



Flood Hazard News

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Added Benefits of Grade Control Structures

by

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and Ben Urbonas, P.E., Chief, Planning and South Platte River Programs

Statement of Problem

Urbanization of watersheds changes the hydrologic regime by:

- Increasing frequency of runoff
- Increasing peak discharges
- Increasing volume of runoff
- Decreasing time to peak
- Increasing duration of flow, especially with detention practices in place

Combined with the steep channel slopes prevalent in Eastern Colorado the result is often severe erosion, degradation, widening and lateral migration of these channels.

Solution

Years of observations have shown us that on-site runoff reduction practices (mostly on-site detention) have only a limited effect on mitigating the above-stated problems. Studies in Maryland and Washington also confirm the fact that even small amounts of land development (i.e., 10 to 15% of total

imperviousness) change the 2-year (i.e., geomorphologically dominant flow) and smaller runoff flows dramatically.

These effects are amplified in semi-arid and arid regions because runoff from undeveloped catchments is almost zero during a 2-year storm.

We have found that grade control structures, placed to reduce the longitudinal slope of the natural channels, have not only accomplished the goal of stabilizing degrading streams and gulches and protecting existing riparian zones, but have been a very positive factor in encouraging further growth of a wide variety of wetland and riparian vegetation. This has increased the wetland and wildlife habitat areas along the channels of urban catchments in the Denver region. Although stream bank stabilization is often also needed, grade control structures by themselves, installed before development begins or in its early stages, have proven to be the

most important feature in reducing stream degradation and erosion. Its benefits also include the reduction of silting-in of downstream aquatic habitat.

Examples

The remainder of this paper is devoted to case studies of various projects we are aware of in which the installation of grade control structures had some or all of the benefits described above.

Sand Creek in Aurora

Sand Creek was channelized by a developer in the 1960's. At that time the channel was straightened and steepened. Hundreds of houses were built in the 100-year floodplain, and the City of Aurora and the District constructed a channelization project to remove them from the 100-year floodplain. The project, which was constructed in 1988, consists of soil cement channel banks, vertical drop

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Figure 1. Left – Looking upstream at one of the vertical grade control structures. Right – Looking downstream.

Tucker-Talk

by L. Scott Tucker

Timely Comment from the District's Executive Director



District Activities

It is difficult to say anything profound about the year 2000 that hasn't already been said, so I won't try. The District is prepared for the year 2000 and is as excited about the work we are planning to do as we have been for the past 30 years. The Urban Drainage and Flood Control District was created in 1969 by the state legislature. In the early years, the District only had funding for planning activities. Since the beginning in 1969, District's activities have expanded dramatically from planning to design and construction, maintenance, floodplain management, and a myriad of supporting activities.

In the year 2000, the District's programs will continue at an active pace. Even though master planning on major drainageways was one of the first activities of the District, requests from local governments for assistance with additional master plan studies continues at a pace that we cannot keep up with. The focus has changed with the addition of stormwater quality to the traditional drainage and flooding considerations and a reorientation from a focus on a drainageway to a watershed perspective. Master planning continues to be a key lynch pin activity because so much of our future activities are guided by these planning efforts.

The District's floodplain management program was also one of the early efforts of the District. The thrust of floodplain management activities is non-structural and preventive in nature. Our initial thinking in the early 70s that management of the floodplains in order to prevent the construction of buildings and other structures that would be damaged during a 100-year flood is still proving to be a sound and viable direction. One of the components of the floodplain management program is the review of proposed developments in 100-year floodplains made at the

request of local governments. If a developer-constructed project is designed in accordance with District criteria and built as designed, the District will make the project eligible for maintenance assistance. In most cases when this is done the District will actually maintain that facility for the local government after the project is completed. Many local governments take advantage of this maintenance eligibility feature and send their proposed floodplain developments to us for review. The development pace in the Denver area remains at a high level with no abatement in sight. Development activity historically has tended to go in cycles, but of late this cycle seems to be on a long upward trend. At the latest count we had over 100 projects in various stages of maintenance eligibility review.

Another floodplain management program that was initiated in the mid 1970s in response to the Big Thompson flood that killed approximately 150 people is the flood warning program. A small but important change this year was the leasing of space two floors above our main office to house the flood warning center. In the past, this space has been leased by the District's contract meteorologist but this change will allow us to house the District's equipment and the meteorological contract service in our own space. The addition of new field stations continues as well as the upgrading of the hardware and software elements of the flood warning program.

The District's capital improvement program also continues on an active pace. All of our capital projects are shared on a 50/50 basis with local governments so with every dollar of District money spent there is at least one dollar of local funding going into the projects as well. The Board of Directors recently adopted the capital

improvement program for the years 1999 through 2003. For the four years 2000 through 2003, the District has allocated \$28.6 million to its capital program. The capital program still consists primarily of design and construction of projects but some capital funding has been allocated to floodplain preservation in the form of acquisition. Also the initial capitalization of the flood warning program is funded through the capital improvement program. Some 125 projects are identified in the CIP over the next four years.

The glue that keeps the major drainageway infrastructure together is maintenance. Without maintenance all of the District's efforts as well as those of others would slowly deteriorate and become non-functional. The District's maintenance program is unusual in that the District maintains drainageway facilities on behalf of other parties, primarily local governments, because the District owns very few facilities. Also, all of our maintenance activities are undertaken by contracting with the private sector. At the December, 1999 Board meeting, the Board approved a \$5.5 million maintenance program for 2000. These expenditures are based on a work program consisting of 339 identified maintenance efforts comprising routine, restoration and rehabilitation projects. Routine work consists of mowing and trash debris removal that is needed on a continuing bases. Trash seems to find its way to the drainageways and without an effort to continually remove trash it is hard to imagine what these urban drainageways would look like. Our restoration projects include repairs to drainage facilities that are of a relative minor nature. Rehabilitation projects are larger scale projects that look like a capital project except they are done to repair an existing public facility.

The District's fifth major program is the South Platte River. All the things we do for the other major drainageways including planning, design and construction, and maintenance are done on the South Platte River as well, but under the auspices of a single program. This allows us to focus our energies and efforts from stem to stern on the South Platte River and closely coordinate all the activities involving the South Platte River. In 1999 we completed the second phase of the Globeville project which is a large flood control and river restoration effort at the northern Denver boundary with Adams County. The cost of Phase 1 and Phase 2 efforts was \$6 million. Funds are committed for the third and final stage of the Globeville project which is estimated to cost approximately \$7 million. We are hopeful that construction on the third phase can be initiated in 2000, but there are still difficult problems to be resolved. It has been exciting to see all the positive developments, in terms of restoring the South Platte River as it flows through the Denver metropolitan area, and to be a part of that revitalization. In the words of Joe Shoemaker, the river has been returned to the people and it has become an important resource to the metropolitan community.

The District has several special projects in which it is involved each year. Of special note in 1999 is the completion of the revisions to Volume 3 of the *Urban Storm Drainage Criteria Manual*. Volume 3 identifies Best Management Practices that can be used by local governments and the local development community in the Denver region for improving stormwater quality. In addition to the traditional hard copy a version of the criteria manual is included on a CD as well. Another activity in the special project category is the District's continued support of local governments in the nationwide pollution discharge elimination system (NPDES) permitting program. The District continues to support the three local governments with Phase 1 stormwater permits (Denver, Lakewood, and Aurora) and Arapahoe County that has applied for a Phase 1 stormwater permit.

Cooperating Technical Communities

The District in May of this year became the first Cooperating Technical Community with FEMA. Cooperating Technical Communities (CTC) are communities or regional or state agencies that have the interest and capabilities to partner with FEMA in their flood hazard mapping program. The thrust of the program is for us to work together to create and maintain accurate up-to-date flood hazard data for the thirty-two communities participating in the National Flood Insurance Program (NFIP) which are served by the District. The initial agreement with FEMA sets forth the basic intent of the cooperative effort. Specific activities are to be defined by task agreements as the program moves forward. Thus far FEMA and the District have executed two task agreements. The first task agreement set forth the hydrologic and hydraulic data parameters that the District would use to conduct flood studies and that FEMA would accept. A major issue that was resolved was the use of "future conditions hydrology." Because of the continuing growth of the Denver region it is important that land use decisions be based on future basin hydrology. FEMA on the other hand develops mapping for flood insurance purposes which must be based on existing hydrology. Task Agreement No. 1 sets forth the conditions under which future conditions hydrology can be used in flood insurance rate maps and when existing condition hydrology must be used.

Task Agreement No. 2 defined a project supported by a small grant from FEMA to utilize local government digital mapping products in lieu of the more traditional paper mapping product. The intent is to develop a system where local digital mapping can be used for developing Flood Insurance Rate Maps. The use of local digital products has the advantage of being more easily updated as changes occur and more accurately portraying local field conditions.

FEMA and the District are now negotiating Task Agreement No. 3, which would allow the District to evaluate requests for Letters of Map Change (LOMCs) which include Letters of Map Revision (LOMRs) and

Conditional Letters of Map Revision (CLOMRs). If these discussions are successfully concluded, the District would in effect evaluate local LOMR and CLOMR requests for the 32 communities in the NFIP within the District, and make recommendations to FEMA. FEMA would still issue the letters because this is a statutory responsibility. The District would charge the same fees that FEMA now charges which would finance the District's review of the submittals. The big advantage to the Denver area communities in the NFIP is that the technical evaluations would all be done in Colorado where the evaluator can meet with the applicant if needed and could visit the site as well. In addition the work would be done under the supervision of the District and could be coordinated more closely with the local governments involved, and with the District's maintenance eligibility program since many of the projects are going through both the maintenance eligibility process and the letter of map change process. It is exciting to be working with FEMA on a truly partnership basis.

Federal Regulatory Initiatives

The federal regulators worked overtime in 1999 writing water related regulations to tighten the noose around the regulated community including local governments. In December, the Environmental Protection Agency (EPA) published the NPDES stormwater regulations for control of Phase 2 communities. The Phase 2 regulations address stormwater discharges from small municipal separate stormwater systems and construction sites that disturb one to five acres. The stormwater discharge regulations apply to all communities located within "urbanized areas" as determined by the latest census by the Bureau of the Census. An urbanized area is any area with a population of 50,000 or more and having a population density of 1,000 people per square mile. An urbanized area can consist of one or more local governments. This regulation will affect most of the local governments in the metropolitan Denver area. The bottom line is that local governments will have to apply for a stormwater discharge permit by March

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Maintenance Program Activities

by

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

Routine Maintenance

Through the routine maintenance program \$679,000 was spent in 1999 for mowing and debris pickups. This work was done on approximately 210 different sections of drainageways within the District boundaries. This equates to a total of over 100 miles of drainageways in the Denver area on which we performed scheduled mowing and debris pickup maintenance.

For 1999 we continued with the increased level of mowing and debris pickups on many urban drainageways. Most of the more urban drainageways now receive four to five mowings and debris pickups per year. Three to four mowings per year was inadequate for effective weed control and for overall appearance.

Other drainageways we maintain are more rural in character. On portions of some of these drainageways we have taken the opportunity to reduce or eliminate our mowing activities. This has been done to encourage habitat and leave a more natural character in the drainageway corridor.

For the calendar year we awarded seven separate contracts for routine work. Four of those contracts were awarded through an internal review of proposals submitted by potential contractors. The remaining three were awarded through a direct competitive bid process.

Restoration Maintenance

In 1999 the restoration program completed \$2,261,000 of work. Restoration projects typically address isolated drainage problems where the solution involves small-scale construction. Ninety individual activities were completed during the year. A major advantage of the restoration program is the opportunity to use it to react quickly to local drainage needs.

