
The District's experience to date

By Bill DeGroot, P.E., Chief, Floodplain Management Program

Introduction

In November, 1997, the Federal Emergency Management Agency (FEMA) published "Modernizing FEMA's Flood Hazard Mapping Program, A Progress Report." One objective of the program was to implement a Cooperating Technical Communities Program (now called Cooperating Technical Partners) with state and local entities that had demonstrated sufficient technical capabilities to assume certain flood hazard identification functions.

On May 17, 1999, FEMA and the Urban Drainage and Flood Control District (District) executed the first Cooperating Technical Partnership (CTP) agreements in the nation. The agreements were signed in a ceremony at the opening session of the annual National Flood Conference, which was being held in Denver. FEMA was represented by Michael J. Armstrong, Associate Director for Mitigation; and the District was represented by Cathy Reynolds, Chairman of the Board, and Scott Tucker, Executive Director.

Two agreements were signed. The first was a "Memorandum of Agreement" in which the two parties agree to cooperate, in a general way, on flood hazard identification efforts. This agreement is sometimes referred to as the "Barney" agreement, after a certain purple dinosaur ("I love you. You love me.").

The second agreement, "Task Agreement 1 – Hydrologic and Hydraulic Data Preparation and Review" set forth specific areas of cooperation that have carried through to this day. This agreement, and four subsequent task agreements, will be discussed below.

Task Agreement 1

In this agreement the District agreed to conduct its flood hazard area delineation (FHAD) studies in accordance with FEMA's guidelines; and in accordance with the Colorado Water Conservation Board's (CWCB) rules and regulations. In return, FEMA agreed to perform "limited review of UDFCD flood studies for general conformance to applicable standards as referenced in this Agreement." What this means is that FEMA's Map Coordination Contractor (MCC) does not conduct a rigorous review of District studies, so that they can be accepted more quickly, and put on the Flood Insurance Rate Maps (FIRMs).

FEMA recognizes the District's rainfall runoff model, the Colorado Urban Hydrograph Procedure / Stormwater Management Model (CUHP/SWMM) as the basis for establishing flood discharges. Previously, we had had some nasty disputes with FEMA over the conflict between our model and FEMA's desire to use regional regression analyses.

Another long running disagreement between the District and FEMA (and FEMA's predecessor) is the use of future watershed conditions hydrology. The District has always used future conditions hydrology in its FHAD and master planning studies; whereas FEMA uses existing conditions for their FIRMs. The reasons for the disagreement are not important to this article, but they were real and long standing.

Task Agreement 1 addressed the disagreement as well as it could under those circumstances. First, the parties each acknowledge the other's position. Then, procedures are established for new hydrologic and hydraulic studies

At the signing ceremony, from left to right, Michael Armstrong, Scott Tucker, Cathy Reynolds and Art Patton.

done by the District. For hydrology, the District will complete hydrologic analyses for both existing and future conditions. If the future conditions discharges are within 130% of the existing, FEMA will accept them for use on the FIRMs. If the difference is greater than 130% the existing conditions hydrology will be used for the FIRMs.

FEMA also agreed to include future conditions hydrology information in Flood Insurance Studies (FIS) and FIRMs in accordance with a then on-going study under FEMA's Map Modernization Program.

For hydraulics, the agreement states that if base flood elevations (BFEs) were calculated for both existing and future discharges, and they were within 0.5 feet, then FEMA would consider a request to publish only the future hydrology BFEs and floodways.

The agreement also discusses digital mapping and cost sharing, but there is nothing there of great import. Finally, the agreement establishes a dispute resolution procedure.

How has it worked?

FEMA's recognition of the District's hydrology model has meant that the District has been able to move forward with numerous FHAD and master planning studies with confidence that a dispute with FEMA does not await at the end of the process, even if the future discharges exceed 130% of existing. Now the District, as a part of each study involving new hydrology, will complete a hydrology report and submit it to FEMA for acceptance. All such studies have been accepted by FEMA.

In a number of cases, most notably the Willow Creek FHAD, Plum Creek and Tributaries FHAD (which will be discussed in greater detail below) and Big Dry Creek FHAD, the discharges were within 130%. In these cases FEMA wrote letters accepting the hydrology and we were able to proceed with requests for Letters of Map Revision based on the future hydrology.

There have also been cases where the future hydrology exceeded the existing by more than 130%, with the Upper and Lower Box Elder Creek and Tributaries FHADs being the biggest examples. The District has published the FHADs using the future hydrology conditions, and we also have the existing discharges flood outlines and profiles in digital form ready to go when FEMA converts the affected FIRMs to Digital FIRMs (DFIRMs).

FEMA published a new rule in 2002 that allows local governments to request that future conditions 100-year floodplains be shown on FIRMs. These are shown in addition to the existing discharges floodplain, which is still the official floodplain for flood insurance purposes.

There has not been a situation develop where the 0.5 feet difference in BFEs has come into play. Neither has there been any need to invoke the dispute resolution procedure.

Task Agreement 2

In November, 1999, the District and FEMA Region 8 executed an agreement for a $20,000 grant to be used for a pilot project to combine AutoCAD files from the District's FHAD for Willow Creek, Little Willow Creek and East Willow Creek in Douglas County, completed by Icon Engineering, with Douglas County ArcInfo GIS road center line base maps to produce a sample DFIRM using FEMA's then current DFIRM Spatial Database requirements.

The District's GIS consultant, Merrick and Company, completed the project for the District. A number of problems were encountered which won't be detailed here. However, as a result of this initial experience a draft guidance document (*UDFCD Guidelines for FHAD Mapping for use in DFIRMs*) was prepared to guide future FHAD studies. This document was used by WRC Engineering for the Big Dry Creek FHAD and Plum Creek and Tributaries FHAD; with very good results. The document was revised to make a few minor changes and a final version was published in March, 2002. FEMA has accepted the DFIRM conversion of the Willow Creek FHAD flood data. The Big Dry Creek and Plum Creek flood data have been added to the Willow Creek data and the entire package was submitted to FEMA for review in November, 2002. The guidelines are now incorporated into all District FHAD contract documents.

Task Agreements 3, 4 & 5

In early 2001, FEMA and the District entered into Task Agreement 3 to conduct a pilot project for the District to review requests for Letters of Map Change, specifically Conditional Letters of Map Revision (CLOMR) and Letters of Map Revision (LOMR) for the 32 communities within the District that are participating in the National Flood Insurance Program (NFIP). The project was funded by a $100,000 grant administered through FEMA Region 8.

The District retained Icon Engineering to assist with the technical reviews of the applications. The project began on Monday, July 2, 2001, and a request was received that day. The agreement called for a six-month evaluation of the District's performance, which was held in Denver on February 26, 2002. At that time FEMA agreed to provide additional funding to finish the year (Task Agreement 4 for $40,000), and a second year of the pilot was also agreed to (Task Agreement 5 for $140,000).

Thirty-seven cases were assigned to the initial grant. Of those, thirty-four were successfully completed, two applicants withdrew, and one was still active and was reassigned to the second grant. The average time taken from receipt of all data to providing a draft letter to FEMA for signature was 21 days. FEMA received fees from the applicants totaling $121,200 and the District expended $98,661.94. A final report on the initial grant will be completed by January 31, 2003.

Broomfield DFIRM conversion

In 2000, the voters of Colorado established the new City and County of Broomfield. The new county came into

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Tucker-Talk

by L. Scott Tucker

Timely Comment from the District's Executive Director

Stormwater Quality

Many small cities and counties throughout the United States will soon have to submit applications for Phase II stormwater permits. To my knowledge just about all permits will be granted under general permit authority of the state or EPA. The states and EPA were to have their general permits ready to go by mid-December 2002 and the Phase II communities have until March 10, 2003 to submit the information required.

The State of Colorado published a general permit for stormwater discharges from municipal separate storm sewer systems on December 13, 2002. Over 30 communities in the Denver metro area are required to submit stormwater management plans to the state for approval by the March 10 deadline. The management plans are to outline what the communities are going to do in each of six areas of activity. John Doerfer in another article in this issue of *Flood Hazard News* discusses the effort local governments and the District have been making to respond to the Phase II permit requirements.

The permit will be for a five-year period. However, the state, during the five-year permit period may require changes to the management plan to address negative impacts caused by stormwater, to include more stringent requirements if necessary to comply with new federal requirements, and to include other conditions deemed necessary by the State.

Phase I communities in the Denver area are the City and County of Denver, City of Aurora and City of Lakewood. These communities were issued individual Phase I stormwater permits in 1996, and in 2001 they submitted applications to renew their permits. So far their permits have not been renewed and they are operating under their original permits.

So the regulatory screws continue to tighten. Soon practically all communities in urban areas in the United States over 50,000 population will be under a National Pollutant Discharge Elimination System (NPDES) permit. Fortunately, so far the permitting requirements have been reasonable for both Phase I and II communities. Unfortunately, however, there are potential storm clouds, so to speak. First there is the fundamental problem of regulating a non-point source of pollution, stormwater, by a point source regulatory program, NPDES. Second, the specter of end of pipe numerical effluent limits still hangs over the head of municipal stormwater dischargers like the Sword of Damocles. Third, Total Maximum Daily Load studies may require much more of local government than is now being required. And last, but not least, how are water quality standards going to be applied to municipal stormwater? Some thoughts regarding these issues follow.

There is a fundamental disconnect between the NPDES program and stormwater. The NPDES program is designed to regulate point sources such as wastewater treatment plant discharges. Such discharges are steady, predictable and not subject to huge swings in flow rate. A treatment process can be designed to remove pollutants from the waste stream and the plant discharge can be monitored to insure water quality requirements are being met at the end of the pipe. Now picture a rainstorm over a metropolitan area and huge quantities of water flowing out of hundreds of stormwater outlets in the area. There is no practical way to control or monitor or measure the flows from such a myriad of outfalls. Nor is there any practical way to control all the pollutants that stormwater may pick up as rain falls through a dirty atmosphere and then through a city environment comprised of everything from soup to nuts.

Many communities just wish the mandate would go away, but this is not going to happen. There is too much popular support for us as a nation to have clean water. One of my mantras has been, however, that we need to have a regulatory program that is tailored to fit municipal stormwater discharges. Such a regulatory program could keep the feet of local governments to the fire but in such a way that recognizes the physical realities of stormwater. To me it doesn't make sense to continue to implement a regulatory program that doesn't fit the physical realities of municipal stormwater discharges. Unfortunately it will take Congressional action to make a change, which is very difficult to accomplish.

The second issue mentioned was end of pipe numerical effluent limits (NEL). This problem is an outgrowth of the disconnect discussed above. Non-point sources such as municipal stormwater discharges simply do not lend themselves to NEL. First, local governments do not have total control over what gets into their storm sewer system. Second, it is difficult and prohibitively expensive to treat stormwater to levels like in waste treatment plants. In fact in some cases it may be simply impossible to meet NEL, such as for fecal coliforms. If a NEL can't be met except through a prohibitively expensive treatment process then what?

