



FLOOD HAZARD NEWS

Vol. 21, No. 1

December, 1991

A COOPERATIVE APPROACH TO PREPARATION OF AN NPDES APPLICATION

by

Ben Urbonas, P. E., John Doerfer, and L. Scott Tucker, P. E.

INTRODUCTION

By now everyone dealing with stormwater management and engineering knows that the 1987 reauthorization of the Clean Water Act (CWA) mandates all municipalities in the United States to obtain a National Pollution Discharge Elimination System (NPDES) discharge permit for their separate stormwater systems. The 1987 CWA treats municipal and industrial stormwater discharges as point sources and provides for issuance of permits under Section 402. Scott Tucker first reported on this topic in the 1985 *Flood Hazard News* (FHN) "Tucker Talk." Since then we have tried to keep you up to date on its evolution and status (see FHN 1986 through 1990). The purpose of this article is to describe the joint effort by the District, Aurora, Denver and Lakewood to prepare NPDES permit applications for those three cities.

JOINT TASK FORCE

The final Environmental Protection Agency (EPA) municipal NPDES separate stormwater regulations became effective on November 16, 1990. In the last issue of FHN we reported that a joint effort between the District, Denver, Aurora and Lakewood was started to help each city prepare their NPDES discharge permit applications. What has been accomplished since then is an example of how municipalities and regional, state and federal agencies can work together to get this federally mandated job done.

In February of 1990, the Urban Drainage and Flood Control District began discussions with Aurora, Denver, Lakewood and Arapahoe County, all of which were believed to have populations exceeding 100,000. As it turned out, Arapahoe County, in

the final EPA regulations, was not listed as having an unincorporated urban population of 100,000 and it decided to delay its application until the 1992 moratorium expires. Nevertheless, the three cities and Arapahoe County, in April, set up a Joint Task Force (JTF). Despite its decision to hold off on permit application, Arapahoe County staff continued to actively participate in all JTF meetings.

Goals and Objectives

The first official task of the JTF was to define its goals, objectives and responsibilities. It listed the following as its goals for the Part 1 portion of the NPDES application:

- *Coordinate application effort of the three cities,
- *Jointly negotiate application requirements with the State of Colorado,
- *Jointly conduct activities whenever possible and practical,
- *Share knowledge and experience between applicants,
- *Facilitate use of resources of other organizations,
- *Evaluate which BMPs are most effective and reasonable,
- *Develop dry weather screening work plan,
- *Develop a joint stormwater monitoring program for Part 2.

Responsibilities

Responsibilities of each member of the JTF were identified and agreed upon at the same time its goals and objectives were clarified. First, all initial commitments by JTF members were only for the preparation of Part 1 of the NPDES application. Second, the underlying responsibility for the preparation of the NPDES application rests with each local government. Third, the public

works or utility departments of each local government will coordinate the permit application activities within their municipality.

The District agreed to coordinate the JTF activities and to provide technical support as needed and appropriate. In addition, the District agreed to contract for all support consulting and other services using its own resources during the Part 1 phase of the application process. The activities of the JTF were recently extended into Part 2 of the application process as discussed later in this article.

Consulting Services

With the stated goals and objectives, and the above responsibilities in mind, JTF helped the District select a consultant to provide advice, technical information, data, reports and training on an as needed basis. The selected consultant, CH2M-Hill, was hired by the District in June, 1990, and, to date has provided the following:

- *Attended progress meetings and offered advice when needed,
- *A manual of "Proposed Stormwater NPDES Protocols",
- **"Dry Weather Screening Analysis Protocols - Training Manual",
- *Two-day dry weather screening training course,
- *Assembled and delivered much of the material contained in "Joint Appendices," which contains information common to all municipalities within the District,
- *Mockup of the Part 1 Application format for cities to use, and
- *List of waters impacted by urban runoff identified in various State of Colorado reports.

In addition to the products and services provided by CH2M-Hill, the

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1991 Professional Activities of District Staff

Scott Tucker, Executive Director

- *"Impact on Local Governments", presented at APWA Clinic on Understanding the Storm Water Permit Regulations, Phoenix, in February.
- *"Stormwater Regulations," presented at Colorado GEM Environmental Seminar in Denver in March.
- *"The Day the Rains Came - We'll Do What We Can, But Can We Do What They Want," coauthored with Ben Urbonas, presented at 1991 Conference on Colorado Environmental Regulation: Where Is the Pendulum Now? in Denver in April.
- *Testified before House Water Resources Subcommittee on behalf of the National Association of Flood and Stormwater Management Agencies, on Stormwater Issues to Consider in the reauthorization of the Federal Water Pollution Act, Washington, D.C. April 25, 1991.
- *"The Denver Metro Area's Approach to Preparing Municipal Stormwater Permit Applications," Presented at ASCE Conference on Water Resources, Planning and Management/Symposium on Urban Water Resources in New Orleans in May.
- *."Implementing the Stormwater Regulations," presented at the Association of State Floodplain Managers Annual Conference in Denver in June.
- *Chaired Panel Session on Federal, State and Local Issue Analysis at Engineering Foundation Conference on "Effects of Urban Runoff on Receiving Streams: an Interdisciplinary Analysis of Impact, Monitoring, and Management," in Crested Butte, CO in August.
- *"The Most Disturbing Stormwater Management Questions," presented at 1991 International Public Works Congress and Equipment Show, Institute for Water Resources session on CSO/Stormwater Issues in San Francisco in August.
- *Instructor for Three APWA one day clinics on Understanding the Stormwater Permit Regulations in Philadelphia, Chicago and Kansas City in September.
- *"Congressional Issues," presented at National Association Of Flood and Stormwater Management Agencies Symposium on Municipal Stormwater Permit Issues in Washington, D.C. in October.

Bill DeGroot, Chief, Floodplain Management Program

- *Re-elected Secretary/Treasurer of the Colorado Association of Stormwater and Floodplain Managers.
- *Appointed to the Colorado Natural Hazards Mitigation Council.
- *Field Trip Coordinator for the 1991 annual conference of the Association of State Floodplain Managers in Denver in June.

Kevin Stewart, Project Engineer, Floodplain Management Program

- *Attended Spring Meeting of the Colorado Emergency Management Association (CEMA) in Glenwood Springs, April.
- *Speaker at the ALERT Users Group Annual Conference in Monterey, California, May.
- *Session moderator and field trip tour guide at the 15th Annual Conference of the Association of State Floodplain Managers in Denver, June.
- *Presided at the Fourth Annual Conference of the Southwestern Association of ALERT Systems (SAAS) in Dallas, Texas, October.
- *Attended meeting of Governor Romer's Colorado Natural Hazards Mitigation Council in Golden and asked to serve on the Council's Dam Safety and Warning Subcommittee, November.

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

- *Co-chaired an Engineering Foundation Conference on Impacts of Urban Stormwater Runoff on Receiving Systems in Crested Butte, August.
- *Continues to serve as Chairman of ASCE's Subcommittee on Urban Gaging Networks sponsored by the USGS.
- *Chaired a session on Stormwater Planning and presented a paper on Rainfall Hyetograph Density Accuracy on Computer Simulation of Runoff at an International Conference on Computer Applications in Water Resources in Taiwan, July.
- *Made several presentations in Colorado on the joint approach of the District, Denver, Lakewood and Aurora to preparation of separate stormwater NPDES discharge applications for each of the three cities.

Barbara Benik, Project Engineer, Master Planning & South Platte River Programs

- *Judge for the Colorado Water Conservation Board Flood Poster Contest for elementary students in April.
- *Speaker at the Colorado Association of Stormwater and Floodplain Managers workshop in Breckenridge, CO, in Oct.
- *Co-authored an article, with Merle Grimes, "Regreening of the South Platte River" published in the October issue of "Land and Water" magazine.
- *Led a field trip of the South Platte River for the 1991 annual conference of the Association of State Floodplain Managers in Denver in June.

Michael Sarmento, Inspector/Technician, Maintenance Program

- *Attended American Concrete Institute seminar on hot and cold weather concrete.
- *Attended a seminar on slope restoration methods in Berkeley, CA, Sept.
- *Attended an OSHA excavation standards session on "competent person requirement" sponsored by the Colorado Contractors Association.
- *Received certification as an Associate Engineer Technician in transportation engineering and highway construction from the National Institute of Certified Engineering Technicians.

Paul Hindman, Project Engineer, Design and Construction Program

- *Appointed Chairman of the Institute for Water Resources of the Colorado Section of the American Public Works Association.

Tucker-Talk

by L. Scott Tucker

Timely Comment from the District's Executive Director



Midcourse Correction Needed for Municipal Separate Stormwater Permit Program

Most, if not all would agree that mandatory stormwater quality management is here to stay. There are some fundamental questions, however, about the Congressional mandate and how it should be implemented and enforced. Publication of the stormwater regulations by EPA in November 1990 marked the end of the talking stage and signaled the start of the implementation phase. Some 173 cities and 47 counties with populations over 100,000 are now required by federal law to submit applications for NPDES (National Pollutant Discharge Elimination System) permits for their municipal separate storm sewer systems. Most, if not all, of these communities are now in the midst of preparing applications. However, all is not well with the process and there are fundamental issues facing local governments that need to be addressed.

Regulatory Approach

The NPDES program is a classic federal command and control approach. Local communities are cast as polluters because of their stormwater systems and must obtain permits for the discharge of that pollution or face fines and penalties. Local communities are held responsible for defining what the problem is, defining pollutants, implementation, and financing.

Congress passes the legislation but local governments must pay for the implementation. The Federal Water Pollution Control Act (WPCA) passed in 1972 marked the beginning of the Nation's efforts to clean up its waters. The last amendment to the WPCA were passed in 1987 and is known as the 1987 Clean Water Act (CWA). In 1991 and beyond local governments across the nation are having to find the money to implement Congress's 1987 mandates. There is no connection between the action of Congress in 1987 and any increase in taxes or fees at the local level in 1991 or 1992. Who will the taxpayers hold accountable for

any stresses or problems with local budgets which might in part be brought about by the new federal requirements?

The regulatory approach is by nature adversarial. It would seem more logical if this is indeed a serious national problem for federal, state and local governments to address the issue on a cooperative basis. Technical support is lacking and there is certainly no financial support as there was for the wastewater treatment program.

Municipal Stormwater as a Point Source

Municipal separate storm sewer systems are being regulated as point sources through Section 402 of the Water Pollution Control Act which is known commonly as the NPDES program. The purpose of the NPDES permit program is to make unlawful without a permit the discharge of any pollutant from a point source by any person. Typical point sources include publicly owned treatment works (POTWS) and industrial treatment facilities. These are generally closed systems with fairly predictable discharges from a single pipe, they can be measured and sampled at regular intervals, and there are relatively few of them.

Municipal stormwater on the other hand is a rainfall driven system which varies considerably from region to region, city to city, area to area within a city, storm to storm, season to season, etc. etc. It is an open system and there is no control over the inputs yet a city or county is held responsible for what comes out the end of the pipe. Potential sources of pollution are diverse, difficult to identify, variable, and discharge into receiving waters at many many locations. Municipal stormwater is in reality not a point source yet the regulatory box in which it has been placed is a point source program.

Maximum Extent Practicable (MEP) Standard Vs Numerical Effluent Limitations/Water Quality

In recognition of the difference between classic point sources and

municipal separate storm sewer systems, Congress required a different standard for municipal stormwater than for other point sources. The standard for stormwater is to reduce the discharge of pollutants to the maximum extent practicable. Congress did not refer to Section 301 or to water quality standards as they did with stormwater discharges associated with industrial activities. However, the issue has been raised that stormwater discharges from municipal storm sewers should eventually be required to meet numerical effluent limitations based on water quality standards just as for any other point source. This raises some fundamental issues and problems. Numerical effluent limits are calculated based on the various pollutant contributions to a receiving water body and then determining the limits for each source in order for receiving water quality to meet established water quality standards. Currently there are no standards for wet weather discharges and allowable loads are typically determined based on meeting water quality standards established during low flow conditions. What would an appropriate numerical effluent limit be for stormwater? Would all outlets have to be monitored? How would a violation be determined and what would be the consequences of a violation? In the arid southwest there is typically no flow in receiving waters except when there is a storm. What would be the standard in these cases?

In an "attainment study", Sacramento recently determined it would have to collect and treat its stormwater for certain heavy metals to meet proposed State of California water quality standards. They estimated the cost of the collection and treatment system to be approximately two billion dollars or \$35 to \$45 per household per month for 30 years. The population of the Sacramento area is about 900,000 people. Even with this level of effort Sacramento could not guarantee

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Floodplain Management Notes

by

Bill DeGroot, P. E.

Chief, Floodplain Management Program

Implementation Planning

The Urban Drainage and Flood Control District has always had an evolving process for dealing with drainage and flood control problems. Starting in 1969 with problem identification, the District's programs have evolved over the years to incorporate master planning of remedial projects, to obtaining the funding capability to design and construct portions of the remedial master plans, to prevention of future problems through establishment of the Floodplain Management Program, to the funding capability for maintenance of drainage and flood control facilities.

Several years ago the Master Planning Program began assisting local governments with drainage and flood control master planning for future development. We now have a number of these master plans completed and ready to guide new development. However, we have a problem. All of these plans rely heavily on regional detention facilities. Regional detention is a technically sound option that consistently looks good during plan formulation. It also has a sense of fairness about it, as opposed to requiring downstream properties to accept larger developed basin discharges.

However, implementation of regional detention is proving to be a sticky problem. Owners of identified detention sites obviously cannot be required to construct a facility for everyone upstream. Upstream owners who are not ready to develop do not have the motivation, or often the money, to participate. Local governments also do not have the money to participate in construction of a facility, and oftentimes cannot even afford to secure the needed right-of-way for future implementation. "Buy my land or let me develop it" is the refrain from the owner of the planned detention site, and it is not an unreasonable one.