Nature dictates that as long as sediment is being carried by a stream some of that sediment will drop out when the stream

expands into a quiescent pool. One of the on-going obligations created when detention ponds are built is to keep those ponds relatively free of accumulated sediment. We have removed sediment from two-dozen detention ponds over the last two years. It takes a continual effort to keep these flood protection facilities functioning as intended. We envision that it will be more difficult to carry out this type of regular maintenance in the future as the Clean Water Act regulations become more restrictive. We also repaired the trickle channels and outlet structures in three of those regional detention ponds.

Over the years the City of Boulder has built erosion prevention features on rural sections of **Boulder Creek** east of the City. Some of these improvements have recently been damaged. Our work will repair the damage and reinforce the improvements. An earlier project by a federal agency had straightened portions of the creek alignment. We will also return some local sinuosity to the creek.

In contrast to the work on rural Boulder Creek we are also doing repairs to the trapezoidal concrete channels in the **Montbello Drainageways**. There are nine miles of concrete channels in this portion of Denver. The concrete panels lining these urbanized drainageways tend to buckle from hydrostatic pressure or collapse as a result of being undermined. Ninety percent of these channels are squeezed into the median between the opposing traffic lanes. There is little room for creativity in repairing these confined linear channels.

On the banks of the valley where **Harlan Street Outfall** discharges into **Clear Creek** the City of Wheat Ridge is building some playfields. The lower three hundred feet of Harlan Street Outfall needed repair as the result of severe erosion. Our funds for the channel repair were combined with Wheat Ridge money to reconfigure the outfall to address the erosion and to provide more useable area for sports.

In a similar cooperative project we are combining funds with the City of Lakewood to accelerate improvements to **McIntyre Gulch** along Alameda Parkway. These channels currently have a longitudinal slope of about two-percent. Drop structures and erosion resistant materials will be used for these narrow channels.

Rehabilitation Maintenance

Thirty-one projects were at various stages of design or construction during 1999. Those projects are listed in the accompanying table titled "STATUS OF MAINTENANCE REHABILITATION PROJECTS". Rehabilitation projects usually take the form of consultant-designed repairs that are intended to address severe problems that have occurred on a previously improved urban drainageway. By the end of 1999 the District will have spent about \$2,161,600 on rehabilitative design and construction for the year. A few of the unique projects are discussed below.

Over the past three years we have reported on our project on **Niver Creek** in Adams County near the South Platte River. Construction is now complete. The result is that the deteriorated pipes, the concrete-lined channel, and the eroded open channel were replaced by a new roadway bridge, a rehabilitated open channel with drop structures and a wetland bottom, and an expanded trailhead park.

Shaw Heights Tributary joins Little Dry Creek at Sheridan Boulevard and 76th Avenue in Westminster. Upstream from that point Shaw Heights Tributary passes through a small park. Above that it is compressed into a narrow corridor between a railroad track and residential backyards. Design is underway to contain the backyard erosion and to replace the temporary erosion control measures that were installed to protect the railroad and a nearby sewer line.

In last year's *Flood Hazard News* we reported on the sediment trap that was

being constructed on **Willow Creek** at Dry Creek Road in Arapahoe County. It was completed in early summer of 1999. Four months later we removed nearly 1000 cubic yards of accumulated sediment from the facility. We expect to need to clean it again in the summer of 2000. About a mile away a comparable sediment control facility is being designed for **Little Dry Creek** (not related to the Little Dry Creek mentioned above) at Arapahoe Road in Arapahoe County. This site is just upstream from the Holly Dam regional detention pond. The new sediment trap will serve as a forebay for the detention facility and is expected to simplify our sediment removal procedure.

Three large projects, which included significant revegetation efforts, were completed in 1999. Two of them were on **Goldsmith Gulch** in the City of Denver; one in Bible Park and the other in Cook Park. The third project was on **Greenwood Gulch** at Holly Street in Greenwood Village. All three projects were situated on parkland or open space and benefited from the design efforts of landscape architects. Our climate does not always agree with our revegetation schedule and our desire for quick re-establishment of plant life. On each of the three sites we have had to return with contractors to replant or reinforce the vegetation we originally installed. Clearly, part of the problem is the power that the stream has to wash away new seedlings. But, the more important factor is our semi-arid climate. Limited and sporadic moisture typically dictates that it will take three years to get the plant community re-established on a given project site.

South of Dry Creek Road in Arapahoe County the **Jamison Tributary** to Willow Creek flows through a naturally-contoured urban corridor. It is a small channel but the gradient is steep

STATUS OF MAINTENANCE REHABILITATION PROJECTS

Project	Jurisdiction		Cost	Status
ADAMS COUNTY				
Little Dry Ck., Shaw Heights. - South of 80 th . Repair bank erosion, partic.	Westminster	Design	65,000	50%
		Const.	400,000	0%
Sand Creek -confluence w/ S. Platte R. Repair bank erosion, participation	Commerce City	Design	14,600	25%
		Const.	next year	0%
Niver Creek - S.Platte to Steele St. Replace pipes,repair channel, partic.	Adams County	Design	by others	100%
		Const.	272,500	100%
ARAPAHOE COUNTY				
Cherry Creek - west of Colorado Blvd. Repairs to outlet of tributary.	Glendale	Design	\$10,000	5%
		Const.	next year	0%
East Toll Gate Trb. - Along Uravan Av Drops and channel repair	Aurora	Design	29,610	50%
		Const.	next year	0%
Little Dry Ck. - east of Holly at Arap. Sediment trap and park repairs, partic.	Arapahoe County	Design	41,800	40%
		Const	next year	0%
Little Dry Ck - north of Belleview Ave Repair several erosion sites, partic.	Cherry Hills Village	Design	29,744	100%
		Const	76,989	100%
Piney Creek Tribs-north of Orchard Rd Repair 2 regional detention ponds	Arapahoe County	Design	by others	100%
		Const.	61,764	100%
S.J.C.D. North - East of Sheridan Bvd. Repair low flow channel and drops.	Arapahoe County	Design	34,387	40%
		Const.	next year	0%
Willow Creek - s. of Dry Creek Road Sediment trap	Arapahoe County	Design	29,600	100%
		Const.	211,496	100%
Willow Creek, Jamison Trib. - Dry Ck Road. Repair drop structures.	Arapahoe County	Design	by others	100%
		Const	329,888	30%
BOULDER COUNTY				
City Pk Drainageway - w.of Hwy 287 Replace low flow chan./drops, partic.	Broomfield	Design	by others	100%
		Const.	50,000	100%
Coal Creek - west of Erie at r.r. tracks Rebuild obliterated channel	Erie	Design	by others	75%
		Const.	next year	0%
Fourmile Canyon Creek West of Broadway at Lee Hill	Boulder	Design	46,192	100%
		Const.	238,075	100%
Elmer's Twomile Ck. - s. of Iris Ave. Rebuild detention pond and channel	Boulder	Design	by others	70%
		Const.	100,000	0%
DENVER COUNTY				
Bear Creek - Raleigh to Sheridan Repair bank and rebuild drop	Denver	Design	\$111,588	100%
		Const.	525,638	100%
Bear Creek - N. of Hampden at Lamar Improve pedestrian bridge	Denver	Design	by others	100%
		Const	82,078	100%
Cherry Creek - W. of Colorado Blvd. Repair drop structure	Denver	Design	37,344	60%
		Const	next year	0%
Cherry Creek - S.Platte R. to Delgany Low flow channel protection, partic.	Denver	Design	35,960	100%
		Const	323,640	100%
Cherry Ck, Babi Yar T.-Yale &Havana Drops, bank repair	Denver	Design	34,865	100%
		Const.	322,556	30%
Goldsmith Gulch - Cook Park Low flow channel repairs	Denver	Design	94,564	100%
		Const.	462,709	100%
Harvard Gulch - DeBoer Park Rebuild trickle channel	Denver	Design	39,845	30%
		Const	next year	0%
Lakewood Gulch - In Martinez Park Trail repairs, participation	Denver	Design	by others	90%
		Const	6,000	0%
Lakewood Gulch - Federal to Knox Channel erosion repair	Denver	Design	78,432	100%
		Const.	next year	0%-phase 3
South Platte River, Westside Trib. - N.E. of 6 th and I-25. Install pipe.	Denver	Design	43,868	95%
		Const.	next year	0%
DOUGLAS COUNTY				
Cherry Creek - S. of Arapahoe County Trail construction, participation	Parker	Design	by others	100%
		Const.	\$39,481	100%
Marcy Gulch - N. of Highlands R. Pky Build drops and channel work, partic.	Douglas County	Design	by others	100%
		Const	205,705	100%
Sulphur Gulch - W. of Hwy #83. Rebuild drop structure	Parker	Design	45,000	0%
		Const.	next year	0%
Tallman Gulch - In Rowley Downs Trail construction, participation	Parker	Design	by others	85%
		Const	75,000	0%
JEFFERSON COUNTY				
Dutch Ck - NE. of Pierce & Coal Mine Repair eroding channel	Jefferson County	Design	\$76,558	95%
		Const.	next year	0%
Ralston Creek - west of Brooks Drive Repair narrow eroding channel	Arvada	Design	48,237	100%
		Const.	240,039	100%

enough that several drop structures were originally built to control the grade. Five of the drop structures have been damaged or undermined by erosion. We are rebuilding the drops with grouted boulders and have designed a cutoff wall to be installed with each structure.

The town of Erie is northeast of the City of Boulder and has been experiencing a recent surge in population growth. A tributary to **Coal Creek** drains the new developments on the southwest side of Erie. It flows to the north until it encounters a railroad track where the water simply ponds until it can flow between the ties and rails of the track. For this project we will participate with Erie in the funding to channel the water to the east, parallel with the railroad tracks, to an appropriate connection with Coal Creek.

In the early to mid-1980s the Maintenance Program rehabilitated six drop structures on **Cherry Creek** between University Boulevard and Holly Street in Denver. We rebuilt all six of them as sloping riprap drop structures making use of the existing sheet pile as the cutoff wall for our new drops. Each of the rebuilt drops starting failing almost immediately. Areas of the riprap appeared to be undersized and, in general, riprap is only as strong as its weakest area. We have re-built four of them as grouted sloping boulder structures and will begin the fifth one in the spring of 2000.

The City of Parker has been active in extending its trails system. On **Cherry Creek** near the Arapahoe County line and on **Sulphur Gulch** in Rowley Downs trail connections are being built. The Maintenance Program was able to help fund these projects because the

trails in both areas will provide maintenance access that otherwise would not exist.

Welcome to New Staff Member

Cindy Thrush has joined the District as a Project Engineer in the Maintenance Program. Cindy is a registered professional engineer with over 13 years experience working in the field of stormwater management, including the areas of water quality, floodplain management, capital improvement projects and maintenance projects. She received her BS in Civil Engineering from Oregon State University and has worked for both the public and private sectors. Most recently Cindy worked for Arapahoe County. She is an active member of the Colorado Association of Stormwater and Floodplain Managers and the American Society of Civil Engineers.

Willow Creek Project Wins Award

The District and project sponsors Arapahoe County and South Suburban Parks and Recreation District won the 1999 Colorado Association of Stormwater & Floodplain Managers (CASFM) Grand Award for Engineering Excellence presented at their annual conference in September. The Willow Creek Project is a multi-faceted project that addresses both the flood control and water quality aspects of stormwater management. It was a joint project between the District's Capital and Maintenance Programs.

The project is located in Arapahoe County in a natural open space park

area. The watershed area tributary to the project site is 8.10 square miles (5184 acres), the 2 year discharge is 1650 cfs and the 100 year discharge is 6100 cfs. The Willow Creek watershed is fully urbanized in the lower half of the basin where the project is located, and is actively being developed in the upper half of the basin (Highlands Ranch area).