To illustrate the point consider the NEL that has been imposed on Los Angeles County in California. The State has issued a permit that requires Los Angeles to have a zero discharge of trash from their storm sewers in ten

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Floodplain Management Program Notes

By
Bill DeGroot, P.E., Chief, Floodplain Management Program

Food for thought
Many years ago, soon after we moved to Denver, my wife and I took a series of walking tours of historic Denver neighborhoods. During one of those walks we came across a man who was renovating an old warehouse into street level commercial spaces and upstairs lofts. One of our fellow walkers asked the man what motivated him to preserve that historic building. His response: "To make money." I've never forgotten that, and it's a useful lesson for floodplain managers.

Developers want to make money. If you can show them how to make money while preserving the natural and beneficial values of the floodplain they will often accept that. We are seeing more and more development proposals in which the floodplain is set aside for open space, trails, habitat, etc.; and the developer markets them as amenities to his project. Not only are floodplains preserved but the brain damage resulting from confrontations with developers is significantly reduced as well.

LOMC pilot project
On July 1, 2001 we began a pilot project with FEMA to assume the responsibility to review requests for Letters of Map Change for the 32 communities within the District that are participating in the National Flood Insurance Program. We are now six months into the second year of the project. For more information please see the cover story of this issue.

Broomfield DFIRM conversion
Last year we also tried our hand at converting a paper Flood Insurance Rate Map (FIRM) to a FEMA Digital FIRM (DFIRM) format. A paper describing that effort is on our web site. Go to udfcd.org and click the Broomfield DFIRM link.

FEMA map modernization
President George W. Bush's proposed budget for fiscal year 2003 included $300 million in new money for FEMA's map modernization effort. Unfortunately, Congress did not act on FEMA's budget (among many others) prior to adjourning for the year.

At the time they left town the Senate budget proposal included the full $300 million and the House version stood at $200 million. As this is written we have no idea what the new Congress will do or when.

In anticipation of some significant level of funding, FEMA asked each state to prepare a Map Modernization Implementation Plan (MMIP). Colorado's plan was prepared by the Colorado Water Conservation Board (CWCB) under the direction of Brian Hyde and Tom Browning. The key part of the plan from our standpoint is that the District would be given the responsibility for map modernization for the seven counties within the District.

The year in review
We continue to be just about maxed out on development referrals, and it is a constant struggle to assure that new development doesn't increase the flood hazard potential within the District.

Our maintenance eligibility program continues to flourish under David Mallory's direction. See David's column elsewhere in this issue.

Kevin Stewart continues to assure that we have the best possible flood detection and warning system, and he continues to be in demand as an expert in this field (see his list of professional activities on page 22 and his column in this issue). If you check out our web site at www.udfcd.org you will also see Kevin's handiwork.

Implementation efforts
Implementation of portions of our master plans, particularly regional detention facilities, is always a challenge. We continue to have some successes that I would like to highlight.

We completed an Environmental Assessment (EA) of alternatives for the Irondale Gulch watershed within the Rocky Mountain Arsenal (RMA). The comment period is complete and we are expecting a FONSI (Finding of No Significant Impact) at any time. The FONSI will allow us to move forward with intergovernmental agreements between the District, Denver and RMA; and between the District, Commerce City, Adams County and RMA for the construction, operation and maintenance of these facilities on the RMA.

I would like to acknowledge the assistance we received from Tim Kilgannon and Tom Jackson in guiding us through the EA and FONSI process.

Denver, Aurora and the District have agreed to fund the final design and construction drawings for a detention pond called Silverado II, which is to be located on Pena Boulevard right-of-way.

Last year I wrote about the completion of the Green Valley Ranch Golf Course detention facility. Here is an aerial view showing the road embankment that creates the detention, the creek, a water quality pond for local runoff and portions of the 16th and 17th holes.

We anticipate that a major developer in the area will construct a significant portion of the pond once the design is complete. We are also talking to two other developers about building three additional ponds called for in the master plan.

The Parkfield developers, represented by Ken Schmidt, have continued to implement portions of the Irondale master plan. In 2002, a connection was completed between the RMA and Parkfield Lake, a spillway was completed at the lake, and an inlet channel was partially constructed.

Floodplain delineation
We did not complete any flood hazard area delineation (FHAD) studies this year. However, I'm reviewing two drafts as this is written. Both FHADs should be published in early 2003. One is for Cherry Creek from the reservoir to the District's upstream boundary. The other is for Little Dry Creek and Tributaries in Arapahoe County. Both are being completed as part of outfall systems planning efforts for the two watersheds.

We began a FHAD for Ralston and Leyden Creeks in Arvada in order to account for the effects of the new Leyden Lake Dam project on the downstream floodplains. We are also doing a FHAD for Kinney Creek and Fonder Draw in Douglas County as part of an outfall systems planning study. In 2003 I hope to begin re-studies of the South Platte River through Adams County and Clear Creek through Adams County.

All of these studies are prepared in digital form compatible with FEMA's Digital Flood Insurance Rate Map (DFIRM) specifications. This will make it easier to add these floodplains to the DFIRMs.

Good examples photo album
We are continuing efforts to put more information on our web site. One project in the works is a photo album of good projects. We are often asked for examples of good projects by developers and their consultants, and we thought that the web would be the best way to distribute this information, particularly as new projects are completed.

The photo album will have chapters on drop structures, pedestrian/bicycle bridges, low flow channels, formal channels, stormwater detention facilities, integrating the floodplain into a development, and multiple use facilities. As this is written there are photos in the first two chapters. We will be adding to the other chapters as time and good photos permit. To access the photo album, go to our web site and click the "Good Examples" button.

Activity summary map
One of our publications is our "Activity Summary" that briefly describes the District and provides an overview of each of the District's programs. It also includes a large map that identifies all District studies completed or in progress. Unfortunately, we only publish the Activity Summary in January of odd numbered years, and the information regarding District studies is more and more out of date the further you get from the publication date.

To overcome that problem we are going to experiment with putting the map on the web site where we can frequently update the status of all our studies. We envision a process where the user can click on a given drainageway or watershed on the map and instantly obtain all the information we have on that drainageway or watershed, including completed study titles and dates, on-going studies, scheduled studies, and, perhaps, construction information as well. The map should be on our web site the first quarter of 2003.

Parkfield Project Photos

Parkfield Lake outlet channel.

Parkfield Lake spillway.

Parkfield Lake inlet channel forebay.

Master Planning Program Notes

by

Ben Urbonas, P.E., Chief, Master Planning Program

Planning Projects

Only one planning project was completed in 2002; 20 projects are in progress; and we hope to begin 3 in 2003. The planning activities with our city and county partners continue to be quite active. We now have a total of over 110 watershed-level major drainageway and outfall system plans in our inventory and we will be adding quite a few in the next couple of years. These master plans guide the District's capital program and land development activities by the cities and counties.

***Criteria Manual* Updates**

Several updates and corrections were issued to all three volumes of the *Urban Storm Drainage Criteria Manual (Manual)* in 2003. Some were quite extensive. For example, the entire Structural BMPs chapter of Volume 3 was updated to adjust recommendations for the details of several BMPs that were necessitated by the feedback we were getting for the field and our own observations. The updated details are an improvement over the old ones. Another major revision was in the storm sewer design protocols. We revised the *Manual* to be in full agreement with the NeoUDSEWER software.

All revisions and updates for Volumes 1 and 2 are posted under www.udfcd.org/usdcm/vol1&2.htm for downloading. We urge everyone who has our *Manual* to do so, and replace the outdated pages in the document you own. Volume 3 of the manual can now be downloaded from www.udfcd.org/usdcm/vol3.htm in full. The entire volume, dealing with water quality and BMPs, is being offered to the public for free in electronic form. We will no longer be offering this volume in printed form and suggest all owners (old and new) visit our web site to download the latest versions of each chapter. We will continue to update our *Manual* as we learn more about the technologies we recommend or national and sate policies, rules and regulations require such changes.

STATUS OF PLANNING PROJECTS

Project	Sponsor(s)	Consultant	Status
Lower First Cr. OSP Update	Adams County, Commerce City, Brighton	Turner Collie & Braden	Completed in 02
Basin 4100, DFA 0054 & 0056 Update	Thornton & Adams Co.	Kiowa	Completed in 02
Broomfield & Vicinity MP Update	Broomfield & Westminster	Kiowa	95% Complete
Oak Gulch & Stroh Ranch	Parker & Douglas Co.	Knight Piésold	95% Complete
Plum Creek OSP - FHAD	Douglas Co.	WRC	90% Complete
Horse Creek OSP	Adams County & Aurora	n/a	85% Complete
Unnamed Tributary to W. Toll Gate Creek	Arapahoe Co., ECCV & Aurora	Kiowa	80% Complete
Todd Creek & DFA0052	Adams Co. & Thornton	Kiowa	75% Complete
Four Mile Canyon & Wonderland Cr. Updates	Boulder.	Love & Associates	75% Complete
Upper Piney Cr. & Tribs	Aurora	Olsson Assoc	70% Complete
NE Sheridan OSP	City of Sheridan	Moser Assoc.	65% Complete
Applewood OSP	Jefferson Co.	Kiowa	60% Complete
RMA 815 & Adj. Areas	Commerce City, Adams Co.	Love & Assoc.	60% Complete
Second Creek (Lower) MP Update	Adams Co., Brighton & Commerce City	Kiowa	50% Complete
Fairmount Area OSP	Jefferson Co., Golden	Moser Assoc.	50% Complete
Denver High Line Canal Marcy G. to Mississippi Av	Denver WD & WMD, Greenwood Village, S. Suburban Park & Rec. Dist. Littleton, Cherry Hills Village, Arapahoe Co.	WRC	50% Complete
Cherry Creek MDP u/s of Cherry Cr. Reservoir	Parker, Douglas Co., Arapahoe Co.	URS	50% Complete
Rocky Mountain Ditch	Denver	HDR	50% Complete
Kinney Cr & Fonder Draw	Douglas Co.	n/a	Mapping Started
Third Creek (Lower) MP Updates	Adams Co., Commerce City, Brighton	n/a	Mapping Started
Lower Brantner Gulch	Adams County, Thornton	n/a	Mapping Started
White Gulch OSP	Arvada	n/a	Start in 03
Lemon Gulch OSP	Douglas County	n/a	Start in 03
Massey Draw & SJDC(S)	Jefferson Co., Arapahoe Co.	n/a	Start in 03

Another important part of the *Manual* is the software and spreadsheets that support the technical requirements and recommended calculations of drainage and flood control facilities. All of these are also updated on a regular basis and we urge you to check our web site for the latest versions for free downloads. As you have yourself experienced, the technology is evolving rapidly and the only way we can make our latest updates available to everyone is through this form of distribution. So, do not assume you have the latest recommendations or criteria. Check our web site at www.udfcd.org to make sure you do.

District's Software

We now have a more stable version of the *CUHP* and *UDSWM* software for downloading. In addition, *UDPOND* and *NeoUDSEWER,* both coded in Visual Basic, may also be downloaded. Both have been totally rewritten by Michael O'Brian with the help and guidance of John O'Brian and Prof. James C.Y. Guo. At this time we are working at developing a graphical interface for the preparation of inputs for the current *UDSWM* package. In addition, we hope to have the entire *UDSWM* and *CUHP* packages rewritten in VB.NET in 2003 as a combined software package that will be windows compliant and network capable. In time we hope to integrate the *CUHP* and *UDSWM* into a single package with a continuous simulation option.

