FLOOD HAZARD NEWS

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# IMPROVED VERSION OF THE COLORADO URBAN HYDROGRAPH PROCEDURE

*by*

E. F. Schulz[1] Ben Urbonas[2] and Bill DeGroot[3]

The Colorado Urban Hydrograph Procedure (CUHP) has been used extensively for the Master Plan design of flood drainage facilities throughout the Denver Urban Region. However, few actual flood measurements were available in the Denver region when the *Urban Storm Drainage Criteria Manual* was first introduced in 1969. The CUHP was based on the Snyder synthetic unit hydrograph concept.

The unit hydrograph for an ungaged watershed is developed by estimating $t_p$ and $q_p$ the parameters for lag time (or time to peak) and peak discharge, respectively, using the following equations:

$$t_p = C_t \, (LL_{ca})^{0.3} \qquad \text{(Eq. 1)}$$

$$q_p = \frac{Q_p}{A} = \frac{640 \, C_p}{t_p} \qquad \text{(Eq. 2)}$$

The time coefficient, $C_t$ and the peak coefficient, $C_p$ must be estimated for the geographic area being studied. These coefficients originally were developed for the Drainage Criteria Manual (1969) using very little local data. Recognizing this lack of data, the Urban Drainage and Flood Control District, in cooperation with the U.S. Geological Survey, began the installation of a number of stream gaging stations and recording rain gages in 1969. By 1973, 30 urban watersheds in the Denver-Boulder Metropolitan area were equipped with this type of sophisticated recording equipment.

The data from these watersheds were used to derive 97 unit hydographs. The unit hydrographs were derived using a computer-based method developed by the Hydrologic Engineering Center (HEC 1 Program). The resulting $t_p$ and $q_p$ parameters were correlated with the physical watershed, urbanization and storm variables; and the following empirical relationships for estimating $C_t$ and $C_p$ were developed:

$$C_t = \frac{7.81}{(I_a)^{0.78}} \qquad \text{(Eq. 3)}$$

and

$$C_p = 0.89 \, (C_t)^{0.46} \qquad \text{(Eq. 4)}$$

where $I_a$ represents the imperviousness of the watershed. These coefficients can then be used to estimate storm hydrographs by use of Eqs. (1) and (2).

A sensitivity analysis was made by the second author on the effects of the use of the Eqs. (3) and (4). The watershed imperviousness was systematically varied from 20 to 80 percent for six trial watersheds in the Denver region, covering a wide range of geometric properties. The physical characteristics for four of the watersheds were taken from data published in the Denver Region under Project REUSE in 1972. The physical characteristics of the other two watersheds were obtained from two studies performed by the District. Comparison of the storm hydrographs computed using the original (1969) and revised (1975) procedures shows that the two procedures yield essentially the same peak flow and time to peak when the imperviousness of the watershed exceeds about 50%. The revised (1975) procedure yields storm hydrograph peaks averaging 27% lower at an imperviousness of 20%. The comparison in peak discharge between the old and revised methods is shown on Figure 1.

It has been suspected for some time that the original Drainage Criteria Manual procedure overestimated hydrograph peaks for watersheds having small percentages of watershed imperviousness. This has been substantiated from the analysis of the actual data from the Denver Urban Network.

The shape of the unit hydrograph in the CUHP is obtained from empirical values of the width of the unit hydrograph at 75% and 50% of the peak discharge. Three empirical relationships were developed from the unit hydrographs derived using the HEC 1 Program. The first

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The URBAN DRAINAGE & FLOOD CONTROL DISTRICT



FLOOD HAZARD NEWS
Bill DeGroot, Editor

## Improved Version

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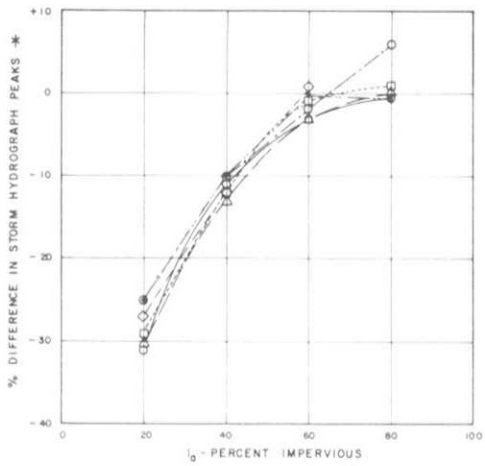


* 1969 procedure results used as base.