We need to know if we are going to be able to cause these master plans to be implemented with regional detention, or if we should be headed in another direction. In order to make that determination, the Floodplain Management Program is undertaking two "implementation studies." These studies will use the master plans for

the Irondale Gulch basin and the Lone Tree, Windmill and Dove Creek Basins as starting points, and will be looking at the institutional and financial aspects of plan implementation as well as the technical side.

The Irondale Gulch study includes Commerce City, Adams County, Denver, Aurora and the Rocky Mountain Arsenal as sponsors. The Lone Tree study has Arapahoe County, the Arapahoe County Water and Wastewater Authority, and the Cherry Creek Basin Water Quality Authority as local sponsors.

Our intent is to have implementation plans developed for these two master plans by mid-1992, or to know that we have to go another direction with the master plans. I would be interested in your thoughts regarding this issue.

Revising FEMA Maps

In December, 1990, I wrote a letter to the new Federal Insurance Administrator, C. M. "Bud" Schauerte, in response to his open invitation to comment on the National Flood Insurance Program (NFIP). A few of my comments and his responses are paraphrased below.

I told him that the requirement to provide four discharges, four profiles, two flood outlines and a floodway for every map revision request was costing local governments and private parties a great deal of money. In particular, the 10- and 50-year information is not used on Flood Insurance Rate Maps, and the 10-, 50- and 500-year information is not used in the NFIP's floodplain management regulations.

Mr. Schauerte's response was that since the Flood Insurance Study (FIS) has four profiles, they want four profiles for revisions to assure continuity. Question: If nobody uses it, who cares if it is continuous? He also indicated that, in most cases, providing the additional information didn't take much additional effort. Comment: We pay for that additional effort, and FEMA pays to review it. The costs add up and no one uses the product.

Mr. Schauerte did indicate that on occasions when defining the other profiles becomes complex they have accepted only the 100-year profile. Comment: While I applaud that action, it makes me wonder all the more why we have to develop the additional profiles just because they are not complex. It's still information we don't need and don't use.

I also indicated to Mr. Schauerte that our requests for map revisions seemed to be subjected to endless nit-picking, to the point that the reviewers must be paid by the comment. He expressed concern for a cost-effective review and revision process. My impression over the last twelve months is that the process has been improved. I am seeing fewer comments that I would characterize as nit-picking, and the overall process seems to be operating more smoothly.

I am still of the opinion that a project which is designed and constructed under the supervision of Colorado registered professional engineers (and this opinion holds for any state) should be presumed to be sound. The amount of money we could save, and FEMA could save, would be significant. Let's spend our limited resources on protecting the people from flood hazards, and not talking to ourselves and writing reports that nobody else will ever use or even look at.

Flood Warning Program

The District continued to operate and expand its flood warning program in 1991 under the direction of Kevin Stewart.. Kevin's detailed report on this year's effort appears elsewhere in this issue.

Tucker Appointed to Committee

Executive Director Scott Tucker has been appointed to the eleven member Committee on Natural Disasters of the Commission on Engineering and Technical Systems of the National Research Council (NRC). The NRC was established by the National Academy of Sciences in 1916. It serves as the operating agency of the National Academy of Sciences and National Academy of Engineering. The NRC is organized into nine major units, one of which is the Commission on Engineering and Technical Systems.

The purpose of the Committee on Natural Disasters is to conduct on-site studies after the occurrence of natural disasters and perform other studies to determine how state-of-the-art engineering and social sciences can be applied to improve public safety and welfare in the event of natural disasters.

Photo Page - Flood Control Projects In Action

Everyone in the flood management business likes to see his or her project or facility in action, or at least see the high water marks following a flood event. We have had the

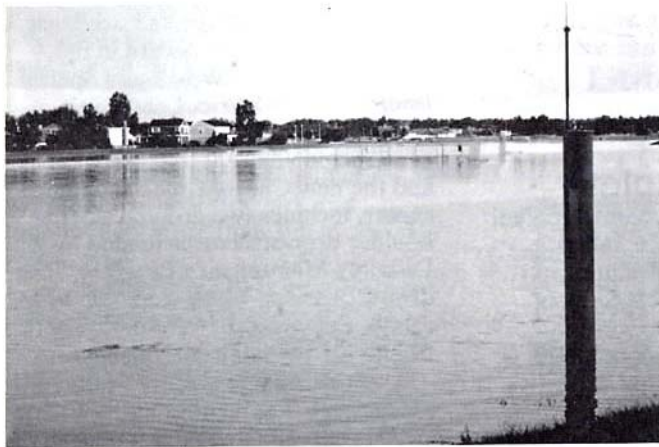
opportunity this year to photograph a number of flood events or the immediate aftermaths of events, and several of those photographs are presented below.



Kelly Road Dam, normally dry, on Westerly Creek on June 6, 1991.



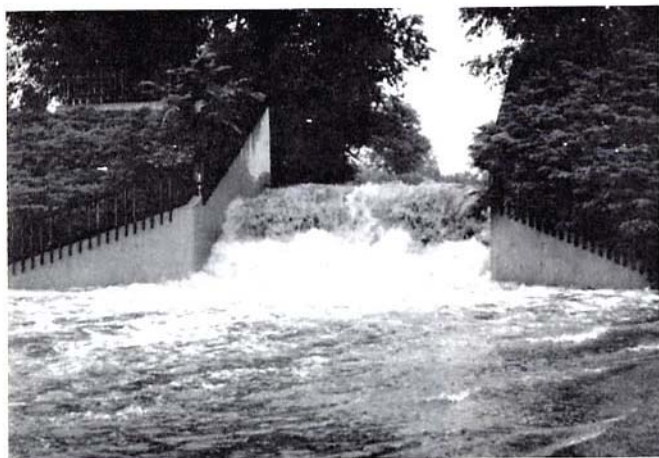
The side channel spillway into the off-line detention at Veterans Park in Denver on July 20, 1991.



Expo Park on Westerly Creek in Aurora on June 6, 1991. Detention in a park. Note the ball field back stops in the center of the picture and the ALERT gage standpipe in the right foreground.



High water line on a grass lined channel on Westerly Creek in Montview Park in Aurora from the June 6, 1991, event.



A baffle chute drop structure on Harvard Gulch in Harvard Gulch Park in Denver on July 20, 1991.



A park in Arvada along Ralston Creek in Arvada on July 22, 1991. Parks in floodplains are excellent uses of flood hazard areas.

EROSION CONTROL CRITERIA MANUAL

By Ben Urbonas

Kiowa Engineering

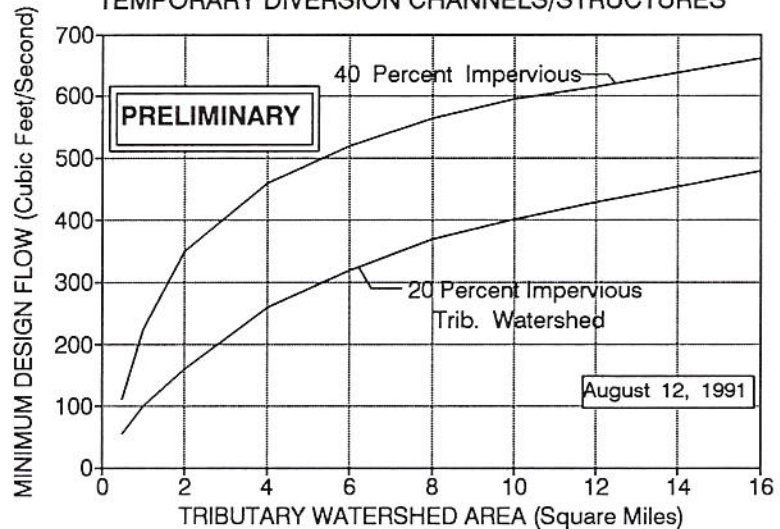
Corporation is assisting the Urban Drainage and Flood Control District with the preparation of an erosion control criteria manual. This effort was precipitated by the separate stormwater NPDES permit application process. Construction is one of the industrial activities required to obtain NPDES discharge permits. After discussions with Pat Nelson of the Colorado Water Quality Control Division (CWQCD) it appears that an erosion control criteria manual in the Denver metropolitan area may facilitate the issuance of general permits for construction activities within cities and counties.

The State would benefit by endorsing a single set of technical erosion control details, which then can be used by local governments. The State then approves a single set of technical criteria instead of having to review and approve a set for each city and county or an erosion control plan for each development. While the model criteria are being developed, each local government or other jurisdiction can choose to develop and adopt their own.

This manual provides an option for the local governments to consider, including technical details and a draft model erosion control ordinance. The manual initially will be issued by the District as an interim document. Copies will be provided to all local governments and to a group of consulting engineering firms within the District. We hope this will provide an opportunity to test it at the actual working level. We will ask for comments and will modify the manual before formally distributing it as the District's soil erosion control criteria.

The manual will contain recommendations not previously contained in the *Urban Storm Drainage Criteria Manual*. For example, we had to develop criteria for the sizing of temporary stormwater diversion pipes or channels. Under a USGS-District cooperative data collection effort we collected substantial data on peak runoff rates at 18 different urban watersheds. These data record range from six to 12 years in length. A preliminary data analysis of these data resulted in the accompanying figure, which will be included in the interim document as our recommendation for the sizing of temporary diversions. We also recommend that one-half of these flow rates need to be used if the

SUGGESTED MINIMUM DESIGN FLOW FOR TEMPORARY DIVERSION CHANNELS/STRUCTURES



diversion will be in operation only between September 30th and April 15th. Such structures are expected to fully contain about 95 percent of all stormwater runoff events in the Denver area. If you have any thoughts about this figure and its use, we would like to hear from you.

Criteria Manual Revisions Complete

The District has recently mailed substantial revisions to the *Urban Storm Drainage Criteria Manual* (USDCM) to all manual holders of record for whom we have current addresses. If you have not received these revisions and feel that you should have, please let us know.

The revisions include corrections to errors found in the "Rainfall" and "Runoff" chapters; a significant addition of wetland bottom channel criteria to the "Major Drainage" chapter, and a new "Structures" chapter which includes a greatly expanded section on drop structures.

The District is currently involved in the formulation of a new chapter on erosion and sediment control for construction activities (see other story on this page). That chapter should be out by mid-1992.

Awards of Interest

For the second 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.

The Associated Landscape Contractors of Colorado selected Cherry Creek Park for its Excellence in Landscape Grand Award in the category of Public Works and Special Improvement District Landscape Construction. The park, which was constructed adjacent to Cherry Creek and the new Cherry Creek shopping center, includes two grouted sloping boulder drop structures funded by the District's Maintenance Program. The drop structures, which were due to be rebuilt in any event, were designed to fit into the overall park concept.

The Adams County Trails and Open Space Foundation has recognized the District as a "Friend of the Trail" for its support of the Adams County Trail System.

L & M Enterprises, Inc., a frequent construction contractor for the District, was named Contractor of the Year by the U. S. Army Corps of Engineers for its construction of the South Platte River channel downstream from Chatfield Dam. Our congratulations to L & M.

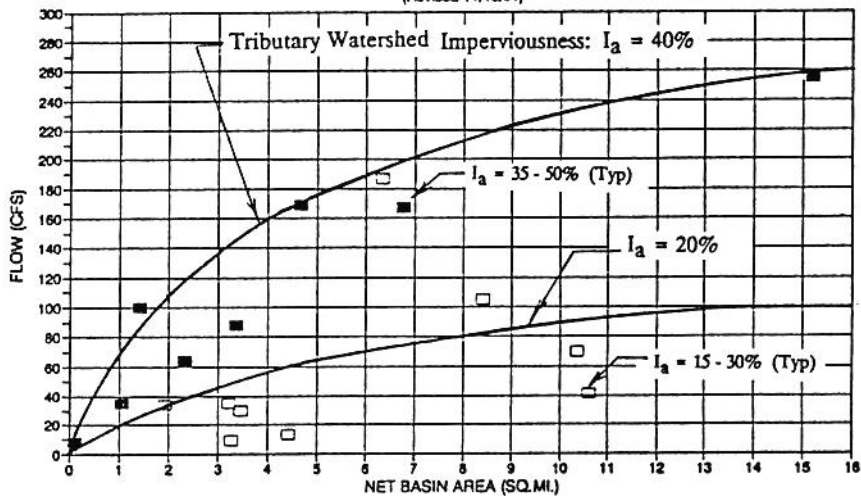


One of the grouted sloping boulder drop structures in Cherry Creek Park.

**** Errata ****

Replace the figure under
"Erosion Control Criteria Manual"
article, wrong figure was sent to the printer.

**ADJUSTED TRIBUTARY AREA VS.
50 PERCENTILE COMPUTED OUTFLOW**
(Revised 11/15/91)



This figure covers the April through September period. When construction is expected to be totally completed within October through March period, without a possibility of extending into the April through September period, temporary design can be based on 50% of these flows.

Temporary Diversion Facility Sizing Nomograph for Denver Region.

PLANNING PROGRAM ACTIVITIES

by
Ben Urbonas
Chief, Master Planning Program

Planning Projects

Master planning program activity in 1991 was less intense than in 1990. The table titled "Status Of Planning Projects" lists the projects that were under way in 1991 and the ones that are expected to begin in 1992. Eight master planning program projects were completed in 1991 and three are scheduled to begin in 1992. We will begin consultant selection for these three as soon as the funding agreements are finalized between the District and local sponsors.

In our last survey of the cities and counties within the District we received several requests to address stormwater quality in our master plans in the future. Traditionally we have focused our planning effort at solving flooding and drainage problems. However, we have completed several master plans that suggest stormwater quality facilities. These are master plans for First Creek; Second Creek; Third Creek; Irondale Gulch; Cottonwood Creek; and Lonetree, Windmill and Dove Creeks. We now address stormwater quality in all of our master planning projects and we foresee the focus towards water quality planning to increase.

Technology Transfer

University of Colorado at Denver is considering offering short courses in 1992 on the use of CUHP, UDSWM2-PC, UDSWORM, UDPOND, UDSEWER, or UDINLET program(s). If you have a preference for which of these you would like to see offered and for more information on what may be coming up in the future, contact Dr. James C.Y. Guo at 556-2849.