The primary purpose of the project was to stabilize the Willow Creek channel and to repair a vertical channel bank approximately 30 feet in height. Through the creativity and willingness of all project sponsors, several

bioengineering techniques were used instead of traditional stabilization techniques. During the design phase, an opportunity arose to address water quality concerns, specifically sediment from the upstream watershed. A sedimentation pond was constructed to remove sediment before it reaches the Englewood dam flood pool area. The pond enhances the water quality of the stormwater before reaching the open space area, and it mitigates excessive sediment buildup that repeatedly closed the recreation trail downstream of the project area.



The sedimentation pond during construction (left), soon after completion (center), and after several small events (right)

Stormwater Permit Activities

by
John T. Doerfer, Project Hydrologist, Master Planning Program

Smaller municipalities in the District have known for some time it was likely they would eventually be required to obtain a permit for their stormwater discharges. That time has finally arrived for “Phase II” sources, including small municipalities within “urbanized areas” as defined by the Census Bureau, and construction sites that disturb 1 to 5 acres. Regulations that define permit application requirements for Phase II sources were signed October 29, 1999 and published in the *Federal Register* on December 8, 1999 (FR 68722).

Who. The following municipalities are defined in EPA’s rule as governmental entities located fully or partially within either the Denver or Boulder Urbanized Area: Adams County, Arvada, Boulder, Boulder County, Bow Mar, Broomfield, Cherry Hills Village, Columbine Valley, Commerce City, Douglas County, Edgewater, Englewood, Federal Heights, Glendale, Golden, Greenwood Village, Jefferson County, Lakeside, Littleton, Mountain View, Northglenn, Sheridan, Thornton, Westminster and Wheat Ridge.

In addition, Lafayette and Louisville, which are located outside of the Denver and Boulder Urbanized Areas, must be examined by the State of Colorado for potential designation to be permitted. The state may designate other municipal entities as well, based on relationships of their storm-sewer systems to adjacent permittees or receiving waters.

What. The following six (6) management programs, or “minimum control measures”, as defined in the Phase II regulations are required by municipalities:

Public Education and Outreach. This program requires distribution of educational materials on stormwater and the steps the public can take to reduce pollution.

Public Involvement and Participation. All state and local public notice requirements must be followed when implementing programs.

Illicit Discharge Detection and Elimination. Procedures must be developed and implemented to remove illegal discharges, including sanitary wastewater connections to storm sewers, and illegal dumping.

Construction Sites. Municipalities must develop an ordinance, if one does not already exist, to control pollutants in runoff from construction sites that disturb greater than one acre. Best Management Practices (BMPs) must be identified, along with requirements for receipt and review of sediment control plans and public comments. Inspections and enforcement procedures must be implemented.

New Development and Redevelopment. All program elements are similar to those defined for construction sites; however, the BMPs to be required are permanent features of the development.

Pollution Prevention during Municipal Operations. This program requires municipalities to evaluate and modify

their maintenance practices at parks, open space, transportation, streets, new construction, and stormwater systems to enhance water quality.

When. The first critical deadline defined in the final rule occurs in one year (December 8, 2000) when the Water Quality Control Division, Colorado Department of Public Health and Environment, must complete its own rulemaking to incorporate the federal Phase II regulations. EPA must also issue a “menu of BMPs” as guidance to municipalities before one year (October 27, 2000). A year later, EPA plans to issue guidance on “measurable goals” that are recommended to evaluate the success on the six minimum control measures. If it does not meet this time frame, municipalities will not be judged accordingly until the measurable goals are published. In three years (December 8, 2002), general permits must be issued by the state. This is important because the general permits will define the requirements, including specific actions and elements of the six management programs. Within 3 years and 90 days (March 10, 2003), municipalities must submit their general permit application to the state. The Phase II municipalities must fully implement permit provisions within 5 years thereafter.

Grouted Sloping Boulder Drop Structures

The District revised the Hydraulic Structures chapter of the *Urban Storm Drainage Criteria Manual* in 1990 to provide better guidance for the design of drop structures and check structures. One of the new drop structure designs, the Grouted Sloping Boulder (GSB) drop, has become far and away the most popular design.

Unfortunately, we have continued to see design drawings that provide inadequate

details for construction. We therefore retained McLaughlin Water Engineers, Ltd. to prepare example design drawings. Last year we published details for a drop structure with a trickle channel. This year we have revised the details for a drop structure with a trickle channel and have prepared an example of a drop structure with a low flow channel. We are encouraging design engineers within the District to refer to these details when preparing

construction drawings. Copies of the details, either hard copy or electronic, can be obtained by contacting David Mallory at the District, or by visiting our web site at www.udfcd.org.

Design and Construction Program Notes

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

The year 1999 was another busy year for the District's Design and Construction Program, one which saw us committing over \$9 million to design and construction projects by year end. Most of this funding has gone toward construction as well as initiation of several new design projects. Design and Construction currently has in excess of 80 active projects in varying stages from design through construction.

The Willow Creek project, in cooperation with Arapahoe County and the District's Maintenance Program, was completed this past year and has served as an example for alternative and innovative ways to provide streambank protection as well as water quality enhancement. In September, the project received the 1999 Grand Award for Engineering Excellence from the Colorado Association of Stormwater and Floodplain Managers at their annual conference in Steamboat Springs.

Marston Lake North Drainageway between Kenyon and Bear Creek was completed by late 1999, and has been another innovative project in solving a serious flooding problem within Fort Logan National Cemetery as well as a streambank stabilization problem between Kenyon and Bear Creek within Denver's Bear Creek Park. A new overflow drainage structure was installed across Kenyon extending to Bear Creek in a closed conduit. Low flows continue through the existing culvert and meander down the 40-foot vertical slope to Bear Creek passing through a series of ponds and drops creating a water feature which blends in well with the park environment. This was a cooperative project with the City and County of Denver.

Kalcevic Gulch was another project completed in 1999 in cooperation with Adams County. Kalcevic Gulch between the Lower Clear Creek Canal and 70th Avenue had long been a source of flooding problems and steam bank instability. The failure of 68th Avenue

STATUS OF DISTRICT DESIGN PROJECTS

Project	Participating Jurisdiction(s)	Status
Grange Hall Creek	Northglenn	Complete
Lakewood Gulch - Perry St.	Denver	Complete
Drainageway E	Columbine Valley	Complete
Irondale 80 th Ave. Outfall	Adams County, Commerce City	Complete
Little Creek	Arapahoe County	Complete
Goose Creek Phase 3	Boulder	Complete
Pleasant View Trib. to Lena	Jefferson County	Complete
Rangeview Gulch	Littleton	Complete
Greenwood Gulch @ Monaco Way	Arapahoe County	Complete
Monaco Park Outfall	Commerce City	Complete
Westerly Cr. @ Expo Park	Aurora	Complete
Valley Club Acres	Arapahoe County, Aurora	Complete
Shaw Heights Tributary	Westminster	90% Complete
Niver Creek Tributary L	Thornton	90% Complete
McKay Outfall	Adams County	50% Complete
Cottonwood Creek	Arapahoe County	40% Complete
Lena Trib. H	Jefferson County	95% Complete
Pinehurst & Academy Park Tribs.	Denver	5% Complete
Cherry Creek Drop Structures	Glendale	95% Complete
Clear Creek @ Kipling	Wheat Ridge	95% Complete
Drainageway G	Jefferson County	50% Complete
North Tributary of Massey Draw	Jefferson County	50% Complete
Lakewood Gulch @ Welchester Park	Jefferson County	50% Complete
Piney Creek	Arapahoe County	25% Complete

STATUS OF DISTRICT CONSTRUCTION PROJECTS

Project	Jurisdiction(s)	Cost	Status
Longs Way Tributary	Parker, Douglas Co.	\$350,000	Complete
I-25/46th & Pecos Ph. IV and V	Denver	600,000	Complete
Brighton North Outfall	Brighton	1,000,000	Complete
Parker/Mexico Outfall	Arapahoe County	800,000	Complete
West Evans Ph. III	Denver	500,000	Complete
Lakewood Gulch - 10 th Ave.	Denver	700,000	Complete
20 th & Meade Outfall	Denver	800,000	Complete
Willow Creek	Arapahoe County	550,000	Complete
Bear Canyon Creek	Boulder	700,000	Complete
Clinton Street Outfall	Arapahoe County	100,000	Complete
Grange Hall Creek Phase I	Northglenn	850,000	Complete
46 th and Pecos Outfall	Denver	600,000	Complete
Lakewood Gulch @ 10 th Ave.	Denver	950,000	Complete
Little Dry Creek Phase C	Westminster	650,000	Complete
20 th and Meade Outfall	Denver	800,000	Complete
Willow Creek	Arapahoe County	583,000	Complete
West Evans	Denver	500,000	Complete
Lincoln Ave. @ Newlin & Cherry	Parker	500,000	Complete
Longs Way Tributary	Parker, Douglas Co.	425,000	Complete
Marston Lake North	Denver	950,000	Complete
University/Mexico Outfall	Denver	500,000	Complete
Niver Creek Trib. M	Federal Heights	200,000	95% Complete
Cherry Street Bridge	Glendale	1,500,000	95% Complete
Clear Creek @ Ford Street	Golden	1,500,000	80% Complete
Drainageway E	Columbine Valley	1,088,000	80% Complete
Westerly Creek @ Expo Park	Aurora	3,400,000	5% Complete
Granby/Sable Outfall	Aurora	160,000	95% Complete
Greenwood Gulch @ Monaco Way	Arapahoe County	450,000	30% Complete
Irondale Gulch 80 th Ave. Outfall	Adams County	800,000	10% Complete
Little Creek Phase II	Littleton	950,000	50% Complete
Massey Draw @ Carr Street	Jefferson County	775,000	95% Complete
West Dad Clark Gulch	Douglas Co.	450,000	50% Complete

due to overtopping floodwaters in the mid-nineties prompted Adams County

to move this project forward with the District's assistance. The project now

provides 100-year flood protection through this reach of the gulch.

We also completed the last phase of improvements to Little Dry Creek in the City of Westminster. The last reach constructed this year extended from Lowell Boulevard upstream to England Park near 72nd Avenue, and consisted of open channel improvements and grade control structures. The City of Westminster celebrated the completion of this multi-phased project through a dedication ceremony held on October 21. Mayor Nancy Heil (also a newly appointed UDFCD Board Member) officiated at the dedication and recognized several individuals from the City, District, Sellards & Grigg Consulting Engineers and contractors who had worked on the project since its inception in the late seventies.

Another unique project, which saw completion of its first phase of construction in 1999, was Grange Hall Creek in the City of Northglenn. This multi-phase project calls for stream bank stabilization and grade control along the main stem of Grange Hall Creek and its North Tributary from their crossings at the Union Pacific Railroad eastward to the Northglenn city boundary. Early in the design process, it was decided that we wanted to utilize a type of drop structure which would blend in more with the surrounding land forms. It was decided that a concrete drop utilizing colored concrete and free formed to give the appearance of a natural rock outcrop in the stream bottom would best serve this purpose. We recognized that most contractors would not have any experience in the construction of this type of faux rock drop and as a result we had Colorado Hardscapes construct a referee sample at the project site for contractors to view during the bidding process. Plans are to bid the second phase of construction early in 2000.

The year 2000 looks to be no less busy than 1999 with additional funding identified in the 5-Year Capital Improvement Program for 40 new or on-going projects.

District Sponsored Project Wins Award

Taggart Engineering Associates, Inc. (TEA) has won the American Consulting Engineers Council of Colorado 1999 Engineering Excellence Award for "Lena Gulch Drop Structure Below Maple Grove Reservoir." The project was sponsored by the District, Lakewood, Wheat Ridge and The Consolidated Mutual Water Company. Other consultants were SDG, Inc., CTL Thompson, EDAW, Inc., and Arrow Engineering and Surveying. The contractor was L&M Enterprises, Inc.

A design was required to replace a failing concrete drop structure and to protect endangered homes in the floodplain below Maple Grove Reservoir. Since the structure was adjacent to Kenneth King's property, which was certified by the National Wildlife Federation as a Backyard Wildlife Habitat, an environmentally sound solution was required.