LEGEND

| AREA NO. | SYMBOL | AREA(mi.²) | LENGTH(mi.) | DISTANCE TO CENTROID(mi.) |
|---|---|---|---|---|
| 1 | | 67.60 | 17.28 | 8.11 |
| 2 | | 19.47 | 14.15 | 7.48 |
| 3 | | 6.16 | 5.50 | 2.95 |
| 4 | | 3.15 | 3.67 | 1.78 |
| 5 | | 4.77 | 1.70 | 1.51 |
| 6 | | 1.97 | 3.14 | 0.91 |

FIGURE 1. REVISED CUHP RESULTS VS. 1969 CUHP RESULTS

empirical relationship is represented by the regression equation:

$$q_p = \frac{Q_p}{A} = 1387\ (A)^{-0.348} \qquad \text{(Eq. 5)}$$

The other two regression equations are:

$$W_{50\%Q_p} = \frac{500}{(Q_p/A)} \qquad \text{(Eq. 6)}$$

and

$$W_{75\%Q_p} = \frac{260}{(Q_p/A)} \qquad \text{(Eq. 7)}$$

The runoff chapter of the Drainage Criteria Manual has been revised and updated to include results of the analysis of the actual flood measurements in the Denver-Boulder metropolitan region.

At the time revisions were being prepared, two meetings were held with Denver area consulting engineers at which time, their inputs were solicited. The revised chapter contains a sample problem demonstrating the use of the new empirical relationships. The revisions are based mainly on the data from the Denver Metropolitan region. However, one of the graphs also includes data obtained from Pennsylvania, North Carolina, Texas, Illinois, and Kentucky

The revisions further include additions to the references in the Bibliography at the end of the runoff chapter. In the 1969 edition of the Drainage Criteria Manual, it was stated that revisions to the manual would be issued when additional data became available. The 1975 revisions were prepared accordingly. As more data become available, further evaluations of the procedure will be made.

# Utility Coordinating Committees

*by Ed Collins*
*Mountain Bell*

You know the scenario well—

The city widens and repaves a street. It's nice and smooth. Everybody's happy. Then a week later, along comes one of the utility companies with pavement breakers. They cut a series of rectangular holes in the brand new pavement to reach a buried cable or pipe. Motorists, who have just survived the trials of a closed street, now must hurdle a series of barriers. Oh, yes—the crews eventually repair the holes and leave—but in their wake are unsightly patches in what was a smooth stretch of street.

Time and again, such occurrences drive citizens of every community in the nation to ask, "Why can't those utilities get together? Can't all the work be done simultaneously? Isn't anyone at the utilities talking to community public works units?"

Well, like the proverbial weather—the problem has been talked about for years, with few people doing much about it. But now that has changed.

Mountain Bell, Public Service Co., and the host of other utiliites which more than ever before have "gone underground" have seen the need to form Utility Coordinating Committees with many municipalities and other governmental units throughout the Denver Metro area.

The idea is to maintain close coordination in planning, construction and maintenance of utilities, streets, alleys, water and sewage, both currently and for the future, so they're all carried out simultaneously.

Now that simple statement belies the complex results that can be obtained from such a coordinating job. First of all, there is the big result just mentioned—reducing damage and interruption of service by keeping to a minimum the need to disturb underground pipelines, conduit and other lifelines.

But that's just the tip of the iceberg. When all the private and public utilities are talking, you get the best possible land use, consistent with the new concern for the environment. Everyone is playing from the same sheet of music—in concert—rather than in hit-and-miss fashion. Consequently, you also get economies of money, manpower, and materials.