Tucker (continued from page 3)

years. They have to meet interim goals of a ten percent reduction each year. How in the world does the State expect this to be realistically accomplished? Technically, Los Angeles will be in violation of their permit if these conditions are not met and then subject to citizen suit and enforcement actions by the state. This is a regulatory program run amuck.

Most Phase II communities will be initially permitted without having to consider the implications of a Total Maximum Daily Load (TMDL) study. TMDL studies are performed for water bodies that are not meeting their beneficial uses. Wasteload allocations (WLA) are assigned to each point source which if met will theoretically restore the beneficial use to the stream. TMDLs are done for each pollutant that is causing the water not to meet its beneficial use. For point sources the TMDL WLA will be enforced and implemented through NPDES permits. What this means is that Phase I and Phase II municipal stormwater permitted entities can expect their permits to be cranked up a notch or two to meet the WLA assigned to them if a TMDL has been completed in their watershed. Local governments will have to do whatever it takes to meet the WLA requirement regardless of cost. TMDLs are a big sleeping giant that could escalate the cost of complying with Phase I and Phase II permits dramatically.

The last issue is how water quality standards will be applied to municipal stormwater. The bottom line in municipal Phase I and Phase II permits is that stormwater discharges must not cause or have the reasonable potential to cause or contribute to a violation of a water quality standard. Also, if a TMDL is in place the WLA necessary to meet requisite water quality standards are to be expressed in numeric form in the TMDL. For the classic or normal point source these are translated to numeric maximum allowable concentrations of the pollutant in question at the end of the pipe. The discharger is required to monitor the effluent and report any exceedences. The impracticality of doing this for storm sewers, however, is recognized and EPA in recent guidance stated that "… wasteload allocations in TMDLs may be expressed in the form of best management practices (BMPs) under specified circumstances". The EPA guidance goes on to say "… that most WQBELs (Water Quality Based Effluent Limits) for NPDES-regulated municipal and small construction storm water discharges will be in the form of BMPs, and that numeric limits will be used only in rare instances." So for the time being meeting water quality standards will mean implementing the BMPs that are determined necessary to meet the standard. The good news is that compliance will be based on doing the BMPs you said you were going to do in your NPDES permit and not on numeric effluent limits at the end of the pipe. The bad news is that the BMPs that are determined to be necessary to meet water quality standards could be quite extensive and expensive, much more than the initial Phase I and Phase II permits.

To summarize the municipal stormwater NPDES permit program in my view, it could be said that what we see now is just the beginning. Requirements will be ramped up with each 5-year permit renewal. If a TMDL has been completed for an impaired receiving water and a WLA has been assigned to municipal stormwater the increased requirements could be substantial. Just look at Los Angeles and a requirement of zero trash in stormwater discharge at the end of ten years. Also, there is always the specter of end of pipe numerical effluent limits being applied to municipal stormwater. EPA has been careful to say, for example, that wasteload allocations may be expressed in the form of BMPs, leaving the door open to impose numerical effluent limits if they or a state chooses to do so.

Board Chairmanship Change

Councilwoman Cathy Reynolds has been Chairman of the Board of Directors of the Urban Drainage and Flood Control District since 1980 and she has served on the Board since 1976. Her term as a Councilwoman in Denver will end in July 2003 and she will no longer be able to serve on the Board. Speaking for myself, the staff, and the entire Board, her leadership will be greatly missed. She is a natural leader, which is demonstrated by the fact that a disparate Board made up of mayors and county commissioners from all over the metro area expressed their confidence in her by asking her each year for 22 years to be their chairman. No mean feat from a pretty tough crowd. I have worked with Cathy on many issues and will miss her guidance. She is not only smart, but she has good common sense, good instincts, and a good sense of humor. I have always respected, trusted, and followed her judgment and advice. We will all miss Cathy a great deal.

CTP (continued from page 2)

being on November 15, 2001. The District saw the creation of this county as an opportunity to prepare a new countywide Digital Flood Insurance Rate Map (DFIRM), utilizing FEMA's DFIRM specifications. Our belief was that we could learn a great deal about the process that would be involved in such an effort while completing a countywide map for a small county, which was affordable to the District. Although this project was not the subject of a CTP task agreement, we felt our relationship with FEMA was such that we could both benefit from this effort.

After the District had begun its DFIRM conversion effort, FEMA published a draft Implementation Strategy for Flood Map Modernization. We determined that our Broomfield effort very closely resembled FEMA's definition of a Level 1 Flood Map Upgrade. The process we followed and the lessons we learned are discussed in a paper published on our web site. This paper is intended to demonstrate how the District has in effect developed a Level 1 map upgrade for Broomfield, and how that DFIRM is vastly superior to the current paper FIRM. The paper has been provided to FEMA for their use in finalizing DFIRM conversion guidance. The DFIRM was provided to FEMA in November and is currently undergoing their reviews.

South Platte River Program Notes

by

Ben Urbonas, P.E., Chief, South Platte River Program

The South Platte River Program continues to work with the cities, counties, special districts and property owners along the river to help preserve its corridor, improve conditions and habitat of the river, and assist with the maintenance of this valuable natural resource downstream of Chatfield Reservoir. One of the largest open space preservation activities this year was the acquisition, by Adams County, of the Bromley property. We were proud to assist this effort and contributed a significant portion of the total funding. This effort will now insure that approximately 140 acres of land will be preserved and reclaimed for wildlife and human enjoyment as a natural area along the river.

Maintenance Activities

Routine Maintenance

In 2002, South Platte River routine maintenance efforts included:

- 192 river miles (equivalent) of trash and debris pickup and removal
- 3.6 acres of string-trim mowing at access ramps and rest areas
- 78 miles (equivalent) of recreation/maintenance trail edge mowing

Due to this year's drought conditions, the projected need for 9.1 miles of tree trimming and pruning along the river trails was unnecessary.

Approximately 180 truckloads of trash and debris were removed from the river and taken to landfills. Next year we will be adding a total of 5.3 miles of trash and debris pickup to our routine maintenance activities. The ultimate goal will be to include the entire reach of the river from Chatfield Reservoir to 168th Avenue. Colorado Total Maintenance, Inc. has been selected to perform these services in 2003.

For the sixth consecutive year we participated in the Greenway Foundation's annual NIMBY (Not In My Back Yard) Fest volunteer trash pickup, during which an additional 60 cubic yards of trash were removed. In addition, government personnel and volunteer groups have picked-up and removed trash from the river corridor throughout the year. Trash is also regularly removed from trash receptacles that are maintained by park personnel along all recreational trails.

Not only does our routine contractor remove lightweight debris, but also many heavier items such as 200 cubic yards of reinforced concrete pipe, heavy equipment tires and scrap metal. This effort has not only made the river more scenic but has also improved safety for recreational users.

Routine maintenance continues to be the most cost effective program in terms of environmental enhancement and public service. Without it, the trash along and in the river would accumulate tremendously. The routine maintenance program now completes more than twice the number of trash pickups and trail mowings along the South Platte River than we did 15 years ago

Noxious Weed Management

In 2002 the Routine Maintenance Program continued to work with local government agencies to control infestations of non-native and undesirable tree species along the river. In the City of Brighton's Morgan Smith nature area we removed approximately 50 Russian Olive trees and planted 80 Cottonwood trees and Peach Leaf Willows. Working with the South Suburban Park and Recreation District and the City of Littleton, we removed 180 Russian Olives from the riverbanks in South Platte Park. In addition, we removed over 50 dead Siberian Elms in Denver County. Most of the trees that are removed, with the exception of Russian Olive, are mulched and placed back on the banks to protect soils from erosion.

The removal of invasive non-native trees provides the opportunity for native cottonwoods, box elders, willows, and others to be planted or to establish naturally on their own. These native species provide the best habitat for the indigenous wildlife along the river.

An area of growing concern is Invasive Noxious Weeds. These weeds threaten habitat, decrease the value of infested lands to the indigenous wildlife and adversely affects public use. With the adoption of an integrated approach to noxious weed management, the routine maintenance program is now equipped to deal with invasive weed species. Our efforts include aggressive weed mowing, hand pulling and selective use of approved herbicides. Our relationship with various county weed managers allows us to coordinate everyone's activities to maximize public benefit of these efforts.

For the second year in a row, District personnel have attended the Colorado Weed Management Association's (CWMA) yearly conference. This forum provides training in Noxious Weed management and control and an opportunity to network with experts in this field.

District personnel also attend monthly CWMA meetings sponsored by the Colorado Division of Wildlife. The relationships that have developed from these meetings are helping us to continue to be an effective partner in the fight to control noxious and invasive plant species.

Restoration Maintenance

In 2002, the restoration maintenance program did the following projects:

- Constructed a new boulder grade control structure at the Henderson flow gage near 123rd Avenue in Adams County (See "Rebuilding Henderson Gage Control Section")
- Reconstructed of the Gardener's Diversion Dam just upstream of the York Street bridge in Adams County

The reconstruction of the Gardener's Diversion Dam was a cooperative design and construction effort between the District and Xcel Energy. An old, failing, wooden diversion structure, operating as a makeshift river grade control, was removed and replaced with a sloping, partially grouted boulder grade control structure. For safety and fish passage reasons, a boatable chute (assuming we have adequate water flow) was incorporated into the structure. Xcel split the cost of the grade control and designed and paid for a concrete water diversion/bypass structure in order to supply water to the Cherokee Power Generating Plant.

The District continued to assist local governments with maintaining the recreation trail used by the District for maintenance access.

In 2003 we expect the program to include the following restorative maintenance projects:

- Construction of sloping boulder grade control structure and bank restoration upstream of 120th Avenue in Commerce City
- Extension of the river recreation trail northward below 104th Avenue (also funded by Adams County)
- Construction of boulder grade control structure and old bridge pier removal at 16th Street in Denver
- Several bank stabilization and restoration projects in Adams County, Thornton, and Littleton
- Design and construction funding assistance for pedestrian trail crossing in Adams County

Cooperative Projects with Private Property Owners

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. To date over 630 acres of such easements have been dedicated, resulting in over 24 bank stabilization and/or river grade controls and riparian revegetation projects since 1988. In most cases, the local parks departments use these easements for the construction of recreation trails which double as river maintenance access.

No new cooperative projects were constructed this year, however, two more easement dedications were completed. The previously mentioned Bromley property, purchased by Adams County, included a flowage and drainage easement that now allows the District to perform river maintenance and have a voice in how this property will develop. The McIntosh Farm Company also dedicated 31 acres of riparian area in order to get District assistance with bank stabilization and restoration along their property. We hope to complete this bank work in 2003.

Capital Improvement Projects

Upper Central Platte Valley Project

The U.S. Army Corps of Engineers has now completed the river reclamation improvements for the Colfax Reach (I-25 to 14th Avenue) of the river in Denver. The Corps has also completed a Feasibility Study of a river restoration project for the Sun Valley and Zuni Reaches (14th Avenue to upstream of 8th Avenue) in Denver. Final design is underway by the Corps for this $18,000,000 project; however, Congress has not yet authorized construction funds.