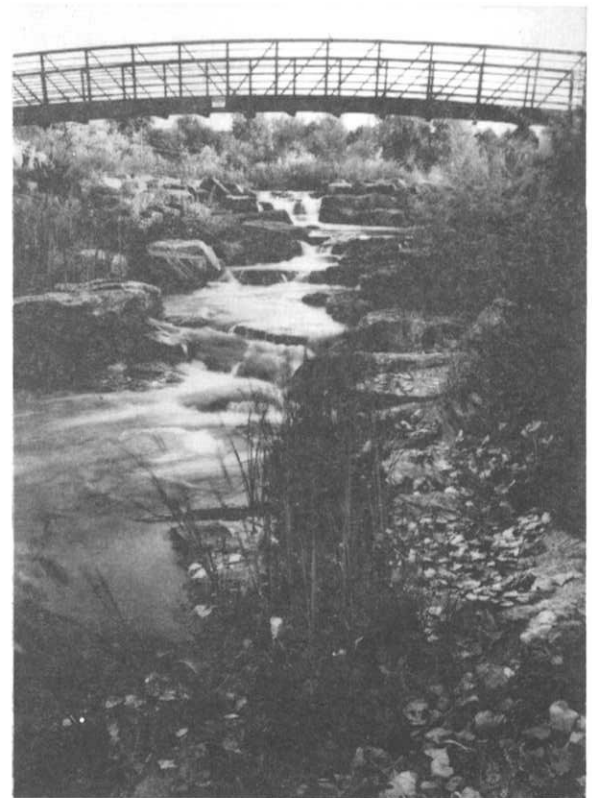
TEA relocated the waterway through a 4-stage grouted boulder drop structure with planted riprap banks to dissipate energy and control major floods. The modified stream funnels the wide floodplain through the upstream curved grouted boulder drop crest, falls into a deep stilling pool, then over a lower drop cascade, into a second stilling pool, and then safely transitions to the downstream waterway. The complex grouted boulder and planted rock configurations are designed to achieve flood control, aesthetic, and ecological objectives. What looks like natural rocks and rock outcroppings is actually a complex design to direct flow and dissipate energy.

TEA further developed planted rock and stabilization soil lining techniques. Organic clayey soil fills the rock voids for the full riprap thickness. Plants with substantial root growth were used to act like a

natural glue in the rocks and keep water turbulence out during high water, increasing the riprap integrity and allowing the plants to further dissipate energy.

The crest of the drop structure is built on a strong base, interlocking steel sheet piling. Joints are filled with a new sealant that expands upon contact with water, preventing the normal seepage through the piling. Above the gulch, an existing pedestrian bridge has been reset at a higher level for increased capacity.

The project maintains the property's Backyard Wildlife Habitat status with wetlands and riparian planting including sedges, grasses, bushes, and trees. The Kings participated in the sophisticated landscape plan by planting the berry and fruit bearing trees and bushes which provide food and shelter for wildlife. Chubs, small mouth bass and blue gills have returned with the improved water aeration. Hellgramites (a species dependent on high oxygen content) have been observed here for the first time. The Kings, who are avid bird watchers, have documented 65 different bird species passing through and living in their wildlife habitat.



South Platte River Program Notes

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

Maintenance Activities

Routine Maintenance

In 1999 the South Platte River routine maintenance included an equivalent of

- 9.5 miles of tree trimming and pruning along the river trail,
- 6 acres of string trimming at access ramps and rest areas,
- 73 miles of trail edge mowing, and
- 199 miles of trash and debris pickup and removal along the river.

A total of 150 truckloads of trash and debris were removed from the river and taken to landfills. This removal volume, up 46 percent from last year, was achieved in part by studying statistical data pertaining to trash and debris accumulation patterns gathered over the past four years, thereby tailoring our removal program to maximize results.

For the third consecutive year we participated in the Greenway Foundation's annual NIMBY Fest volunteer trash pickup, during which an additional nine truckloads of trash were removed. In addition, government personnel and volunteer groups picked up and removed trash from the river corridor throughout the year. Unfortunately, we do not have an estimate of the volume removed by them. Trash is also regularly removed from trash receptacles maintained by park personnel along all recreational trails.

Although routine maintenance is rarely noticed by the public, without it the South Platte River corridor within the District would take on an unkempt "look" and "feel." Routine maintenance is essential for the preservation of wildlife habitat and to provide the public with a more pleasant experience whenever visiting the many trail and pocket park facilities along the River.

Tamarisk Infestation.

The South Platte River downstream of 88th Avenue in Adams County is experiencing rapidly spreading Tamarisk infestation. Tamarisk, also known as Saltcedar, is a juniper-type plant. It has crowded out the riparian growth along the banks of the many Western rivers, including the Colorado River in Utah, to a point that fishermen and even deer cannot get to the water through the dense brush.

In 1999 we started an eradication effort in hopes to check its spread. This proved to be very effective and eliminated existing plants on publicly owned lands. We will continue to monitor these areas for new growth. The worst of the infestation, however, is along the shorelines of old gravel pit lakes adjacent to the river located on privately owned land. As long as these Tamarisk colonies remain, the South Platte River corridor throughout northern Adams County and beyond will continue to be under the threat of new infestations.

Restoration Maintenance

In 1999 the restoration maintenance program again stabilized, rehabilitated, and revegetated several riverbanks that had suffered severe erosion in the past few years. The program also helped to repair damages to a recreation trail (i.e., maintenance access) along the river.

We continue to assist Denver Parks and Recreation Department with the replacement of old wooden pedestrian bridges across the river. The new steel bridges have 10 feet wide concrete decks and conform to ADA requirements. The bridge at Huron Street in south Denver is scheduled for replacement in January 2000. This project will also widen the tight trail curves approaching the bridge to make them safer and accessible by snow removal equipment.

The next bridge to be replaced will be near First Avenue (extended). This project is particularly challenging because one end is close to Interstate 25 and the other end constrained by limited channel right-of-way. Work on this project should start late in 2000.

This year over 4500 feet of badly eroded and degraded (i.e., trashed) riverbanks were cleaned up, regraded to a gentler slope, protected with buried rock riprap, and revegetated. All of our revegetation includes grasses, trees and shrubs native to this area. Some of the species used include Cottonwood, Sand Bar Willows,



Before and after views of the Metro bank stabilization project.

Chokecherry, Golden Current, Three-Leaf Sumac, Sage, and Rabbitbrush. These bank repair projects comprise the bulk of the restorative maintenance work performed by the South Platte River Maintenance Program.

The largest restorative maintenance project this year restored 1500 feet of badly eroded riverbank adjacent to the recreational trail and the Metro Wastewater Reclamation Plant (Metro) at 64th Avenue and York Street in Commerce City (See Before and After photos). This project removed an old five-foot high berm at the top of the bank to restore a connection between the river and the adjacent lands. The construction and revegetation has been mostly completed. The area will now be planted with cottonwood trees, more willow and possibly other shrub in early Spring of 2000. This project was jointly funded by the District and Metro.

The second phase of the joint District-Metro project involves the installation of a sloping grouted buttress to an existing sewer crossing that has developed into a six to eight foot vertical drop. The drop evolved as the South Platte River bottom degraded vertically over the last 15 years. Where once the river flowed without a drop and the sewer line crossing had over four-feet of cover, we now have a vertical drop. This has created a hazard to the public and a barrier to possible fish migration. This second project is being done at Metro's request to make the existing drop safer for boater passage, more structurally sound and provide for fish migration. This project should be completed in January 2000.

Often severe bank erosions occurred in response to a single flood event. Because it takes time to obtain federal permits, perform engineering design and to contract for bank restoration work, it is sometimes necessary to immediately arrest fast eroding banks with temporary repairs under emergency permits. This is done by dumping clean concrete rubble or riprap along the bank during high water periods. When the high water recedes, usually in the fall or winter, the final bank restoration project can be constructed. At that time, the

previously dumped rubble is incorporated into the final design.

Cooperative Projects with Private Property Owners

Two cooperative projects in Adams County will be constructed soon. One involves the stabilization of 1500 feet of an actively eroding bank that has moved over 500 feet laterally in the last few years. The property owner is very concerned with how much farmland is being lost and how the erosion is endangering an existing oil well.

The other Co-op project currently in design involves working with the Ready Mixed Concrete Company to clean up and stabilize an existing bank adjacent to future gravel mining. This bank work will consist of bendway weirs similar to the photos shown in last year's *Flood Hazard News*. Both projects will be constructed on flowage and maintenance access easements dedicated to the District in exchange for the bank stabilization work.

Since the inception of the South Platte River Program in 1987, over 400 acres of easements have been dedicated in exchange for river restorative maintenance work. These easements allow the District to actively participate with local governments in preserving floodplain/riparian areas along the river corridor. Next year we hope to obtain an additional 60 acres of easement from CAMAS, Inc. from McKay Road to 104th Avenue in Adams County.

Capital Improvement Projects

Upper Central Platte Valley Project

As reported in 1998, the preliminary design report for the Upper Central Platte Valley project has been published. The challenge that remains is to find \$19,000,000 to construct this terrific river restoration project. Toward that end the City and County of Denver is exploring the possibility of funding through the U.S. Army Corps of Engineers river restoration program.

Globeville Area Project

Phases 1 and 2 of this project have been completed. However, before the benefits of this work can be fully realized, Phase 3 of this project will need to be built. The design for Phase 3

is now 95% complete and right-of-way is being acquired. Farmers Reservoir and Irrigation Company has objected to the design concept, which requires significant modification of its diversion dam. Because of this the construction of this project is now expected to begin toward the end of 2000. When completed, about 300 acres of urbanized lands in Denver and Adams County will have been removed from the regulatory 100-year floodplain. In addition, a major hazard to the public that may be on the river, such as tubers, boaters and trail users will have been eliminated.

Other News and Projects

Low Flow Channel Improvements

In 1998 we reported on a project to provide an improved low flow channel from 15th Street through City of Cuernavaca Park. Most of the improvements have been completed. These include a series of boatable grade control structures between 19th Street and the HOV bridge ¼ mile downstream, a low flow training channel jetties along Commons Park and another grade control structure at 16th Street. These modifications should significantly improve the boater experience and safety in this reach of the South Platte River.

Master Plan in Adams County

Since late 1998 the District has been working with Adams County, the cities of Brighton, Thornton, Commerce City, South Adams County Water and Sanitation District and the Denver Water Department to update the South Platte River Major Drainageway Plan through Adams County. The consultant for this project, Camp Dresser and McKee has conducted a number of meetings with project sponsors to help define what issues and concerns about the river they have and would like to see addressed in the master plan. We received the draft Phase A report in December and now hope to have the project completed in 2000. This is a multi-objective planning project that is examining water quality, aquatic habitat, terrestrial habitat, open space, recreational needs of the sponsors, water resources development, gravel mining needs and activities, land development trends along the river, etc. on a reach-by-reach basis.

Structures (From page 1)

structures, and a sandy channel bottom. The design discharge was 21,000 cfs. One result of the project is a channel with a lush bottom of varied plant life (Figure 1).

Cook Creek at Lone Tree Golf Course

When South Suburban Recreation and Park District bought this private course, Cook Creek, which runs through the course, was suffering from severe degradation caused by urbanized discharges and steep channel slopes (Figure 2). The project consists of several grouted sloping boulder drop structures (GSB) placed to flatten the slope of the channel to arrest the degradation. Now Cook Creek supports a wide variety of vegetation, and has swallowed a great number of golf balls



Figure 2. Cook Creek at Lone Tree Golf Course.



Figure 3. Cook Creek after construction of the grade control structures.

as well (Figure 3).

Jackrabbit Gulch at Union Ridge Park

This was a situation similar to Cook Creek. The solution was also similar although a different hybrid drop structure design was employed. The project was completed in 1992 (Figure 4).