It also results in a one-point contact for each agency or utility to deal with the others. No more confusion and buck-passing within these units or among them. Responsibility and accountability are spelled out, so roadblocks in communication and action are eliminated. It all adds up to the biggest plus—better public relations.

In an era when just about everybody questions the motives and abilities of private businesses and government at all levels, it is crucial to demonstrate to citizens that they *can* trust these bodies to do something efficiently and well.

Most important, these benefits accrue not only on current projects, but because the big emphasis is on future planning, you are constantly building a firm foundation for smooth operations for tomorrow—much the same way the footing of a dam serves to give the basic strength to the rest of the structure.

So—how does one go about forming a utility coordinating committee? I should preface the "how-to" details with this important point: these committees are strictly informational and advisory. They are not meant to be another layer of bureaucracy to be laid on a governmental body or private utility's management. This is an important point, because a committee has more than enough to do without taking on the job of executing its proposals. And nothing would "turn off" cooperation with agencies faster than forcing the committee's views onto the operations side.

Members review, in the planning stage, every utility project involving use of public rights-of-way. The goal is to iron out potential conflicts before they occur. If they do this job right, the application of their findings can be carried out smoothly by the operating departments of the various agencies.

The Public Works Association recommends strongly that the chairman of each coordinating committee be from a municipality or county, rather than from one of the utilities and that each governmental agency act as the control center.

The association also recommends that each community adopt a long range plan of capital improvements. Of course, it should be updated periodically to account for changes as they become necessary. This gives the utilities an early-warning system by which they can anticipate changes and additions in their plans. It goes without saying that each utility should also have long range planning and forecasting to mesh with the governmental agency's.

While experts guard against setting hard and fast guidelines, they say priorities should be established for installing utilities. Usually sanitary sewers are installed first, then storm sewers and water lines. Electric needs follow, then telephone and gas.

Finally, one of the basic tools to make a committee go is a supply of good maps of the street system backed up by a good record of existing underground services. Each utility is coded on the map.

One of the indirect offshoots of our drive to get Utility Coordinating Committees established is the Underground Utility Location Center, or "Dig Center," as we call it.


The major work of the center is the handling of requests by telephone for field location of underground utilities. As these requests come in, the name, telephone number, company affiliation and address of the area where locations are needed is recorded, along with any other information pertinent to the job. From field locator schedules for the date the caller needs the locations made, a

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# Tucker-Talk

by L. Scott Tucker

*Timely Comment from the District's Executive Director*

*CHERRY CREEK PUBLIC MEETING*

A public meeting was held on June 24 to advise the public of the master planning study on Cherry Creek. About 150 people attended the meeting held at Place Junior High, on the north bank of Cherry Creek. The study team was introduced, goals and objectives of the study were discussed, and a movie and slides showing previous flood events and current status of Cherry Creek were shown. Public input followed, with most comments coming from representatives of Homeowners Associations and public interest groups concerned with how Cherry Creek affects them.

The planning team of Merrick & Company, Harman, O'Donnell & Henninger and Alan M. Voorhees are scheduled to complete Phase A of the study by April 19, 1976. Four more public meetings are planned during the course of the Phase A work. Problems will be defined and preliminary concepts for solving those problems will be discussed at the next public meeting.

*DEFINITION OF BENEFITS PASSED BY COLORADO LEGISLATURE*

Proposed legislation defining benefits was discussed in the last issue of *Flood Hazard News* by Senator Joe Shoemaker and Jim Downey. This legislation has now been passed by the Colorado General Assembly. The legislation defines the term "benefit" for the purposes of assessing a particular property within a drainage district or special improvement district. Defined benefits include any increase in market value, provision for accepting additional waters from upstream lands, adaptability of property to a higher use, alleviation of health and sanitary hazards, reduction in maintenance costs, increase in convenience, and ecological and recreational improvements.

The new law has not been tested as of yet, but offers exciting possibilities with regard to financing drainage projects. Our congratulations to Senator Shoemaker for another fine legislative effort.