Phase 3 of Globeville Project

The District has been working with the City and County of Denver to develop a new design for Phase 3 of the Globeville project along the South Platte River. This phase will relocate the diversion dam for Burlington Ditch upstream of Franklin Street and, in the process, take over 200 acres of residential, commercial and industrial lands out of the FEMA designated 100-year floodplain in Denver. Because of the unusual geometries involved, the entire diversion system and channel modifications are being studied at the Colorado State University Foothills Hydraulics Laboratory in Fort Collins. Denver and the District hope to have this project sufficiently advanced to begin construction in late 2003.

District projects in the news

Jewell Wetlands

The Jewell Wetlands project was a joint effort between Aurora and the District to provide flood detention in the upper Westerly Creek watershed, while preserving what the E PA described as one of metro Denver's most important wetlands. The prime consultant for the project, Design Concepts, received two design awards from the Colorado Chapter of the American Society of Landscape Architects. The project received the CCASLA's Merit Award for Design, and a special Land Stewardship Award, which recognizes a project that creates a model for future projects by other landscape architects.

Leyden Dam

Leyden Dam, a water supply reservoir for about 90 years, was converted to a flood control facility by Arvada, Westminster, Jefferson County and the District. An article describing the design and construction of the project was the cover story in the July, 2002, issue of *Public Works* magazine.

Parkfield Lake II

The project consists of a 7-acre stormwater detention pond/wetland, approach channel and 56th Ave. crossing constructed on the Rocky Mountain Arsenal (RMA) by the Parkfield developers. The District acted as facilitator of the agreement between the RMA, Parkfield and Denver which allowed the project. As part of the agreement, Denver assumed the maintenance of the completed facility. In turn, the District agreed to make the project eligible for District maintenance assistance. This made it easier for Denver to accept the responsibility. The District also contributed one-third of the cost of the 56th Ave. crossing. The DIA Partnership, at its 2nd Annual "The Sky's the Limit Awards Event" presented an award to the project, stating, in part, that, "This project added to the sustainable and smart growth image of the (DIA) district in a demonstrable way that coalesces commercial, residential and open space recreational land uses."

Maintenance Program Activities

by

Mark R. Hunter, P.E., Chief, Maintenance Program

Routine Maintenance

Through the routine maintenance program $629,800 was spent in 2002 for mowing and debris pickups. This work was done on approximately 245 different sections of urban drainageways within the Urban Drainage and Flood Control District (District) boundaries. The table below summarizes the miles of drainageways within each county in the District on which we performed regularly scheduled mowing and debris pickup maintenance.

Adams County	19.5 miles
Arapahoe County	35.3 miles
Boulder County	16.4 miles
Broomfield County	0.2 miles
Denver County	44.7 miles
Douglas County	6.1 miles
Jefferson County	26.5 miles
TOTAL	148.6 miles

Many of the more urban drainageways now receive four or five mowings and seven or eight debris pickups per year. In the early 1980s the sole purpose of the routine program was to pick up large debris that could otherwise contribute to blockages and flooding problems. These days urban drainageway corridors are prized as neighborhood amenities. Along with that outlook comes the community desire for a level of drainageway maintenance that goes beyond our original flood control debris pickups. Three or four debris pickups per year is now inadequate on the more urban drainageways that we maintain.

For the year 2002 we awarded eight separate contracts for routine work. All eight contracts were awarded through a direct competitive bid process. This was the second year all routine contracts were competitively bid. For the year 2002 we added a provision to the routine contract documents that will allow us to negotiate contract renewals for 2003 if we are satisfied with the contractor's work.

Restoration Maintenance

In 2002 the restoration program completed $2,392,500 of work. Restoration projects typically address isolated drainage problems where the construction will cost from a couple thousand dollars up to $150,000. Eighty-eight individual activities were completed during the year. A major advantage of the restoration program is the ability to use it to react quickly to local drainage needs.

In last year's *Flood Hazard News* article we discussed two weaknesses that can trigger the failure of drop structures. A drop can fail when water flows through, under, or around it due to an inadequate cutoff wall. In the second case, a drop can be damaged when the structure itself is not robust enough to withstand and dissipate the stream's energy. In 2002 we repaired more drop structures that suffered from water going through them or under them.

A baffled chute drop structure was built in the mid-1970s on **Niver Creek** at York Street in Adams County . This eight-foot tall structure was built without a cutoff wall to stop the subsurface movement of water. Recently this facility showed signs that it had problems when water got under the concrete then spurted a couple feet into the air at the bottom of the structure. We installed a steel sheet pile cutoff wall at the upstream end of the drop and used low pressure injection of concrete to fill the voids under the sloping panels of concrete.

We participated in the construction of a grouted boulder drop structure in 2000 on **Little Dry Creek** in Cherry Hills Village. In 2002 it began showing signs of water flowing under the apron of grouted boulders. Access to this site was limited and we wanted to try solving this problem without resorting to driving a sheet pile cutoff wall. We contracted with a firm specializing in concrete stabilization and had them inject their product in a grid pattern at varying levels under the drop structure. We will monitor the results of this practical alternative to drop structure repair.

It is common to have utility lines cross streams. On **Big Dry Creek** in DeKoevend Park at University Boulevard and Arapahoe Road the stream had eroded such that the full barrel of an unprotected sewer line was exposed. With the financial assistance of the sewer district we reinforced the utility crossing, installed a sheet pile cutoff wall, and placed grouted boulders for the drop structure face. The structure is quite narrow in order to preserve the nearby park trees.

A very congested reach of **Skunk Creek** near 30th Street in Boulder has been eroding both vertically and horizontally for several years. A small grouted boulder drop structure will be built to carry the low flows. A concrete wing wall for a roadway culvert will be extended to control the lateral erosion. Two small wetland sites will be included in the construction.

The **Montbello** area of Denver is served by nearly 10 miles of concrete lined drainage channels. They have been constructed over the last 25 years as the subdivisions have been built. Their top widths vary from 12 feet up to 35 feet. Most of them were built without weep holes or substantial reinforcement. We set apart some funds each year to replace the very worst sections of these concrete channels. Our replacement concrete panels include weep holes and steel reinforcement.

Within the City and County of Denver we are participating with the Denver Parks Department in developing maintenance inventory reports for the major drainageways where large maintenance projects are still needed. Studies for **Harvard Gulch, West Harvard Gulch, Lakewood Gulch, Cherry Creek, and Sanderson Gulch** have either been completed or will be completed in 2003. These reports inventory the condition of existing

facilities and structures, develop preliminary cost estimates for repairs or replacement, and prioritize the severity of drainageway problems. These studies assist the District and Denver in gaining perspective of the overall drainageway needs within the City and help allocate the limited funds to the most pressing problems.

Northeast of Pierce Street and Coal Mine Avenue in Jefferson County a beautiful corridor of native grasses and Crack Willow trees, some of them nearly 100 years old, has been preserved along with the right-of-way for **Coon Creek**. In a couple places the tree roots had intertwined to form two-foot to four-foot tall natural drop structures. Guidance from the community and the flexibility of our restoration contractors combined to produce low flow grouted boulder drop structures and limited bank protection that preserves the trees and will keep the creek from eroding the back yards.

Any channel built since March, 1980 must pass a design and construction review process if those drainage facilities are to be eligible for repairs and general upkeep by our drainageway maintenance program. **West Cook Creek** near Lincoln Avenue in the City of Lone Tree was designed and built to eligibility standards several years ago. A combination of sedimentation and localized erosion had recently caused standing water to occur in the channel. Since it qualified for maintenance assistance we reshaped the banks, built a short low flow drop structure, and revegetated the channel.

Rehabilitation Maintenance
Seventeen projects were at various stages of design or construction during 2002. Those projects are listed in the accompanying table titled "STATUS OF MAINTENANCE REHABILITATION PROJECTS." Rehabilitation projects typically are designed by private consultants and built by private contractors. They are intended to correct severe problems that have occurred on a previously improved urban drainageway. By the end of 2002 the District will have spent about $2,195,541 on rehabilitative design and construction for the year. A few of the unique projects are discussed below.

STATUS OF MAINTENANCE REHABILITATION PROJECTS

Project	Jurisdiction		Cost	Status
ADAMS COUNTY				
Clear Creek – S. Platte R. to York St.	Adams County	Design	$75,615	95%
Build drops to control grade.		Const.	Next year	0%
Niver Ck, Trib M – N.E. of Huron St. &	Thornton	Design	43,600	100%
88th Ave. Drops & repair bank erosion.		Const.	293,053	100%
ARAPAHOE COUNTY				
East Toll Gate Trb. – Along Uravan Av	Aurora	Design	159,640	100%
Drops and channel repair		Const.	538,422	100%
Little's Creek – Gallup to Elati	Littleton	Design	33,620	50%
Drops and channel repair		Const.	Next year	0%
Willow Creek – N. of County Line Rd	Centennial	Design	67,450	50%
Build drops to control grade		Const.	Next year	0%
BOULDER COUNTY				
No Changes in 2002				
BROOMFIELD COUNTY				
No Changes in 2002				
DENVER COUNTY				
Cherry Creek – Highline canal crossing.	Denver	Design	Included	100%
Repair drop structure, participation		Const	439,550	100%
Goldsmith Gulch, - North of Hampden	Denver	Design	66,000	100%
Channel and bank repair.		Const.	815,000	0%
DOUGLAS COUNTY				
Big Dry Creek – In Heritage Park	Douglas County	Design	By others	100%
Drops and repair steep banks, partic.		Const.	300,000	100%
Tallman Gulch – At Siebert Circle	Parker	Design	53,559	50%
Drops, channel repair, and trails		Const.	Next year	0%
JEFFERSON COUNTY				
Coon Creek – West of Sheridan Blvd	Jefferson County	Design	44,610	100%
Drops and repair eroding channel.		Const.	145,626	100%
Lakewood Gulch – Van Gordon-Welch	Lakewood		Included	40%
Drops and repair channel, participation		Const.	200,000	0%
Lena Gulch – Colfax at Zeta Street	Golden	Design	20,000	60%
Drops and repair channel, participation.		Const.	Next year	0%
Lena Gulch – From 20th to Youngfield	Lakewood	Design	25,000	30%
Drops and repair channel, participation.		Const.	Next year	0%
Lilley Gulch – Wadsworth to Estes	Jefferson County	Design	70,171	100%
Repair channel and trail.		Const.	280,240	100%
Lilley Gulch – East of Pierce Street	Jefferson County	Design	49,918	100%
Drops and repair channel, participation		Const.	233,899	20%
McIntyre Gulch – West of Holland St.	Lakewood	Design	Included	100%
Repair channel banks, participation.		Const.	265,000	0%
S.J.C.D. North – West of Sheridan Blvd	Jefferson County	Design	11,134	100%
Floodplain determination.		Const.	No const.	0%

Several regional and local governments participated with us in rebuilding some critical facilities on **Cherry Creek.** In southeast Denver where the Highline Canal crosses Cherry Creek there was a massive 12 foot tall drop structure composed of dumped concrete rubble. Erosion had exposed the Highline Canal siphon under the creek and the rubble appeared inadequate to resist a major flood event. This project was a tremendous multi-party success that resulted in a substantial grade control structure plus trail and park improvements for the large open space area.