Cherry Creek through Denver Upstream from University Boulevard

Grade control structures (wooden) were first built in the 1930's. The District's Maintenance Program has been replacing the existing structures that have failed, and the District's Design and Construction Program, in cooperation with Denver, Glendale and Arapahoe County, has been adding additional ones where needed over the last 10 years. The replacement

structures are GSB drop structures with design discharges in the 7,000 to 10,000 cfs range. Areas upstream from the original grade control structure locations are heavily vegetated, while areas still unprotected by grade control structures have an entirely different vegetative regime (Figure 5).

Hidden Lake Inlet Channel

Hidden Lake was drained and fill material excavated from the lake bottom in about 1990. The lowered lake bottom and urbanized runoff resulted in severe erosion damage to the inlet channel. The District's Maintenance Program was called upon to correct the problem by constructing a GSB drop structure at the downstream end of the inlet channel. The channel is now overgrown to the point where some tree thinning may be necessary to maintain the needed flood capacity (Figure 6).



Figure 4. Top – After construction in June, 1992.
Bottom – August, 1999.



Figure 5. Left – Lush vegetation above a GSB drop structure on Cherry Creek. Right – An entirely different regime in an area of Cherry Creek not protected with a grade control structure.



Figure 6. Left – Hidden Lake inlet channel in early 1991. Center – Immediately after construction of GSB drop structure and channel grading. Right – Same view in August, 1999.

South Platte River

In addition to several major grade control structures, the District has installed a total of 16 sloping, three-foot high, boulder grade control structures along the South Platte River in Adams and Arapahoe Counties. The river bottom has been degrading over the years, which has exacerbated bank undermining and erosion. The result was that much private and public property and infrastructure (roads, utilities, etc.) was being damaged on a continuous basis. Based on the recommendation in a master plan completed in 1995, the District initiated an annual river survey program; and where more significant bottom degradation was detected, grade control structures were installed (Figure 7). Observations over a ten-year period reveal that the river bottom has virtually stopped degrading and bank erosion has slowed. Each grade control structure covers the main channel of the river, which has approximately a 10-year flood capacity of 10,000 cfs. Each is

constructed of one layer of three to four foot boulders on a graded rock foundation, sloped at a 10 to 12 percent grade, with the downstream end embedded into the river bottom at least five feet. A boater and fish passage chute is provided in each, creating a relatively deep scour hole downstream of the structure and adding to the aquatic habitat of the river. Many of the structures have experienced 14,000 to 15,000 cfs flows without any evidence of damage.

Summary

We know the effects urbanization will have on downstream channels and over the years we have developed successful, field proven, designs to deal with those problems. One unanticipated but welcome benefit has been the



Figure 7. South Platte River grade control structure.

establishment of extensive amounts of wetland and riparian vegetation along many ephemeral drainageways upstream of these grade controls, vegetation that never existed before in our semi-arid region.

Acknowledgements

John Pflaum, McLaughlin Water Engineers
 Chuck McKnight, Sellards & Grigg

Floodplain Management Program Notes

By

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

The Year in Review

One of the advantages of editing this publication is that I get to read the boss's column before writing this one. It turns out that he covers several items I was going to address, so I urge you to read his column, beginning on page 2, if you have not already done so.

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 has expanded under David Mallory's direction. He currently has about 110 separate projects somewhere in the process between design review and final acceptance of construction. He also put together a one day seminar on the program for local government staff and developer consultants. Although the attendance was good, a number of developer consultants who could have definitely benefited from the seminar failed to attend, and their submittals continue to show it.

Kevin Stewart continues to assure that we have the best possible flood detection system, and he continues to be in demand as a international 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.

Last year I reported that I had been trying for five years to negotiate intergovernmental agreements between Denver, the Rocky Mountain Arsenal, Commerce City, Adams County and the District for the implementation of the Irondale Gulch master plan, and that I thought 1999 would finally be the year. Wrong! Although we did make progress we didn't get it done and I am now out of the prediction business.

We have started a master plan revision process for the lower portion of the First Creek watershed, and have been

working with Aurora, Denver Gateway Regional Metro District and Oakwood Homes on a cost sharing agreement for implementation of the regional detention facilities called for in the upper First Creek master plan.

We have also begun revising the South Boulder Creek master plan. Our first step was to revisit the hydrology, and preliminary results indicate that the discharges will probably be going up. Stay tuned for this one.

I have continued to represent the National Association of Flood and Stormwater Management Agencies (NAFSMA) as an advisor to the Technical Mapping Advisory Council. I really respect the amount of hard work the Council members, including Brian Hyde from the Colorado Water Conservation Board, have put into their recommendations to FEMA, and FEMA's proposed map modernization plan. Unfortunately, unless and until FEMA receives some significant funding source (\$750 million over seven years), most of these recommendations will languish.

What Colorado Can Do To Reduce Its Vulnerability To Flood Disasters
Governor Owens recently hosted a Flood and Drought Preparedness Conference. This is how I would have answered the flood part of his question: "What Can Colorado Do To Reduce Its Vulnerability To Flood and Drought Disasters?"

Background

Floods happen all the time. We only notice them when they occur in areas we have developed, and they are large enough to cause damage and/or loss of life. In response to ever increasing flood losses, efforts have been made to reduce these losses through the construction of flood control projects such as dams and levees; and later, through efforts to reduce development in floodplains. Still the losses continue to mount. Let's examine why this is

happening and what the implications are for Colorado.

The 100-year flood is the national standard for planning for floods, and has been for more than 25 years. It has a 1% chance of being equaled or exceeded in any given year, or about a 25% chance of being equaled or exceeded over the life of a 30-year mortgage. Larger floods are used in the design of some facilities; such as dams, to insure against a catastrophic failure.

The selection of the 100-year flood standard has perhaps left us with a problem similar to the Y2K situation. When early computer developers used two digits for the year, the next century was way off. So we had a multi-billion dollar problem to fix.

Similarly, the 100-year flood probably seemed like an extremely rare event when the Congress established it as the standard. We try to manage the 100-year floodplain, with some exceptions that I will discuss later, and we accept, whether intentionally or not, the damages from larger floods. However, this happens often enough somewhere in the country that the flood damages suffered by the nation continue to increase. Perhaps, as with the Y2K decision, we have gotten ourselves into a bind we need to fix.

When I first got interested in floodplain management, as a result of seeing the effects of the 1972 Rapid City flood up close and personal, the research literature had three general ways to address flood hazards: 1) keep floods away from development (structural flood control), 2) keep development away from flood prone areas (non-structural measures), or 3) spread the loss burden (flood insurance).

Where Are We Today?

Today we still have the same three basic options available to us. The themes are somewhat varied but the bottom line results are the same. When the Urban Drainage and Flood Control District

began operations in 1969, one of its first decisions, and one of the most important, was to adopt a two-pronged approach of fixing past mistakes while keeping new ones from being created. This included formulation of master plans for remedial flood control projects and the construction of those flood control projects as funding permits; in conjunction with the delineation and regulation of 100-year floodplains.

Having followed that course of action for 30 years, we can now say that while the District's population has increased by about 850,000 people, with all the structures that accompany those people, the total number of structures located within the defined 100-year floodplains has decreased by more than 4000 structures. Twenty-five years ago, flooding was almost an annual occurrence along Westerly Creek in northeast Denver, Lena Gulch in Wheat Ridge, and many other locations. Now, you seldom hear about them, even though we have had many rainfall events that would have caused the flood damages we used to experience.

While this is a real success story we still have thousands of structures located within the 100-year floodplains in the Denver area and throughout the state, and many thousands more structures at risk from larger, less frequent, floods. Obviously, the occupants of those structures are also at risk. These floods are also what are termed flash floods, which means that they happen in a hurry, limiting our ability to conduct emergency efforts to protect structures.

Earlier I said that we regulate the 100-year floodplain, with some exceptions. What I meant by that is that current National Flood Insurance Program (NFIP) regulations allow quite a bit of development in 100-year floodplains. Without getting technical, the regulations allow development in portions of floodplains that can cause the flood levels to rise as much as a foot, without protecting either the new development or any existing development from that extra foot of flood depth.

Also, the NFIP maps floodplains based on existing watershed development even

though it is well known that urbanization of watersheds dramatically changes the hydrologic regime, including increasing flood discharges from any given rainfall event. Some flood control projects, such as flood control channels, can increase flood peaks downstream by reducing floodplain storage. Allowing developers to fill parts of the floodplain has the same effect.

Fortunately, within the District, the local governments use 100-year floodplains based on expected future urbanization of the watersheds; many do not allow the full one foot rise; and all of them require some amount of protection against that increase in flood depth. We also have a substantial flood detection and flood warning system in place.

We are apparently expecting an additional one million people in the Denver area over the next 20 years. Even if we can keep every structure that is built for those one million people out of every 100-year floodplain, Colorado's vulnerability to floods is going to increase, because larger floods can and do occur, as we know from the Big Thompson flood in 1976 and the Fort Collins flood in 1997. We also have the threat of dam failures, as happened to Estes Park in 1982.

The Answer to the Governor's Question

The only way to reduce today's property loss vulnerability is to continue to fix the mistakes of the past by pursuing remedial projects. Those can be structural projects like flood control dams and enlarged flood control channels, or they can be non-structural projects, such as acquisition and relocation or demolition of structures, and return of the floodplain to open space uses more compatible with the flood hazard. At the current funding level we are many years away from removing even the 100-year flood threat from thousands of existing structures. There is no alternative to increased funding if a near-term reduction in vulnerability is the goal.

Therefore, we need to continue to encourage owners of structures in floodplains to obtain flood insurance.

And we need to improve and expand our flood detection and flood warning and response capabilities. We can also have recovery plans ready to go so that we can respond to the next big flood, recover from it, and mitigate against it happening again in that area. These activities also require funding, but at a much lower level than traditional remedial projects.

For future vulnerability, we need to continue to keep new development out of the floodplains as much as possible, and we need improved tools to be able to do that. Tax credits for donating floodplain land for open space, wildlife habitat, etc. is one example of an improved tool.

We can also revisit the 100-year flood standard and make a conscious decision to keep it and accept the damages that come from larger floods; or decide that the State of Colorado wants to adopt a higher standard. NFIP regulations allow it and FEMA encourages it. We can also revisit the floodplain management criteria for development in the floodplain. Other states have adopted more restrictive criteria than the NFIP minimums. Colorado could do the same. NFIP regulations allow it and FEMA encourages it. These are policy matters with little budget impact.

We need to continue to produce watershed master plans which can be used to guide new development throughout the watershed, and not just in the floodplain.

Summary

Colorado has thousands of structures and their occupants at risk from 100-year floods; and thousands more at risk from larger floods and/or dam failures. We have spent the last 25 to 30 years using essentially the same tools to address those hazards, and to try to keep things from getting worse in the face of a burgeoning economy. To correct the existing hazards will cost a lot of money. There is no way around that. We can improve the tools available to us to prevent new problems from being created by new growth in Colorado.

Flood Warning Program Activities

by

Kevin G. Stewart, P.E., Project Engineer, Floodplain Management Program

District Acquires Flood Prediction Center

Since June, 1988, Henz Meteorological Services (HMS) had operated the District's Flash Flood Prediction Program (F2P2) from the Diamond Hill Office Complex at 2480 West 26th Avenue in Denver. In the fall of 1998, HMS chose to move their business from this location to Littleton.

This gave the District an opportunity to secure dedicated office space at Diamond Hill for future F2P2 operations. This represents a fundamental change for the District, considering that the F2P2 has operated from the offices of the private meteorologist since its start in 1979. The program's satellite downlink system, emergency power generator and other existing rooftop communications equipment at Diamond Hill factored heavily in the District's decision to develop a more permanent Flood Prediction Center. Remodeling of the 1,119 square-foot FPC in Suite 310-B was recently completed. The FPC will continue to be staffed by a private meteorologist during the flood season from 15-April through 15-September. HMS provided the forecasting services for 1999.

