



FLOOD HAZARD NEWS

Vol. 15, No. 1

December, 1985

WETLAND BOTTOM CHANNELS— AN EMERGING ISSUE

by
Bill DeGroot and Scott Tucker

The District has constructed or required the construction of trickle channels in grass-lined channels since the District's beginning in 1969. This requirement has been motivated by the desire to control erosion in channels, enhance maintenance access, and insure free flowing channels. Consequently, the improved grass-lined channels in the District take on the character of clean, green and grassy strips through urban areas approximately following the thalweg of the historical channel, with a maintenance access road that generally doubles as a hiker/biker trail.

With recent changes in administration of Section 404 of the Clean Water Act, the EPA has placed emphasis on preserving or creating wetlands. It turns out that all channel bottoms qualify as wetlands and our trickle channel policy has the effect of eliminating or preventing the development of wetlands. The District is not opposed to the "wetland bottom" channel concept but we have to develop criteria and re-orient some of our thinking. The purpose of this article is to develop the issues involved and to discuss some of our thinking as to how the issues can be addressed. It is not easy to change 16 years of practice overnight, but we feel there is merit in re-evaluation and we are taking steps to do so.

The *Urban Storm Drainage Criteria Manual* (USDCM) provides basic guidance in the Denver area for flood control and storm drainage design, Section 2.3.3 of the Major Drainage Chapter. Volume II, states that: "trickle channels or underdrain pipes are required on all urban grassed channels. Concrete trickle channels are preferred because of their ease of maintenance. Other types are acceptable if they are properly designed. Trickle channels may not be practical on major streams and rivers or in large channels through fine sand soils." A trickle channel is a small channel located within the major

channel. Its purpose is to confine the normal base flows and runoff from minor rainfall events to a small protected area with the following benefits:

1. The remainder of the channel bottom is kept dry and accessible for routine maintenance such as mowing and trash removal. The channel bottom is also available for other recreation and open space type uses.
2. Erosion and meandering caused by constant base flows is controlled.
3. Sediment deposition is controlled by confining the base flows, thus increasing the velocity and sediment transport capability of the base flow.

The Urban Drainage and Flood Control District is authorized to levy up to 0.4 mill for the maintenance and preservation of floodplains and floodways within the District. In order to assure that new flood control facilities built by developers and local governments would not require inordinate amounts of maintenance assistance, the District's Board of Directors established criteria which must be met in order for a project to be eligible for District maintenance assistance. The District policy states that drainage and flood control facilities constructed by, or approved for construction by, local public bodies on or after March 1, 1980 will not be eligible for District maintenance assistance unless:

1. The design of the facility is in accordance with the *Urban Storm Drainage Criteria Manual*.
2. The design of the facility is approved by the District.
3. The facility is built in substantial conformance with the approved design.
4. Maintenance access, both legal and physical (a trail), is provided.

For new developments adjacent to

major drainageways the developer has three basic options. He can stay out of the floodplain, he can fill the fringe area outside the floodway or he can construct a flood control channel to reduce the extent of the floodplain. No matter which option is pursued by the developer, the drainageway must be maintained to preserve the roughness characteristics which were used in the calculations to define the floodplain or design the channel. In other words, if a roughness coefficient (Manning's n) of 0.035 is used to design a grass-lined channel, that channel must be maintained to preserve that roughness characteristic.

The most popular type of channel used by developers is the grass-lined channel. The grass can either be native to Colorado, which does not require irrigation, or it can be irrigated bluegrass. In either case, the USDCM requirements for a trickle channel come into play. The need for a trickle channel to facilitate maintenance and prevent unwanted growth is apparent for those grass-lined channels with low roughness coefficients.

Recently the extension of jurisdiction of the Corps of Engineers' 404 Permit process to very small wetlands and drainageways has fostered the concept of the "wetland bottom" channel. The concept of the wetland bottom channel is to specifically prohibit a hardened trickle channel within a grass-lined channel in order to promote the growth of wetland vegetation, such as cattails and willows in the channel bottom. The District anticipates increased pressure from certain 404 Permit referral agencies for wetland bottom channels and against hard lined trickle channels.

In anticipation of this eventuality the District has commissioned a study of potential criteria for wetland bottom channels. In the interim we have developed the following

(Continued on Page 7)

Professional Activities of District Staff

Bill DeGroot presented "Multiple Use Concepts In Floodplain Management" at the 1985 Association of State Floodplain Managers Conference. Scott Tucker and Mark Hunter were co-authors.

Scott Tucker, Mark Hunter and Bill DeGroot made presentations at the "Short Course on Flood Mitigation in Floodplain and Wetland Areas", sponsored by Simons, Li & Assoc. and the Federal Emergency Management Agency.

Kevin Stewart was a lecturer at the "Short Course on Urban Storm Water Modeling Using Colorado Urban Hydrograph Procedures", sponsored by the University of Colorado at Denver and the District.

Bob Hoffmaster, Mark Hunter, Scott Tucker, Ben Urbonas and Bill DeGroot participated in the APWA/AWRA seminar, "Urban Storm Runoff Quality Control Issues".

Kevin Stewart made a presentation at the 1985 National Flood Insurance Program Annual Conference.

Bob Hoffmaster chaired the Colorado Section of APWA's Utility Coordinating Committee. Activities included a seminar on utility coordination.

Ben Urbonas gave a keynote talk at the "Stormwater Detention" session of the New Jersey Seminar on Floodplain Hydrology. Ben also presented "Standardization of Detention Pond Design For Phosphorus Removal" in Montpellier, France at a NATO Special Studies Seminar and was one of four delegates from the U.S. sponsored by EPA to go to Spain for discussions on urban stormwater quality control.

Ben Urbonas was the chairman of the ASCE Hydraulics Division Task Committee for the Design of Stormwater Design Outlet Control Structures that published a special ASCE report; "Stormwater Detention Outlet Control Structures."

Frank Rosso made a presentation on placement of grouted riprap at an APWA seminar on construction inspection.

VEGETATION STUDY

The District has recently completed a drainageway vegetation study. The study primarily covers topics such as seed bed and soil preparation, soil types, natural grass seed mixtures, planting, weed control, fertilizer and routine maintenance of drainageway vegetation. The study includes using natural grasses in conjunction with "hardscape" materials, i.e., riprap and interlocking concrete blocks.

The study also investigates other aspects of the District's vegetation management procedures such as site construction guidelines, maintenance standards, erosion control methods and construction inspection procedures. This study produces a sound vegetation management program from which the District can expect consistent results. It will also be a valuable source of information to which consultants and other agencies could refer in developing seeding specifications for a specific site or in developing their own set of standards and procedures.

Anyone interested in obtaining a copy of this vegetation study can write to the District and enclose a check for \$20.00 plus \$3.00 for postage and handling.

URBAN RUNOFF CONFERENCE

A conference on "Urban Runoff Quality, Its Impact and Quality Enhancement Technology" is being sponsored by the Engineering Foundation from June 22-27, 1986 at New England College, Henniker, New Hampshire. The conference chairman is Ben Urbonas, Chief, Master Planning Program, Urban Drainage and Flood Control District.

The objective of the conference is to bring together the actual experience of local governments, state governments and federal agencies since the National Urban Runoff Program was completed in 1983. The control of non-point sources is a topic which is receiving considerable attention at the Federal level, but will require implementation at the state and local level if it is ever to be successful. Hence, this conference will be aimed at bringing the gap between various levels of government and professions that have been researching and working on this topic in recent years.

Attendance at Engineering Foundation Conference is by invitation or application only. To request an invitation or application, contact the Engineering Foundation, 345 East 47th Street, New York, N.Y. 10017, telephone: (212) 705-7835.

MEET THE NEW BOARD MEMBERS



NELSON McNULTY
Mayor, City of Edgewater

Nelson McNulty became Mayor of Edgewater following the resignation of former mayor, Rex Swann, in March. He later won re-election to a full term in November. Prior to becoming Mayor, McNulty served on the City Council more than three years and had served on the Planning and Zoning Commission for approximately six years.