Vertical degradation on the South Platte River has migrated upstream in the channel of **Clear Creek** to the point that a previously installed bio-engineering bank protection project has been undermined and severely damaged. The encasement for a recent utility crossing has also been exposed. Design is underway for a grouted boulder drop structure on Clear Creek near the confluence with the South Platte River to control the grade of the channel.

The **East Toll Gate Tributary** in Aurora had several grouted riprap drop structures with deep stilling basins that drained into an 18-inch diameter trickle flow/underdrain pipe. The pipe was damaged or plugged in several areas. The drops were deteriorated and had

become a safety problem because of the deep stilling basins. Rebuilding the drop structures and regrading the channel allowed all runoff to flow on the surface through the improved corridor.

Creeks in our semi-arid region tend to have a mind of their own when it comes to the width to depth ratio for the low flow channel. **Harvard Gulch** flows through DeBoer Park in south Denver. It had a thin slope-paved concrete trickle channel that had become displaced and broken-up. Last year the five-foot wide concrete trickle channel was replaced with a boulder-edged low flow channel that varies from 12 to 18 feet wide. The outcome is an attractive creek corridor through an irrigated park. An additional feature that has developed over the past year is that the creek has deposited sediment in the now-wider low flow channel. The result is mounds of material and volunteer vegetation scattered throughout the creek alignment that have become a maintenance issue for us and the parks department.

Denver Parks Department initiated a large project on **Goldsmith Gulch** north of Hampden Avenue to control the low flow channel through an urban wetlands area. The project will also restore the ground water level for the wetlands and will relocate a playground. We joined with the parks department to assist with some of the channel restoration and to extend the project further south to repair a damaged channel in a commercial area. The combined efforts will produce a well coordinated project with two damaged reaches of the gulch being repaired in a single effort.

Several multi-purpose projects were funded this year through intergovernmental agreements. The result of this combined funding is projects that meet a variety of neighborhood needs. In Highlands Ranch, Douglas County we cooperated with the Highlands Ranch Metro District to build trails and creek crossings and to construct channel improvements on a portion of **Big Dry Creek** where the subdivision developer had stayed completely out of the floodplain during his development activities. Multi-party funding also helped us on **Lilley Gulch** in Jefferson County east of Pierce Street. On this project we cooperated with Jefferson County Open Space in adding a portion of Lilley Gulch to their active park areas. This was accomplished by reshaping an abandoned irrigation pond and by constructing drop structures and wetlands.

Harvard Gulch Low Flow Channel

Before construction

Immediately after construction

One year later

Vegetation Thinning within Minnesota Drive Tributary

By Libby Kaiser, Student Intern

Regular routine mowing of portions of the Minnesota Drive Tributary prevents overgrowth of vegetation around the storm sewer outlets draining to Cherry Creek. Despite the mowing at the outlets the rest of the stormwater channel had become a tangled mess of invasive weeds, shrubs, suckers and dead branches.

This gnarled jungle was thinned out in July, 2002, to restore capacity and facilitate maintenance of Minnesota Drive Tributary. This tributary runs parallel to Cherry Creek along residential backyards between Monaco and Holly Street in Denver, Colorado.

Before and after views of Minnesota Drive Tributary.

A private contractor was paid $4,490.00 to cut and remove all woody vegetation within the channel as well as remove the lower branches of mature trees up to a height of approximately six feet above the ground. The result is a drainageway free of organic debris that more effectively prevents flooding near the homes that line its southern bank while also facilitating access by maintenance crews.

Rebuilding Henderson Gage Control Section

by
Ben Urbonas, P.E. and Bryan Kohlenberg, P.E.

The District, in cooperation with the Metro Wastewater Reclamation District and the Colorado Division of Water Resources, in early 2002 installed a grade control structure just downstream of the historic Henderson Gaging Station on the South Platte River in Adams County. A problem crept up on everybody as the River's thalweg slowly degraded over the years. For years the Division of Water Resources staff would lower the water level measuring float and adjust the "shift" on the gage's rating curve to compensate for the River's degradation. But in 2000 it had dropped too far to use this adjusting procedure and to record low flows at this gaging site.

Three options to correct this problem were possible. One was to abandon the gaging site. This was really not an option, since too many water users and data collectors depended on this gage for information. The second option was to totally rebuild the gaging site, including the wet well and all of the flow measuring and water sampling equipment. Although this option was viable, the Division had no funds for such an undertaking and it would have disrupted many of the data and water sampling efforts for an extended period of time. The third option was to install a grade control structure immediately downstream of the gaging site to restore the thalweg so as to permit recording of low-flows again at this gaging site.

Due to ongoing downstream river degradation, the District had identified the need for a grade control structure in this area in its 1985 master plan for the South Platte River. What lacked were the funds to install it. This was the case until the Division staff contacted us in 2001requesting that we help with their problem. In addition, Metro Wastewater Reclamation District stepped up to the plate and agreed to fund a portion of the cost

Metro also had a need for improved reaeration of the River. Working with their staff a design evolved that provided for:

Before and after views of the gage control section

1. Grade and flow stage control
2. Reaeration of the River
3. Reasonably safe boater passage
4. Unimpeded fish migration

With combined contributions from the District, the Colorado Division of Water Resources and the Metro Wastewater Reclamation District, we hired a consultant to help design this facility. Construction was completed in the spring of 2002.

Notice the cleanup of the site that occurred as a result of this project (see the before and after photographs on this page). Over the years much rubble was dumped on the River's channel bottom and its banks at this location. All of this rubble and other trash were removed, the site regraded and then revegetated with native vegetation and grasses. Unfortunately the very dry weather that we experienced in 2002 retarded the reestablishment of the new vegetation, but we expect it to green up when the conditions return to normal.

The site can be viewed at www.hydrotechnica.com/hydrocam.php under station name PLAHENCO. This link provides a time-delayed picture of the site looking from the Henderson Gage stilling-well downstream at the new grade control structure.

Flood Warning Program Activities

by
Kevin G. Stewart, P.E., Information Systems Manager, Floodplain Management Program

Introduction
Douglas and Jefferson County officials will likely remember the 2002 flood season in a much different way than their neighbors to the north and east. Colorado's worst wildfire ever, the Hayman Fire, which scorched nearly 138,000 acres in Park, Teller, Douglas and Jefferson counties between June 8 and July 2, created a heightened awareness concerning flash floods and threatened water supplies. While the state's prevailing water worries remain focused on historic drought conditions and depleted water resources, the rapid deployment of early flood detection equipment and the implementation of specialized precipitation forecasting and notification services in 2002 rivaled that following the 1976 Big Thompson Canyon flash flood.

In spite of the drought, some flooding did occur this past year in the District with a few events escaping nearly unnoticed. The District's flood prediction program tied the year 2000 for a record low 23 days of flood potential. The National Weather Service (NWS) issued no flash flood watches that affected the District during 2002, setting another record for the 24-year-old program. Flash flood warnings were issued for 2 days (July 3 and August 5) based on observed and estimated storm rainfall.

District and Denver Assist Hayman
Before the fire was under control, the U.S. Forest Service (USFS) contacted the District concerning how to address the fire-related flash flood threat and what types of early detection equipment were available for rapid deployment. With the Hayman Burn Area being outside the District, the District's ability to help financially was limited. The District did, however, provide the USFS with a list of contacts from Jefferson and Douglas Counties, the State of Colorado, the Denver Water Department, the U.S. Geological Survey, the NWS and DIAD Inc. The District also participated in the initial meeting held in Jefferson County where a recommendation for deploying ALERT gages was made. Subsequent to that meeting, things happened very quickly due to the urgent nature of the problem.

A current Denver/District project to expand the ALERT system made immediate access to equipment possible. With the full support of and swift actions by Brian Schat of Denver, Denver Public Works officials quickly approved delaying their project and assisting their neighbors to the south and west. DIAD provided the communications, sighting, installation and data collection/display expertise; and as soon as fire managers declared it safe, five Denver ALERT gages were deployed in the field. A short time later a more-distant good neighbor, the State of Ohio, provided 20 additional stations. Readers interested in the Hayman early flood detection system can find more information from the District's "Fire Weather" page at alert.udfcd.org.

Flood Warning Research
A May, 2002, report entitled: *An Evaluation of the Boulder Creek Local Flood Warning System* is now available from the District. Dr. Eve Gruntfest, Kim Carsell and Tom Plush with the Department of Geography and Environmental Studies at the University of Colorado at Colorado Springs conducted the study. The Boulder/Boulder County Office of Emergency Management was the local sponsor. The report includes findings from recent Colorado and U.S. flood disasters and recommends ways to improve Boulder's local flood warning program, which has been serving the community for the past 24 years. A public survey revealed what floodplain residents understand about their community's flood threat, the warning process, and personal flood safety. The report recommends that the District take a more active role in educating the public concerning flash flood dangers and personal safety actions. The District intends to investigate how to best implement these recommendation in 2003. A copy of this report can be obtained from the District's website.

EMWIN-Denver Planned for 2003
The Emergency Managers Weather Information Network or EMWIN is a national program supported by the National Weather Service. It provides an effective low-cost way to disseminate current information about severe weather and floods (watches, warnings, advisories, and other graphical and text-based products) to local decision-makers and citizens using satellite, radio and Internet communications. The technology has the potential to include local weather information not originated by the NWS and by adding a few enhancements, email notifications and text paging can be automated. A hybrid EMWIN system like this has been developed by Harris County, Texas to serve the greater Houston area and surrounding counties. In November the District, with the Colorado Office of Emergency Management, hosted a meeting with local area emergency managers and invited Houston guests to look at developing a similar system for the District. A consensus was reached to move ahead and plans are currently underway. The District has budgeted $15,000 to assist with developing the EMWIN-Denver project in 2003.

CoCo RaHS Update
The Community Collaborative Rain and Hail Study (CoCo RaHS) is a research and education project designed to involve local citizens of all ages in helping scientists better understand localized rain and hail patterns from spring and summer thunderstorms. The project is lead by Nolan Doesken, Assistant State Climatologist with Colorado State University's Colorado Climate Center. The District helped fund a student intern from Metropolitan State College (Christopher Spears) to expand CoCo RaHS in the Denver area this past year. By the first of August, 185 new applications had been processed from the Denver area and volunteers were being trained. The District and many other local sponsors

will continue to support CoCo RaHS in 2003 with the goal of eventually having one observer for every square mile. Anyone interested in becoming an observer should visit the CoCo RaHS website at www.cocorahs.com.

ALERT System News

The District's ALERT flood detection network continues to expand and provide valuable early flood detection and decision support for local emergency management and response agencies. The total system is now comprised of 157 stations measuring rainfall at 135 locations, stream/reservoir water levels for 76 points, and weather data (wind, temperature, humidity, pressure and other parameters) at 17 sites. The District's ALERT web server continues to be a highly desirable and reliable means of accessing ALERT data in real-time.

Following a large storm in July, 2001, Denver Wastewater Management officials asked the District to incorporate alphanumeric paging to notify key people when messages and storm track forecasts were being issued. This practice proved useful and was continued in 2002. The District also acquired software from NovaLynx Systems, Inc. to automatically send pages when user-specified ALERT gages alarmed. Denver officials participated in testing this process in 2002, again with favorable results.