ALERT System Notes

Like many other Millenium-frustrated computer owners, Y2K is forcing the District to make some significant changes to the ALERT system. Since the first IBM PC/XT base station was purchased by the District in 1985, a UNIX-like operating system (OS) known as QNX has been in use. This highly reliable OS has evolved over the years to accommodate new computer technologies, but its basic design has remained essentially unchanged. The popularity of Internet TCP/IP communications and the desire by software developers to make the "old-reliable" OS more UNIX compatible, has lead to its obsolescence. Consequently, the District will be replacing QNX-2 with the "new improved" QNX-4 system. It was not

surprising to learn that, in addition to the OS upgrade, some other costly software changes would also be required--specifically, the ALERT database/display software. While this may sound relatively simple, consider the following facts: 1) the existing 15-year-old database and archive files must be converted to a new format; 2) many existing custom features must be individually revised; and 3) maintaining a similar "look and feel" is desirable to minimize operator retraining needs. It should be clear that we do have a major project ahead. One irony in all of this is that the existing QNX-2 operating system is entirely Y2K-compliant.

Computer hardware upgrades are also necessary since all seven District-supported base stations currently use 486 processors and other components that are not Y2K-compliant. Considering the software challenges mentioned above, replacing the hardware appears the easy part.

A new flood detection network (FDN) is being considered for southwest Denver in the vicinity of Marston Lake. The preliminary investigation for this ALERT expansion project should be completed by summer 2000 with implementation funding possible before yearend.

ALERT Mesonet growth continued in 1999. Additional weather stations are also planned for 2000. The newest weather station in this network was installed near Elbert in June. This platform incorporates new sonic wind sensing technology with no moving parts. Traditional spinning-cup anemometers and wind vanes use bearings that require periodic replacement and it is difficult to detect when these instruments are failing. Thus far, the wind data collected from the Elbert station appears quite good. A second sonic anemometer will soon be operating a new weather station site on Squaw Mountain in Clear Creek County south of Idaho Springs.

The Denver Department of Environmental Health recently asked the District to help install an ALERT weather station at The Urban Farm at the old Stapleton Airport as part of the District's regional gaging network. The Urban Farm occupies the building formerly used by National Weather Service. The NWS forecast office was relocated to Boulder in May of 1998. The DEH will provide 100-percent of the funds needed to purchase and install the station. The District will assist DEH with future maintenance.

The Urban Farm's mission is to teach agricultural and environmental education to children, youth and their families though links with schools from Denver and the surrounding area. Learning modules will include studying floodplain management practices, land use controls, how urban growth impacts stormwater quality, and the effects of urban development on streamflow and flooding. The idea of having access to weather data from the entire ALERT mesonet was very attractive to the project. This will also be a new learning experience and educational outreach opportunity for the District.

Counting the Urban Farm weather station and the possibility of another weather station near Marston Lake, the ALERT mesonet is expected to grow to 17 stations by the end of 2000.

The District ALERT base station logged over 3900 modem connections during 1999 representing over 2200 hours of connect time. These numbers reflect a slight downward trend compared to the previous year's record of 4900 logins/3500 hrs. This may be indicative of the milder flood season that we experienced, or it may be that users are beginning to prefer the Internet access alternative found at 'alert.udfd.org'. The District provides local government agencies and certain other cooperators with free dial-up access to the base station. Now that network communications and web browsers have become part of our daily lives, Internet

product improvements are planned ALERT data users can expect the District to continue efforts to improve Internet access to ALERT data in 2000.

1999 Floods & Threats

Certain parts of Colorado were declared federal flood disasters during 1999. La Junta in Otero County was hardest hit when spring floodwaters from the Arkansas River overtopped flood control levees causing damage to more than 200 homes. Eleven other Colorado counties were later added to the federal disaster list. District local governments once again avoided flood "disaster" but did not make it through the flood season completely unscathed. As usual, localized flood damages occurred in the Denver area on a number of days this past year. The following briefly describes the more notable events.

April 29 - May 1

On April 30 and May 1, the NWS issued flood watches for the South Platte River and other large Denver area streams. Gradual rises in river stage were observed due to relatively high rainfall accumulations over the prior week. ALERT rain gages in Boulder County had 7-day rainfall totals approaching six inches, but fortunately no high intensity rains occurred during this period. Englewood Dam recorded a record high water depth of 16.2 feet on April 30. Spillway flows begin at a depth of 40 feet. The ALERT station for this site has been in operation since June, 1987.

Thursday, May 20

This was the first flash flood threat day of the 1999 flood season, with the Carr Street gage on Ralston Creek in Arvada providing one of the verification statistics (see table for annual peak). Ralston Creek did overtop its banks in places but no major flood damages resulted. Heavy rain also occurred in Denver at a number of locations. The first Message 1 internal alert was issued by HMS at 2:29 PM, followed 30 minutes later by a Red Flag update.

Friday, June 11

Winter appeared to have returned to southern Douglas County when an intense storm brought 8 to 12 inches of hail to the headwaters of Cherry Creek near Franktown and Larkspur. A

warehouse roof collapsed injuring three workers according to the *Denver Rocky Mountain News*. While heavy rain and hail caused some minor street flooding in the metro area, the District was not impacted by the Douglas County storm. Messages were issued by HMS at 12:47 PM alerting District counties of the potential for one-inch rains lasting 30 to 45 minutes accompanied by 1" diameter hail between 2:00 and 10:00 PM.

Monday, June 14

Aurora received the heaviest rain amounts causing problems for some local drainage facilities. The Sable Ditch rain gage exceeded its alarm threshold three times during the storm. A maximum intensity of 5.67"/hour was measured at 3:16 PM during the 90-minute event which produced 1.61" of rain. Small hail also hindered storm drainage systems and may have caused some gages to underestimate rainfall.

Wednesday, July 28

A massive rain-induced landslide near the headwaters of Clear Creek marked the second anniversary of the Fort Collins flash flood disaster. In the Denver area heavy rains were measured at a number of gages with the higher amounts being reported in Aurora (1.73" at Side Creek Park) where alarm thresholds were exceeded at 4 sites. July 28 also represents the first NWS flash flood watch issuance of the year affecting the District. The NWS watch was issued shortly after 4 PM prior to the occurrence of heavy rain.

Saturday, July 31

Rains near Georgetown caused two minor mudslides forcing closure of I-70 for the second time this week. In Denver and Aurora, street flooding kept

1999 Peak Flows. The table lists some of the more notable peaks measured by the ALERT system in 1999.

Date/Time	Location	Peak (cfs)
April 30 14:07	Holly Dam	100 (Depth 11.8')
April 30 16:54	Cherry Creek at Champa	4,450
April 30 20:06	Englewood Dam	* 153 (Depth 16.2')
May 20 15:48	Ralston Creek at Carr Street	2,300
May 27 17:07	Bear Creek at Morrison	660
June 14 15:28	Sable Ditch at 18th Avenue	220
July 13 11:46	Ralston Reservoir	* 210 (Elev. 6047.4)
July 28 19:04	W. Toll Gate Creek at Horseshoe Park	930
July 28 19:29	E. Toll Gate Creek at Buckley Road	1,320
July 31 19:21	Havana Park Detention	100 (Depth 7.0')
July 31 21:08	Sand Creek at mouth	2,200
Aug 4 19:25	South Boulder Creek near Eldorado Sprgs	370
Aug 4 22:36	Harvard Gulch at Jackson Street	580
Aug 5 00:03	South Platte River at Dartmouth Avenue	3,510
Aug 5 01:26	South Platte River at 19th Street	5,670
Aug 5 04:57	South Platte River at Henderson	9,120
Aug 10 16:56	South Platte River at 19th Street	** 5,670
Aug 10 15:41	Westerly Creek at Montview Blvd.	720

* Indicates new record
** Equals Aug 5 peak

public works and police departments busy. Martin Luther King Blvd. in the Park Hill area of Denver was barricaded due to flooding between Colorado Blvd. and Quebec Street. In Aurora, water was above the curbs at a number of major intersections. Sand Creek recorded its annual peak while the Havana Park detention facility in the Westerly Creek basin overflowed into neighborhood streets. Flash flood warnings were issued for parts of Jefferson and Boulder County outside

the District. The ALERT system measured its highest rainfall amount of 1.77" in the mountains of Boulder County between Nederland and Ward. Thunderstorm rain in Denver and Aurora exceeded one inch at 8 gaging stations with 1.69" occurring at Horseshoe Park in Aurora. This day marks the 23rd anniversary of the Big Thompson Canyon flash flood that killed 145.

Wednesday, August 4

Few will argue that this was the worst flood day of the year for the District with Massey Draw in Jefferson County being one of the hardest hit areas. A District construction project at Carr Street received considerable damage along with five homes in the area.

North of Denver high water closed I-25 between 104th and 144th Avenues. At U.S. 36 and I-25, a Toyota dealership was flooded ruining 45 cars with damages estimated at \$500,000. U.S. 36 was nearly impassible at Federal Blvd. where mud-clogged storm drains made matters worse. CDOT maintenance crews were out until after midnight Thursday cleaning up U.S. 36. A mobile home park along Niver Creek near 92nd and Pecos had 5 feet of water flowing through it around 4 PM. M. Scott Carpenter Middle School near 70th and Mariposa reported 6 feet of water in the building. The school is located near Kalcevic Gulch in Adams County. In Boulder County runoff from heavy rains damaged roads in Eldorado Canyon State Park along South Boulder Creek. The NWS said that 2 to 3 inches fell in Westminster and Federal Heights in 90 minutes. The storm activity began around 3 PM, just before rush hour.

The ALERT system reported rainfall totals not representative of the flooding

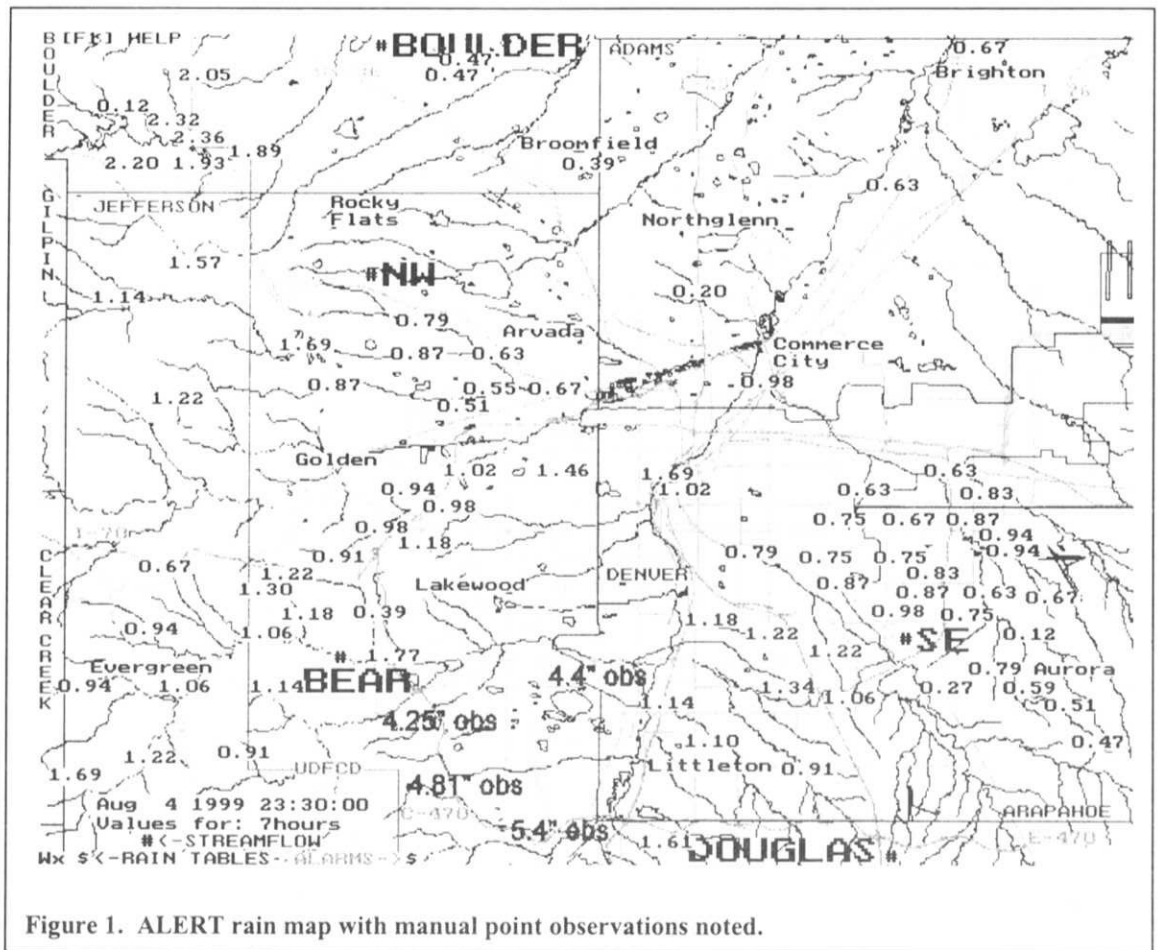


Figure 1. ALERT rain map with manual point observations noted.