McNulty has a Bachelor of Science Degree in Business Administration and a Bachelor of Science Degree in Electrical Engineering. He is the owner of Scientific Instruments Company, which develops custom electronic equipment.

He has held several leadership positions with the Edgewater Community Church. He is President of Colorado Foster Parents Association, and has operated a foster-parent group home for twenty years. He has also been PTA President, Treasurer of Edgewater Business-Men's Association, Director of the Edgewater Little Playhouse and Registration Chairman for the Institute of Electrical and Electronic Engineers Vehicular Technology Conference.

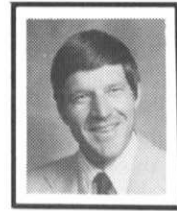
INTERESTING AND AVAILABLE

A 16-page brochure which summarizes the recently completed master plan for the South Platte River is available from the District. Simply write us or drop by the office for a copy.

Tucker-Talk

by L. SCOTT TUCKER

Timely Comment from the District's Executive Director



NPDES—Its Impact on Local Governments NPDES Requirements Surface Again

The Clean Water Act of 1972 as amended requires EPA to issue permits and to control pollution levels entering the nation's waters from manmade point sources of pollution. Although stormwater discharges were identified as point sources of pollution, EPA in 1973 exempted stormwater runoff discharges uncontaminated by industrial or commercial activity from the requirement to obtain a National Pollution Discharge Elimination System (NPDES) Permit. The EPA's logic in 1973 was that these discharges were ill suited for inclusion in the NPDES Permit Program and could be better dealt with through non-point source controls. EPA reasoned that pollutants would best be eliminated from storm sewers by "process changes" which would prevent pollutants from entering rainwater runoff rather than by treating the discharge by the traditional "end of pipe" NPDES Permit method. Also, EPA recognized that to issue permits to the tremendous number of stormwater sources would not be administratively workable within the framework of the NPDES Permit Program. EPA's original approach made a lot of sense.

Logic did not prevail, however, and shortly thereafter the Natural Resources Defense Council (NRDC) challenged EPA's authority to exempt categories of point sources from permit requirements of the Clean Water Act. The U. S. District Court for the District of Columbia held that EPA could not lawfully exempt discharges which it identifies as point sources from regulation under NPDES Permit Program. The Court did, however, recognize the agency's substantial discretion to define what activities constitute point and non-point sources. Further, the Court recognized EPA's discretion to use administrative devices such as area permits to manage its work load. On appeal the U. S. Court of Appeals for the D. C. Circuit affirmed the District Court decision.

Pursuant to the District Court deci-

sion and the Appeal Court affirmation EPA in 1976 published regulations which required NPDES Permits for all stormwater discharges other than rural runoff. Since the publication of those 1976 regulations industry on the one side and environmental groups on the other have been challenging in court, negotiating with, and pressuring EPA to modify the regulations to support their respective interests. EPA has struggled with these special interest groups and has held in abeyance the requirement to obtain stormwater permits until the publication of regulations in September 1984. The September 1984 regulations require that the stormwater discharges submit their applications by March 26, 1985. It further subdivided stormwater discharges into Group I and Group II. The Group II category was required to submit narrative descriptive material of the drainage area receiving water and any treatment being provided. The Group I category was required to submit sampling data in addition to the narrative description sampling data.

As you can see EPA has been trying to avoid the requirement of individual permits for stormwater discharges in municipalities; however, the noose is getting tighter and tighter and the regulatory path is leading toward the requirement of permits for municipal stormwater discharges. Subsequent to the publishing of the September 1984 regulations EPA has published further modifications, clarifications, and revisions. Important clarifications are that all municipal storm sewer discharges are classified in the Group I category. This means that sampling is required. EPA also extended the time deadline to obtain permits until December 31, 1987 for the Group I category and June 30, 1989 for the Group II category.

The bottom line is that EPA has been forced to move in the direction of requiring permits for municipal point source storm sewer discharges.

They have taken the position that the permit applications must be accompanied by sampling data. It is not clear exactly what form the permitting process will take. Will it be possible for EPA to issue "areawide" permits to individual municipalities, special districts, or regional areas? Or will sampling be necessary for every municipal stormwater discharge? The regulations promulgated to date are not clear on this subject.

It appears to me that Congress has been unwilling to re-examine NPDES requirements as they impact municipal stormwater discharges. This unwillingness is leading us toward a permitting process that will require local governments to submit NPDES applications including narrative and sampling data for their storm sewer discharges by December 31, 1987. The cost for doing this could be as high as \$8.5 billion if EPA requires individual permits from all municipal discharges, which EPA has estimated to exceed one million in number.

To me a much more reasonable and sane approach would be for EPA to identify municipal stormwater point sources as Group II discharges thus lessening considerably the application cost burden. Where storm sewer discharges are identified as impairing beneficial use of receiving waters, those particular storm sewer drainage basins could be analyzed for ways to improve the water quality. It will be, however, an unfortunate waste of resources to require municipalities to go through a costly sampling process for end of pipe discharges. The critical issue here is the receiving waters. If beneficial use of receiving waters are being impaired because of storm sewer discharges then those particular discharges should be examined. If beneficial uses are not being impaired then why waste time and money to obtain sampling data. Any sampling effort should be oriented towards what is happening in the receiving waters.

The whole area is a big can of worms. In a meeting with a staff member of the Senate Environment and Public Works Committee the

(Continued on Page 11)

DESIGN AND CONSTRUCTION NOTES

B.H. Hoffmaster
Chief, Design and Construction Program

The year 1985 brought more work. During the year 31 projects were either begun, continued and/or completed. With the work load, there was an expansion of personnel in the program from one to two by the addition of Dave Lloyd as a Project Engineer. Dave had been a Project Engineer in the Maintenance Program.

The year saw the basic completion of the Goldsmith Gulch Detention Pond at Union Avenue, a \$2,197,400 project. The project extends from Interstate 225 to Belleview Avenue. The project sponsors were the City of Denver, Goldsmith Metropolitan District and the Urban Drainage and Flood Control District. The project was a multi-use project that included flood control, park development, and road and water line construction. The area will be called George C. Wallace Park. The originally proposed flood control features of the project were modified to fit into a park regime that will provide both passive and active recreation areas. Drop structures were worked into the design so that they may be used as part of the passive system where people may rest on the energy dissipators, and water falls are created. Normally the "trickle channel" is located at the low point of the system, but here, between two drops, it is up on the side of the pond so the low areas may be used for soccer fields. The playing field area has sub drains installed. Union Avenue was constructed on the dam embankment for the main detention pond. The design engineer was Greenerhorne & O'Mara, Inc. who included as part of their team the firm of William Wink Associates, a landscape architect firm.

The Little Dry Creek Project at 72nd Avenue and Raleigh Street, another project that involved park land, was completed this past year. The project was discussed in the last issue of Flood Hazard News. The project sponsors were the City of Westminster and the District. This project was basically a channelization project with approximately 662 feet of grass lined channel, 450 feet of concrete lined channel and the addition of an 18 feet by 11 feet box culvert under 72nd Avenue. The grass-lined channel traversed a park downstream of 72nd Avenue. A hiker-biker trail/maintenance road and a trickle channel were constructed in the channel that extends and blends into the park. The park was then landscaped by the City. The trickle channel has a