ALERT system expansion in 2002 consisted of 7 stations: a rain/stream gage at Powers Park on Slaughterhouse Gulch in Littleton; a combination weather station/stream gage on Marston Lake North Drainageway in southwest Denver; a rain/stream gage co-located with an existing long term stream gage (Bear Creek at Sheridan) and 4 new stations installed by the City of Boulder to measure rainfall and stream levels on the lower portion of South Boulder Creek downstream of Eldorado Springs. Some additional stations in Denver and Aurora are expected to be online by April including a rain gage at the Denver Zoo and a weather station at Aurora Reservoir, among others. New stream gages will soon be operating on Sanderson Gulch, Lakewood Gulch and the South Platte River in Denver, and on Sand Creek and Murphy Creek in Aurora. DIAD Inc. of Longmont provided the 2002 ALERT maintenance services for the 11th consecutive year.

Marston Lake North ALERT gage

Looking ahead, the District intends to improve its web server capabilities in 2003 by incorporating XML features that integrate weather and flood data from other online sources into single displays. Other XML applications will focus on simplifying user interpretation of stream level information.

Meteorological Support

The District's flood prediction program provides forecast and notification services directly to District local governments from April 15 through September 15 each year. HDR Engineering, Inc. Hydro-Meteorological Services of Denver provided the forecasts during 2002. This was the second consecutive year for HDR as the District's meteorological services provider.

2002 District Floods

This past year will be long remembered as a year of record drought and disastrous wildfires in Colorado. With an extraordinarily low snowpack and an early spring start to the fire season, the flood potential for the District remained essentially nonexistent until June 3. While 16 days between June 3 and September 15 did produce what may be considered "heavy rainfall," the most notorious flood event of the year did not occur until September 13, just two days prior to the end of the District's 2002 flood prediction services. ALERT gages triggered rainfall rate alarms on 7 days (June 3&19, July 22, Aug 5&20, and Sept 12&13). The following briefly describes some of the more noteworthy events:

23 Days with Flood Potential

April	None	0
May	None	0
June	3-4,19-20	4
July	3-6,10,21-22	7
August	4-6,20,27-29	7
September	8-9,11-13	5

Monday, June 3. Much of Boulder County's mountains received welcomed rainfall totals between 1 and 2 inches. The heaviest rainfall intensities occurred between 6 and 7 PM near Big Elk Park and Taylor Mountain in the northern portion of the county. Low threat messages were in effect for the District with the "all clear" being issued by 9 PM. Messages were re-issued at 10 PM for Douglas County when a surprise storm near Franktown produced 1.2" in less than an hour. A quick-hitting hailstorm moved through East Denver during the evening producing 1.75" diameter stones. No major stream flooding was reported.

Wednesday, July 3. Precisely one month after the first message-day of the year, the NWS issued an early morning (12:04 AM) flash flood warning for east-central Jefferson County and southwest Denver just north of Chatfield Reservoir. Heavy rain and hail was reported but the short-lived event ended before flooding became serious. Radar-estimated rainfall rates exceeded 3" per hour but the storm lasted no more than 10 to 15 minutes. Consequently, only minor street flooding resulted and the warning was later judged unwarranted. A Rocky Mountain News article indicated that as much as 2" of rain may have fallen but the ALERT rain gages a few miles east in Littleton measured maximum amounts of only 0.20 inches. Storms of similar magnitude in the Hayman Burn Area to the south had been cause for flash flood warnings on more than one occasion over the

2002 Peak Flows. Some notable peaks measured by the ALERT system

Date/ Time	Location	Peak in cfs
May 24 03:28	South Platte River at Henderson	** 3,020
June 3 23:21	Harvard Gulch at Jackson Street	380
June 4 00:00	Slaughterhouse Gulch - Powers Park	55 (Depth 6.9')
June 4 00:07	Holly Dam	89 (Depth 10.2')
June 7 02:08	Boulder Creek near Orodell	** 185
July 6 10:31	South Platte River at Union Avenue	530
July 6 11:17	Englewood Dam	145 (Depth 13.3')
July 6 12:33	South Platte River at Dartmouth Ave.	760
Aug 5 19:12	Third Creek at DIA	270 (Depth 9.7')
Aug 27 04:26	Cherry Creek at Castle Oaks Road	Est. >2,000 (Depth 7.2')
Sept 12 17:49	Westerly Creek at Montview Blvd.	590
Sept 12 20:50	Cherry Creek at Steele Street	620
Sept 13 14:35	Harvard Gulch Park at Logan Street	770
Sept 13 14:46	Goldsmith Gulch at DTC/Temple Pond	370 (Depth 4.9')
Sept 13 15:00	Goldsmith Gulch at Eastman Avenue	730
Sept 13 15:40	South Platte River at 19th Street	2,290

* New record ** Peak due to snowmelt
Visit alert.udfcd.org for a complete listing of record high water measurements

previous month. The fire was just declared fully contained on July 2.

Wednesday, July 10. Flood potential existed in the District for a 4-day period beginning July 3, instilling hope that Monsoon rains would soon begin and provide some relief to the worsening drought and fire danger. On July 6, a 10-inch thunderstorm near Ogallala, Nebraska produced a flash flood that destroyed a large section of I-80 and caused the death of a truck driver, another indication that rich Gulf moisture had arrived in eastern Colorado. However, the rain that did occur in July was of little help. July 10 is noteworthy because of a severe storm in Douglas County that produced 2.56" of rain and very large hail. Only isolated heavy rains were reported with most of the ALERT system measuring totals of well less than an inch. A newspaper article credited this day with "the second large thunderstorm of the season" producing torrential rain, hail and street flood in the Denver area.

Sunday/Monday, July 21/22. Another isolated midnight storm near Red Rocks Park in Jefferson County dumped 1.46" in 45 minutes causing the only rainfall rate alarms recorded by the ALERT system for the entire month of July. A Roxborough Park resident observed 1.59 inches. No stream flooding was reported.

Monday, August 5. A heavy thunderstorm near DIA set a record high water level for the 2-year-old ALERT stream gage on Third Creek. The rain gage at that station measured 2.36" and prompted the NWS to issue a flash flood warning, the second and final warning of the season for the District. The storm at DIA occurred between 2:30 and 3:30 PM. Most of the metro area received less than an inch of rain, but two gages in the Bear Creek basin measured over an inch.

Tuesday, August 27. Nocturnal events seemed to be the norm for 2002. Consequently events like this one, judged quite significant by hydrologists and engineers, escaped media attention. In the early morning hours a 4-foot deep flood wave was observed cascading down Cherry Creek in Douglas County. A heavy rainstorm near Franktown east of Castle Rock caused the flood. The official Cherry Creek stream gage near Franktown recorded one of its highest peaks in recent history showing a very rapid 9-foot rise with an approximate (unofficial) peak flow of 5000 cfs. The Parker stream gage reported a mere 2.5-foot rise with a peak flow of less than 200 cfs. Town of Parker officials photographed the event and documented the flood's rapid attenuation, noting that flows amounted to a trickle when it finally reached the Douglas/Arapahoe County line. The ALERT rain/stream gage at Castle Oaks Road recorded a new high water record of 7.2 feet at 4:26 AM, but the rain gage measured only 0.79 inches. One CoCo RaHS observer in the area reported 2.02 inches. County officials did confirm that water overflowed the county road between the bridge and its intersection with SH 83 (Parker Road) to the east. The peak flow at this location was estimated to be greater than 2000 cfs. Follow-up efforts are underway to more accurately document this flood. HDR is performing a reconstruction of the storm using archived Radar data and more detailed efforts will be made to verify peak flows and runoff volume.

Friday, September 13. In addition to being the last big warm season storm of the year for the District, the urban flood that occurred on this Friday the 13th has become an annual tradition in Denver. Once again the I-25/Logan Street underpass (commonly known as Lake Logan) was inundated by stormwater, this time disrupting traffic for over 3 hours between 3:30 and 6:30 PM. A number of motorists were rescued from their vehicles. The ALERT system performed well and the potential for heavy rainfall was recognized well before noon. However, it is very difficult to predict exactly when and where storms will develop. ALERT rain gages along Harvard Gulch exceeded 0.5" in 10-minute alarm thresholds at 2:05 and 2:15 PM, and 1.0" rate alarms at 2:23 and 2:31 PM. Rainfall totals 1.06" to 1.18" were measured near the I-25 corridor between the Denver Tech Center and Broadway. This event was rivaled by the July 8, 2001 storm, which had twice as much rain measured with some point estimates exceeding 4 inches.
Visit the District's website for more color photos, figures and links not included in this printed edition of *Flood Hazard News*.

Cherry Creek on August 27

Stormwater Permit Activities

by

John T. Doerfer, Project Hydrologist, Master Planning Program

The past year was particularly active in terms of municipal stormwater permit activities. All of the cities and counties within the District needed to discuss permit requirements with the Colorado Water Quality Control Division (WQCD) during the year. The cities of Denver, Aurora, and Lakewood negotiated terms for the renewal of their permits that were initially issued in 1996. The "Phase II" municipalities, those with less than 100,000 population, needed to consider the management programs they will be responsible for developing and implementing under Clean Water Act regulations, and the implications of compliance under a general permit that was just recently proposed by the WQCD on December 13, 2002. The District assisted its member governments in 2002 with these efforts, and will continue to do so in 2003.

Phase I Municipalities

The cities of Denver, Aurora, and Lakewood are classified as "Phase I" municipal separate storm sewer systems (MS4s) under the EPA discharge regulations because of their population size (greater than 100,000). The WQCD, as state agency with regulatory authority designated by EPA, issued permits to the three cities in June 1996 after applications were submitted in November 1992. The individual permits were for a 5-year permit term and expired on April 30, 2001. The three cities submitted permit renewal applications in October 2000, but as of the current date have not yet been reissued permits for a second term. A number of meetings were held to discuss permit conditions during the first half of 2002. The cities continued implementation of their stormwater management programs under previous permit conditions and expect their permits to be renewed early in 2003.

The Phase I cities have fully implemented all of their current permit requirements. There will likely be a few additions and changes made, primarily to shift emphasis to education of industries, when the permits are reissued. A wet-weather monitoring program conducted for the cities by the District with assistance from the U.S. Geological Survey will continue. This monitoring is intended to assess long-term trends and provide data for watershed planning.

Phase II General Permit

A major effort this year was to provide assistance to municipalities within the District that fall under the regulatory definition as Phase II municipalities, often referred to as small MS4s. They are required to apply for and be issued a general permit by WQCD in 2003. This affects most of the cities and counties within the District, with the exception of Phase I cities and those with less than 1000 population that were granted waivers (Bow Mar, Lakeside, Morrison, and Mountain View).

EPA published the federal regulations for Phase II municipalities on December 8, 1999. In contrast to Phase I regulations that defined what information must be included in an application for an individual permit to be written, the Phase II regulations defined the terms and conditions a Phase II MS4 would be subject to under a general permit that applied to all small MS4s. The six management programs that must be developed, implemented, and enforced by a small MS4 are: (1) Public education and outreach; (2) Public involvement/participation; (3) Illicit discharge detection and elimination; (4) Construction site runoff control; (5) Post-construction runoff management in new development and redevelopment; and, (6) Pollution prevention/good housekeeping for municipal operations.