In March of 1991 the Ohio Department of Natural Resources, in cooperation with the Ohio Homebuilders Association released a training video on "Keeping Soil On Construction Sites: Best Management Practices." This video, ten training work books and an instructor's manual costs only \$20.00. Order from and make the check payable to Ohio Federation of Soil and Water Conservation Districts (OFSWCD), Building E-2, Fountain Square, Columbus, OH 43224. We have viewed this video and recommend it to everyone designing, inspecting and installing erosion control practices.

STATUS OF PLANNING PROJECTS

Project	Sponsor(s)	Consultant	Status
Thornton Criteria	Thornton	WRC Engineers	Transferred to City
Westminster Criteria	Westminster	WRC Engineers	Transferred to City
Denver Criteria	Denver	Kiowa Engineering	50% Complete
Cottonwood Creek	Arapahoe Co.	Delta Env. Consultants	Completed in 1991
Beebe Draw	Brighton, FRICO & Adams Co.	Wright Water Engineers, Inc.	95% Complete
Jackass Gulch	Littleton	Centennial Engineering	Completed in 1991
Sable & Granby Update	Aurora	Kiowa Engineering	Completed in 1991
Moon Gulch	Jefferson Co. & Arvada	HDR Engineering	50% Complete
Western Hills Outfalls	Adams County	WRC Engineering	Completed in 1991
Bullhead Gulch	Lafayette & Louisville	ASI	75% Complete
Happy Canyon Creek	Douglas Co. & Arapahoe Co.	Kiowa Engineering	75% Complete
Columbine Basin	Arvada & Wheat Ridge	Muller Engineering	50% Complete
Toll Gate & Tributaries	Aurora	Kiowa Engineering	Completed in 1991
Upper Lena Gulch Update	Jefferson Co., Lakewood & Golden	Boyle Engineering	20% Complete
Westerly Cr. u/s of Havana	Aurora	n/a	Beginning Work
Lower Slaughterhouse Update	Littleton	Boyle Engineering	10% Complete
Upper Weir Gulch Update	Lakewood & Jefferson Co.	n/a	Beginning Work
NPDES Data Management Software	None	Jansekoc	Completed in 1991
NPDES Protocols	None	CH2M-Hill	Completed in 1991
Erosion Control Criteria	None	Kiowa Engineering	Completed in 1991
Weaver Creek Trib.	Jefferson County	n/a	Scheduled for 1992
Newlin/Baldwin Gulch	Parker & Douglas Co.	n/a	Scheduled for 1992
Box Elder Creek, Ph.1	Aurora	n/a	Scheduled for 1992

Also, we ordered this video for our library and, beginning in February, we will loan it for up to three days to anyone requesting it.

Software

In 1990, the University of Colorado at Denver completed the development for the District of a storm sewer design package and a normal depth (i.e., prismatic) open channel design and evaluation package. In 1991 UCD completed the stormwater detention design package. Anyone interested in testing this software, especially the inlet design software as it is being developed should contact Dr. Guo at the above telephone number.

Area NPDES Applications

As we reported to you last year, the final NPDES separate stormwater permit application regulations became effective as of October 31, 1990. Since

that time we have been working with representatives of Denver, Lakewood, and Aurora to help them prepare their individual NPDES permit applications. I am happy to report that the three cities met the deadline and together delivered Part 1 of the applications to Colorado Water Quality Control Division (CWQCD).

Pat Nelson of the CWQCD helped by clarifying for the cities, in a timely manner, the various provisions that had to be addressed. Her help, and the combined assistance we received from the CWQCD helped the cities to complete their applications in a timely manner, and in as cost effective a manner as possible working under the EPA regulations.

We began work on Part 2 of the application, which requires the cities to suggest a stormwater quality management plan they will implement. As a part of this, the cities have to

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MAINTENANCE PROGRAM ACTIVITIES

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

Program Direction

The 1991 Maintenance Program budget was \$5,492,320. This number is about \$340,000 above the budget for 1990. Most of this money was used to fund additional channel rehabilitation work as will be discussed below.

During the year we had the opportunity to reorganize the Maintenance Program toward the goal of more effectively cooperating with the 36 local governments within the District. Some job duties were reassigned such that the Project Engineers are now responsible for all maintenance service activities in their respective counties. All activities such as preparing the county work program, developing cost and budget projections, and adding and deleting work program items in response to changes in needs are no longer dealt with by two or three persons but are managed solely by the Project Engineer.

The Maintenance Program continues to operate through three sub-programs titled routine, restoration, and rehabilitation. Maintenance activities range from routine trash and debris removal and channel mowings, to restoration of individual deteriorated facilities and major rehabilitation of previously-improved drainage channels. The highlights of each sub-program for 1991 are discussed below.

Routine Maintenance

Each year the routine portion of the Maintenance Program expands to include mowing and debris removal on more drainageways. For 1991, expenditures increased by about two percent over 1990. In previous years, our total annual costs have been decreasing even though the volume of work has been increasing. Our perception is that contract prices for routine work have stabilized and that our future annual costs will be rising.

As mentioned in last year's *Flood Hazard News*, we have directed the mowing contractors to leave small pockets of cattails and native grasses at mature height in select drainageways. In the short term we have seen no adverse results. We will continue to monitor these areas to determine whether such vegetation may cause

STATUS OF MAINTENANCE REHABILITATION PROJECTS

Project	Jurisdiction(s)	Cost	Status
<u>ADAMS COUNTY</u>			
Middle Branch Hylands	Westminster	design- \$22,000	100%
Drops and low flow		const- \$275,000	0%-phase 2
Grange Hall Creek	Northglenn	design- \$95,198	100%
Drops and low flow		const- \$369,537	100%-phase 1
Grange Hall Creek	Northglenn	design- \$20,000	50%
Drops and low flow		const- \$140,000	0%- phase 2
Niver Creek	Thornton	design- \$74,014	100%
Baffle chute drop		const- \$116,441	100%-phase 1
<u>ARAPAHOE COUNTY</u>			
Big Dry Creek	Arapahoe Co.	design- \$63,242	95%
Branch 2 (Fillmore)		const- \$300,000	0%
Cherry Creek	Arapahoe Co.	design- \$82,754	100%
Iliff Boulder Drop		const- \$255,992	100%
Lee Gulch	Littleton	design- \$25,980	95%
Product comparison		const- \$150,000	0%
Little Dry Creek	Arapahoe Co.	design- \$70,910	65%
Erosion repair		const- \$275,000	0%-phase 1
West. Toll Gate Creek	Aurora	design- \$42,780	100%
Summer Valley Ranch		const- \$326,286	100%-phase 2
Willow Creek	Arapahoe Co.	design- \$48,239	95%
Low flow erosion repair		const- \$300,000	0%-phase 1
<u>BOULDER COUNTY</u>			
Fourmile Canyon Creek	Boulder Co.	design- \$64,774	100%
28th st.-renaturalization		const- \$211,361	100%
Fourmile Canyon Creek	Boulder Co.	design- \$16,538	25%
30th st.-drop, bank repair		const- \$20,000	0%
Lac Amora tributary	Broomfield	design- \$30,000	0%
Drops and low flow		const- \$200,000	0%
Wonderland Creek	Boulder	design- \$25,000	0%
Hwy 119-channel and drops		const- \$150,000	0%
<u>DENVER COUNTY</u>			
Cherry Creek	Denver	design- \$65,585	35%
Holly drops		const- \$200,000	0%-phase 1
Cherry Creek	Denver	design- \$79,018	100%
Corona/Wash.drops		const- \$171,805	100%
Cherry Creek	Denver	design- \$103,389	100%
Creekfront bond project		const- \$828,000	0%
Cherry Creek	Denver	design- \$12,200	100%
Stability study		const- N/A	N/A
Goldsmith Gulch	Denver	design- \$15,400	100%
Iliff trash rack		const- \$35,000	0%
Harvard Gulch	Denver	design- \$35,960	100%
McWilliams Park		const- \$105,000	0%-phase 1
Lakewood Gulch	Denver	design- \$90,211	100%
Rude Park channel repair		const- \$183,717	100%-phase 1
Weir Gulch	Denver	design- N/A	N/A
Fence repair		const- \$47,400	0%
<u>DOUGLAS COUNTY</u>			
East Dad Clark Gulch	Douglas Co.	design- \$31,981	95%
Highlands Ranch		const- \$85,000	0%
<u>JEFFERSON COUNTY</u>			
Clear Creek	Jefferson Co.	design- \$25,000	0%
52nd Ave		const- \$100,000	0%
Dry Gulch	Lakewood	design- \$16,157	100%
14th ave.		const- \$58,400	0%
Little Dry Creek	Arvada	design- \$35,000	0%
Harlan to Club Crest		const- \$150,000	0%-phase 1
McIntyre Gulch	Lakewood	design- \$102,893	100%
South Branch A (Alameda)		const- \$117,336	100%-phase 1
Ralston Creek	Arvada	design- \$43,596	100%
Brooks Drive		const- \$270,000	0% phase 1
SJCD (SO)	Jefferson Co.	design- \$30,000	0%
Columbine Knolls South		const-no budget	0%

erosion by diverting the flow of water or may cause sedimentation by impeding the water. Meadowood Creek west of Buckley Road between Iliff and Dartmouth in Aurora and Coon Creek southeast of Belleview Avenue and Kipling Street in Jefferson County are two locations where we have left such pockets of tall vegetation.

Restoration Maintenance

The restoration program completed a little over \$1.1 million worth of work in 1991. This has been our average annual level of work except for 1989 when we did \$1.5 million of restoration work. Nearly 90 individual projects were done in 1991. As community groups and neighbors become more involved in public works activities in their neighborhoods, more lead time and coordination is needed to carry out a project. This will result in a more successful project, but the impact of this valuable interaction is felt in the lengthened processing and scheduling of restoration projects. Examples of restoration projects are given below.

Public preferences are an important component of our decision process. Neighborhood attitudes and desires can vary widely. On the north branch of Lilley Gulch at Holland Street just south of Bowles we excavated a 10 foot wide pilot channel through a lush growth of cattails to divert the creek flow from private residential property and return it to the dedicated drainage easement. In concurrence with local citizen wishes we used small equipment and did as little damage to the remaining cattails as possible.

Two miles from the site mentioned above we worked on the channel of the north tributary to SJCD South at Kendall Street just north of Ken Caryl Road. In this instance the community called for the installation of a concrete lined trickle channel to accommodate the base flows and to eliminate standing water.

In each case we believe the work we did was an effective solution to the problem. We will continue to accommodate local preferences as much as possible in the maintenance and reconstruction of drainage facilities.

The Adams County Regional Park is located at 124th Avenue and the S. Platte River. As part of the development of the park complex Brantner Gulch has been modified so it now flows through Mann Lakes before it discharges into the South

Platte River. In order to maintain the lake and creek levels the outlet and spillway needed to be rebuilt. The spillway was set at the appropriate level to keep the 10-year flood on the South Platte River from spilling into the lakes and also to keep the lake levels from flooding the adjacent facilities when Brantner Gulch floods. A 24-inch outlet pipe was also installed to discharge the base flows that enter the lake. The structures are functioning as intended except that late this fall a beaver took up residence in the lakes and has occasionally blocked the outlet pipe causing the lakes to rise and flood part of a fairway and, on one occasion, get within a foot of one of the greens on the golf course.

In the town of Parker is a small drainageway named Plaza Drive Creek which parallels Plaza Drive. This 800 foot long reach is at a 2% longitudinal slope and has been squeezed into a 30 foot wide right-of-way. After reviewing three sites where a product called "Landglas" had been installed under conditions similar to those at Plaza Drive Creek we decided to use the product to solve our erosion problems in Parker. "Landglas" is an inert glass-strand material that is "shot" onto the subgrade and then set in place with an asphalt emulsion. The advantages we see are that it conforms tightly to the ground, is inert to sunlight and weather degradation, and provides an open matrix to allow vegetation growth. Should this prove to be a cost effective product for reducing erosion in small grass-lined drainageways that are narrow and steep we will do further installations in the District.

Rehabilitation Maintenance

Twenty-eight projects were at various levels of active design or construction during 1991. Those projects are listed in the accompanying table titled "Status Of Maintenance Rehabilitation Projects". By the end of 1991 we will have spent about \$1.5 million on rehabilitative design and construction. Several large projects have been delayed from 1991 to 1992. This accounts for the relatively low volume of rehabilitation work for 1991. Accordingly, the amount of work done in 1992 will be well above the annual average of \$2-2.25 million. A few of the unique projects for 1991 are discussed below.

Grange Hall Creek - This 1100 foot long project north of 104th Avenue at Marion Street was built with the financial cooperation of the

City of Northglenn. This project included our first installation of a boulder-sided trickle channel with a soft earth bottom between the boulders. A soft bottom should improve groundwater recharge and animal habitat. Pollution carried by the creek should also be reduced as a result of the vegetation we expect to thrive in the soft bottom.

Another feature of this project was some of the worst subgrade soil conditions we have encountered. Unfortunately, the extra quantities of subgrade stabilization material caused a tremendous cost overrun.

Cherry Creek - Between Market St. and Colfax Ave. the Maintenance Program is coordinating with the District's Capital Program and the City of Denver Bond Program to build a reinforced low flow channel and to rebuild three deteriorated drop structures as two grouted boulder drops. This drainage work will be combined with an urban linear parkway within the vertical-walled portion of the creek. Bids were opened in mid-November. Construction should begin in early 1992. When complete this \$2,000,000 project will also provide a pedestrian connection between Larimer Street and the Colorado Convention Center.

A stream stability study of Cherry Creek from University Boulevard to the Cherry Creek Reservoir has been completed. This allows the Maintenance Program to proceed with rehabilitation of existing drop structures on the creek. The first two deteriorated structures to be rebuilt will be the one at Holly Street and the one upstream of Cherry Street near the Four Mile Historic Park.