STATUS OF DISTRICT CONSTRUCTION PROJECTS

Project	Participating Jurisdiction(s)	Cost	Status
Boulder Co. Justice Center Flood Barrier	Boulder County	\$ 516,000	50% Complete
Dakota Tributary to Weir Gulch	Denver Lakewood	\$ 824,700	80% Complete
First Avenue Trib. to Weir Gulch Newland Detention Pond	Lakewood	\$ 120,000	Complete
Goldsmith Gulch Detention at Union	Denver Goldsmith Metropolitan District	\$2,197,400	95% Complete
Goose Cr., Wonderland Cr. Boulder Slough	City of Boulder	\$1,600,000	1% Complete
Harlan Street Storm Drain Schedule III	Mountain View	\$ 241,800	Complete
Lafayette Drainageway No. 4	Lafayette	\$ 287,400	Complete
Lena Gulch Schedule III & IV	Wheat Ridge	\$2,124,100	96% Complete
Little Dry Ck. (ADCO) Phase A	Westminster	\$1,333,800	Complete
Little Dry Ck. (ADCO) Lowell Bridge	Adams County Westminster	\$ 573,200	1% Complete
Little Dry Ck. (ARAP) at Quincy	Arapahoe County Cherry Hills Village Cherry Hills Country Club	\$ 178,700	Complete
Little's Creek at Rapp St.	Littleton	\$ 30,000	Complete
Monaco Street Storm Drain	Greenwood Village	\$ 206,400	79% Complete
Parker/Iliff Huntington Estates	Arapahoe County Aurora	\$ 358,400	75% Complete
Upper Sloans Lake Schedule III	Edgewater Lakewood	\$ 890,080	73% Complete
Weir Gulch Schedule I	Denver	\$1,495,000	Complete

concrete bottom with the sides constructed out of varying sizes of rock imbedded in concrete. The effect blends into the park atmosphere and gives a more natural mountain stream look. The design engineer was Sellards and Grigg, Inc., who sub-contracted for landscape services with the firm William Wink Associates. The construction was done by Lillard and Clark Construction Company.

The Marston Lake-North project, located from Pinehurst Country Club (north of Quincy Avenue) to State Highway 121 (New Wadsworth), is being designed. Construction of the first phase is expected in 1986. The project is sponsored by the City and County of Denver (Wastewater Management Division and the Denver Water Board) and the District. This project involves work in Pinehurst Country Club that is sensitive to the environment. Efforts have been made to require use of materials and finishes that will blend into the golf course setting. The channel also parallels Quincy on the Denver Water Board property. Here again, with a

series of drop structures, design work has been coordinated to limit the impact of the structural aspects of the drop structures as viewed from Quincy Avenue. This includes mounding of earth, shrubbery, and lines in the concrete to break up the flat surface. Upstream, the channel is located between the Marston Lake Dike and Marston Shore Condominiums. Here, since there is very little available right-of-way, concrete is to be used. Efforts were made to keep the concrete surfaces as low as possible, with a wood fence on top, to keep from impairing the view of Marston Lake. An interesting structural problem in this location was locating the channel so as not to affect the stability of the Marston Lake Dike. The result was a channel with a vertical wall on the condominium side and a sloping wall on the Marston Lake embankment with proper sub-drainage. The design engineer is WRC Engineering, Inc. assisted by William Wink Associates.

Another project in the design stage is Sand Creek from Peoria Street to Colfax Avenue in Aurora. This pro-

ject will relieve a long existing flood hazard to homes and businesses in the Morris Heights Subdivision. The problem was created many years ago when Sand Creek was rerouted as part of the subdivision platting. The design proposes a soil cement embankment along each side of the channel from 6 to 8 feet high and 9 to 10 feet thick. The slope will be 2:1. This appears to be the first soil cement used for channel embankment in the Metro Area. The project has required a 404 permit from the U.S. Army Corps of Engineers. There have been extensive discussions of the impacts on, and mitigation of, environmental concerns. Since the channel bottom will remain a sandy bottom, present thought is to bring back native vegetation as much as possible. Studies done by Robert Jarrett of the U. S. Geological Survey indicate that the type of plants that will grow in this particular environment will have only a minor effect on the capacity of the project at design depth. Still to be resolved are the fishery questions. Above the soil cement embankment the slope changes to 4:1. This area will be native soils and will be grassed, with shrubs and tree clumps, and will have a path system. The design engineer for this project is Greenhorne & O'Mara, Inc., assisted by William Wink Associates and Thorne Ecological Institute.

STATUS OF DISTRICT DESIGN PROJECTS

Project	Participating Jurisdiction(s)	Status
Depew St. Basin—Weir Gulch	Lakewood	98% Complete
Goose Cr., Wonderland Cr., Boulder Slough	City of Boulder	95% Complete
Greenwood Gulch—Big Dry Creek (ARAP)	Greenwood Village	60% Complete
Little Dry Creek (ADCO)	Adams County Westminster	95% Complete
Little Dry Creek (ARAP)	Arapahoe County Cherry Hills Village Cherry Hills Country Club	Complete
Marston Lake North	Denver	95% Complete
Massey Draw	Jefferson County	90% Complete
Parker/Iliff—Huntington Estates	Arapahoe County Aurora	Complete
Parker/Mexico	Arapahoe County Aurora	95% Complete
Sand Creek	Aurora	95% Complete
Shaw Heights	Adams County Westminster	40% Complete
Slaughterhouse Gulch	Arapahoe County Littleton	75% Complete
South Jefferson County Drainages	Arapahoe County Last Chance Ditch Company Nevada Ditch Company	95% Complete
Upper Sloans Lake	Edgewater Lakewood	95% Complete
Westerly Creek—Interim Lowry Detention	Denver	50% Complete



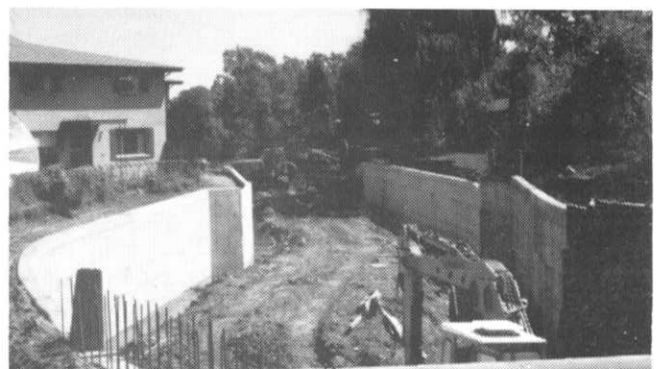
Drop structure on Goldsmith Gulch. Note trickle channel on the side of the pond.



Little Dry Creek at 72nd Ave.



Weir Gulch Schedule 1 in Denver.



Lena Gulch in Wheat Ridge.

RECENT PLANNING PROGRAM ACTIVITIES

by Ben Urbonas, Chief, Master Planning Program

South Platte Master Plan Completed

The last issue of the *Flood Hazard News* reported on the completion of the Phase A report of the South Platte River major drainageway plan. Now I am pleased to report that the final major drainageway plan for the South Platte River has been completed. This report, which represents the end product of a two year planning effort, is in two volumes. Volume I contains the preliminary engineering design of the major drainageway flood control features. Volume II contains the recreational plan for the 41 miles of the South Platte River from Chatfield Dam through Baseline Road at Brighton. Both volumes can be purchased at the District offices for \$30.00 and either volume may be purchased separately for \$20.00

The master planning effort for the river was the largest and most comprehensive multi-jurisdictional effort undertaken by the District. The final report is an example of cooperation and hard work on behalf of twelve local governments, the Greenway Foundation and six local, state and federal agencies. We at the Urban Drainage and Flood Control District wish to acknowledge the sponsorship support and/or assistance of the following:

Project Sponsors: Adams County, Arapahoe County, Douglas County, Jefferson County, City and County of Denver, Town of Columbine Valley, City of Brighton, City of Commerce City, City of Englewood, City of Littleton, City of Sheridan, City of Thornton and Greenway Foundation.

Project Advisors: Denver Regional Council of Governments, Colorado Water Conservation Board, South Suburban Parks & Recreation District, Colorado Division of Wildlife, U.S. Army Corps of Engineers, and Colorado Division of Parks and Outdoor Recreation

Project Consultants: Flood Hydrology: Merrick and Company; Geomorphology: Michael A. Stevens, Consultant; Major Drainageway Planning: Wright Water Engineers, Inc., Urban Environments, Ltd., and Denton, Harper, Marshall, Inc.