that occurred. Boulder County gages recorded the highest 24-hour amounts with six mountain stations exceeding 3 inches. There are no automated gages in the Massey Draw area, nor along Kalcevic Gulch or the northern portion of I-25. Figure 1 shows 7-hour rain totals ending at 11:30 PM. The larger numbers noted as "obs" were obtain from the NWS and other observers for the area in and surrounding Massey Draw. Henz Meteorological Services was hired by the District to reconstruct the Massey Draw storm using archived radar data and rainfall estimating techniques that they developed for predicting flood potentials. The rain activity actually lasted 6 to 8 hours and HMS estimates that the maximum rain depth may have exceeded 7 inches for that period. Fortunately, most of the storm was characterized by relatively low rain intensities or the flooding would have been much worse. The peak discharge estimated for Massey Draw at Carr Street from high water surveys indicated that the event was

much less than a 100-year flood, more on the order of a 10-year event.

Thursday, August 5

Given the flood problems from Wednesday and the highly saturated ground conditions over much of the District, the NWS issued a flash flood watch lasting from noon through 10 PM. While the Denver metro area experienced a few localized storms, Bear Gulch in the Box Elder Creek basin east of DIA was hardest hit by flooding. A dog kennel near E. 88th Ave. and Imboden Road in Adams County was flooded and a number of animals were killed. The District had Leonard Rice Consulting Water Engineers obtain high water measurements for this flood. The highest rain measured in the metro area was at Westwoods in Arvada where 1.02" fell.

Tuesday, August 10

The Wheat Ridge Municipal Building and Police Station experienced minor



Composite photo taken on August 5 looking downstream at Massey Draw from Carr Street in Jefferson County. Road maintenance crews helped direct water toward the main channel during the storm by constructing a temporary earth dike shown in photo.

flooding when parking lot runoff exceeded storm drain capacities and entered the building around 4:30 PM. The problems were caused by a very intense short duration storm that swept through the area, accompanied by high winds downing large tree limbs. A nearby ALERT station (Upper Sloan Detention Basin) measured an unimpressive rainfall total of 0.47", but the storm lasted only about 6 minutes. The storm's high intensity was estimated to be a 10 to 20-year event at this location. Elsewhere in the Denver area, more than 3 inches was reported to have fallen in less than an hour. The highest ALERT rain measurement was 2.52", near I-225 and Sand Creek in Aurora. In addition to the wind and rain, hail and lightning caused problems for many areas including DIA. The earliest HMS messages were issued for Jefferson, Boulder and Douglas Counties before noon.

Thursday, August 19

Only one flash flood warning was issued by the NWS during 1999 that affected the District, and it happened on this day at 5:21 PM. The warning specifically mentioned East Toll Gate Creek in Aurora and was based on a Doppler Radar estimate of 3.5" from a stationary storm over a 60 to 90-minute period. The ALERT system recorded a maximum measurement of 1.69" at Side Creek Park south of Buckley ANG Base. Further upstream, amounts of 1.30" and 1.42" were measured. Local newspapers contained reports of minor street flooding along Gun Club Road between E. Quincy and E. Mississippi Avenues. From the data available, it appears that the radar may have

overestimated rainfall for this storm by a factor of two.

Summary

During the 1999 flood season, the District's Flash Flood Prediction Program (F2P2) issued messages to local governments on 46 days (1 in April, 9 in May, 6 in June, 14 in July, 13 in August, 3 in September). On 8 of these days, the ALERT system recorded rainfall rate alarms caused by 1" amounts falling in less than one hour.

On 12 other days, street-flooding rainfall rates of 1/2" in 10 minutes were measured. The only NWS flash flood warning issued within the District was for the Aurora storm of August 19. Flash flood watches were issued for July 28 and 29 and for August 5.

The F2P2 has been in operation for 21 years. ALERT data is currently available from 143 gaging stations (125 rain gages; 64 water level sensors and 14 weather stations).

Tucker (Continued from page 3)

10, 2003. The District plans to continue to assist local governments in developing stormwater management programs to meet the requirements of the new regulations and in developing permit applications.

The Corps of Engineers in 1999 proposed new Section 404 Permit regulations to replace the Nationwide Permit 26. Nationwide Permit 26 allowed certain activities to take place in the nation's waters if they were under defined acreage thresholds in terms of wetlands impacted. The Corps' replacement permit program will instead permit specific activities and has lowered the acreage threshold requirements to the extent that many more individual permits will be required where once a nationwide permit would be applicable. The potential impact on District programs is significant because of the potential need to obtain many more individual permits than was required under Nationwide Permit 26.

The EPA is also proposing to revise the Total Maximum Daily Load (TMDL) Program. Basically, EPA is tightening the requirements for the development of TMDLs for impaired waters. Proposed regulations require that an implementation plan be developed as part of the TMDL process. Implementation in all likelihood will be largely directed at the regulated community that hold NPDES permits, such as municipal stormwater permittees. The purpose of a TMDL study is to identify the load reductions of a given pollutant required for the impaired water to meet standards, and to assign load reductions to the various dischargers. For those that have NPDES permits, you can rest assured the permits will be modified to reflect the load reduction that is identified in the TMDL study. Cost is a relatively minor consideration and dischargers will be expected to do whatever it takes. The cost implication on local government for TMDL programs could be significant. Yes, indeed, the noose is tightening. These regulatory initiatives portend a shift from local control of land use and public works activity to much more federal oversight and involvement.

Master Planning Program Notes

by

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

Planning Projects

The projects ongoing in 1999 and to begin in 2000 are listed in accompanying "Status of Planning Projects" table. The master planning workload has grown immensely in the last three years and shows no sign of letting up. For example, in 1999 we added 11 new projects and completed five, and in 2000 we expect to begin seven new planning projects and complete six. Most of the completions are expected to occur towards the end of the year.

Technology Transfer & Education

Erosion Control Training

Scott Olson is no longer with Red Rocks Community College. Nevertheless, Red Rocks is hoping to continue to offer training in runoff quality management during construction. Red Rocks also can certify for the Colorado Department of Transportation that an individual has successfully completed the *Erosion Control Supervisor Training* program. A certified supervisor is now required on CDOT construction projects. Contact Red Rocks (telephone 988-6160) if you are interested in obtaining more information.

Software

We are beginning to convert the *CUHPFPC* and *UDSMPC* to run totally under the Windows 95 system. This was prompted by some of the software users being unable to run it on the new operating systems such as NT 4.xx. This will be a slow and protracted process. We need to maintain the same mathematical engine, while providing a user interface for data entry, edit and output that is user-friendly. At the same time, the software needs to recognize, read and convert old input files. In the meantime, both programs, and other District supported software, can be obtained through *Computer Software Library, Inc.* P.O. Box 27517, Denver, CO, 80227, Tel. 303-947-3413, FAX 303-985-8882, the District's software distribution agent.

STATUS OF PLANNING PROJECTS

Project	Sponsor(s)	Consultant	Status
Academy Tributary to Bear Creek	Denver, Lakewood & Jefferson Co.	Kiowa	Completed in 1999
City of Englewood OSP	Englewood	TCB	Completed in 1999
Pinehurst Tributary to Bear Creek	Denver, Lakewood & Jefferson Co.	Kiowa	Completed in 1999
Pleasantview Area OSP	Jefferson Co. & Lakewood	Turner Collie & Braden	Completed in 1999
Quincy Reservoir Watershed Outfall Plan	Aurora	TCB	Completed in 1999
Basin 4100, DFA 0054 & 0056 Update	Thornton & Adams Co.	Kiowa	30% Complete
Big Dry Cr. Tribs (ARAPCO)	Arapahoe Co.	WRC	55% Complete
Broomfield & Vicinity MP Update	Broomfield & Westminster	Kiowa	55% Complete
Cottonwood Area Catchment OSP	Parker & Douglas Co.	Farnsworth & Polk	40% Complete
Four Mile Canyon Cr.	Boulder & Boulder Co.	Love & Associates	30% Complete
Globeville-Utah Junction	Denver & Adams Co.	Kiowa	95% Complete
Holly Hills Trib. To Harvard Gulch	Arapahoe Co. & Denver	SEC	50% Complete
Lower Box Elder OSP	Adams Co. & Denver	Wright Water	20% Complete
Lower First Cr. OSP Update	Adams County & Commerce City	Turner Collie & Braden	30% Complete
Niver Creek Extension in Federal Heights	Federal Heights, Thornton, & Adams Co.	Kiowa	75% Completed
Plum Creek OSP - FHAD	Douglas Co.	WRC	5% Complete
Sulphur & Tallman Gulches Outfall Plan	Douglas Co. & Parker	Kiowa	55% Complete
Town of Erie OSP	Town of Erie	Love & Associates	30% Complete
Applewood OSP	Jefferson Co., Golden	n/a	Started Mapping
Upper Piney Cr. & Tribs	Aurora	n/a /	Started Mapping
Unnamed Tributary to W. Toll Gate Creek	Arapahoe Co., ECCV & Aurora	n/a	Started Mapping
Fairmount Area OSP	Jefferson Co., Golden, Arvada	n/a	Start in 2000
Lower Irondale & Basin 4000 OSP Update	Commerce City, Adams Co. & Denver	n/a	Start in 2000
High Line Canal - North of Cherry Creek	Denver WD, Denver WMD & Aurora	n/a	Start in 2000
High Line Canal - Lee G. to Little Dry Creek incl. Little Dry Creek	Denver WD, Greenwood Village Littleton & Arapahoe Co.	n/a	Start in 2000
Oak Gulch & Stroh Ranch	Parker & Douglas Co.	n/a	Start in 2000
Todd Creek	Thornton & Adams Co.	n/a	Start in 2000
NE Sheridan OSP	City of Sheridan	n/a	Start in 2000

We will probably do the conversions in stages. First we will do a basic conversion to make it run on the Windows 95 system. After we have an operating package, user interface enhancements will be added. If you have any suggested improvements to the current software you want to see incorporated in the update, please e-mail me your suggestions.

Urban Storm Drainage Criteria Manual Updates

In 1998 we started what we thought will be a three-year effort to update the *Urban Storm Drainage Criteria Manual*. With the help of CH2M Hill and the Stormwater Manual Advisory Committee (SMAC), comprised of representatives from large and small municipalities in and outside the Denver area, CDOT, industry, and the home

builders association we have completed updating *Volume 3 – Best Management Practices* and it is now available to the public. If you want to purchase a copy, contact Dena by mail or phone or go to our web page (www.udfcd.org) for ordering instructions.

