FLOOD PLAIN REGULATION*

Every year, the floods get bigger and more expensive. Or so it seems. In a number of cases, the floods have not worsened, but the value of structures and uses on the flood plain has increased. The local community and the nation may be asked to pay for damage that should not have been allowed to occur.

With notable exceptions, the approach of United States' municipalities and the state and federal governments has been to control floods rather than to control flood damage. Cost and benefit analyses of flood control projects are based on average yearly flood damage with little or no consideration of the flood plain uses.

The following report is a study of what has been and what can be accomplished by flood plain regulation in zoning ordinances and subdivision regulations. Some strong words have been said on the subject of flood plain control in the past. It is our hope that stronger local action will take place in the future.

Flood Plain Regulation can Save Money and Lives

In 1937, Engineering News-Record editorialized:

Traveling down the Ohio during the recent flood one could notice scores of farm homes completely inundated, though standing only a stone's throw from high ground. Villages were flooded, while

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a few hundred yards away dry land rose above the muddy waters. Is it sound economics to let such property be damaged year after year, to rescue and take care of the occupants, to spend millions for their "local protection," when a slight shift of location would assure safety?

Similar situations have occurred in connection with more recent floods. In the Kansas River Valley, immediately after the 1951 flood, the flood plain was reoccupied, with extensive rehabilitation and improvement common throughout the valley. As a result, the Preliminary Report on Flood Protection in the Kansas River Basin reports:

Each new flood, even of the same height as the previous one, results in higher damages consequent upon these successive failures to restrain expansion of flood plain use.

Regardless of any flood protection program for the future, the State of Kansas should simultaneously provide for some adequate and continuing process of the control of flood plain occupancy, so as to avoid the increase in future damage and in hazards to human life. Many of the operations now resumed in the flood plains adjacent to every one of the urban area should have been permanently prohibited in these areas of high exposure. With each new effort toward protection, new encroachments occur and with each new encroachment the magnitude of damage for the future rises. Such unrestrained opposing of forces has neither logic, economy nor wisdom.

Apparently, a similar situation also occurred in Milwaukee County, Wisconsin, which brought about the enactment of flood plain regulations in the zoning ordinance. The flood plain regulations are essential to the general welfare, in the words of the zoning ordinance:

In view of the periodic floods that occur along certain natural water courses....whereby the County Board and the Town Board are called upon to prevent flooding and to erect flood control works at great cost and inconvenience to the residents of Milwaukee County, because of unregulated and unrestricted development which has taken place in the flooded areas...

[Emphasis furnished]

"Settlement Control Beats Flood Control" was the title of a speech presented before the Association of American Geographers at Cleveland, March 31, 1953, and reprinted in Economic Geography, July, 1953, pp. 208-215. In this article, Dr. Kollmorgen, Chairman of the Department of Geography at the University of Kansas, makes a strong plea for flood plain control while attacking the
economics of the flood control program of the U.S. Army Corps of Engineers. Apparently, the Corps of Engineers program calls for the flooding of 150,000 to 200,000 acres of land to protect 185,000 acres which is presently subject to flood damages. In summarizing his observations, Dr. Kollmorgen reaches the following conclusions, among others:

1. Urban and industrial losses would be largely obviated by setback levees and zoning and thus cancel the biggest share of the assessed benefits which now justify big dams.

2. Farm improvements in valleys several miles or less in width would be zoned to flood-free elevations and therefore cancel the second highest assessed benefits which now largely justify the big dams.

3. Crop losses on wide flood-plains would be mitigated by damming narrow tributary valleys - largely V-shaped valleys - but occasional losses would be accepted on this usually highly productive land.

4. Land and soil destruction by flooding is largely a myth and therefore does not justify flooding out one set of farmers behind dams to save another set of farmers below the dams.

The argument of this report is not directed against all or even a majority of the flood control projects of the Corps of Engineers and the Bureau of Reclamation. Our purpose is to suggest an important alternative way of reducing flood damages. Furthermore, a large number of communities presently harassed by floods may have many years to wait before they receive any possible benefits of the federal money spent on flood control projects. Many of these communities can do much to solve their own flood problems without waiting on federal assistance upstream.

ZONING ORDINANCE LIMITATION OF FLOOD PLAIN USES

Zoning ordinances which include flood plain regulations vary in the degree to which they restrict the uses of the flood plain. The ordinance provisions analyzed below range from ordinances which prohibit all buildings and structures to those which specify a number of permitted land uses and buildings which are less expensive and more transient in nature than homes and factories.
Buildings, structures and quarrying prohibited

The zoning ordinance of Azusa, California (1949) contains one of the most restrictive provisions that we have seen:

- Water Conservation Districts

...STATEMENT OF POLICY. There are certain areas of the city which under present conditions are not suited for permanent occupancy or residence by persons for the reason that they are subject to the periodical spreading of water and other hazards. Therefore, for the public interest, health, comfort, convenience, preservation of the public welfare, the City Council does hereby create districts within which it shall be unlawful to erect, construct, alter, or maintain structures of any type.

...USE PROHIBITED. All buildings or structures; mining and/or removal of rock, sand, and gravel, or manufacturing any products from the same for commercial purposes.