*USGS MEASURES STORMWATER QUALITY PARAMETERS*

The District, Denver Water Board, and USGS have agreed to finance a stormwater quality data collection program for two drainage basins. One basin is approximately 3 square miles in size and industrial and heavy commercial in nature. The second basin is approximately 1 square mile in size and is comprised primarily of single family low density housing. Data will be collected for two years and analysis will proceed as the data is collected. A final summary report will be prepared by the UGS and will be completed by May, 1978.

The Denver Regional Council of Governments, as a part of their study under Section 208 of Public Law 92-500 (Water Quality Act Amendments), contracted with the USGS for a third quality data collection site. The third site selected consists primarily of higher density residential developments.

Water quality samples will be collected at one point in each basin at five minute intervals. Synchronized with the collection of water quality samples will be runoff measurements. Three rain gauges will be located in each basin, with one gauge being synchronized with the runoff measuring device.

*TWO PHASE A REPORTS COMPLETED*

Phase A of the Hidden Lake master planning project was completed in June, 1975. Adams County and Arvada, the local participating entities, have chosen the recommended alternative and the engineer (Hydro-Triad of Denver, Colorado) is proceeding with preparation of a preliminary design of the selected alternate.

Phase A for SJCD (North) and the north tributary to SJCD (South) was completed in July. The report is now being reviewed by Jefferson County and Arapahoe County. Following the selection of an alternate by the local entities, the engineer (CH2M-Hill) will proceed with Phase B, preliminary design.

*ENGLEWOOD DAM COMPLETED*

Englewood Dam was completed by the contractor, Herren-Strong, in early July, 1975. Englewood Dam represents the first facility owned and maintained by the Urban Drainage & Flood Control District. Herren-Strong and the project engineer, McCall-Ellingson & Morrill, are to be congratulated for a job well done.

Arapahoe County Commissioner John Nicholl addresses a contingent of local officials at Englewood Dam "topping out" ceremonies.

*HOLLY DAM PROJECT CONTINUING*

Final design for the Holly detention facility located near Englewood Dam was recently completed by McCall-Ellingson & Morrill. As soon as the design is approved by the state engineer, bids for the work will be requested. If all goes well, construction should get underway this fall.

*NEW STAFF ADDITION*

Mrs. Trudy Nash joined the District staff in April of this year. Trudy is keeping our records up to date, which is providing us with a sound basis for proper financial

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## Tucker Talk

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management. Prior to joining the District, Trudy had worked with Package Creators, Inc. in Denver, Colorado for 23 years.

*SEVERAL DISTRICT PAPERS ACCEPTED FOR PRESENTATION*

Bill DeGroot and myself presented a paper on "Regional Preventive and Remedial Flood Plain Management" at a conference on Flood Plain Management. The conference was held at Rindge, New Hampshire from July 20 through July 25, and was sponsored by the Engineering Foundation.

Brian Kolstad will present a paper on "Implementation of a Multi-Jurisdictional Urban Flood Control Project" at the ASCE Hydraulics Division Specialty Conference in Seattle in August. This paper will be authored by Brian and myself.

At the ASCE National meeting to be held in Denver in November, 1975, District staff will be involved in the presentation of four papers. One is on the "Structural Aspects of Urban Flood Control" that will be written and presented by Brian Kolstad. A second is "Re-Development of the South Platte River Through Denver, Colorado" that will be authored by Rick Lamoreaux of the Denver Planning Office, Senator Joe Shoemaker, and Bill DeGroot. A third paper on "A Regional Approach to Drainage and Flood Control" will be presented by myself. Bill DeGroot will help write it. A fourth paper on the "Regulation of Flood Plains" will be presented by Bill DeGroot. We are looking forward to telling our story at the National ASCE Conference in November.

I will have an opportunity to lead a workshop at the National Forum on the Future of the Flood Plain, sponsored by the Bureau of Outdoor Recreation, League of Women Voters, and National Association of Counties to be held in Minnesota in September

*SANDERSON GULCH CONSTRUCTION*

Construction on North Sanderson Gulch got underway in May of this year. The contractor for this phase of the project is Pascal Construction Company. Bids were recently opened on a second phase of the project in Denver. The low bidder was Winslow Construction Company. Work on this portion of the project will most likely be initiated in August.