The District is also grateful to all the individuals and groups that attended the public hearings and presented testimony. Also, a special thanks goes to all the individuals and

STATUS OF PLANNING PROJECTS

PROJECT	COMPLETED	UNDERWAY	PLANNED
	1985		FOR 1986
Boulder & Adjacent County		*	
Lower Ralston & Van Bibber Cr.		*	
South Platte River	*		
Quincy Drain/Shop Creek		*	
Adams County, Commerce City		*	
Direct Flow 0056 & 4100		*	
Interim Lowry Detention		*	
Columbine Valley/Littleton/Bow Mar	*		
Four Square Mile (ARAPCO)	*		
Arapahoe County Criteria	*		
Big Dry Creek (ADCO)		*	
Broomfield NE		*	
Boulder County Gunbarrel Area		*	
Jefferson Co/Adams Co/Boulder & Westminster Criteria		*	
Thornton Criteria			*
Lone Tree, Dove & Windmill Creeks		*	
Bear & Mt. Vernon Creeks			*
Cottonwood Creek			*
52nd to Pecos to South Platte			*
Lower Big Dry Creek (ADCO)			*

groups, too numerous to mention here individually, that worked hard on this project with us to make it an outstanding example of community cooperation.

Technology Transfer

In May of 1985 and January of 1986 the District was a cooperator with the University of Colorado at Denver (UCD) in presenting a short course on urban hydrology based on the District's Urban Storm Drainage Criteria Manual (USDCM) and computer programs. Both sessions were well attended. The faculty consisted of representatives from UCD, the District and Boyle Engineering Company, the PC computer program developer.

This course represents the first attempt by our metro area institutions of higher learning to develop short courses in urban drainage and flood control technology. We have been discussing with UCD to continue making this type of training available. We understand that the Civil Engineering Department of UCD expects to utilize the proceeds from the first set of courses to develop additional short courses in this field. It is my understanding that

plans are underway to have a short course on the design of stormwater detention facilities in the summer of 1986. If you wish to obtain advance information on this short course, you can contact Professor James Guo at the Civil Engineering Department of UCD.

When the District announced the availability of the CUHPE/PC and UDSM2-PC programs, we did not expect such an overwhelming response. As a result, we are thinking of organizing an Urban Storm Drainage Criteria User Group meeting. My thinking is that this could be an annual meeting lasting one or two days. Anyone wishing to present a paper related to urban drainage and flood control, especially if it relates to USDCM or related computer programs, would have a chance to do so. Papers could be written in advance and could possibly be printed as conference proceedings. Such an annual meeting could serve as a forum for stormwater management professionals to exchange ideas and techniques. We could learn from each other, relate our experiences in using the USDCM, share our problems and successes and eventually result in im-

(Continued on Page 11)

DESIGN NOTES

Supplement to Flood Hazard News (December, 1985)

MULTIPLE USE CONCEPTS IN FLOODPLAIN MANAGEMENT

by

William G. DeGroot, L. Scott Tucker, Mark R. Hunter

Introduction

A complete floodplain management program must include all activities necessary to reduce future flood hazards (preventive) while correcting past mistakes (remedial). These actions include land use controls; and the planning, design, construction and maintenance of flood control facilities.

Local governments, which are the agencies usually responsible for providing remedial flood control facilities, are being increasingly squeezed between revenues and the demand for services. The public wants relief from flooding problems while also looking for more amenities, including recreational facilities. It therefore makes sense to combine public uses whenever feasible. Flood control facilities, while necessary and useful, are dry most of the time; and are therefore available for other public uses (such as recreation and open space) which are compatible with the flood hazard.

Land developers also face multiple requirements when subdividing or building. These can include floodplain regulation requirements, park and school land dedication requirements, stormwater detention facilities, open space or landscaping requirements and marketing considerations. These requirements can break a project—or make it.

Both public agencies and private developers should look to the concept of multiple use to provide needed facilities and desirable amenities which improve the quality of life. Shared land, shared facilities, and shared construction and maintenance responsibilities can all help meet the needs of society at reasonable cost. Good planning can assure multiple use. Bad planning results in loss of opportunity for multiple use and higher costs to the public.

This is not a new concept but it is too often overlooked or ignored. The purpose of this paper is to focus on concepts of multiple use and examples of public- and private-sector multiple use projects in the Denver area.

Channels

Flood control channels, whether

built for remedial purposes or as part of new development, offer the opportunity for greenbelts and trail systems. Maintenance trails can easily double as hiker/biker trails (Figure 1). Pocket parks can be created at intervals along the channels. These are small parks which can consist of play ground equipment, benches, picnic tables, bicycle racks, exercise stations, drinking fountains, trash receptacles, etc.

The type of channel can obviously affect the amenity provided. For example, the Urban Drainage and Flood Control District (UDFCD) and the City of Denver had planned to con-

struct a concrete channel for a section of Weir Gulch at its confluence with the South Platte River to remove a public housing area from the floodplain. A citizen's group called the Platte River Development Committee (PRDC, now the Greenway Foundation), which was revitalizing the South Platte River with parks, trails and other amenities, proposed a joint flood control and recreation project for Weir Gulch. With additional funds provided by the PRDC the three parties were able to acquire additional right-of-way which permitted the construction of a blue grass channel, boat launching lagoon providing



Fig. 1—
Littles Creek
channel and
trail.

Fig. 2—Weir
Gulch
channel and
park.



access to the river, parking lot with basketball court, and play structure. The end result was a facility that not only provides the desired flood protection, but is a park for the housing area and provides a link to the South Platte River facilities (Figure 2).

Detention

Detention facilities can include every type of facility from major Corps of Engineers' flood control projects to the smallest of "on-site" ponds. Several examples of multiple use detention facilities are given below.

Holly Dam. Holly Dam controls a drainage area of 2.1 square miles. The 100-year flood volume of 252 acre-ft. will be contained in the flood pool which is owned by the South Suburban Recreation and Park District. The park district has constructed tennis courts in a terraced fashion stepping down into the flood pool. The lowest courts are at the 10-year flood pool elevation. They have been flooded once in the 7 years since they were built (Figure 3). A soccer field was rough graded into the flood pool in the embankment borrow area at the time of construction but has not yet been developed. Maintenance of the facility is shared by the UDFCD and the park district.

Englewood School Detention. The UDFCD and the City of Englewood determined that the best solution to a flood control problem on Little Dry Creek was the construction of a side-channel storage facility to shave the peak from flood hydrographs. Fortunately, the ideal location for such a facility was the 11 acre athletic fields of Englewood High School. The school board, although originally skeptical of the idea, eventually agreed to the concept. The resulting project provides 89 acre-feet of flood storage. In return for the authorization of the school board to use the land, the project added blue grass sod, one additional soccer field, concrete bleachers, concession stand and an office/press box. The school district maintains the bulk of the facilities, with the flood control maintenance responsibility limited to the inlet and outlet facilities, as well as after storm clean up.

On-Site Detention. Local on-site detention to maintain peak discharges at pre-development levels is required by many Colorado communities. These facilities can be stuck away in a corner where they are neglected, become maintenance problems and/or lose their effectiveness;

or, they can be integrated into the overall development plan where they become assets to the development, and, because they are assets the chances of them receiving the needed maintenance are greatly enhanced. Figures 4 and 5 show how these on-site facilities can function as multiple use assets.

Open Space

Open space, particularly riparian land, is most beneficial to the overall quality of life of an area. In many instances in the Denver area, developers have found that the best way to address the flood hazard potential is to set the floodplain aside as open space area as an integral part of the development plan. With the addition of trails for hikers/bikers and for maintenance activities the flood-

plains become linear parks and connecting links between different portions of the community (Figure 6). One caution is that the increased frequency and amount of runoff resulting from urbanization can cause significant erosion problems which should be addressed at the time of development.

Trails

Trails are perhaps the most common example of multiple use. Every flood control facility, whether a channel or an open floodplain, should have a maintenance trail along its entire length. The UDFCD constructs maintenance trails along all of its channelization projects. The fact that these trails can also be used for hiker/biker trails is a bonus to the community.