Volume 3 now is available in printed form and as an interactive CD. The latter contains some AutoCAD™ details for pond outlets and Excel™ spreadsheet files to assist in the design of BMPs. If you have any AutoCAD™ details that you are willing to share with us, please do so. We will incorporate the most useable ones into our future updates of the manual.

We have begun the consultant selection process for the update of Volumes 1 and 2 and hope to have the first draft of the manual available early in 2001. If you are willing to volunteer your time to review and comment on this draft, please let me know. We will need broad review to insure technical integrity and to incorporate the latest thinking from end users before it is published.

Stormwater NPDES Activities New EPA Initiatives

In October, 1999, EPA published the final Phase II regulations for stormwater permits affecting municipalities with less than 100,000 in population (*see a related article by John Doerfer*). We worked with local cities and counties on formulating comments which we and a number of municipalities in Colorado submitted to EPA. EPA received a large number of comments and because of this, the release of the final document was delayed. What this means is that Phase II municipalities will have to have their permit application or a Notice-of-Intent (NOI) filed with the State of Colorado by March 2003.

In the meantime, the State of Colorado has to promulgate its own regulations that define what information these applications or NOIs will need to contain and whether the permits will be individually issued to each applicant or will be issued as a general permit for all Phase II municipalities in the State. If the latter, then the State will need to decide if the applications will take a

form of a NOI or as an individual application.

New Regulatory Initiatives by EPA

Last year I advised the readers that Colorado municipalities need to be concerned about the *Advance Notice of Proposed Regulations* published in 1998 by EPA. If EPA follows through on all of the topics it hopes to address by these regulations, land use control decisions of the cities and counties will be governed, to a large extent, by EPA regulations promulgated under the Clean Water Act. I again urge city and county government staff and elected officials to get on top of these issues. If followed through as published, these regulations will have a profound long-term impact on local government activities, decisions and budgets.

Monitoring Program.

The District, on behalf of Denver, Aurora, Lakewood and Arapahoe County, has coordinated a water-quality monitoring program. This effort follows through with their municipal stormwater permit requirements. Since 1998, the U.S. Geological Survey, under a cooperative agreement with the District, has been collecting water samples during storm runoff and snowmelt events at three sites along the South Platte River and two sites along its tributaries. The goal is to provide long-term monitoring data for the analysis of water quality trends in the receiving waters of this metropolitan area, and to also provide data for the total maximum daily load (TMDL) studies being conducted by the State of Colorado under the Clean Water Act.

Offer of Assistance to Municipalities

The District held a workshop on December 7, 1999, with municipalities within the District to review the requirements of the Phase II rule. Those requirements which may be addressed in a more cost-effective way by joining forces were also discussed. The District is prepared to assist local municipalities, as a group, in preparing for their permit applications and implementation of their permits. Towards that end, many of the products that were developed for the Phase I municipalities, such as educational brochures, erosion control training, and Volume 3 of the *Urban*

Storm Drainage Criteria Manual may be usable to meet Phase II permitting activities.

Should your city or county within the District's service area decide to work toward preparing information to support a permit application, or is taking an initiative to develop its own stormwater quality management program, or simply wants to develop a stormwater system inventory, call us. We can probably provide you with advice and some of the developed products and data management tools that can help make your job easier and consistent with others in this region. Because of staff and budget limitations, our support will be targeted towards activities and products that serve all municipalities in our metropolitan area.

1999 Professional Activities of District Staff

Scott Tucker, Executive Director

- *Received William E. Korbitz Leader of the Year 1998 Award from Colorado Chapter of American Public Works Association in January.
- *Chaired Stormwater Management session at National Association of Flood and Stormwater Management Agencies (NAFSMA) annual conference in Philadelphia in November.
- *Member of Board of Directors and Chairman of the Stormwater Management Committee of NAFSMA.
- *Presenter at National League of Cities workshops on Phase II Stormwater Regulatory Program in Washington, DC, in March and Los Angeles in December.

Dave Lloyd, Chief, Design and Construction Program

- *Presented "Channel Improvements in Denver Metro Area – Where We've Been & Where We're Going" at the CASFM annual conference in Steamboat Springs in September.

Bill DeGroot, Chief, Floodplain Management Program

- *Chair of the Floodplain Management Committee of the National Association of Flood and Stormwater Management Agencies (NAFSMA), and chaired a session on Floodplain Management Issues at NAFSMA's annual meeting in Philadelphia in Nov.
- *NAFSMA's technical advisor to the Technical Mapping Advisory Council.
- *Member of ASCE's Technical Mapping Advisory Task Committee.
- *Co-authored, with Ben Urbonas, "Urban Watershed Flood Mitigation Planning and Floodplain Management," which Ben presented at a NATO sponsored *Advanced Research Workshop on Floods* held in the Czech Republic in May.
- *Presented an update on FEMA's Cooperating Technical Communities Initiative at the Colorado Association of Stormwater and Floodplain Managers annual conference in Steamboat Springs in September.

Kevin Stewart, Project Engineer, Floodplain Management Program

- *National Hydrologic Warning Council (NHWC) Representative for Southwestern Association of ALERT Systems.
- *Member of Colorado State Hazard Mitigation Team and the Grant Program Application Review Subcommittee.
- *Member of Colorado Natural Hazards Mitigation Council Dam Safety and Warning Subcommittee.
- *Participant at NWS National Quantitative Precipitation Estimation Workshop in Boulder in April.
- *Presenter, session moderator and Council Chairman at 3rd NHWC National Conference and Exposition in San Diego, CA in May.
- *Lecturer and participant at NATO Advanced Study Institute, *Coping with Flash Floods* in Ravello, Italy in November.

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

- *Appointed to the French NOVATECH 2001 Conference's Scientific Committee as one of the two United States members. This Committee will help shape the program, evaluate abstracts of proposed papers for acceptance and chair sessions at the conference scheduled to take place mid-May, 2001.
- *Continuing as a Principal co-investigator (Eric Strecker & Jonathan Jones principal co-investigators) for an EPA funded ASCE effort to develop Nationwide BMP Evaluation Data Management software and to accumulate and evaluate BMP data for performance and its relationships to design parameters.
- *Co-authored two papers on the EPA-sponsored ASCE-BMP database project.
- *Spoke to an audience of 150 on the topic of the ASCE-BMP database at the APWA National Convention held in Denver in September, 1999.
- *Presented a paper co-authored with Bill DeGroot titled "Urban Watershed Flood Mitigation Planning and Floodplain Management," at a NATO sponsored *Advanced Research Workshop on Floods* held in the Czech Republic in May.
- *Spoke to an audience of 800 at the 4th Brazilian Urban Drainage Symposium held November 29 – December 1 in Belo Horizonte, Brazil.
- *Described the *Urban Storm Drainage Criteria Manual Volume 3 – Best Management Practices* to the Denver chapter of the American Water Resources Association in September.
- *Appointed as the general chairman for an Engineering Foundation Conference on the topic of stormwater BMP use and receiving water interaction in urban areas. This conference is tentatively scheduled to take place in August, 2001.

Cindy Thrush, Project Engineer, Maintenance Program

- *Secretary of the Board of Directors for the Colorado Association of Stormwater and Floodplain Managers (CASFM).
- *Speaker on Bio-engineering at the 10th Annual Conference of CASFM in Steamboat in September.
- *Prepared a presentation on the Willow Creek Project for Award at the 10th Annual Conference of CASFM.

Paul Hindman, Project Engineer, Design and Construction Program

- *Chairman of the Volunteer and Sports committees for the 1999 APWA Congress and Equipment Exposition held in Denver.
- *President-elect of the Colorado Chapter of APWA.

(Continued on page 23)

Professional Activities (Continued from page 2)

John Doerfer, Project Hydrologist, Master Planning Program

- *Chairman of the Stormwater Quality Committee, Colorado Association of Stormwater and Floodplain Managers (CASFM).
- *Chairman of Awards Committee, 1999 CASFM Annual Conference.
- *Speaker at NAFSMA-sponsored workshop on Phase II stormwater regulations at National League of Cities annual conference in Washington in March.
- *Speaker at International Erosion Control Association annual conference for Special Session on "How the New NPDES Phase II Stormwater Management Regulations Will Impact Smaller Municipalities and Construction Sites," in Nashville in February.

Mark Hunter, Chief, Maintenance Program

- *Member of International Erosion Control Association (IECA) standards committee on riprap and standards committee on articulating blocks.
- *Secretary of the Board of Directors for the IECA-Mountain States Chapter.
- *Member of IECA Conference Planning Committee, Technical Review Committee and Awards Committee.

Bryan Kohlenberg, Project Engineer, South Platte River Program

- *Continued as NSPE's scoring coordinator for the Jefferson Chapter and Colorado State MATHCOUNTS competitions for 7th and 8th graders.

David Bennetts, Project Engineer, Maintenance Program

- *Co-authored and co-presented "Can Bioengineering Projects Work in Semi-Arid Environments" at the CASFM conference in Steamboat Springs in September.

Michael G. Sarmento, Engineering Inspector, Maintenance Program

- *Attended the IECA course on "Design Procedures for Channel Protection and Streambank Stabilization" in November.

EPA-Sponsored ASCE BMP Database Software Released

The District, along with Wright Water Engineers and URS Woodward Clyde, is a participant in an American Society of Civil Engineers (ASCE) project funded by a U.S. Environmental Protection Agency (EPA) grant. The project has developed the National Stormwater Best Management Practices (BMP) Database, Version 1.0. It is being distributed by the American Society of Civil Engineers (ASCE) and the US Environmental Protection Agency (EPA) to stormwater managers, researchers, regulators and consultants throughout the country. The user-friendly Microsoft Access™-based database serves two key purposes: 1) guides data collection and reporting efforts for those monitoring and tracking BMP performance, and 2) provides access to BMP performance data in a standardized format for over 70 BMP studies conducted over the last fifteen years.

The database software package, which is currently being distributed on CD-ROM free of charge, has two key components: data entry and data retrieval. Parties using the data entry portion of the database are encouraged to submit their data for inclusion in the national database, and some EPA grant funding is currently available for this purpose through ASCE.

The data retrieval, or "search engine," portion of the software enables users to retrieve data on over 70 BMPs which have met criteria for inclusion in the database. The BMP data retrieval component of the database is available over the Internet at <http://bmpdatabase.org/>.

For more information on the database or the overall project, see ASCE's web site at <http://www.asce.org/peta/tech/nsbd01.html> or contact Jane Clary at Wright Water Engineers, Inc.; 2490 West 26th Ave., Suite 100A; Denver, CO 80110; phone: 303-480-1700; e-mail: clary@wrightwater.com.

District Wins Accounting Award

For the eleventh 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.

**Remember that color
versions of all of the
photographs in this issue
can be seen on our web site
at:**

www.udfcd.org

Novatech 2001 Conference in France Stresses Sustainable Urban Development

By Ben Urbonas, P.E.

In 1998, I had the pleasure to participate at Novatech 98 conference held in Lyon, France. This is a major international conference held every three years. As the name implies, its purpose was to exchange information on new and emerging technologies in stormwater management. The next one will take place mid-May, 2001 and will stress the topic of sustainable urban development in terms of stormwater issues.

Anyone interested in an outstanding international venue on stormwater technical issues is encouraged to attending. All sessions have simultaneous translation from French to English and vice versa. The program and the opportunity to meet and exchange ideas with professional colleagues in other countries are outstanding. You will not regret the trip. Since it takes time to come up with the resources to pay for this type of a conference, I suggest you start panning for it now. A major fringe benefit can be had if you extend your stay for a tour of the French countryside in the Provence or the Burgundy regions.

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FLOOD HAZARD NEWS

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