North Sanderson Gulch Groundbreaking — from left to right: Bud Rupert, Lakewood; Deryl Gingery, Gingery Associates, Inc.; Mayor James Richey, Lakewood; Scott Tucker, UDFCD; Dick Pascal, Pascal Construction Co.; Ray Bullock, Lakewood.

## New Board Members Appointed

Manuel L. "Sam" Sandos and Cathy Reynolds, both Denver Councilmen, have recently been appointed to the District's Board of Directors. They will fill vacancies left by Irving Hook and Ivan Rosenberg.

Mayor Bill McNichols and Councilman Ken MacIntosh will continue as the other Denver representatives on the Board.


North Sanderson Gulch Project Engineers — Mike McDermid, Gingery Associates, Inc. and Brian Kolstad, UDFCD.

## Coordinating Committees

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time is selected for a gas, a telephone and an electric locator, and these times are given to the caller. The recorded information is then forwarded to each of the dispatch centers by teletype. These requests to locate are either picked up by the field locators at the beginning of the day, or are transmitted to them by short-wave radio.

Even though it is difficult to make a realistic dollar-and-cents evaluation of the center's effectiveness in reducing damage to underground utilities, all three participants are convinced that damage has been materially reduced. Contractors are particularly pleased that by making one call they can arrange for the location of three underground utilities.

It is just as difficult to put a dollar-and-cents result on the Utility Coordinating Committees. But we do know they are working. After all, as the Bell System advertising motto of a couple years ago put it, "Understanding Begins With Communication."

*Ed Collins is Metro South District Laison Representative for Mountain Bell. He has actively participated in the formation of three utility coordinating committees in the Denver area. Anyone wishing further information on these committees can contact Mr. Collins at 2180 South Leyden, Denver, Colorado 80222.*

## Meet the New Board Members

GILBERT A. BEAN
Mayor of Westminster

Gilbert A. Bean was born in Santa Anna, Texas, and shortly thereafter his family moved to the vicinity of Birmingham, Alabama. After his schooling years, he ventured to Phoenix, Arizona where he lived for the next eight years. In 1936 he went to Gillette, Wyoming, where he met and married Wyoma Christy. In 1940 they moved to the Denver area.

Business interests attracted him to Westminster and in 1953, he constructed Westminster's first shopping center. Mayor Bean first became involved in city government in 1954, when he served a single term on the city council. He became reinvolved in city government in 1963 and has served on council as councilman, mayor pro-tem, and mayor since that time.

He has served on many boards as a city representative, including the Council of Governments, Jefferson County Government Association, Adams County Government Association, Chamber of Commerce, Governor's Safety Council, and now the Urban Drainage & Flood Control District Board.

Some of his activities since arriving in Denver have included Supervisor in charge of Air Corps Supply at Lowry Field, mechanic with United Airlines, construction business, hardware and appliance dealer, and supermarket owner. He was one of the organizers of the First National Bank of Westminster in 1959, and still serves as a director.

Urban drainage and flood control, Mayor Bean stressed, is one of the more important governmental functions he has been privileged to serve on . He believes flood control is important to the whole metro area, both from the standpoint of preventing flood damage and also from the point of utilizing flood waters for the benefit of the metro area.

Gil and Wyoma Bean and their son Mark reside at 8125 Lowell Boulevard, a residence which he designed and built in 1959.

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**Boulder Mayor Penfield Tate, Boulder County Commissioner Wally Toevs and Boulder City Manager Archie Twitchell meet the press at Viele Channel groundbreaking.**

## FLOOD PLAIN MANAGEMENT
## Developing a Program

by BILL DeGROOT

ADMINISTRATOR FLOOD PLAIN MANAGEMENT PROGRAM

I have been writing this column for over a year now. I have kept the heading of "Flood Plain Management, Developing a Program" because I believe that a good flood plain management program should be constantly changing and adjusting to the current situation.