On the other hand, trails built as



Fig. 3—Holly Dam tennis courts flooded.

Fig. 4—Detention in a park.



hiker/biker facilities can also be used to provide access for flood control maintenance purposes. For example, when the Colorado Greenway proposed a trail along Beaver Creek it provided the opportunity for the UDFCD to open up an almost inaccessible reach of Bear Creek by joining with the other trail sponsors to provide a part of the construction costs. The end result of the Greenway project was a recreational trail which also provides flood control maintenance access. Another example is a joint project between the UDFCD and the Greenway Foundation for a trail link along Lakewood Gulch from the South Platte River to a Denver park six blocks away (Figure 7).

Guidelines For Multiple Use

Over the years the UDFCD has developed an informal set of guidelines to assist in the formulation of multiple uses. These guidelines are summarized below:

1. Uses must be compatible with the flood control purposes of the facility. Park, recreation and open space uses offer the greatest opportunity for multiple uses.
2. Public land is expensive to acquire and maintain. Multiple use can result in shared acquisition and maintenance costs. Look for right-of-way already in public ownership, or look for a potential "partner" in the use and maintenance of a project site.
3. Consideration of multiple use possibilities should begin early in the project planning stage. Multiple use should always be foremost in the minds of the planners.
4. Multiple use facilities develop a greater constituency for their continued operation and maintenance than single purpose projects, particularly flood control projects which function only occasionally.
5. Multiple use typically involves more than one agency. Future responsibilities; particularly maintenance, public safety and liability exposure; must be understood and accepted up front.
6. Multiple use can be stimulated by local governments through many avenues, such as the transfer of development rights.

A Final Example

Diligence in the pursuit of multiple use concepts for the Hidden Lake



Fig. 5—
Skyline Park
in downtown
Denver.

Fig. 6—Open
space trails
and picnic
area.



Fig. 7—
Lakewood
Gulch Trail.

Outlet Channel project resulted in a unique multi-faceted project involving several agencies. The situation at the beginning of the project was this. The Hidden Lake Dam embankment had been declared unsafe by the State Engineer. The lake provided a valuable benefit, however, in reducing downstream flood peaks and the UDFCD wanted to insure the continued existence of the reservoir in order to decrease the required size of downstream channel facilities. The right-of-way needed to construct the required outlet channel, service spillway and emergency spillway consisted of two parcels: the Shattuck parcel, consisting of 9.7 acres; and the Kareus/Sullivan parcel of 6.0 acres.

The following arrangements were developed to secure the acquisition and long term use and maintenance of the two parcels. The Shattuck parcel was acquired through negotiation; with Hyland Hills Metropolitan

Recreation and Parks District, Adams County Parks and the Land and Water Conservation Fund providing \$197,000 and UDFCD and Adams County Public Works providing \$35,000. The Kareus/Sullivan parcel was acquired through eminent domain proceedings by UDFCD and Adams County Public Works at a cost of \$222,156.

Title to the Shattuck parcel was vested with Hyland Hills, and the flood control interests were given easements for the outlet channel, service and emergency spillways and embankment. Title to the Kareus/Sullivan parcel rests with UDFCD, although it will eventually be transferred to Adams County. Hyland Hills has executed a long term lease with UDFCD for the use of the parcel with such uses being consistent with the proposed emergency spillway. Hyland Hills has constructed four ball fields on the two parcels using proceeds from the Col-

orado Lottery. A major concession facility is also planned.

The end result of this project is a 15.7 acre park and flood control facility. The combined funding (from 6 sources) resulted in facilities which would have been significantly more expensive to implement independently. The UDFCD will maintain the flood control facilities, while Hyland Hills will maintain the ball fields, including the emergency spillway area.

Summary

Multiple use concepts are a viable way in which to combine uses of land and monetary resources to obtain multiple objectives at a lesser cost to each of the individual interests. Flood control uses are particularly suited to be combined with park, recreation and open space uses. Examples of various types of multiple use projects in the Denver area demonstrate the value of this concept.

On the light side—



Not everyone likes parks which double as detention ponds.

Routine Maintenance of Flood Control Facilities

by Dave Bennetts,
Field Maintenance Supervisor

An important part of the District's Maintenance Program is routine maintenance on improved drainageways and flood control facilities. Routine maintenance consists of regular, scheduled mowings of native vegetation, trash and debris removal, and weed control. This type of maintenance is sometimes considered less important than the more obvious types of maintenance such as repair of drop structures or channel shaping but it plays an important part in the total maintenance of a drainageway. Routine maintenance is also the fastest growing of the three maintenance categories. The 1985 routine maintenance program is 13.5% larger than last year's in terms of dollar volume of work done.

Mowing consists of cutting the native vegetation to a height of 6 to 8 inches at regularly scheduled intervals through the spring and summer growing season. Usually a drainageway is mowed 3 to 5 times per year. Mowing stimulates growth in the vegetation and helps control weeds that may invade the native grasses. Mowing also helps control rodents that may live in the tall grasses.

Removal of trash and debris from drainageways serves two purposes. First, removing large debris helps prevent excess damage to streets and bridges during a flood due to debris blockage of bridges and culverts. The type of debris we remove includes tires, shopping carts, dead trees and domestic trash such as old couches and dryers that are often dumped on drainageways. These trash and debris removals are done three to five times per year depending on the drainageway. Second, by keeping a drainageway clean and functioning properly it becomes something that the neighborhood appreciates and protects. This helps reduce the amount of domestic trash dumped in the drainageway.

The maintenance program pursues weed control by using two different approaches. One is properly timed mowing of the vegetation. This is the preferable method and should be done such that the weeds don't have a chance to get tall and go to seed. The second method of weed control is by direct chemical application. This is scheduled as required based on field inspections and is the most effective method when there is a strong stand of weeds.

The goal of the routine mainten-

ance program is to reduce the potential for flood damage and to keep the drainageways functioning as designed. We also strive to provide the neighborhoods with an aesthetically pleasing drainageway that they can be proud of. The routine maintenance program will continue to provide this level of service and contribute to the total maintenance of the drainageway.

Wetlands (continued)

thoughts for design and analysis of this type of channel:

1. The channel hydraulics should be analyzed for two conditions.
 - (a) Velocities, and consequently the allowable longitudinal slope of the channel, should be based on a new or "smooth" channel with a Manning's n of about 0.035.
 - (b) Depth, on the other hand, should be determined on the basis of a mature channel with fully developed wetland vegetation. The Manning's n value in this case could easily exceed 0.1, particularly in a small channel. (See "Determination of Roughness Coefficients for Streams in Colorado" by USGS).
2. The growth of significant amounts of wetland vegetation in the channel bottom tends to slow the water down and promotes aggradation of the channel bottom. This, in turn, promotes additional growth, lower velocities, more aggradation and so on. Therefore, additional freeboard should be provided to account for the loss of capacity resulting from aggradation.

An example of a fictitious channel using simple normal depth calculations follows:

Example:

Given:

$Q_{100}=1000$ cfs	Allowable velocity = 7.0 fps
Bottom width = 20'	Allowable depth = 5.0'
Side slopes = 4:1	Allowable Froude No. = 0.80
New channel $n = 0.035$	Mature channel $n = 0.105$

Using normal depth calculations find:

1. New channel allowable slope, velocity, Froude number and depth
2. Mature channel depth

A slope of 0.007 with $n=0.035$ gives a depth of 4.0', a velocity of 6.9 fps, a Froude No. of 0.73 and a top width (with 1' of freeboard and

a 10' wide maintenance trail) of 70'.

Now for a mature channel with an $n=0.105$ the depth becomes 6.8', the velocity drops to 3.1 fps, the Froude No. become 0.26 and the top width (with 1' of freeboard and a 10' wide trail) is 93'.