Colorado adopted similar regulations, with some refinements, on January 8, 2001. Acting under a consent decree, EPA was required to provide a "menu" of best management practices (BMPs) and the "measurable goals" that small MS4s could select from in defining their management programs. EPA also had to prepare a "model general permit" in December 2002, and the consent decree set March 10, 2003 as the deadline for MS4s to submit permit applications.

These regulations established a short timeframe for small MS4s to prepare application materials and to provide comment on the exact terms to be included in these general permit. During the latter half of 2002, the District supported and coordinated a number of meetings of the Municipal Workgroup of the Colorado Stormwater Task Force. This group provided a forum to discuss with WQCD the stormwater management program elements that Phase II MS4s will need to decide upon and propose in their permit applications to comply with the general permit. Each of the six management programs was discussed; in addition to the discussion of permit application forms and draft general permit in time to provide meaningful comment to the WQCD. Phase II MS4s have 5-years to fully implement their programs and the District intends to continue providing assistance to them during this period as needed and requested.

District wins accounting award

For the fourteenth year in a row the District has received a "Certificate of Achievement for Excellence in Financial Reporting" from the Government Finance Officers Association of the United States and Canada.

The certificate is presented to government units whose comprehensive annual financial reports achieve the highest standards in government accounting and financial reporting. Congratulations to Frank Dobbins, Chief of Finance and Accounting, for continuing this string of awards.

Design and Construction Program Notes

By
David W. Lloyd, P.E., Chief, Design and Construction Program

In this past year the District's Design and Construction Program committed over $9.1 million to design and construction projects throughout the Denver Metropolitan area. Our work load continues to be in the area of 80 to 90 projects that are either in the design process, obtaining lands and easements, or under construction.

Notable projects this past year included construction of improvements to the Pinehurst Tributary to Bear Creek. This project, located almost entirely on Colorado Academy, a private school located in Jefferson County, consisted of a regional detention pond and channel improvements. Incorporated into the channel improvements were two "faux" rock drop structures as well as a new outlet spillway from the existing Woodys Pond. This was a cooperative project with Denver, Jefferson County and Colorado Academy (CA). During the design process CA developed a master plan for The Alumni Nature Preserve that encompassed most of the drainage facilities. The preserve will be made up of various geozones each representing a particular ecological and cultural environment and connected by an extensive pathway system, part of which will provide maintenance access for the drainage improvements. This project has been a fine example of various stakeholders partnering to develop a truly multifunctional drainage improvement project.

This past year saw the start of the fourth and final phase of the Goose Creek project in Boulder. This has been a multi-year project (the first phase was constructed in the mid-80s), of which the fourth phase should be completed in the spring of 2003. This multi-million dollar project will remove hundreds of properties, both residential and commercial, from the 100-year floodplain. Congratulations to the City of Boulder for staying the course in implementing this important drainage and flood control project.

STATUS OF DISTRICT DESIGN PROJECTS

Project	Participating Jurisdiction(s)	Status
Pinehurst & Academy Park Tribs	Denver	Complete
Plaster Reservoir Detention	Broomfield	Complete
Parker/Jewell Outfall	Arapahoe County	Complete
Sand Creek Stapleton to Toll Gate	Aurora	Complete
Sulpher Gulch	Parker	Complete
McKay Outfall	Adams County	95% Complete
South Trib. Slaughterhouse Gulch	Littleton	95% Complete
Lakewood Gulch at Tennyson	Denver	95% Complete
Little Willow Creek	Douglas County	90% Complete
Parker/Mexico Outfall	Arapahoe County	75% Complete
South Lakewood Gulch	Lakewood	75% Complete
Kalcevic Reservoir	Adams County	50% Complete
Lena Gulch @ Mountain Side	Jefferson County	50% Complete
Irondale 80th Ave. Outfall	Adams County	50% Complete
Piney Creek	Arapahoe County, Centennial	50% Complete
Lena Gulch	Golden	50% Complete
Arvada Channel	Arvada	30% Complete
Upper Big Dry Creek	Highlands Ranch	30% Complete
Lena Gulch	Jefferson County	25% Complete
Lake Erie Tributary 1	Adams County, Thornton	20% Complete
Utah Junction Outfall	Adams County	10% Complete
Hoffman Drainageway	Adams County	10% Complete
Piney Creek	Aurora	5% Complete

STATUS OF DISTRICT CONSTRUCTION PROJECTS

Project	Jurisdiction(s)	Cost	Status
Bear Creek Maintenance Access	Morrison	$817,300	Complete
Leyden Dam	Arvada	1,604,000	Complete
Little Dry Creek RR Culverts	Adams County	3,200,000	Complete
Niver Trib. M Outfall	Federal Heights	172,000	Complete
Marcy Gulch	Highlands Ranch	1,800,000	Complete
Lemon Gulch	Douglas County	815,000	Complete
Dad Clark Gulch	Highlands Ranch	523,000	Complete
Wonderland Creek	Boulder	575,000	Complete
Indiana St. Outfall	Lakewood	950,000	Complete
Virginia Village Phase II	Denver	1,296,000	Complete
13th & Ulster Outfall	Denver	673,000	Complete
Drainageway G	Jefferson County	1,285,000	Complete
Little Dry Creek at City Ditch	Englewood, Cherry Hills	89,600	Complete
Massey Draw North Trib.	Jefferson County	521,000	Complete
Sanderson Gulch	Lakewood	400,000	Complete
Swansea Outfall	Denver	446,000	Complete
University/Mexico Outfall	Denver	648,000	Complete
Virginia Village Phase III	Denver	860,000	Complete
West Evans Outfall	Denver	661,000	Complete
Bayaud & Hooker Outfall	Denver	851,000	Complete
Erie Drainage	Erie	248,000	Complete
Cottonwood Creek	ArapCo, Greenwood	1,360,200	95% Complete
Brookridge/Grant Outfall	Arapahoe County	996,000	95% Complete
Drainageway 4	Lafayette	400,000	95% Complete
Kenneys Run West Fork	Golden	2,293,000	95% Complete
Pinehurst Tributary	Denver, Jefferson Co.	769,000	95% Complete
Baldwin Gulch	Douglas County	1,017,000	90% Complete
Goose Creek	Boulder	3,480,000	75% Complete
Park Hill Outfall	Denver	1,849,000	50% Complete
Happy Canyon Creek	Douglas County	301,000	25% Complete
Plaster Reservoir	Broomfield	475,000	20% Complete
Clear Creek at Washington St.	Golden	3,322,000	15% Complete

This coming year looks to be equally as busy with almost $8.8 million identified in the 5-Year Capital Improvement Program for 33 new or existing projects.

The new year has all the appearances of a banner year as we anticipate going to construction with the long awaited Van Bibber Creek Flood Protection Project.

This project, in which the District and City of Arvada have partnered with the U. S. Army Corps of Engineers, is projected to be bid by the Corps in January, 2003. This project officially began in 1989 when the District and Corps entered into an agreement for the feasibility study of the Van Bibber project. Even prior to 1989, the District and Arvada worked with the Corps in the development of a reconnaissance report and made their first major land purchase in anticipation of the project in 1988. This past year, the City of Arvada has been purchasing the needed lands and easements needed for the project as well as relocating utilities that are in conflict with the proposed improvements.

The Leyden Lake project features a 380 feet wide roller compacted concrete spillway with a capacity of 75% of the probable maximum flood.

The Marcy Gulch channel stabilization project included a dozen soil cement drop structures to stabilize the longitudinal slope of the channel, along with restoration and creation of wetland areas. Last spring 200 high school students spent several hours on a Saturday planting upland shrubs and wetland plants along the newly completed construction area. The photos to the right and below show the students in action.

Maintenance Eligibility Notes

By
David Mallory, P.E., Senior Project Engineer, Floodplain Management Program

Low mortgage rates continue to fuel robust development

Home mortgage rates hit a 40-year low in 2002. The result was a continued boom in land development activities. Residential development has slowed somewhat in the southern tier of the Denver Metropolitan Area and commercial development in general. However, all other areas continue to experience strong growth. We processed 240 construction plan submittals this year, a 10% increase over last year. Seventy of those reviews resulted in approval letters. Doing the math tells me we averaged 3.4 review cycles for each design approval letter.

The review cycle rate is down slightly from last year, which is the direction we want to move. In September, we were happy to welcome Terri Fead, P.E., on a part-time basis to help with plan reviews. It's been a real challenge to keep up with the workload this year and Terri's involvement has been a tremendous benefit to the program. Our goal for next year is to review original submittals within three weeks and re-submittals within two weeks.

In last year's *Flood Hazard News* I suggested meeting with District review staff as a strategy for reducing the number of review cycles. A number of development applicants have taken us up on the offer. Meetings prior to plan submittal and as a means to provide direction in addressing review comments has proved helpful in obtaining design approval. We believe the practice is helpful in moving projects through the system. We are also available by e-mail, fax or telephone to answer questions on design criteria or the maintenance eligibility program.

A new feature for 2002 was online access to the District's maintenance eligibility database, updated bi-monthly. The *Guidelines for Maintenance Eligibility Of Flood Control Facilities Constructed By Others* (Maintenance Eligibility Guidelines) will be posted on the District's web site in the near future.

One of the main goals in reviewing development proposals for the Maintenance Eligibility Program is implementing District master plans. Consider for example the Brantner Gulch basin in the City of Thornton. In 1998, the District, Thornton and Adams County completed the *Northern Tributary Watersheds Major Drainageway Planning Study*. This year development pressure affected almost the entire drainage basin. The area in question is located between 124th and 140th Avenues, and Holly Street to Riverdale Road. Some 14-quarter section development proposals are in process or are under construction. Many of these proposals have different development groups and/or design engineers. All of the public major drainageway infrastructure will be constructed by private groups and in tandem with on-site development.

Brantner Gulch looking upstream (West) approximately one-half mile downstream of Holly Street

Major drainageway components include grade control and drop structures, flood attenuation and water quality ponds, and roadway crossings. In some cases the development applicant has requested revisions to the District's master plan. The overarching drainageway strategy is floodplain preservation coupled with stream stabilization. All of these tributaries to Brantner Gulch are stable in their pre-development condition. In stark contrast is Brantner Gulch east (downstream) of Holly Street. This reach has been heavily impacted by adjacent development that stayed out of the floodplain, but failed to install adequate stream controls. Fortunately, one of the current development proposals will stabilize this stream reach and mitigate past damage. The development community has generally been very cooperative through this effort. Public review agencies have also worked together in order to achieve a positive and coordinated outcome. Only through a public/private sector partnership, based on a comprehensive master plan and using proven design principals can "historic" conditions be preserved. The benefit is reduced public burden in terms of maintenance costs, increased community assets in terms of open space, trails, recreation, and habitat preservation, and improved product marketability for the housing projects.

Trash rack design notes

The District issued updated Volumes 1 & 2 of the *Urban Storm Drainage Criteria Manual* (USDCM) in June of 2001. Trash rack design criteria was further updated through revisions posted on the District's web site in July, 2001. This update addressed the need for trash racks at detention pond outlet structures, storm sewer outfalls and roadway culverts. Several plan submittals this past year demonstrated some confusion relative to trash rack design. The following discussion is a summary of District design guidelines taken from Section 8.0 of the Culvert Chapter and Section 4.8 of the Storage Chapter, Volume 2, USDCM, and the

Maintenance Eligibility Guidelines. An update to Volume 3 of the USDCM was issued and posted on our web site in June, 2002. Please refer to that document for appropriate design guidance for trash racks located at water quality outlet works.