Fourmile Canyon Creek - This creek is east of 28th Street in North Boulder. We are using two different approaches in rehabilitating adjacent reaches of the creek. This is because the creek changes personality as it flows to the east. From 28th to 30th Streets the channel was highly vegetated and appeared quite natural because the existing drop structures fit the natural contours. Our project renaturalized the area by rebuilding the drop structures as low-flow channel grouted boulder features and by relocating the desirable growth out of the low flow channel and retaining as much other vegetation as possible.

Downstream of 30th Street the creek has a quite different character. The drop structures are 100-year capacity concrete retaining walls and the only vegetation is some dryland

(Continued on Page 13)

South Platte River Program Notes

by

Barbara Benik, P.E., Project Engineer, and
Ben Urbonas, P.E., Chief, South Platte River
Program

Maintenance of South Platte River

This year, the South Platte River routine maintenance work included an equivalent of 65 miles of mowing, 8 miles of tree trimming and pruning, and 114 miles of debris removal. The biggest problem with debris removal is when illicit trash dumping occurs, and the worst item for us to get rid of is an old tire. Landfills charge extra for each tire, and disposal costs can really mount up when someone dumps 200 tires into the river.

Restoration projects along the river included the following during 1991: repair of erosion damages along the maintenance trail and the repair of the trail damaged by vandalism in Denver; repair of erosion at large storm sewer outlets; restoration and revegetation of 800-feet of bank in Brighton and 1600-feet of bank at several locations in unincorporated Adams County; rehabilitation of a check structure in Denver downstream from Mississippi Avenue which included the removal of large, protruding sections of steel sheet piling from the river bottom; and the installation of a sloping boulder grade control check structure in Littleton's South Platte Park immediately upstream from Mineral Avenue.

The 404 General Permit that was issued in 1987 continues to be a real benefit to our program. In August, the Corps of Engineers moved the 404 process from the Omaha office to their local office at Chatfield. The average turnaround time under the General Permit has dropped to less than nine days since the 404 duties were relocated to the Denver area. By contrast, an Individual Permit for the Central Platte Valley rechannelization and restoration project was submitted to Omaha by Denver in October 1990 and took one year to resolve and be issued. Since our General Permit is due to expire in November 1992, we are now preparing an application for its renewal.

Cooperative Activities

This year we successfully completed another cooperative project. The Eppinger project included approximately 900-feet of bank cleanup and stabilization. The

owners, Virginia A. Eppinger and the Arthur W. Eppinger Family Trust, dedicated 28 acres for river channel maintenance access and flowage right-of-way to the District. This cooperative project is unique in that it is the first parcel on the South Platte River where the land ownership was dedicated to the District in fee simple instead of an easement. This site was littered with tons of asphalt, debris, and reinforced concrete pipe ranging from 18-inches diameter up to 96-inches diameter. While this first phase has stabilized 900-feet of river bank and has vastly improved the appearance of the site, it will take us several years to fully restore all of the banks and channel dedicated to the District.

Capital Improvement Activities

This year we completed one construction project, the second phase of bank restoration work between 78th and 88th Avenues that is jointly funded with Thornton. As a result, a total of 3,700 feet of bank is now stabilized and cleaned up. Funds permitting, we hope to complete the entire project in 1992 with the restoration of an additional 1,000-feet of bank. As a final step in 1992, we hope to revegetate the bank with riparian and dry land species for the entire length of 8,000 feet.

The "Globeville and North Areas" preliminary design of the South Platte River was completed and turned over to the District by Hydro-Triad, Ltd. This study was sponsored by the District, Adams County, Denver and Commerce City.

The final design by McLaughlin Water Engineers, Ltd. of the lower Central Platte Valley flood control and river reclamation project is also complete. Bidding on this project, which covers widening of the river channel between Cherry Creek and I-25 and reconstruction of the diversion structure and boat chute at Confluence Park is expected to proceed as soon as Elitch Gardens makes the decision to move forward with their relocation to the Central Platte Valley. Denver will be bidding and constructing this project.

Other News

The concrete dam located in the South Platte River just downstream from Union Avenue is undergoing major modifications to improve boater safety. The existing structure drops eighteen feet at a 3:1 (horizontal:vertical) slope. The modification will create a series of



Debris at the Eppinger property prior to beginning the cleanup.

seven drops, approximately 2.5 feet high, over a distance of about 1,300 linear feet. While this project is being funded by the Colorado Water Conservation Board, the District is advising CWCB on the design and has agreed to assist them with ongoing maintenance of this structure. We are encouraged to see this project finally underway as there have been two deaths that have been directly attributed to the unsafe nature of the existing concrete dam. Project completion is scheduled for May, 1992.



Before and after views of the Mississippi Ave. check structure.

ALERT Weather Stations Assist Forecasts

By John Henz
Henz Meteorological Services

Henz Meteorological Services (HMS) was the designated private meteorological service (PMS) for the District's 1991 Flash Flood Prediction Program (F2P2). HMS has pioneered the development of quantitative precipitation forecasts (QPF) for short periods of 6 to 12 hours since 1979 within the F2P2. The initial QPFs were issued for 6-hour time periods in 1979 and have evolved into basin-specific QPFs with time distributions of precipitation for 5 to 90 minute periods.

During 1991 operations, HMS integrated output from four new ALERT surface weather stations into its daily convective QPF. A major QPF task is to identify differences in the precipitation production of thunderstorms located in the western foothills and over the eastern plains of the District. HMS utilized the ALERT weather stations located at Quincy Reservoir and Diamond Hill to represent plains weather conditions while stations near Blue Mountain and at Hiwan Country Club represented the foothills environment. The location of the four stations is shown in the following figure.

The daily QPF is prepared using the HMS Convective Storm Model, a two-dimensional cloud model which inputs surface weather conditions and upper air profiles of temperature, moisture and wind. The

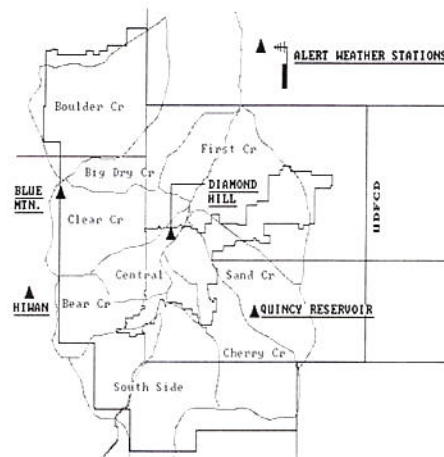
ALERT weather stations provided direct input of surface temperature, dew point, wind direction and speed. Examples of foothills and plains QPFs are shown in the tables below for August 18 and August 27, 1991.

On August 18, the District plains were hazarded by isolated heavy thunderstorms in northeastern Douglas County and southeastern Jefferson County before 6:00 p.m. The 6:00 p.m. QPF showed temperatures at the Quincy and Diamond Hill weather stations below the 82 degrees needed to produce heavy rainfall. On the other hand, foothills temperatures were still in the 65-70 degree range needed to stoke another foothills storm capable of producing heavy rainfall. A thundershower over the southeastern Jefferson County plains briefly dropped 0.50-0.70 inches in 45 minutes and ended before 7:00 p.m. as expected. Meanwhile, a heavy thunderstorm formed in the foothills near Idaho Springs between 7:00 and 9:00 p.m. which produced heavy rainfall, flooding and landslides along Virginia Creek in Clear Creek County west of the District.

On August 27, the foothills ALERT weather stations indicated cool temperatures and low dew points supportive of only isolated 0.25-0.50"/30 min. rainfalls. Plains stations indicated support for storms producing 1.0-1.5"/30 min. rainfalls in Denver and Aurora and 0.35-0.75"/30 min. rainfall elsewhere in the District. An official 0.91 inches of rainfall fell in less than 30 minutes at Stapleton International Airport while the

foothills of Jefferson County received less than 0.20 inches.

In each case, the ALERT weather stations provided key data for differentiating between foothills and plains QPF trends which would not have otherwise been possible. As more ALERT weather stations are added, further QPF refinements may be possible, such as providing basin-specific forecasts every 15 minutes for each successive 1- to 3-hour period.



AUGUST 18, 1991

OBSERVED TEMP/DEW PT	REQ'D TEMP/DEW PT	QUANT. PRECIP FORECAST
BLUE MTN 61F/51F	62-70F/47-52F	0.70"/15MIN - 1.70"/HR
HIWAN CC 66F/49F	"	"
FOOTHILLS FORECAST: HEAVY THUNDERSTORMS COULD REQUIRE MESSAGE 1'S		
QUINCY 73F/56F	79-84F/52-56F	1.00-1.50"/30MIN
DIA HILL 77F/46F	"	"
PLAINS FORECAST: STORMS ENDING WITH NO MESSAGE 1'S REQUIRED		

AUGUST 27, 1991

OBSERVED TEMP/DEW PT	REQ'D TEMP/DEW PT	QUANT. PRECIP FORECAST
BLUE MTN 70F/43F	70-78F/50-55F	< 0.50"/30MIN
HIWAN CC 76F/49F	"	"
FOOTHILLS FORECAST: WINDY THUNDERSHOWERS WITH BRIEF MODERATE SHOWERS		
QUINCY 72F/57F	77-84F/50-55F	1.00-1.75"/30MIN
DIA HILL 78F/56F	"	"
PLAINS FORECAST: ISOLATED MESSAGE 1 THUNDERSTORMS IN DENVER AND AURORA		

DESIGN AND CONSTRUCTION NOTES

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

This year was one of much activity as well as one of transition for the Design and Construction Program. Approximately \$7,000,000 was encumbered for design and construction projects this year which marks an all time high for the Capital Improvement Program.

August of this year saw the retirement of Bob Hoffmaster as Chief of the Design and Construction Program. Bob had served in this capacity since coming to the District in 1979. Throughout his twelve years here, he did much to shape the Design and Construction Program into what it is today. We'll not only miss Bob's professional nature around the office but also his contagious laugh.

Bob's retirement has brought a new face to the Program, that of Paul Hindman as Project Engineer. Paul has been a Project Engineer with the Maintenance Program since coming to the District in 1985. I look forward to the working relationship that he and I will have together over the next years.

This past year saw the completion of a project long in the planning process. The Westerly Creek Dam Project, designed and constructed by the Corps of Engineers, was completed in April of this year. After many long years of perseverance by local officials, the Westerly Creek Project was finally authorized by Congress in 1986. Congress appropriated the funds needed for construction in 1988 and the project got under way at that time. The dam itself took approximately two years to construct; fully detains the 100-year event from the approximately ten square miles of upstream drainage basin; is 9,100 feet in length containing over 3,000,000 yards of compacted earth fill; will safely pass the Probable Maximum Flood of 69,700 cfs; and contains over 4,000 acre-feet of storage at the spillway crest.

In April of this year, the first phase of the North Branch of Upper Sloan Lake Project was completed at a cost of just under \$1.5 million. In addition to storm sewer improvements, this project also consisted of the construction of detention storage in an existing City of Edgewater park, Citizen's Park. Approximately 11 acre-feet of storage

STATUS OF DISTRICT DESIGN PROJECTS

Project	Participating Jurisdiction(s)	Status
Cherry Creek Erosion Study	Arapahoe County, Denver & Glendale	Complete
Goldsmith Gulch Cherry Cr. to Dartmouth	Denver	Prelim. Design on Hold
Gunbarrel Area	Boulder County	Complete
Hays Lake Dam	Arvada, Oberon Ditch Co. & Rio Grande RR	Complete
Lena Gulch Isabell Crossing	Jefferson County	Complete
Little Dry Creek-ADCO Clear Cr. to Lowell	Adams County	Redesign started
South Jefferson County	Arapahoe County, Nevada Ditch Co., Last Chance Ditch Company, Littleton	Complete
Lakewood Gulch/Dry Gulch	Denver	Complete
Van Bibber Cr.	Arvada & Corps of Engineers	Feasibility 75% Complete
Lower Hoffman Drainage	Thornton & Adams County	95% Complete
Coal Creek Improvements	Boulder County, Louisville & Lafayette	Complete
Slaughterhouse Gulch Grant Pond to Arapahoe Rd. 4 Square Mile-	Arapahoe County	Start
Westerly Basin	Arapahoe County	Start
First Ave Trib. Phase 2 & 3	Lakewood	50% Complete
University/Mexico Phase III & IV	Denver	Complete
I-25/35th Av. Phase II	Denver	Complete
Sand Creek - Phase II	Aurora	Start
Sloan Lake No. Trib. Ph. II	Edgewater & Wheat Ridge	75% Complete
Spring Creek	Arapahoe County	50% Complete
Kalcevick Gulch	Adams County	90% Complete
Ralston/Leyden Creek	Arvada & Corps Engineers	Feasibility 50% Complete
SJCD at Kendall	Jefferson County	Start
Four Lakes	Arapahoe County	Complete

was created in the park which enables areas downstream of the park to be removed from the 100-year floodplain. One area removed from the floodplain was the commercial area along Sheridan Boulevard which the City of Edgewater has targeted for redevelopment. With help from a grant from Jefferson County Open Space, additional park improvements were constructed in Citizens Park consisting of a new restroom facility, pavillion, and ballfield lighting. Twelve horseshoe pits were also installed since the existing pits had to be removed to make way for the detention pond embankment. The twelve new pits will make it possible for Edgewater to hold league sanctioned tournaments at the park. The second and final phase of this project is currently under design and will be constructed in 1992. This project will extend the storm drainage system up into the City of Wheat Ridge.

The District was pleased this year to be able to participate in the construction of the Brighton Outfall Storm Drainage System. Four separate phases of construction were completed this year at a cost exceeding \$3 million. The project consisted of approximately 4,500 feet of open channel and over 12,000 feet of storm sewer. The City estimates that this project will solve 40% of their storm drainage problems located mostly in the southern part of the city.