It would be irresponsible, and certainly not in the public interest, to design or accept a design for a channel which would so dramatically lose its flood carrying capacity over time. It is therefore imperative that channels without trickle channels be analyzed for both new and mature conditions.

Some other comments concerning wetland bottom channels are appropriate here. The District's staff has no basic quarrel with the concept of wetland bottom channels with two caveats. First of all, a distinction must be made between channelization along an undeveloped or "virgin" floodplain and channelization in already developed areas which is undertaken specifically for the purpose of alleviating *existing* flood hazards to *existing* development. In other words, a flood control channel being built to reduce flood damages to existing housing and other structures within the floodplain should be treated differently than channelization in newly developing areas. The reason for this distinction should be obvious. Where people are already at risk due to mistakes made before the concept of floodplain management had taken hold, the provision of adequate flood protection should take precedence over preserving or enhancing wetlands, particularly when the wetlands mitigation requirements cause huge increases in project costs. People should come first. In newly developing areas, the developers and the local approving authorities have the opportunities to make adjustments *before* people are put at risk. The second caveat is that the remaining criteria for eligibility for District maintenance assistance will still apply.

The District will continue to closely monitor this emerging issue, and will attempt to respond in a manner which is consistent with national goals of flood hazard reduction and environmental quality. Suggestions and comments concerning the above will be most welcome. Send your comments to Bill DeGroot, Urban Drainage and Flood Control District, 2480 West 26th Avenue, Suite 156-B, Denver, CO 80211.

FIGHTING THE FLOOD OF PAPER [Case History]

by

Paul A. Hindman, Project Engineer

UDFCD vs RAILROAD

This is the first article in a continuing account of true stories of governmental paperwork. I hope everyone finds some humor, possibly disgust, and helpful hints to avoid the following bureaucratic roadblocks.

Fall, 1981—

The City requested the Urban Drainage and Flood Control District improve a portion of a Drainageway along a roadway. At the downstream end the direction of the Drainageway turned sharply to the North (90°) because of the North-South tracks of the Railroad. During high flows (which occurred at least once a year), the water flowed down the Drainageway, missing the turn at the railroad track (it's sometimes hard to get moving water to make 90° left turns) thereby flooding the intersection of the railroad tracks and the road.

May, 1982—

The District hired an engineering consultant to design improvements to the Drainageway which included a transition area at the downstream end to help turn the water to the north, thereby reducing the amount of damage to the intersection of the railroad and the roadway. It should be noted here that all proposed improvements were at least thirty feet (30') west of the tracks but were in the railroad right-of-way. No interruption of train service was proposed.

November, 1982—

The District's Project Engineer contacted the local office of the Railroad by letter requesting they permit us to construct improvements on railroad right-of-way. Subsequent to that letter a "General Application for Railroad Right-of-Way Encroachment" was submitted for approval.

The local railroad agent stated that the Wyoming and the Nebraska offices would also have to approve the application but stated that "everything looks fine."

Also in November the District hired a contractor to construct the improvement along the roadway assuming that towards the end of the project everything would be clear with the Railroad and the transition area could be constructed (bad assumption!).

March, 1983—

After several months of phone calls

to the Railroad's local, Wyoming, and Nebraska offices it was determined the application had never left the local office. The District's contractor was finishing up the other portions of the project so the District's Executive Director transmitted a letter to the Railroad's Nebraska office explaining the situation.

April, 1983—

The application finally left the local office and went to the Nebraska office. They said they had several design questions concerning the improvements (design? we're at the end of construction!). The Wyoming office was considering the design questions raised by the Nebraska office and indicated they would get back to the District at a later date (keep reading—it gets better!?).

June, 1983—

The Contractor had long since finished the job. A transition section from the improved channel to the natural channel was installed upstream of the railroad property until such time as an agreement could be reached with the railroad for construction on their property.

The Nebraska office apparently worked out all of their concerns and submitted a *Drainage Ditch Encroachment* permit for the District to sign and return. The District's lawyer reviewed the permit and found two slight problems which were as follows:

- 1) The District was to control the water in the Ditch "... to the end that no water shall at any time overflow from the Ditch onto the adjacent property of the Licensor," meaning that during and after construction the District was to keep *all* water off of railroad property.
- 2) The District was liable for any damage to the railroad because of "the existence of the Ditch".

September, 1983—

After several more phone calls between the District's staff and lawyers to the Railroad's staff and lawyers, all problems had apparently been worked out. The District's lawyer then sent a marked up copy of the permit to the Railroad.

March, 1984—

The Railroad sent a so called

"revised" permit to the District's lawyer stating all changes had been made and to please sign the permit and return it. In actuality, only one of the items had been revised relating to water control. As the permit was worded the District was still liable for any damage as to "the existence of the Ditch".

April, 1984—

The District's Executive Director wrote a "to the point" letter to the Railroad explaining that the District tried to solve some of the flooding problems which in our opinion would help the Railroad but obviously the Railroad was not of the same opinion, therefore the District was cancelling the project, as it related to the Railroad.

May 18, 1984—

The Railroad sent a letter to the District's lawyer stating that the last permit they had sent to the District had all the necessary revisions and since the District was now cancelling the project, the Railroad was investigating "... what volume of water the District may be discharging onto the "(railroad) right-of-way (now or in the future..." and that they would "... hold the District responsible... for such damage" (and) "... also for any corrective measures necessary to prevent such damage...".

As you can see the situation had gone from bad to worse.

May 29, 1984—

The District's lawyer sent a letter to the Railroad's lawyer stating three items.

- 1) The District had done nothing to increase the flow of water;
- 2) The District was willing to help alleviate any existing high water problems which the Railroad currently experiences at no cost to the Railroad, and;
- 3) If the Railroad suffers any damage due to flooding it is because the Railroad was unwilling to grant a *reasonable* encroachment permit.

September, 1984—

The City sent a request to the District to proceed with the project and stated that they would work things out with the Railroad.

March, 1985—

Trudy Is Retiring

The City's Council passed a resolution instructing City staff to do whatever was necessary to clear things up with the Railroad.

The Railroad's local registered agent sent a letter to the City's lawyer "assuring" that the Railroad is willing to "... cooperate with the City on this project."

The City's Director of Public Works wrote a letter to the local registered agent stating that if the Railroad did not issue a reasonable permit to the District by April 15th, 1985, the City would seek legal remedy. The City's intent was to condemn the Railroad property if the permit was not granted.

April, 1985—

The Railroad sent to the City their standard encroachment permit application (de ja vu 1982). They stated that once the application had been filled out they could "best determine if a meeting with you (the City) and your staff is necessary."

June, 1985—

After several telephone conversations between the Railroad's lawyer and the City's lawyer, an understanding was reached to delete the two items which were previously of concern to the District (see June, 1983). In place of the two items it was agreed that the Contractor constructing the drainage improvements would purchase railroad protective insurance. The City informed the District that they would pay this expense if necessary. The District signed the permits to be transmitted to the Railroad.

It appeared that things were getting better so the District contacted their consultant again to update the design for the Drainageway.

July, 1985—

The Railroad's lawyer and the District's lawyer had a few more items to work out, which they did. The District had a permit in hand. Finally!

If the reader got confused, disgusted, or tired of the above true story, you are not alone. It's now at the end of 1985 and the District still hasn't started construction but plans to before the year is out. Be watching next year when I'll tell you the answer to the three-year-long question. "Will these Drainageway improvements ever get built?"

An era of the District will end with the retirement of Trudy Nash, the District's Chief Accountant, in February, 1986. Trudy started with the District in April, 1975 as Accountant. At the time Trudy started, our accounting system was being revised by Van Schooneveld and Company. The development of the system by Van Schooneveld provided the District with the basis of an accounting system, but it was Trudy who made it work. Since then Trudy has developed the District's accounting system into a dependable, accurate, and efficient system that has provided us with the timely information needed to manage the District and all of its projects.