Trash racks are recommended for:

1. Entrances to long culverts and storm sewers,
2. Entrances to all culverts that have a drop, impact basin or other dangerous outlet condition,
3. Roadway culverts with improved entrances, and
4. Entrances to detention pond outlet structures.

Trash racks are not recommended for:

1. Short, larger diameter culverts (generally if one can see "daylight" through the culvert, a 48-inch object can pass through the culvert, and the culvert outlet is not likely to trap or injure a person, a trash rack is not necessary),
2. Detention pond outlets upstream from roadway embankments that meet the above criteria for short, large-diameter pipes, and
3. Exit or outlet of any structure.

Trash rack design criteria:

1. The ratio of trash rack net open area to total outlet (or conduit) area must conform to Figure SO-7. Generally, the minimum ratio is 4 to 1 for outlets 24 inches in diameter and larger and increases dramatically for smaller diameters.
2. The maximum allowable face slope is 3H:1V (see other recommendations for water quality detention outlets).

An example of a trash rack (from the USDCM)

3. A bottom clear opening of 9 to 12 inches is required to permit passage of low flow debris.
4. The bars on the trash rack face should generally be parallel to the direction of flow and spaced to provide 4.5 to 5 inches of clear opening between bars. Transverse support bars should be as few as possible, but sufficient to support full hydrostatic loads.
5. Collapsible trash racks or gratings should not be used.

In the field

An integral part of the maintenance eligibility process is construction oversight. Construction activity has increased this year over past years. At any given time, we typically have 120 to 150 projects approved for construction spread out over 1600 square miles in many different local jurisdictions. We heavily depend on networking and partnerships developed with local governments and various engineering consultants over the years to adequately cover construction oversight. In some cases, local government inspection staff have conducted construction observations on the District's behalf. Field reports and/or digital photos are typically provided to us through e-mail. We also rely upon local inspection staff, engineering consultants and in some instances, contractors to keep us apprised of construction progress and the need for District construction site visits. During 2002, District staff completed 150 construction site visits. Over 75 current projects were completed and recommended for construction acceptance during the preceding 12 months. Another 20 previously approved projects were re-inspected for adequate vegetative cover and received final approval.

Scott Tucker named Friend of the River

Executive Director Scott Tucker received the Greenway Foundation's Friend of the River Award at a dinner held on November 21 at Platte River Station. Approximately 300 people attended the event. The featured speaker was noted Denver history expert, Dr. Tom Noel.

Scott Tucker visits with well wishers and shows his award to the audience.

2002 Professional Activities of District Staff

Scott Tucker, Executive Director

*Lecturer, Department of Earth and Atmospheric Science, Metropolitan State College, Denver, in April.
*Participant, FEMA Region VIII Strategic Planning Roundtable, Lakewood, in April.
*Chaired stormwater management session at National Association of Flood and Stormwater Management Agencies (NAFSMA) annual conference, in New Orleans, LA, in September.
*Presenter, National League of Cities workshop on Phase II Stormwater Regulatory Program, Salt Lake City, UT, in December.
*Recipient of the 2002 Friend of the River Award from The Greenway Foundation, Denver, in November.
Member, External Advisory Board, Department of Civil Engineering, Colorado State University, Ft. Collins, CO.
Member, Civil Engineering Technology Industrial Advisory Committee, Metropoolitan State College, Denver, CO.
*Participant in Stormwater Managers Roundtable Meeting, Johnson County Kansas Stormwater Management Program, Overland Park, KS, in November.
*Member of Board of Directors and Co-Chairman of the Stormwater Management Committee of NAFSMA.
*Member of American Public Works Association, American Society of Civil Engineers, and Water and Environment Federation.
*Member, Stormwater Advisory Committee, Arapahoe County.
*Member, Stormwater Management Advisory Committee, City and County of Broomfield.

Bill DeGroot, Chief, Floodplain Management Program

*Chair of the Floodplain Management Committee of NAFSMA.
*Chaired a session on Floodplain Management Issues at NAFSMA's annual meeting in New Orleans, LA, in September. Also presented a paper on District Cooperating Technical Partners projects with FEMA.
*Presented an update on the District's DFIRM projects and LOMC pilot project at the FEMA Region 8 CAP conference in Breckenridge in September, and at a FEMA DFIRM workshop in Lakewood in October.
*Member of Association of State Floodplain Managers, American Society of Civil Engineers, and Colorado Association of Stormwater and Floodplain Managers.

Kevin Stewart, Information Systems and Flood Warning Program Manager, Floodplain Management Program

*Chair of National Hydrologic Warning Council (NHWC) representing Southwestern Association of ALERT Systems (SAAS).
*NHWC Alternate Representative to the Advisory Committee on Water Information, Subcommittee on Hydrology, Washington DC.
*Participated in U.S. Weather Research Program, Warm Season Precipitation Workshop at National Center for Atmospheric Research (NCAR) in Boulder in March.
*Seminar speaker on District's local flood warning program at NCAR in Boulder in April.
*Speaker at University of Oklahoma and Rice University National Symposium on Mitigating Severe Weather Impacts in Urban Areas at the Texas Medical Center in Houston, TX in April.
*Member of NHWC review team for NOAA publication entitled: *Use and Benefits of the National Weather Service River and Flood Forecasts, May 2002*.
*Speaker at 18th ALERT Users Group Conference in Santa Barbara in May.
*Speaker at ALERT~FLOWS East Coast Users Group Regional Conference & Exhibition in Philadelphia in May.
*Speaker at NWS Flash Flood Warning Workshop in Boulder in August.
*Participated in NOAA Strategic Planning Workshop in Broomfield in September.
*Speaker at National Safety Council, 90th Annual Congress & Exposition in San Diego in October.
*Speaker at 13th SAAS Conference & Exposition in Houston in October.
*Guest speaker at National Weather Service, First National Hydrologic Program Managers Conference in New Orleans in December.

Ben Urbonas, Chief, Master Planning & South Platte River Programs

*One to two invited lecturers in Santiago, Chile at a two-day seminar dealing with urban stormwater quality and quantity management issues. Gave a total of five talks on a variety of topics including: formulation of policy, planning, water quality, emerging new approaches in urban drainage, etc.
*Gave a talk on "Celebrating Stewardship Through Collaborative Efforts" at the 4th Annual Cherry Creek Stewardship Partners Conference, in November
*Keynote speaker at Minnesota's Water Resources Conference and presented a talk titled, "BMPs – How Do We Use Them?" in October.
*Presented a paper on "Restoring and Stabilizing Streams in Denver Colorado Area" at Minnesota's Water Resources Conference in October.
*Organized and facilitated a session on the topic of "Urban Streams - Colorado Stream Restoration Experiences" at the 9th International Urban Storm Drainage Conference in Portland, OR in September.*Presented "Managing a Major Drainageway System - Urban Drainage and Flood Control District's Experience 1969 – Present." at a seminar sponsored by the Truckee River Yacht Club in Reno, NV in Oct.
*Gave a talk in November at the ASCE Annual Convention in Washington, DC on the topic of "Urban Water Resources Research Council's Conferences and Emerging Issues 1990 to Present."
*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 Stormwater Technical Advisory Committee.

Dave Lloyd, Chief, Design and Construction Program
*Co-authored, with Paul Hindman, "Major Steam Restoration in the Denver Metropolitan Area" which Paul presented at ASCE's-9th International Conference on Urban Drainage, Portland, Oregon.

Cindy Thrush, Senior Project Engineer, Maintenance Program
*Vice-Chair of the Board of Directors for the Colorado Association of Stormwater and Floodplain Managers (CASFM).
*Editor of the CASFM newsletter.
*Co-Authored Paper entitled "Restoring Denver Area Streams and Gulches" presented at the 9th International Conference on Urban Drainage in Portland, Oregon in September.

Bryan Kohlenberg, Project Engineer, South Platte River Program
*Co-authored, with Ken MacKenzie, and presented "Restorative Maintenance of the South Platte River in the Denver Metropolitan Area." at ASCE's 9th International Conference on Urban Drainage in Portland in September.
*Continued as NSPE's scoring coordinator for the Jefferson Chapter and Colorado State MATHCOUNTS competitions for 7th and 8th graders.

Paul Hindman, Project Engineer, Design and Construction Program
*Presented "Major Steam Restoration in the Denver Metropolitan Area" at ASCE's-9th International Conference on Urban Drainage, Portland, Oregon.
*Member of the "Site Selection Committee" for the 2009 American Public Works Congress and Exposition Show.
*Member of the "Awards Review Committee Conference" for the American Public Works Association.
*Chair of the "Education Outreach Committee" for the Cherry Creek Stewardship Partners.
*Chair of "2002 Cherry Creek Watershed Conference", Centennial, CO.
*Presented "Flood Buster" demonstration at 2002 Project WET Water Festival, Denver, CO.
*Presented "Scholarship Update" at 2002 APWA Spring Conference, Grand Junction, CO.

John Doerfer, Project Hydrologist, Master Planning Program
*Chairman, Municipal Workgroup, Colorado Stormwater Task Force.
*Session Moderator and Paper Reviewer, ASCE's 9th International Conference on Urban Drainage, in Portland, OR in September.
*Speaker, "Clean Water Act and Permits," Cherry Creek Stewardship Partners conference, in Centennial in November.
*Member, Operations Committee, Illegal Dumping Task Force, City and County of Denver.
*Member, Impacted Water Supplies Advisory Committee, Colorado Water Quality Forum.
*Member, Urban Water Resources Research Institute, Environment and Water Resources Institute of ASCE.

Mark Hunter, Chief, Maintenance Program
*Committee member for the IECA-Mountain States Chapter.
*Member of IECA Technical Review Committee and Awards Committee.
*Co-Chairman, IECA Stream Restoration Technical Section
*Co-authored paper with Cindy Thrush, "Restoring Denver Area Streams and Gulches" presented at ASCE's 9th International Conference on Urban Drainage in Portland, OR in September.

David Mallory, Senior Project Engineer, Floodplain Management Program
*Presented an update on District/FEMA digital mapping activities in Steamboat Springs in September.
*Member of CASFM and ASFPM.

David Bennetts, Project Engineer, Maintenance Program
*Field Trip Chair for the 13th Annual CASFM Conference in Steamboat Springs in September.

Colorado Division of Wildlife recognized by District

At the April, 2002, meeting of the Board of Directors, Chairman Cathy Reynolds presented a plaque to the Colorado Division of Wildlife honoring them for their contribution toward improving urban stream corridors in the Denver Metropolitan area. The District also recognized the contributions of Dave Weber, Wildlife Biologist, for his leadership role for Purple Loosestrife and weed control.

Chairman Reynolds presenting the awards to the Colorado Division of Wildlife Director, Russell George, and Wildlife Biologist, Dave Weber

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Color versions of all of the photographs in this issue, and additional photos and figures, can be seen on our web site at:

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