A broad definition of flood plain management would include all activities, both preventive and remedial, which reduce or eliminate human suffering and economic loss due to floods. The program I am responsible for could be appropriately titled "Preventive Flood Plain Management".

The cornerstone of the District's program is the adoption and implementation of adequate flood plain regulations by the local governments. The legislation which created the Urban Drainage & Flood Control District in 1969 gave the District's Board of Directors the power to adopt and enforce flood plain regulations. In 1970, the Board adopted a flood plain regulation, but elected not to enforce it. Rather, the Board left that authority with the local governments with the condition that the policy would be reconsidered after a sufficient period of time, if local governments failed to act. By late 1974, it had become apparent to the Board that an insufficient number of local governments had adequate flood plain regulations to control the increase in flood damage potential within the District. The Board thereupon changed its policy to require all local governments with Colorado Water Conservation Board designated flood plains to adopt and enforce adequate flood plain regulations, with the provision that the District would enforce its regulation in those entities not responding to this requirement.

The District determined that 28 of the 33 local governments either had at least one designated flood plain within their boundaries, or had a study underway which would result in the designation of a flood plain within their boundaries. The District analyzed the flood plain regulation programs of these 28 entities, utilizing a checklist developed for that purpose, and found the present situation to be as follows: 19 entities have adequate regulations, 3 entities have a regulation deemed to be inadequate, which is now under revision, and 6 entities presently have no regulation, but are in the process of adopting one. It is expected that all 28 entities will have adequate regulations before the end of 1975.

Closely tied to the local enforcement of flood plain regulations is the District's policy of reviewing proposed developments at the request of the local governments. The District reviews proposed developments along major drainageways whenever requested to do so. This policy is particularly useful to entities with small staffs who do not have the time to expertise to adequately evaluate development proposals. Even with new construction down sharply due to the current economic situation, the District still averages 6-8 review requests per month. To assist developers in preparing drainage reports, the District has published a pamphlet entitled, "Guidelines for Drainage Reports for Developments Located on Major Drainageways."

## Planning, Design & Construction Notes

*by*

*Brian S. Kolstad*
*District Civil Engineer*

SANDERSON GULCH - ENVIRONMENT 76

Environment 76 requested submittal of ideas from citizens of communities in Colorado for improvement of the urban environment. A three-member jury selected 30 ideas, including 5 outstanding from over 400 entries. Some of these ideas will receive monetary awards for direct implementation or for museum quality presentation of their ideas. This program is sponsored by the Colorado Members of the American Institute of Architects (AIA) and is to be in conjunction with the Bicentennial/Colorado Centennial activities.

A group of fourth, fifth, and sixth graders at Schenck School in Denver submitted a project to Environment 76 and received one of the five outstanding awards. The students' teacher, Mrs. Janet D. Justice, set the stage for the student's ideas during an environmental education unit of their science class.

The students selected as their project, Sanderson Gulch from Federal Boulevard to Irving Street. The desires of the students were given in their report to Environment 76 and included needs for a "wild park, not all fancy." The children wanted 10 big rocks to climb on, hanging trees (such as willows), straight trees (such as ponderosa pines or cottonwoods), wildflowers, a multi-purpose ball field, general clean-up, trash cans, bike racks, repairing the bike path, a rock shelter house, a cleaner stream, and if possible, wildlife, such as fish in a pond, turtles, lizards, birdhouse, etc.

The District's Sanderson Gulch construction package from Arkansas to Sheridan will begin construction this summer, and will be coordinated with the Environment 76 project. It is hoped the contractor can complete the work slated from Irving to Federal early in his contract so the students can complete their project by November 14, 1975 — when the demonstration projects will go on display at the Denver Art Museum. If this scheduling is not possible, attempts will be made to implement some of the student's ideas while not interfering with the contractor.

The AIA has assigned architect Fred Zellar to coordinate the student project. His efforts include knowledge and location of proper landscaping, trails and bike racks, etc., suitable to the Denver Parks Department, which will eventually assume maintenance responsibiilty for the completed project.

The District is happy to see these students taking an active interest in this project. We will be doing what we can to help them reach their goals.