The growth of the accounting function has been significant. At the end of 1975 the total equity of the District was \$4,593,000; at the end of 1984 this had increased to \$25,088,000. In 1975 the District was involved in only five construction projects. I could name them—Sanderson Gulch, Weir Gulch, Lakewood Gulch, Viele Channel and Holly Dam. Also in 1975 the District did not have a maintenance program. In 1985 there were 16 active construction projects and 15 active design projects being handled through the Design and Construction Program, more than I can name without some digging. In 1980 the maintenance program was fully funded and Trudy adapted the accounting system to accommodate its needs. The Maintenance Program differs from the Design and Construction Program in that it has smaller, but more projects and contracts. As a case in point the 1985 Maintenance Work Program contained 176 individually identified efforts. The maintenance accounting system was developed on the basis of type of maintenance (routine, restoration, or rehabilitation), county in which maintenance was performed, and contractor doing the work.

Trudy has accomplished all this with the help of only one accounting

assistant who is now Pat Beeson. The volume of work being handled has increased many times more than the number of people involved has increased. This is simply a tribute to Trudy's efficiency and accuracy. In fact our auditors are always amazed at how clean our books are and of the volume of work that is being processed.

Trudy has also been a tremendous factor in the personnel area. She has been the key in developing our insurance program including health, dental, disability, and life insurance packages. Her experience in personnel issues has been invaluable in developing personnel procedures. She keeps track of all vacation and sick leave of each employee. She handles the bonding requirements for the Board of Directors. She is our expert for our retirement and social security replacement plans. If anyone has a question Trudy is the one who can answer it or find the answer.

Before joining the District, Trudy was with Package Creators, Inc. of Denver, Colorado; manufacturers of paper boxes and related products for 23 years. She served as their accountant, office manager, corporate assistant secretary, and corporate director.

Trudy enjoys traveling, crafts, reading, and spectator sports. Retirement will give her more time to enjoy these activities. Also, I am sure her accounting skills will not go unused when various organizations in which she is involved find out she might have some time.

Two things for sure. Trudy has made a unique and invaluable contribution to the District as its first and only accountant since 1975. The second is that I and all the employees of the Urban Drainage and Flood Control District will miss her. We all wish her the best and look forward to hearing about her exploits as she goes forward from here.

Good luck Trudy!

LST



Trudy Nash flanked by Board Chairman Cathy Reynolds and Executive Director Scott Tucker.

DRAINAGEWAY MAINTENANCE OF CHERRY CREEK CHANNEL

by
Frank Rosso, Project Engineer

The City and County of Denver, Wastewater Management Division and the Urban Drainage and Flood Control District, Maintenance Program, broadly inventoried and identified drainageway maintenance needs in the City and County of Denver. Cherry Creek, from Confluence Park at the South Platte River upstream to Cherry Creek Reservoir, was one of the drainageways inventoried. The inventory and identification process categorized the needs for the Maintenance Program service disciplines; including routine maintenance, restoration, and rehabilitation.

Routine maintenance primarily consists of periodic mowing, occasional debris and trash pick-up, and revegetation and weed control operations. Drainageway restoration includes projects such as tree thinning and brush removal from overgrown drainageways, correcting erosion and scour problems along channels or at conduit outfall points, and revitalization of detention ponds. Drainageway rehabilitation involves the rejuvenation of existing major drainageway improvements such as drop structures, major channels, trickle channels and conduits. Generally rehabilitation projects require technical services and design by an engineering consultant.

Since 1980, considerable drainageway maintenance has been accomplished on Cherry Creek in Denver. Routine services have been performed on an annual basis. Drainageway restoration, such as tree thinning, rubble and waste removal, maintenance access construction and streambank stabilization have also been accomplished. To date, the Maintenance Program has expended approximately \$500,000 for routine maintenance and restoration services on Cherry Creek in Denver.

Early in 1985, two significant drainageway rehabilitation projects were identified from the inventory of Cherry Creek. These projects involved streambank stabilization and erosion protection along selected reaches, and the rehabilitation of drop structures. One project involved the installation of erosion protection in areas where severe erosion had occurred. This project was within the walled section of Cherry Creek, predominantly near the Auraria Campus at Champa Street and Speer Boulevard; another portion of the project was near Denver General Hospital at Eighth Avenue and Speer Boulevard;

and the remaining portion was downstream of the Denver Country Club at Second Avenue and Logan Street. Two types of erosion and streambank protection measures were constructed. Rock riprap was one of the erosion protection measures installed. It is the most commonly used measure in the metro area other than broken concrete. "Tri-Lock" erosion protection was the other measure implemented on this project. The completed construction cost for this project was approximately \$165,000.

Mr. David Bennetts was the Maintenance Program's Project Engineer managing this project. McLaughlin Water Engineers, Inc. was the design consultant and provided construction related services during construction. Mr. Jon Sorenson was the consultant's representative.

The other project involved the reconstruction of six existing drop structures near the Cherry Creek Shopping Center, at University Boulevard and Cherry Creek Drive, and near the historical site of the "Four Mile House" at Cherry Street and Cherry Creek Drive South. All of the existing and completed drop structures were geometrically the same. Each existing drop structure was 16 to 20 feet long and 110 feet wide with a 4 to 5 foot drop through each structure. The new structures are 60 to 65 feet long and 110 feet wide with the 4 to 5 foot drop through each structure. The completed drop structures are classified by the Urban Drainage and Flood Control District's criteria as sloping riprap drop structures with a crestwall. The completed construction cost for the drop structure rehabilitation project was approximately \$410,000.

Mr. Frank Rosso was the Maintenance Program's Project Engineer managing the drop structure rehabilitation project. Mr. John Griffith, of J.S. Griffith Project Consultants, was the designer and consultant's representative for this project.

In conclusion, the Cherry Creek channel has historically been, and will continue to be, a multi-use artery for active and passive recreation, a transportation corridor, a flood control facility, an aesthetic resource and an environmental enhancement for the City and County of Denver. As we are all aware, there is great concern about the deterioration of our nation's infrastructure relative to public facilities. The Urban Drainage and Flood Control District's Maintenance Program, in cooperation with the City and

County of Denver, Wastewater Management Division, is implementing projects and improvements to preserve the proper function of the major drainageway infrastructure in Denver.



Cherry Creek drop structure.

DROP STRUCTURE STUDY

The Urban Drainage and Flood Control District has retained McLaughlin Water Engineers, Inc. to conduct an evaluation of drop structure design and specifications. The purpose of this project is to prepare working documents which will assist designers in the selection, evaluation, and design and specification of drop structures. The study is being conducted in two phases with McLaughlin responsible for the first phase.

The first phase consists of a literature search; a review of the design, construction and performance of drop structures built in the Denver metropolitan area; an evaluation of maintenance needs and an evaluation of research needs. McLaughlin will also develop a decision matrix which will assist designers in selecting the most appropriate drop for a site specific problem.

The final report for the first phase will be available in mid-1986. After a review and comment period, during which Denver area consultants will be given the opportunity to voice their opinions, we will proceed into the second phase which will consist of the development of revisions to the appropriate sections of the *Urban Storm Drainage Criteria Manual* as it relates to the design and construction of drop structures. The consultant for the second phase has not been selected.

Anyone interested in commenting on the first phase report should write Bill DeGroot, Chief, Flood Plain Management, Urban Drainage and Flood Control District, 2480 W. 26th Ave., 156-B, Denver, CO 80211.

Tucker—Talk *(continued)*

dialogue seemed to go in circles. It was the Senate staffer's position that the only way we could tell what was in those stormwaters out there is to get sampling information. Further, municipalities should not be concerned about the high cost because EPA will have to be "reasonable" and it will be impossible to obtain samples from every municipal storm sewer. I pointed out that there was a Nationwide Urban Runoff Program (NURP) sponsored by EPA that did sample many storm sewer discharges in the United States and that a general categorization is already available. What we do not know is what the impact is on the receiving waters. That is very variable. If we just go out and get more random samples from storm sewers we are not going to learn any more than what we already know. If we want to identify all discharges that contain toxic or dangerous pollutants all storm sewer discharges will have to be sampled and we are back to a very costly program. So we just go around in circles.