Brighton also plans to begin work next year on an outfall system which will solve many of the drainage and flooding problems common to the north central portion of the city.

We also saw the completion in 1991 of the Tucker Gulch Channel Improvement Project in the City of Golden. The project consisted of approximately 1,700 feet of concrete lined channel capable of handling 100-year storm flows. Cost of the project was approximately \$1,650,000.

Included in the project was the widening of a section of Ford Street along Tucker Gulch as well as construction of a maintenance and hiker/biker trail which ties into the existing Clear Creek trail system.



The recently completed Citizens Park Detention Pond in Edgewater.



The recently completed Powers Park Detention Pond in Littleton.

Maintenance (from page 9)

grasses and volunteer trees. Our work in this reach will include reshaping the riprap stilling basins, replacing some of the lost vegetation, and redefining the trickle channel.

Little Dry Creek - In the early 1980s portions of the reach of the creek from Harlan Street to Club Crest Drive were rehabilitated with the installation of several 2 to 3 foot high low flow channel drop structures. Some of these drops have proved inadequate as the creek has eroded around the ends of the concrete cutoff walls. In the design we will reconsider the effectiveness of low flow drop structures in this type of open channel and will review the stability of such structures.

Willow Creek - North of County Line Road in Arapahoe County, Willow Creek flows through broad sweeping open space bordered by parks and residences. Severe channel degradation is occurring as a result of upstream development. Our work will involve locating grouted boulder drop structures where existing erosion headcutting is active. At one site the headcut is 10 to 12 feet. At this time little work will be done beyond controlling the grade of the channel with drop structures.

STATUS OF DISTRICT CONSTRUCTION PROJECTS

Project	Jurisdiction(s)	Cost	Status
Brighton Outfall System	Brighton	\$3,400,000	Complete
Lena Gulch	Wheat Ridge	\$262,000	Complete
Schedule V			
Little Dry Cr. (ARAP)	Englewood, Co Dept. of Hwys	\$500,000	Complete
Santa Fe to Cinderella City			
Weir Gulch 1st Ave. Tributary			
Phase 1B	Lakewood	\$754,000	Complete
Westerly Creek Dam	Denver, Aurora &	\$12,100,000	Complete
Lowry AFB	Corps of Engineers		
Lakewood/Dry Gulch	Denver	\$850,000	Start
Mississippi/Jason	Denver	\$1,554,900	Complete
Coal Creek Improvements	Boulder County & Louisville	\$342,000	20% Complete
Upper Slaughterhouse	Littleton	\$788,000	50% Complete
Four Square Mile Area	Arapahoe County	\$791,000	Complete
Basin 2 and 3			
Boulder Creek Right-of-Way	Boulder	\$1,800,000	90% Complete
Huron Outfall	Adams County &	\$114,000	Complete
	Co Dept of Hwys		
Tucker Gulch	Golden	\$1,653,000	Complete
Upper Sloans Lake	Edgewater	\$1,448,000	Complete
North Branch			
Upper Westerly Creek	Denver	\$1,286,000	Complete
University/Mexico Drainage	Denver	\$922,000	Complete
Schedule V			

ASFPM FLOODPLAIN MANAGEMENT RESOURCE CENTER

The Association of State Floodplain Managers (ASFPM) has established a Floodplain Management Resource Center (FRC) at the Natural Hazards Research and Applications Information Center (NHRAIC) at the University of Colorado in Boulder.

The FRC is designed to facilitate the sharing of floodplain management information. New and expanding approaches and government programs to prevent and reduce flood damages have resulted in numerous technical documents, manuals, reports, and research projects. The FRC collects and summarizes this data and enters it into a bibliographic data base.

You can call the FRC at (303) 492-6818 between 9:00 am and 4:00 PM, mountain time. A NHRAIC staff member will review the data base and inform you of the publications that fit your needs and how to obtain them.

There is no charge for using the FRC. The FRC is financed by the ASFPM, Corps of Engineers, FEMA, TVA, Office of Wetlands, Oceans, and Watersheds of the EPA, Rivers, Trails, and Conservation Assistance Program of the National Park Service, Eveready Flood Control, and Illinois Association

for Floodplain and Stormwater Management.

Call for Documents

To date, the FRC contains over 550 documents addressing the topics of floodproofing, stormwater management, guidance for local officials, and arid west issues. Efforts are underway to collect, review, and catalog publications pertaining to coastal issues and multi-objective river corridor and floodplain management. If you have any documents or audio-visual presentations on these topics, or if you know of any documents that would be appropriate for inclusion in FRC, please send this information to: Clancy Philipsborn, ASFPM Project Manager; c/o The Mitigation Assistance Corporation; Box 382; Boulder, Colorado 80306 (303) 494-4242

Help the FRC grow! Identify and send documents. Promote its use at meetings and conferences. Call Clancy for promotional materials or with any questions you may have.

FLASH FLOOD PREDICTION PROGRAM & RELATED ACTIVITIES

by

Kevin G. Stewart, Project Engineer
Floodplain Management Program

1991 PROGRAM CHANGES APPLAUDED

This past year represents the 13th operational season of the District's Flash Flood Prediction Program (F2P2). Weather forecasting was provided by Henz Meteorological Services (HMS) for the second consecutive year. The continued success of this program can be largely attributed to the dedicated involvement of many public safety and public works officials from the six-county Denver metropolitan area that the District serves. Efforts to improve services continue by soliciting input from key individuals directly involved with emergency services planning, coordination and operations.

In last year's issue of *Flood Hazard News*, two articles were devoted to describing the evolution of F2P2 communications, recent program changes and the need for further refinements. The main problem identified in 1990 involved a practice of issuing "Thunderstorm Advisories" or TA's to 911 dispatchers. These TA's were generally considered non-emergency weather information and were issued quite frequently, resulting in what was then termed "information overload." On March 14, 1991, a meeting was held by the District to address the issues raised during 1990 and obtain approval from emergency managers concerning 1991 operations. This meeting resulted in implementing the following changes:

1. The practice of issuing TA's was discontinued.
2. Forecasts concerning possible thunderstorm activity, having either no or very low flood potential, would only be available via Electronic Bulletin Board (EBB) or fax. Associated severe weather may be mentioned in this written communication but not used as criteria for contacting dispatchers.
3. Unless the potential for flash flooding exists, dispatchers will not be contacted by the F2P2 meteorologist. The National Weather Service (NWS) is responsible for disseminating all severe weather information.
4. A uniform policy of issuing "Red Flag" messages would be implemented for flash flood predictions or flood related information requiring priority handling by dispatchers.

5. Improved message forms for verbal communications were distributed to all F2P2 contact points.

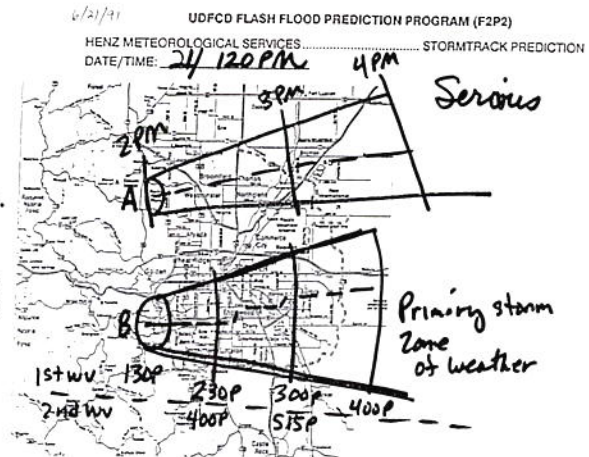
As the 1991 flood season progressed, there were many opportunities to review, critique and further refine internal procedures. By the end of the season, nearly everyone had developed a new level of confidence and comfort with the F2P2. On October 10, the District conducted a program review meeting which was attended by 26 officials from various local government agencies as well as representatives from HMS and NWS. The following feedback was received at that meeting and during the year:

1. The response to fax communications was extremely positive. While internal procedures differed somewhat between the various jurisdictions, the consensus was unanimous that this type of communication should continue.
2. Perhaps the highest compliments related to HMS's storm-track predictions which are presented using an area map and disseminated via fax. Since the fax has become a standard piece of equipment in many offices, the majority of F2P2 contact agencies were able to obtain this product and

considered it very helpful. A number of the users gave specific examples concerning the accuracy and timeliness of the storm-track predictions. This product was first introduced in 1990 and is now considered a standard F2P2 product with the user base rapidly increasing.

3. On some "Message Days" HMS took the initiative to fax completed message forms to certain 911 dispatch points prior to placing the required phone call. The content of the message would be reviewed with the dispatcher to make sure all information was clearly understood. The dispatcher would subsequently initiate the message fanout according to internal procedures. In commenting, Jefferson County Communications stated: "We love the fax... We get so busy that a lot of times we don't have time to sit and take all the message information down by hand, so the fax is wonderful. The information is more accurate and our dissemination is much easier." Douglas County echoed this statement by saying that the use of the fax has 100-percent eliminated the communication problems which were common in past years.

A reduced example of a fax map showing two storm tracks (A and B) for June 21, 1991. Note that the times of arrival of each wave are given on the map, and in the case of Track B, two sets of wave times are given.



- A: 1-2 severe R_s with street/stream flooding. Hail to 1.5"
- B: 2 waves of t-storms 130P → 530P
1. Serious severe weather & rain threat
 2. Urban street + stream flooding threat ≥ 50%
 3. LARGE HAIL 1-2" may clog drains

Henz

4. The uniform Red Flag procedure worked well. Arvada Police requested during the season that only Red Flag messages that affect Arvada be communicated directly to their dispatch. All other messages are received in a timely manner from Jefferson County Communications. It was agreed that this practice should also be implemented for Wheat Ridge and Lakewood Police in 1992.

5. There was a consensus that the information and services provided by the National Weather Service this past year was the best ever. The cooperation between NWS and HMS also received very favorable review.

While the positive comments were many, there is always room for improvement. Concern was expressed about the Limon radar being out-of-service at critical times and the future availability and cost of radar data when Limon is replaced by the NEXRAD radar. Problems with internal communications still exist in some places and more education is needed regarding the meaning of certain message code numbers and Red Flags. Further clarification and definition is needed on when Red Flags should be issued and to whom. Certain jurisdictions continue to struggle over message fan-out procedures and are being asked to address complaints about too much "unnecessary" weather information over the network at undesirable times. One example given by volunteer fire districts involved a NWS Flash Flood Watch issued at 4:00 a.m. with the watch not being effective until much later in the day.

Efforts to improve forecasting techniques will never end and with every event there is a new lesson to learn. But all considered, the main message delivered by emergency service personnel was: **KEEP UP THE GOOD WORK.**

The District appreciates the candid comments received from the many dedicated emergency managers, communications personnel, first responders, public works and public safety staff, department heads and elected officials. The high level of commitment exhibited by these individuals is critical to the success of the Flash Flood Prediction Program and we applaud your efforts.

SIGNIFICANT STORM EVENTS

As mentioned in the preceding article, there were many opportunities this past year to gain experience and evaluate the new procedures. During 1991 it seems that everyone in the

District had at least one turn in dealing with heavy precipitation and some type of flooding problem. Also, other severe weather such as hail, lightning, high winds and tornados frequently accompanied many of the thunderstorms. While the number of occurrences were many, none of these events resulted in what would be categorized as a "major flood." The following days highlight some of the more notable events of 1991:

May 16: The Thursday 11:00 a.m. Heavy Precipitation Outlook (HPO) noted that a general overnight rainfall of 0.75 to 1.50" had occurred. Minor thunderstorms with small hail and low flood potential were predicted for later in the day. By 3:30 p.m. the HPO was updated calling for a 60 to 80-percent chance of a thundershower producing 0.35" to 0.75" in 60-minutes. No internal alerts (MESSAGE 1) were issued since the quantitative forecast fell below message level criteria.

In Jefferson County the heaviest measured rainfall occurred between 7:00 and 9:00 p.m. The automated flood detection network (ALERT system) for Lena Gulch measured a peak rainfall amount of 0.63" in one hour at the Fairgrounds gage. Small hail of sufficient quantity to attract the attention of television news reports accompanied this storm. After presenting their headline report on the weather, Channel 2 News' reporter Steve Sonders gave an excellent cover story on the subject of flooding in Colorado. The report included interviews with District and HMS staff, video of past flood events and mention of the technology used in the F2P2 (e.g. ALERT system, radar and satellite).

While this event is considered at the low end of the "significant events" this year, it was the first storm of the flood season to gain wide media attention. It should be noted that the ALERT system also measured heavy

rainfall along the foothills between Golden and Boulder.

Annual peaks were measured on this day at the following gage sites:
- Jeffco/Van Bibber Creek at Highway 93 (8:12 p.m.)
- Denver/Harvard Gulch at Logan Street (3:03 a.m.)

June 1: On this Saturday morning at 10:15 a.m., the NWS issued a Flash Flood Watch effective until midnight for the entire northeast portion of Colorado including the mountains. The HMS quantitative forecast at noon noted that the prime time for activity in the District would be between 2:00 and 9:00 p.m. and locally heavy rainfall of 1.5" to 2.0" lasting 30 to 60 minutes was likely. The possibility of one-inch diameter hail was also mentioned.

Thunderstorms began developing in the mountains west of the District by 12:30 p.m. By 3:20 p.m., heavy rainfall was reported in the foothills of southern Jefferson and western Douglas Counties. Shortly after 3:30, the action in the District began, resulting in flood problems which lasted well into the evening. Jefferson, Boulder and Adams Counties were the primary areas impacted. Hail and tornados accompanied the storms.

The heaviest reported rainfall of 3.2" in 55 minutes occurred in Lakewood south of Green Mountain. Flooding in Denver was documented at Pinehurst Country Club along Marston Lake North Drainageway where Sheridan Blvd. overtopped near Ft. Logan National Cemetery. Significant flooding was also reported along Dutch Creek through Columbine Valley resulting in damages to the golf course (i.e. destroyed bridges, bank erosion, etc.). The District was provided with excellent home videos of flooding along these two streams.