MASTER PLANS COMPLETED

Two master plans were completed by consulting engineers in June and submitted to and approved by the District Board of Directors. The Colorado Water Conservation Board designated and approved the flood plains delineated in these reports at its July meeting.

The Big Dry Creek study began in September 1973 and included the following entities: Englewood, Littleton, Greenwood Village, Arapahoe County and Douglas County. The report completed by VTN of Colorado, showed four major flooding problems and various types of construction needed to reduce these flood damages.

The Lena Gulch study began in July 1973 and includes the following entities: Wheat Ridge, Lakewood, Golden, and Jefferson County. The report completed by Wright-McLaughlin Engineers presents their estimated optimum combination plan which involves various combinations of construction and flood plain management to reduce the flood damages.

Dekoevend Park, one of several parks located in the Big Dry Creek flood plain.

Each report shows the flood plain for both the existing channel conditions and as it will be after the recommended improvements are made. These reports will be used by the local entities to plan future construction budgets, administer the flood plain, and guide new developments that will occur adjacent to the flood plain.

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## *HORACE SMITH LEAVES DENVER*

Horace L. "Ace" Smith has resigned as director of the Wastewater Control Division in Denver and has taken a similar position in Houston. Mr. Smith has made significant contributions to the field of drainage and flood control in the Denver area.

He was an original member of a group of dedicated public officials who provided the leadership for the creation of the *Urban Storm Drainage Criteria Manual.* The manual, completed in 1969, is the only publication of its kind and has been sold throughout the world.

Mr. Smith was also instrumental in the creation of the Urban Drainage and Flood Control District. He then served as a member of the District Board's Technical Advisory Committee (TAC) where he played an active role in shaping the group's direction.

At a farewell luncheon, Scott Tucker, Executive Director of the Urban Drainage and Flood Control District, recognized "Ace's" accomplishments by presenting him with a plaque.

# EXCERPTS FROM "PROCEEDINGS OF SEMINAR ON FLOOD PLAIN MANAGEMENT"

George Phippen, Chief, Flood Plain Management Services, Directorate of Civil Works, Office of the Chief of Engineers:

> The answer to this whole problem, if you will, lies in a broad concept of flood plain management, which I have tried to support along with others. This idea holds that the problems related to flooding must be described in terms of some reasonable role which this piece of territory known as flood plain is to play in the future, and in the future of some larger area generally. In achieving this role then, we must recognize that the full range of tools in the planner's kit, whether they are tools to modify the behavior of the flood or tools to adjust the manner of flood plain occupancy, must be employed if we are to find and achieve the objectives that this broad idea of flood plain management implies.

Nick Lally, Chief, Flood Plain Management Division, Federal Insuracne Administration:

> In fact, I might just take a moment to say that despite all our glowing terms we use in flood plain management and looking at your program of yesterday and today, all we are really talking about is where are we going to assess the cost of the occupancy of a tenacious flood plain. We can kid ourselves with all kinds of fancy terms, but all we are trying to say to ourselves is who is going to pay the bill. We think it is unfair to require the federal government to pay it and spread the tax through the whole country. This is why people who have heard me discuss this have heard me say time and time again, when you knowingly allow somebody to build in a flood prone area, you're letting him put his hands in your pocket. It's that simple.

Don Barnett, former Mayor, Rapid City, South Dakota:

> I think the first thing that we have to do is have the courage to say no to a developer. Say "No, it's too damn close to the flood way. You can't build there," and write a flood plain ordinance that has teeth in it where you can stop the guy. Some developers want to go in, build, make their dough, cut and run. You have to have the courage to say no to that potential investment in your flood way. That takes courage because the schools need the property tax base. Your county needs it. Your city needs it. Your municipality or special districts get their money from property taxes. They need to strengthen their tax base, but strength in the wrong place is wrong because it endangers life and property in the future.

A limited number of copies of the "Proceedings of Seminar on Flood Plain Management" are available from the Urban Drainage and Flood Control District. Please enclose $5.50 with each order.

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