I make an issue out of this because however it is resolved it is going to have a substantial impact on local governments. As the law is right now, and as regulations are now being promulgated by the EPA, dischargers of stormwater point sources in municipalities will be required to obtain permits. It is my opinion that the administrative burden will range from bad to disastrous and after permit applications are submitted and all those resources are expended, the waters of the nations will not be one bit cleaner for it.

An even bigger concern and one that is not addressed at all in EPA regulations promulgated to date is what the requirements will be to obtain a permit. What will EPA require local governments to do in order to purify the stormwaters? Will civil penalties, which are part of the Clean Water Act, be used to enforce the permit requirements? Will there be some sort of cost/benefit analysis made of permit requirements? Or will local governments be summarily told what they must do to obtain a permit regardless of cost?

The only real possibility to reinsert some common sense in this process is to modify the Clean Water Act. This will mean legislation by Congress. I suggest that Congress change the Clean Water Act to exempt municipal storm sewer discharges from the NPDES Permit system. A study should be undertaken by EPA that identifies a more reasonable approach

to municipal storm sewer discharges. Such an approach should be centered on receiving water impacts and should require studies to be made of those stormwater discharges that are known to impair receiving water uses. These studies should collect sampling data, propose methods to improve the stormwater quality, estimate the cost of those proposals, and based on cost and effectiveness analysis submit recommendations for that particular storm sewer discharge. It may be more cost effective to eliminate the pollutants from entering the stormwaters rather than to try to remove the pollutants at the end of the pipe. In some cases, it may be possible to use other methods to improve the quality of the stormwater. In any event, the objective should be to concentrate on problem areas, consider what is possible, consider what the costs are, consider what the beneficial impacts are, and then make recommendations accordingly. If this is a national problem of significant concern to Congress then Federal money should be provided to assist in this process. I would suggest a 50/50 cost sharing arrangement between the Federal government and local and State interest.

Congress is reluctant to change the Clean Water Act as I have suggested, but they may be willing to consider such a change if local interests appeal to their Congressional delegates and impress upon them the cost to the citizens of the United States of the direction that the program is now going, and to offer to them rational alternatives. I urge anyone who shares my concern to contact their Congressional representatives and express their concerns to them.

Planning *(continued)*

provements to USDCM.

IF YOU WOULD LIKE TO PRESENT A PAPER DURING "THE FIRST ANNUAL USDCM USER GROUP MEETING", send me a one page (250 word maximum) abstract. Everyone is invited to do so and we will make every effort to include everyone wishing to present a paper in the program.

Storm Sewer Design Program

The District recently awarded a contract to UCD to develop a user friendly, interactive personal computer program for the design of storm sewer systems. It is our goal to have a program that utilizes the hydraulic and hydrologic techniques described in the USDCM and that could also interact with the CUHPE/PC program. Work has just begun and, if everything goes on schedule, we

should be receiving an evaluation draft before the summer. Once a fully working program is available, we hope to make it available to all interested parties.

NEW STAFF MEMBERS IN 1985

PAUL HINDMAN

Paul Hindman joined the District in January, 1985, as Project Engineer in the Maintenance Operation. Paul has been working primarily with projects located in Jefferson, Adams and Boulder Counties.

Paul came to the District from Muller Engineering Company where he was a project engineer responsible for public works projects including design and construction of water, storm and sanitary systems. Paul has also had experience with Neilsen, Dragos Engineers, Inc. of Buena Vista, Colorado and the Denver office of Camp Dresser & McKee.

A vacancy occurred in the Maintenance Department when Dave Lloyd transferred from the Maintenance Operation to Design and Construction.

I welcome Paul to the District. Since January Paul has been busy keeping those maintenance projects humming.

FRANK DOBBINS

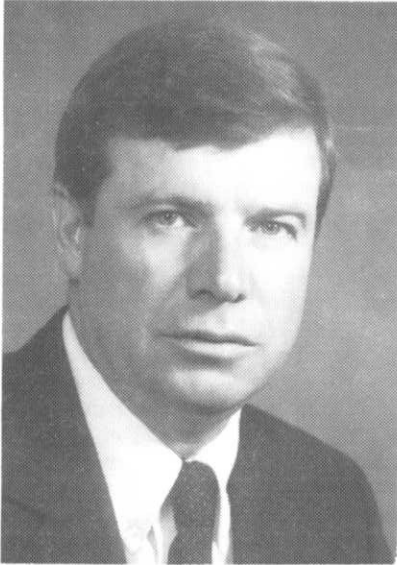
Frank Dobbins joined the District in October, 1985. Since joining the District, Frank has been responsible for developing a computerized data management system for the District's accounting functions. Frank will assume the position of Chief Accountant upon the retirement of Trudy Nash.

Frank came to the District from Benefit Control Center, a subsidiary of the Crane Corporation where he served as Office Manager/Controller. Prior to Benefit Control Center, Frank served as an accountant and auditor for the City of Englewood for eleven years.

The District has a manual accounting system that has worked very well. Frank's challenge is to convert the manual system to a computerized system that also works well and will have flexibility for continued growth in the future.

I welcome Frank to the District and wish him the best of luck for that process known as "computer conversion". It is proving to be challenging and on some occasions perhaps even frustrating, but in the end quite satisfying.

**MEET THE NEW
BOARD MEMBERS**



FRANK McCURDY

Frank McCurdy was appointed to the District 2 Commissioner seat in Douglas County in August, 1983 after a vacancy occurred. He was elected to his first full four-year term as a commissioner in the November, 1984 general election.

McCurdy earned a master's degree in business administration from Auburn University and his bachelor's degree in electrical engineering from the New Jersey Institute of Technology in Clifton, N.J.

He is also a graduate of the U.S. Air Command and Staff College and is a former Air Force fighter pilot. He also served with the U.S. Air Force in the Pentagon as a staff officer.

McCurdy currently is employed by United Airlines as a pilot and has been a flight instructor and manager.

BOARD OF DIRECTORS

EXECUTIVE COMMITTEE:

- Cathy Reynolds, Chairman
City of Denver
- Steve E. Cramer, Chairman Pro-Tem
Adams County
- Ruth A. Correll, Secretary
City of Boulder
- Arlen E. Patton, Treasurer
Engineer
- Eugene L. Otis, Member
City of Englewood

MEMBERS:

- George Hovorka
City of Westminster
- Robert Brooks
Arapahoe County
- David A. Day
Engineer
- Frank McCurdy
Douglas County
- Paul L. Swalm
City of Denver
- Josie Heath
Boulder County
- Federico Peña
City of Denver
- John Mrozek
Alternate
- M.L. "Sam" Sandos
City of Denver
- Nelson McNulty
City of Edgewater
- Rich Ferdinandsen
Jefferson County

DISTRICT STAFF:

- L. Scott Tucker,
Executive Director
- Bill DeGroot, Chief
Flood Plain Management Program
- Kevin Stewart,
Project Engineer
- Ben Urbonas, Chief
Master Planning Program
- B.H. Hoffmaster, Chief
Design & Construction Program
- Dave Lloyd,
Project Engineer
- Mark Hunter, Chief
Maintenance Program
- Frank Rosso,
Project Engineer
- Paul Hindman,
Project Engineer
- Dave Bennetts,
Field Maintenance Supervisor
- Jerry Corder,
Field Maintenance Supervisor
- Gertrude Nash,
Chief Accountant
- Frank Dobbins
Accountant
- Pat Beeson,
Jr. Bookkeeper
- Cindy Griego,
Executive Secretary
- Galene Bushor,
Secretary/Receptionist
- Vivian Austin,
Secretary/Receptionist
- FLOOD HAZARD NEWS**
Bill DeGroot,
Editor

THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

2480 West 26th Ave., #156-B
Denver, Colorado 80211

**BULK RATE
U. S. Postage
PAID
Permit No. 460
Denver, Colo.**