As this storm system moved

The June 1 flooding on Dutch Creek caused major channel erosion and the loss of golf cart bridges on Columbine Valley Country Club.



northward into the Lena Gulch basin (4:10 p.m.), the amount of hail increased, thereby lessening the rainfall somewhat. This aggravated problems in some areas like the Pleasant View Mobile Home Park near Golden and reduced the flood potential for areas downstream such as Lakewood. Even though Lakewood benefited from the hail, one Lakewood homeowner was damaged by Lena Gulch floodwaters as the peak came very close to overtopping West 20th Avenue.

Significant rainfall and runoff was also measured in Wheat Ridge and Arvada. Ralston Creek at Carr Street recorded the second highest peak discharge of the year.

The City of Boulder received its heaviest rainfall of 1991 on this day with the Justice Center ALERT gage reporting a total amount of 1.93". The storm in Boulder County was separate from the event described above with the heaviest rains occurring between 1:00 and 2:30 p.m. Flooding was reported in the City of Boulder along most of the northern or left-bank tributaries to Boulder Creek. The lower reaches of Boulder Creek in Boulder County also flooded.

Flooding was of a sufficient magnitude to prompt the NWS to issue a Flash Flood Warning at 5:20 p.m. for persons in extreme western Adams and Northern Jefferson Counties. This warning was effective until 7:15 p.m. for the entire northwest Denver metro area. Lena Gulch, Ralston Creek and Clear Creek were mentioned specifically in the warning message.

Annual peaks were measured by the ALERT system on this day at the following gage sites:

- Lakewood/Lena Gulch at Maple Grove Reservoir (7:59 p.m.)
- Lakewood/Lena Gulch near Youngfield Street (5:54 p.m.)
- Wheat Ridge/Upper Sloan Detention Basin near 26th and Wadsworth (5:21 p.m.)
- Arvada/Ralston Creek at Simms Street (5:14 p.m.)
- Broomfield/Basin 3207, Pond 6 near 10th and Main (11:08 p.m.)
- Louisville/Drainageway 'D' Detention Basin near McCaslin Blvd. and Via Appia Drive (6:23 p.m.)
- Thornton/Niver Creek Detention Basin at 88th and I-25 (7:18 p.m.)
- Denver/South Platte River near Dartmouth (8:41 p.m.)

June 2: The next day, at 4:45 a.m., the NWS issued another Flash Flood Watch effective from noon to midnight. The HMS assessment at

11:15 p.m. indicated a 60- to 90-percent probability of locally heavy rainfall (1.0" to 1.5"/60 min.) with a risk of severe weather. The prime time for activity was forecast between 3:00 and 9:00 p.m. While the forecast precipitation amounts would not generally be considered a dangerous flood potential, the saturated condition resulting from the storms on June 1 caused reason for concern. Also, an NWS Flood Warning remained in effect for the South Platte River north of Ft. Lupton.

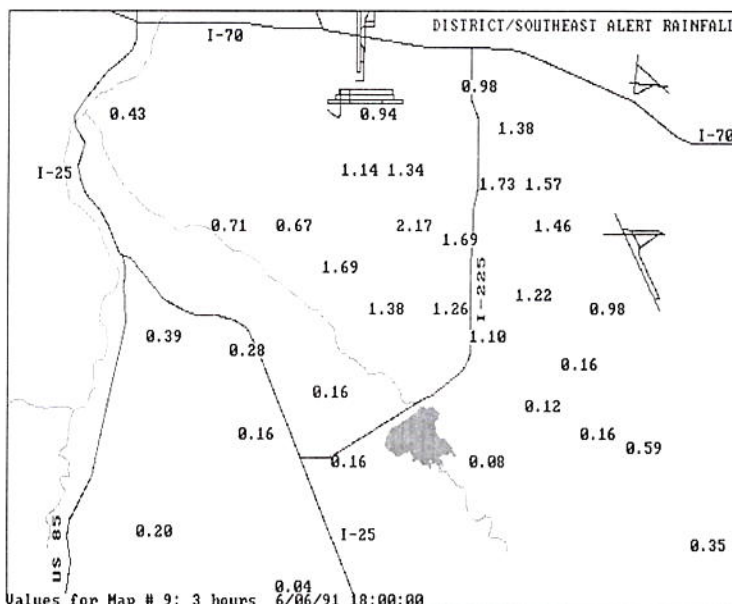
Beginning at 4:50 p.m., an isolated thunderstorm dumped nearly 1" of rain on Goldsmith Gulch north of the Denver Tech Center. A rapid rate of rise measured at the Eastman Ave. ALERT stream gage (Tamarac Square in Denver) prompting the NWS to issue a Flash Flood Warning for Goldsmith Gulch at 5:50 p.m. The peak discharge at Eastman occurred at 5:30 p.m. and downstream of this point, Dartmouth Ave. was overtopped and the upstream embankment of the Highline Canal was breached. Emergency services and public works officials from Denver were advised throughout the day and on location during the flood to prevent citizens from entering the hazard area. No other problems were reported other than normal street flooding.

Goldsmith Gulch seemed to be a favored target for flooding this year particularly at Dartmouth Ave. This event was not the largest event of the year for Goldsmith Gulch.

June 6: It seems like nearly

every year, the first week in June is a good one to watch where flash floods are concerned. On this Thursday, it was definitely Aurora's turn. At 4:40 a.m., the NWS issued another early-bird Flash Flood Watch effective until 9:00 p.m. for the entire front range of Colorado below elevation 8000 feet. The 11:00 a.m. HMS bulletin indicated a 40- to 60-percent chance for a 1.5" to 2.0"/60 to 90-minute rainfall with the prime threat period between 2:00 and 8:00 p.m. Shortly after noon, the NWS issued a Tornado Watch which included the Denver metro area. At 2:15 p.m., radar showed a developing thunderstorm northwest of Parker moving toward Aurora at 15 to 20 mph. HMS estimated that this storm was capable of producing 1.5"/hour rains. At 3:00, the NWS reported strong thunderstorms developing in northeast Park County and heading toward southern Jefferson County at 20 mph. At about this same time, Aurora began receiving its first measurable rainfall. At 3:35, the NWS issued a Tornado Warning for western Adams and extreme southwestern Weld Counties which included the town of Brighton. By 4:05, heavy rainfall was reported in the metro area and between 4:05 and 5:00 the Westerly Creek and Toll Gate Creek basins in Aurora were hit hard.

The ALERT system measured a peak rainfall of 2.17" which fell over a 2-hour period at Expo Park in Aurora (Alameda and Havana). Numerous reports of flooding were received on that day but the primary



Three hour rainfall depths for Southeast Denver on June 6.

disruption involved traffic. News media coverage was extensive.

What typically goes unnoticed during events like this are the emergency preparedness and response actions by local governments. The City of Aurora deserves special recognition for their role on June 6. Many agencies were coordinating operations prior to, during and after the storm. Public works supervisors were dispatched to known problem areas as early as 3:30 p.m., prior to the occurrence of heavy rainfall. Both public works and public safety officials carefully monitored weather information throughout the day and as the storm began, the ALERT system was utilized to guide field operations. The detailed chronology of events kept by the city provides an excellent example of how communities can achieve a well-coordinated proactive response to an urban flash flood.

While this event was relatively big, the flooding cannot be categorized as major. The storm drainage systems worked well with the exception of a few known problem areas like the intersection of Alameda and Havana. The event was classified as a 5- to 10-year frequency runoff and no flood control facilities exceeded their capacity. The Expo Park detention basin came within six-inches of overtopping its spillway and flowing onto Alameda. The ALERT water level sensor at Expo Park proved itself a very useful tool in recognizing when the threat was over.

Annual peaks were measured by the ALERT system on this day at the following gage sites:

- Denver and Aurora/All Westerly Creek stations (between 5:00 and 8:00 p.m.)
- Aurora/Toll Gate Creek at 6th Ave. (5:24 p.m.)
- Aurora/West Toll Gate Creek near Yale Ave. (5:06 p.m.)
- Aurora/East Toll Gate Creek at Buckley Rd. (5:44 p.m.)
- Aurora/Granby Ditch at 6th Ave. (6:46 p.m.)
- Aurora/Sable Ditch at 18th Ave. (4:38 p.m.)
- Aurora/Sand Creek at Sand Creek Park downstream of I-225 (7:04 p.m.)
- Commerce City/Sand Creek at Brighton Blvd (8:20 p.m.)

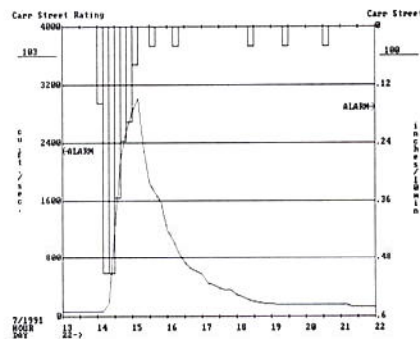
June 21: On this Friday, the first day of summer, at 11:15 a.m., the HMS outlook identified a potentially serious situation developing by mid-afternoon with rainfall amounts of up to 3" possible with intensities of 1" to 1.5"/30min accompanied by severe weather. The HPO also indicated that

internal alerts (MESSAGE 1's) would be issued after the lunch hour. At 12:40 p.m., the NWS issued a Severe Thunderstorm Watch for the Denver area effective until 8:00 p.m. At 1:15 p.m, HMS issued the internal alerts forecasting a "very serious severe weather and urban flooding threat" with the prime time being from 2:00 to 6:00 p.m. At 1:50 p.m., the NWS issued a Flash Flood Watch and shortly after that, a Severe Thunderstorm Warning was issued for a storm over southwest Denver moving northeast at 10 mph.

The afternoon storms did not turn out to be big rain producers but the NWS did issue a Tornado Warning for the Denver metro area at 3:02 p.m. At 5:00, the NWS cancelled the Flash Flood Watch and HMS downgraded the alert status to MESSAGE 1's and extended those messages to 8:00 p.m. The heavy rains did finally arrive that evening with an inch or more occurring at a number of locations. The railroad underpass at 38th and Fox Street flooded, submerging cars and forcing rescue workers to use scuba gear to search for victims. Fortunately, all motorists had escaped their vehicles and no one was seriously injured.

The annual peak was measured by the ALERT system on Cherry Creek at Wazee St. in Denver at 11:31 p.m.

The above discussions should give the reader a good idea about the type of flood season we had in 1991 and how forecast services and technology are used in the District's Flash Flood Prediction Program. F2P2 messages were issued for 40 days between April 15 and September 15 with "message level rainfall" verifying on 35 of those days. While it is not practicable to describe all of the 1991 events in a short newsletter, the following days are also worthy of mention:



Flooding at Valley Mobile Manor mobile home park on July 22 and a combined hydrograph and hietograph for that flood at Carr Street upstream.

July 12: Downtown Golden experienced heavy rainfall and localized street flooding on this Friday afternoon. Emergency crews also responded to Lena Gulch flooding at the Mountainside Estates mobile home park at U.S. Highway 6 and Mount Vernon Road. At 5:10 p.m., the annual peak was measured by the ALERT system at this location

July 20: Denver received most of the action on this Saturday. The heaviest rainfall measured by the ALERT system was in the Goldsmith Gulch, Harvard Gulch and lower Cherry Creek basins. An elderly woman was rescued from her car after attempting to cross Goldsmith Gulch on Dartmouth Ave. Annual peaks were measured by the ALERT system on this day at the following gage sites:

- Denver/Harvard Gulch at Jackson St. (4:57 p.m.)
- Denver/Cherry Creek at Steele St. (5:55 p.m.)

July 22: This Monday afternoon, it was Arvada's turn once again. The Arvada Fire Protection District evacuated the Valley Mobile Manor trailer park along Ralston Creek near 56th and Sheridan. Denver was also involved with rescue operations along Lakewood Gulch where three children narrowly escaped drowning. The weather forecast services (HMS and NWS) were relied upon extensively by both public safety and public works agencies. Local decision making also made effective use of ALERT data. This was another model day on how emergency operations can be successfully coordinated. Annual peaks were measured by the ALERT system at the following gage sites:

- Arvada/Ralston Creek at Carr St. (3:11 p.m.)
- Arvada/Leyden Creek below Simms St. (2:34 p.m.)
- Arvada/Van Bibber Creek at 58th and Miller (2:22 p.m.)



July 25: Between 3:00 and 4:00 p.m., the official Denver rain gage at the National Weather Service office near Stapleton International Airport received its second highest hourly rainfall of record (1.86" in 46 minutes). Flooding problems along I-70 brought traffic to a standstill.

August 2: The annual peak was measured by the ALERT system on Goldsmith Gulch at Eastman Ave. in Denver at 6:31 p.m. Dartmouth Avenue was once again closed to traffic.

August 3: Annual peaks were measured by the ALERT system on this day at the following gage sites:
- Arapahoe County/Englewood Dam (1:13 p.m.)
- Arapahoe County/Holly Dam (11:31 a.m.)

Readers interested in more specific rainfall or streamflow data from the ALERT system for any of the above days should contact Kevin Stewart at 455-6277.

AURORA BENEFITS FROM CREATIVE ALTERNATIVE USES FOR ALERT

The City of Aurora has integrated water resources data from Colorado's GOES satellite-linked monitoring system into the ALERT database. This has provided the City with quick and easy access to important streamflow information which they use to manage their water rights program and diversion operations. Because of this data integration, on at least one occasion this past summer, the City was able to divert runoff water (valued at \$5,000) from a single thunderstorm to storage facilities and verify that the action was within their water rights allocation. Without real-time data, an operation of this type would be extremely difficult to accomplish. Certain State Water Commissioners have also recognized the value of Aurora's ALERT data integration and now routinely access the Base Station to obtain statistical reports.

In addition to capturing water which would otherwise be lost downstream, the Aurora Parks Department utilizes rainfall and weather data from the ALERT system and other sources in continuing efforts to conserve water. Also, the Denver Water Department has completed its third season of using ALERT data to help provide metro-wide ET ratings for their lawn irrigation conservation program.

FLOOD EXERCISES LEAD TO NEW LEVELS OF COOPERATION

Whenever the District becomes involved with installing an ALERT system, a key element of the project is the development of a basin-specific Flood Warning Plan. The cooperating local governments and agencies execute an agreement which is automatically renewed annually for a period of 50 years. The intent of this 50-year term is to commit the parties to an on-going maintenance program. In addition to maintaining the field equipment and other technology, the warning plans are updated and exercised annually. The District and local governments have been doing this since the first warning plan was written for Westerly Creek in 1977.

In recent years, more and more agencies have become increasingly involved with this process. Many individuals are now evaluating ALERT data, working directly with meteorologists and other professionals, and making their own assessments of potential flood emergencies. Public works agencies have taken a more active role in emergency preparedness and field operations. New relationships are developing between public safety and public works officials which require continual adjustment, practice and education in learning how to work together effectively. The District, through its annual flood exercises, has recognized the importance of these relationships and wants to encourage further growth.

Certain jurisdictions, like Denver and Aurora, have developed emergency operations plans which designate a specific public works official as the "Incident Commander" in the event of a flood emergency. Consequently, those designated individuals must become very familiar with how public safety agencies function. Such a role is anything but routine for an individual who may have an engineering and/or public administration background.

To help meet the need for education in this area, the District works closely with public safety and public works officials in designing appropriate flood exercises. From the District's perspective, three areas require special attention in a pre-emergency mode: 1) communications, 2) technical evaluation of data and 3) decision making. Once an Emergency Operations Center (EOC) is activated, many other factors also become critical and are included in designing a comprehensive exercise.

In recognizing these complexities, certain exercises this past year were broken into two parts. The first part involved primarily the technical evaluation and decision making components in which participants would take input from the meteorologist and other data sources, such as ALERT, and make decisions on how to advise public safety or request an EOC activation. The goal here is to learn how to communicate and mobilize personnel before an emergency situation develops. Also, technical personnel receive training on how to use the ALERT Base Station and interpret data with the assistance of exercise software developed for the District. Training of this type can take place at any time and does not need to involve all EOC agencies.

The second part of the exercise, which may occur on a separate day, involves a fully operational EOC with emphasis placed on communications between field personnel and the EOC, and between the agencies at the EOC. All exercises are followed by a critique and emergency plans are revised according to the lessons learned.

It has been the District's experience that the participants take these practices very seriously and much gets accomplished. The cross-training that takes place at the exercise is critical if we are to have any reasonable assurance of conducting a successful response when a flash flood emergency occurs.

THE LONG RANGE FORECAST

The Flash Flood Prediction Program will continue to serve the Denver metropolitan area and seek guidance from the many dedicated individuals involved. The ALERT system, which currently collects data from 120 remote stations, will increase in size with new systems being projected in Jefferson, Arapahoe and Douglas Counties. Boulder County is planning for additional weather stations to aid in fire support and flash flood forecasting. The Bear Creek system will be completed in 1992. Radar will become a topic of increased interest as the National Weather Service moves closer to its planned installation of the NEXRAD Doppler Radar for Denver. And finally, the BIG FLOOD will occur, but don't ask me about where and when, I'm only an engineer. Given the experience this past year, I am willing to predict that this community will be anticipating it and ready to respond when it does happen.

Project Dedication Ceremonies

Dave Lloyd, Chief
Design & Construction Program

Several projects in which the District participated this past year marked their completion through formal dedication ceremonies. Several of these ceremonies are described below.

The North Branch Upper Sloan Lake Project included the construction of detention storage in an existing City of Edgewater park, Citizens Park. As part of the effort to create detention storage which provides many of the residents and commercial businesses 100-year flood protection, the City of Edgewater took advantage of the opportunity to improve the recreational facilities within Citizens Park. With help from a Jefferson County Open Space grant, a new pavillion and restroom facility was constructed. Other improvements included the addition of eight horseshoe pits for a total of twelve, the addition of lighting for the softball field and the installation of a new playground facility.

Citizens Park was formally dedicated on Friday, June 14 at a ceremony held at the park and attended by more than 100 local residents.

On July 31, 1991, officials from the City of Brighton dedicated the Jessup Street Outfall System, a storm drainage project costing in excess of three million dollars. This project was constructed to solve many of the City's drainage woes which have plagued the southern portion of the city for many years. The city is also excited about the recreational opportunities which the newly constructed open channel creates by allowing for a hiker/biker trail connecting the South Platte River with Bromley Lane.

September 26, 1991, marked the culmination of over 25 years of contention that has existed between Jefferson County and the City of Arvada. In 1988, the City of Arvada and Urban Drainage purchased the five acre County Shop Facility located at West 58th Avenue and Independence Street. This property is needed for the proposed Van Bibber Creek flood control project. The sale in 1988 allowed the County to lease the land until its new shop at Highway 93 and Golden Gate Canyon Road opened. With the County's move to the new facility and the demolition of the existing shops, the property was transferred to the City of Arvada on

September 26. The City and District are currently participating with the Corps of Engineers in the development of the Van Bibber Flood Control Project which will hopefully come to fruition in the next few years.

The City of Golden held it's Opening Ceremony for the Tucker Gulch Trail and Flood Control Project on November 2, 1991. This was a joint project between the District, City of Golden, Jefferson County Open Space and the Adolph Coors Company. The project consists of a concrete lined channel needed to convey 100-year flood flows in Tucker Gulch along Ford Street past the Coors Ceramics Plant into Clear Creek. The project also provides an important trail corridor from neighborhoods in the north part of the city to the Clear Creek Trail Corridor.

The Little in Little's Creek

by Frank Rosso, Project Engineer
Maintenance Program

Little's Creek is named for Richard Sullivan Little, a civil engineering graduate from Norwich University in New England who arrived in the area in 1858. The creek passes through urban residential and commercial areas of the City of Littleton which in the 1870's and 1880's were family orchards and farms. The headwaters, five miles southeast of the South Platte River, are located at approximately Dry Creek Road and Clarkson. Along its course to the river, it meanders through a drainageway system comprised of linear greenbelts, roadways, conduits and parks. Its confluence with the river, near Bowles Ave. and Santa Fe Drive, was the location of the Rough and Ready Flour Mill, which was established by Little in 1867, and provided flour to the people of Denver, which at that time was the county seat of Arapahoe County.

In 1872, Little began subdividing a 160 acre parcel which became a portion of the downtown area of Littleton. More than a century later Littleton embarked on an effort to improve its downtown area by putting the mainline railroad tracks, which divided the city, in a depression; and by completing the Little's Creek channelization from the railroad depression to the South Platte River.



Mayor Ron Allison addresses the crowd at dedication ceremonies for Citizens Park.



Refreshments are served at the dedication of the Jessup St. Outfall system.

Now the creek is carried over the railroad depression in a triple box culvert and then dropped into the Little's Creek channel. Part of the depression is drained by a 48" pipe which daylight in the channel about two blocks downstream.

In the Denver Area we have Dry Gulch, Dry Creek, two Little Dry Creeks, two Big Dry Creeks, etc. It's nice to know of one Creek named after an early pioneer, and a civil engineer to boot.



Looking upstream at the Little's Creek crossing of the railroad depression.

NPDES (from page 1)

District developed, in house or through the use of other consultants or services, the products and services listed below. These were provided to the JTF members and, upon request, to other local governments the District:

- *Support of the JTF group activities,
- *USGS Quadrangles enlarged to 1" = 1000' for use as base maps,
- *Drafting of required information onto base maps,
- **"Joint and Independent Activities," a document identifying responsibilities and deadlines for each work item,
- **"Goals and Responsibilities" of the JTF,
- *Data management software written by Michael P. Jansek, P. Jansek, P. Jansek,
- *December, 1990, NPDES workshop for all cities and counties,
- *Draft Erosion Control Criteria by Kiowa Engineering Corp.,
- *Draft Erosion Control Model Ordinance written by Shoemaker, Wham and Krisor,
- *Memo to local governments in District discussing minimum manpower & equipment needs to prepare an application,
- *Legal advice to JTF cities on ordinances, powers, etc., and
- *Notified approximately 6000 industries within District of the CWA and regulatory requirements for industries.

KEY PRODUCTS DURING PART 1 APPLICATION PHASE

All of the many products developed for the JTF group will be made available for use by other local governments within the District when they need to apply for their own NPDES discharge permits. Of these, we consider three products to be key in having a consistent application process throughout the Denver metropolitan area. We will briefly describe these three next and follow that up with a brief description of how a regional wet weather monitoring plan was developed.

Proposed NPDES Protocols

A set of suggested stormwater NPDES protocols was developed to help the communities within the District achieve a uniformity in their applications. As a result, various data and maps required by the EPA regulations were prepared in a fashion that not only meets the regulatory requirements, but does so in a reasonably cost effective manner. The stated objectives in the development of these protocols were:

*To prepare individual applications using the same protocols and similar levels of effort by various municipalities,

*To provide a set of protocols developed in cooperation with the Colorado Department of Health (CDH) and the Denver Regional Council of Governments (DRCOG),

*To facilitate the sharing and use of data whenever watersheds and application requirements interrelate with other jurisdictions,

*To facilitate planning and implementation of management programs and assessment of controls for independent and interrelated systems,

*To conserve resources within the District by reducing duplication of effort in data management, exchange of information, development of separate protocols and data management systems, etc.

The protocol document contains several key items needed to achieve the stated goal of consistency and resource conservation. For example, it describes an approach on how stormwater receiving waters are identified and provides a list of all drainageways within the District, including those identified as receiving waters according to the agreed upon approach. Also, map symbols for receiving waters, major and non-major outfalls, existing NPDES permittees, municipal waste facilities, stormwater quality control structures, etc. are summarized. These are being used by the District to prepare the maps to accompany Part 1 of the applications of each of the three cities.

In addition to the above, this document provides the basis for the linkage between the information identified on the maps and the detailed information entered into a set of 12 data bases, which contain all of the information required by the NPDES regulations. Because of the potential complexity of information management, now and in the future, the document contains work sheets for all of the data bases being managed with the aid of menu driven software. The data base and the information it helps manage will be described later.

Dry Weather Screening Analysis Protocols - Training Manual

Each city had to inventory all major separate stormwater outfalls for the presence of dry weather flows. Whenever dry weather flows were found, they had to be sampled and tested for several parameters. These are to be used to assess if the outfall

may have illicit wastewater connections and if found to be so, to provide the basis to "seek and destroy" these connections.

EPA regulations provided for a variety of options on how to accomplish this task, some of which would be very expensive to the cities preparing these applications. CH2M-Hill was asked to research a set of what appeared to be more cost effective approaches for this task. After discussing their findings and suggestions, the JTF selected an approach, which then resulted in the publication of dry weather screening protocols and a training manual.

The training manual contains a variety of information including procedural guidance on how to assess each major outfall and how to sample and test the water for the required constituents. Among other things, it describes the terminology being used, sources of potential pollutants, field reconnaissance data, dry weather screening data, sampling and sample handling procedures, quality control, safety considerations, staffing and supplies/equipment needs, testing equipment instructions, and the blank forms needed for field assessment and dry weather discharge screening.

Data Management Software

A stormwater data base management system was recently completed for the District by Michael P. Jansek, P. Jansek, P. Jansek. The development of this user friendly, menu driven PC software took almost one year. It was developed in stages to provide the critical features as the data collection by each city progressed. It is now complete and manages a total of 12 interrelated data bases and several utility data bases. In addition to adding and modifying various data base records, the software has user utilities to repair damaged data base indexes, set up monitor and printer information, enter office information for use in reports, permanent deletion of records, maintenance of allowable entry codes and the import of population data from DRCOG or the Census Bureau.

Although Version 1.0 of this program is now complete, we expect it to evolve further. Its capabilities will probably expand to deal with Part 2 of the permit application process and ongoing data maintenance after the stormwater discharge permits are issued. The software will be supported by the District for its use by local governments within the District. If a private party or a municipality outside

the District wants to acquire it, it will be available for purchase through the program's author.

At this time the following groups of information and data can be managed using this software:

- *Information about each major & minor outfall,
- *Land use and population for each outfall,
- *Municipal waste disposal and handling facilities,
- *Existing NPDES permit holders in each watershed,
- *Structural stormwater quality controls,
- *Parks, recreation areas and open space in each watershed,
- *Industrial activities in each watershed,
- *Dry weather field screening results,
- *Drainageway identification list and receiving waters,
- *Dry weather field assessment of outfalls,
- *Drainage basins vs. traffic or population census zones, and
- *Drainage basins vs. population (1990 & 2000).

Monitoring Plan

A wet-weather monitoring plan was developed by the JTF, which is included in Part 1 of the NPDES application. The purpose of the monitoring program, as defined in EPA regulations, is to characterize the quantity and quality of stormwater discharges from commercial, industrial, and residential land uses. This data will be used, along with other available information, to estimate the concentrations and loads from the land surfaces within each city into receiving waters. Water quality samples and stream flow data will be collected during three runoff events in 1992. Approximately 140 constituents will be monitored from a number of small drainage basins in the metropolitan area. A number of potential sites were evaluated for this effort. Each of the sites had to:

- *Have relatively homogeneous land-use type,
- *Have at least 20 acres of tributary watershed,
- *Be suitable for measuring flow in a pipe or a channel,
- *Have no known contamination of soils or groundwater,
- *Have no construction activities during monitoring period,
- *Have no detention effects on smaller storms,
- *Have zero or very small base flow,
- *Be in a location with low vandalism potential,

- *Be accessible during runoff events, and
- *Be publicly owned or have permission granted to use the site.

Some difficulty was encountered in locating suitable industrial sites for monitoring. A number of potential sites were precluded because of Super-fund remediation activities or ongoing highway construction. Never-the-less, the JTF, in cooperation with USGS and CDH, was successful in locating sites that met all of the stated criteria. We are happy to report that CDH approved the proposed monitoring plan. We found the Department staff interested in working with us to get this task accomplished in a cost effective manner. We appreciate the time they dedicated to the review and evaluation of our proposed monitoring plan, which they did despite lack of funding for this new Federally mandated regulatory program.

PART 2 APPLICATION PHASE

Although the Part 1 phase of the NPDES application activities is yet to be completed, JTF is beginning to plan for Part 2. The District and the three cities have executed an agreement to fund the wet weather characterization monitoring effort. A total of \$249,000 was committed by the District, Aurora, Denver and Lakewood, with the District committing one-third of the funds and staff resources to oversee this effort. The U.S.G.S. will conduct the wet weather monitoring effort. After the U.S.G.S. contribution is added to the total, this wet weather characterization effort will have cost about \$360,000. This amount for just the Part II monitoring is twice as much as the EPA estimated total cost of \$175,000 to prepare the three applications of the JTF cities.

We continue to plan for Part 2 and are now discussing the goals, objectives and additional responsibilities, just like we did before JTF work began for Part 1. Much of Part 2 application activities deal with preparation of stormwater management programs and the estimate of urban pollutant loads to receiving waters. This is a very important phase, since the cities will be committing themselves and their fiscal, legal and institutional resources to a set of activities for the first five year term of an NPDES separate stormwater discharge permit. The commitments need to be taken seriously, because of the regulatory nature of such a permit. We have yet

to learn how these permit conditions will be written and, more important, how they will be enforced. In the past, a notice of violation from EPA or the State had the potential for serious fines. There is nothing in the current federal law that treats stormwater permits differently.

CONCLUSION

The District and the three largest cities within the District are working together at this time to prepare all of the information required for each city to submit its own NPDES stormwater discharge permit application. The three cities and the District have defined a set of responsibilities in this endeavor, and each is well on its way toward completing Part 1 of the application. Although the chosen approach required considerable coordination and cooperation between the JTF members, we believe that the effort resulted in savings of monies for the three cities. Tasks that were District-wide in nature were performed or contacted for by the District. Information that was best developed by each city was done so using its staff.

The outcome of all this activity is a set of what we believe to be cost effective protocols, procedures, a data base management system and maps. These will be available at no cost to all cities and counties within the District, and to others for a nominal handling charge. In fact, these tools are already being used by Commerce City, Thornton, Adams County, Arapahoe County and Jefferson County as each prepares for the time they will need to apply for stormwater discharge permits. The cooperative approach has resulted in a number of benefits for all local governments faced with the responsibility of preparing NPDES stormwater permit applications, now and in the future.

We also want to acknowledge the efforts of Pat Nelson and the Colorado Department of Health to effectuate this new Federally mandated program for the State. Without her ongoing participation and timely feedback at the JTF meetings, the permit application process would not be as far along as it is at this time for Denver, Aurora and Lakewood.

Tucker (from page 3)
compliance with proposed standards.

Within the limits of present technology there does not appear to be a way to meet end-of-pipe numbers effectively or economically. We are thus creating a system where all cities and counties will eventually be in a state of non-compliance.

At this time the mandate is for local communities to develop and implement programs that will reduce discharges of pollutants in stormwater to the maximum extent practicable. To conform with NPDES requirements will it eventually become a requirement to develop a system that will meet numerical effluent limitations at the end of the pipe regardless of cost?

Local governments were led to believe or allowed to believe that stormwater was not a typical point source as typically considered in an end-of-pipe driven program. EPA's regulations indeed are written as if MEP is the standard. Some representatives of the environmental community, however, believe that the standard should be based on water quality standards expressed as end-of-pipe numerical effluent limitations if not now, at least in the future. Another disturbing element is that soon after EPA published its regulation EPA General Counsel, E. Donald Elliott, concluded in a memo dated January 1, 1991, that "1) The better reading of Sections 402 (p)(3)(B) and 301 (b)(1)(C) is that all permits for MS4s must include any requirements necessary to achieve compliance with water quality standards."

There is somewhat of a dilemma. Receiving water quality standards should be the bottom line. After all, we are all trying to improve the quality of the Nation's waters. But, should water quality standards be translated to numerical effluent limitations at the end of the pipe for MS4s where exceedences will trigger non-compliance and corresponding penalties. Or, should local governments be required to develop management programs to eliminate pollutants to the maximum extent practicable with monitoring required to provide a long term measure of progress and performance being measured by implementation of features of the management program.

Neither Benefits or Costs Are Known

Programs were imposed by Congress with no knowledge of what the benefits or costs would be. The

cost of the permits were significantly underestimated by EPA as they reported in the November 1990 regulations. EPA estimated that for a large municipality the cost to prepare an application would be \$76,681 based on 4,534 hours to prepare. For a medium municipality they estimated \$49,249 based on 2,912 hours of preparation time. Assuming the monitoring equipment, testing equipment, sample analysis and any other direct costs are free, the per hour cost of these estimates is \$16.91. The cities of Denver, Lakewood, Aurora, and the Urban Drainage and Flood Control District are spending approximately \$1,970,000 to prepare applications for the three cities. Based on EPA's estimate, the cost to the three cities would be \$175,175, approximately one tenth of the real cost.

The cost of implementation is a complete unknown at this time but will certainly be tremendous. The cost of a stormwater treatment system in Sacramento for an area of 900,000 was estimated to cost two billion dollars. On a national scale, the cost of a stormwater quality program could approach or exceed the POTW program. All of the costs of the stormwater quality program are to be borne by local governments. The POTW construction program on the other hand, was supported by large amounts of federal funding.

At the beginning of the 1990s local governments across the nation are facing fiscal problems. This is compounding their ability to respond to mandates from Congress. There have been problems of bankruptcy in Bridgeport, Connecticut; major cities such as Philadelphia and New York have had serious financial difficulties; states such as California, Massachusetts, Rhode Island, and Connecticut have had fiscal crises. In Colorado last November a draconian tax limitation was defeated by a 51 to 49 per cent margin. Another tax limitation measure will likely be back on the ballot in 1992. Several local tax measures were defeated by the voters in the Denver region in the fall of 1990 including a 1% sales tax in Lakewood, a mill levy increase for the Jefferson County School District and a 1/2% sales tax increase for the City of Littleton. At the November 1990 elections in California all referendum issues including Big Green and everything else with a cost associated with it failed to win approval. Local governments are simply not in a good position to continue to take on new

programs mandated by the federal government.

Another point is that POTWs were and are better situated to charge for their services. While some communities have been successful with stormwater utilities it is not a panacea. A stormwater fee is basically another tax and their must be voter approval and/or political acceptability. To compound the problem there is no readily discernible or definable benefit to a stormwater quality management program. We all intuitively agree there will be an improvement in water quality but none of us are sure to what extent. There is general public support for environmental programs but there is also a limit as to how much the public can be taxed before there is tax revolt. In Colorado a constitutional tax limitation measure is a real likely possibility and it would severely limit local governments' ability to provide basic services let alone such programs as municipal stormwater treatment.

What Is The Real Agenda?

When you think about it, local government has limited control over what goes into the stormwater system, yet local government is being held accountable for what comes out the other end. For example, airborne contaminants can impact stormwater quality and certainly the automobile is the source for many contaminants. Given this, one could conclude that the real agenda may be to change the way we live which can only be accomplished through significant changes in lifestyle and/or standard of living.

The existence of another agenda is evidenced by recent remarks by Craig Karras, a representative of the Citizens for A Better Environment (CBE), in a Sierra Club newsletter, The Yodler, ..."It is impossible to regulate the amount of metals like copper and lead which currently flow untreated from storm drains into the bay. Hence the lawsuit. The goal of the suit is not to force cities to build runoff treatment plants at the end of every stream. Such a technological fix would be costly, unsightly, and lethal to a myriad of species. Rather CBE hopes the cities will attack the main culprit: cars. Cars poison the environment in a variety of ways: engines drip oil, exhaust fumes carry nickel and lead, tire wear releases zinc, and brake wear adds copper to the toxic mix. The goal of the lawsuit is to force local governments to restructure their transportation policies which

encourage automotive use." Are operators of municipal stormwater systems being asked to be the vehicle for fundamental social change? If stringent stormwater numerical effluent limitations are established that basically cannot be met, the only way to meet them may be through changes in the basic ways people in urban areas live and work.

A Recommendation

Reauthorization of WPCA is now being considered by Congress, and amendments should be made regarding the stormwater program. Any changes, however, should not disrupt the permitting process that is now underway.

Congress should clarify that the maximum extent practicable (MEP) standard is the standard of performance for municipal stormwater discharges and not numerical end-of-pipe effluent limits in terms of compliance. The law is now written as if municipal stormwater discharges are point sources of pollution. Legislative requirements should reflect the unique nature of municipal stormwater discharges. They are not point sources in a true sense.

Congress should clarify that stormwater quality management is to be accomplished through comprehensive programs emphasizing pollution prevention as opposed to treatment, that stormwater quality objectives be technically and financially feasible, and that realistic time lines be established for achieving performance. In addition, Congress should provide for technical and financial support and not simply and glibly mandate local governments to define the problem and solutions and to shoulder the entire burden for the cost of implementation. Also, Congress should create a process that fosters a cooperative approach to addressing the problem as opposed to the current regulatory approach. At the least there should be a carrot and stick program and not just a stick program.

Stormwater quality management is here to stay and is not going to go away and local governments should make their best effort at developing solid stormwater quality management programs. However, there should be a statutory correction at this point to make what we hope is a "workable" program into a "legal" program.

1991 Staff Changes

Big news in 1991 was the retirement of Bob Hoffmaster in August. Bob came to the District in July 1979 from the San Diego County Public Works Department. Since coming to the District until his retirement Bob was Chief of the Design and Construction Program. Bob was awarded the title of "Old Geezer" when he announced his retirement. He really didn't seem old enough to be retiring, but by giving him the title of "Old Geezer" it made us all feel a lot better.

At a dinner honoring Bob (or his retirement - there seemed to be a little debate there), he passed on the "Old Geezer" handle to Ben Urbonas in the form of a plaque which now proudly adorns the trophy wall. Seriously, he has been an important part of our staff for over 12 years, and contributed significantly to the growth and development of the District. Simply put, Bob is a neat guy, a great human being, and we will miss him.

Bob's retirement triggered other changes and additions to District staff. Paul Hindman moved from the Maintenance Program to the Design and Construction Program. Dave Bennetts was promoted from Field Maintenance Supervisor to Project Engineer in the Maintenance Program to replace Paul. Dave's promotion to Project Engineer was possible because of his graduation in May 1991 from the University of Colorado at Denver with a Bachelor of Science Degree in Civil Engineering. To fill the vacancy left by Dave's promotion Tom Isbester was hired in September as an Inspector/Technician. Tom was a student intern with the District a while he was a Civil Engineering Technology student at Metro State until his graduation in December 1990. Following graduation from Metro Tom went to work for McLaughlin Water Engineers until joining the District staff.

Also big news was the addition of John Doerfer to work with Ben in the District's effort to assist Denver, Lakewood, and Aurora with the NPDES stormwater permitting program. John is a Hydrologist and brings to the District experience in reclamation hydrology with the Colorado Mined Land Reclamation Division and stormwater quality planning and monitoring with the Denver Regional Council of Governments. Stormwater quality is a new area for the District, and John's position is a "temporary" one until the

District's role in stormwater quality is defined. The District is fortunate to have John, and his experiences were an excellent fit for the District's fledgling stormwater quality program.

Planning (from page 7)

answer many questions that cannot be answered at this time. For example, we need to provide an estimate of the expected reduction in pollutant loads that will result from the stormwater management program being proposed by each city. Although we have information about the expected effectiveness of several structural best management practices (BMP's), the effectiveness of many of the other BMP's is not known at this time. Many assumptions and guesses will need to be made to answer these types of questions.

Some of the BMP's the cities will have to include in their stormwater management (SWM) plans that accompany the applications are explicitly defined by EPA's regulations. Other parts of the SWM plan will have to be negotiated between the cities and the CWQCD. This makes the completion of Part 2 very difficult. In essence each of the cities are required to make up a plan to deal with a problem we do not yet understand and to commit fiscal resources to implement programs that we have little or no idea in how effective they will be to solve the yet undefined problem. This is not a pretty picture, especially at a time that the fiscal resources of all local governments are scarce.

Now that the three largest cities within the District are well on their way to preparing their NPDES applications, several smaller municipalities are beginning the task of developing information for their soon to follow applications. The Urban Drainage and Flood Control District has provided those cities and counties with the protocols, manuals, software and maps. We hope to have a training workshop in February of 1992 for all municipalities within the District that want to take advantage of all the information and procedures we developed so far. We are still convinced that significant public resources can be saved through a unified approach in NPDES applications by the cities and counties of the Denver metropolitan area.

SOUTH PLATTE COOPERATIVE PROGRAM FLOURISHES

Barb Benik, P.E., Project Engineer
& Ben Urbonas, P.E., Chief
South Platte River Program

Since the District began the cooperative program within the South Platte River Program in 1988, property owners have contributed over 185 acres of easements and fee simple ownerships to the District. Individual contributions have ranged from less than one acre up to nearly 64 acres. So far, we have entered into seven separate cooperative agreements, with property contributions amounting to at least twenty-five percent of the total cost of each cooperative project.

Since its inception, this program has resulted in the District assisting private land owners with the stabilization and restoration of the banks of the South Platte River. In the past, many of these severely eroded sites had been stabilized with a variety of "creative" ways by some of the property owners. Under the cooperative program, all work is performed to provide structurally sound, environmentally responsive, and aesthetically pleasing banks. In addition, the contributed areas are set aside permanently for river right-of-way and channel maintenance access. Many of the easements we have been granted also provide additional recreational corridor and wildlife habitat. This has been an extremely worthwhile and cost effective program. We wish to thank all of the property owners who have participated with the District in the South Platte River cooperative program and who have contributed land in the process.

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