Farming, recreation and fences permitted

The zoning ordinance of Evansville, Indiana provides for a "Conservancy Zone" which is only slightly less restrictive than the "Water Conservation District" of the Azusa ordinance. It differs from the Azusa provision in that it is permissive, rather than prohibitive. The Evansville ordinance states that the following regulations will apply in a "C-1 Conservancy Zone.

A. Permitted uses (1) Customary agricultural operations provided that no odor or dust producing substance or use shall be permitted within two hundred (200) feet of a residential or business zone boundary.
   (2) Public Recreation.

B. No building or structure designed for or intended for permanent use or occupancy other than fences will be permitted.

Residences prohibited

One of the most shocking features of flood damage is the loss of life. Some communities, to protect the lives of its citizens and to protect their investment in homes, prohibit the building of residential structures on the flood plain. The zoning ordinance of Duval County, Florida (1950), states:
No building intended for residential purposes shall be moved into or constructed on land subject to periodic or frequent flooding, nor shall any existing building so located be enlarged, repaired, or altered.

**Los Angeles County** has comprehensive provisions regulating flood plain uses in Articles 4 and 5 of the basic zoning ordinance (1951). Reproduced below are the sections of Article 4 dealing with uses of the flood plain for residences and similar structures. The relevant sections of Article 5 are reproduced in connection with commercial and industrial uses of the flood plain.

**Article 4. Areas Subject to Inundation**

**SECTION 443. Findings by Board of Supervisors**

It is hereby declared that after due investigation the Board of Supervisors has found that in certain sections of the unincorporated area of the County the contour, elevation and other physical facts are such that these sections are subject to inundation. It is further found that this condition renders these sections unfit for human habitation.

**SECTION 444. Prohibition.**

No building or portion thereof which is designed for living purposes as a hotel, lodging house, school, or institution or home for the treatment of convalescent persons, children, aged persons, the wounded or mentally infirm, or for any combinations thereof, may be built and no existing building may be altered so as to be used either in whole or in part for any one or more of such uses where the land to be covered by such building, or portion thereof, is designated by this Article as unfit for human habitation.

**SECTION 445. Application of Ordinance**

Except as otherwise provided, all of the provisions of this ordinance apply to areas designated by this Article as unfit for human habitation.

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**Residences permitted as a conditional use**

The zoning ordinance of Oceanside, California.(1950), includes an Open Space Zone for the protection of areas which should be kept in open space uses. The provision regulating the open space zone follows:
A. \textit{ZONE O.S., (OPEN SPACE ZONE)} is intended for open space uses without human habitation:

B. To protect watershed areas subject to periodical flooding or other hazards, necessary for flood flows, spreading, or overflow of streams and channels, or

C. To protect reserved area indicated on master plan as necessary for recreation, protection of scenery, or as wasteland lacking water, soil, or other requisites, against premature or inappropriate development, or

D. To protect rights-of-way of State Highways, parkways, or other principal channels of traffic and communication.

Any and every building and premises on land in O.S. Zone shall be for or occupied exclusively and only for protection of the purposes outlined above, and no permanent human occupancy or building or structure shall be permitted except as a Conditional Use Permit may be issued, with specific conditions in each case, under the provision of Section 20.

The Section 20 referred to in the last line of the above citation includes the following parts relevant to conditional permits for "human occupancy" in the O.S. Zone:

\textbf{SECTION 20 Conditional Use Permits}

\textbf{... B. Variances and Adjustments:} The Planning Commission may authorize under Conditional Use Permit, the use of property for those uses concerning which it is stated in this ordinance that "the following uses may be permitted"..., and where said uses are deemed to be a part of the development of the Master Plan or its objectives and shall conform thereto.

\textbf{... II. To permit temporary construction and occupancy} in the O.S. Zone under conditions safeguarding the public interest against liability for damages and against payment for improvements if and when the property is acquired for public use.

\textbf{12. In any such permit} the Planning Commission shall specify conditions to make the proposed use as consistent and unobjectionable as possible to the purposes of the zone or district in which the proposed structure or use is located.
All uses permitted with planning commission approval

The proposed zoning ordinance for Camden, Arkansas (1952) provides the following "F-1 Flood Zone" regulations:

Any land designated as being in the flood zone may not be used for any purpose except as provided below:

1. The planning commission may approve a use that is in harmony with the zoning contiguous to the flood zone.

2. The planning commission in approving a use in the flood zone shall require adequate protection against flood or high water and shall require the applicant to provide adequate facilities for disposing of liquid wastes.

Apparently, this purposed ordinance specifies neither permitted nor prohibited uses, except in relation to "contiguous" zones. In a general way, the ordinance sets performance standards for flood plain locations, to be determined by the planning commission.

The high-water mark as a limitation on flood plain construction

The zoning ordinance of Jefferson County, Wisconsin (1938) protects flood plain occupants by ruling that no building may be constructed with its basement below the high water mark. The definition of high water mark given in the ordinance is "the limit of the soil that is so affected by the water as to be marked with a nature and vegetation distinct from that of the banks." This is the same definition as the one offered in Webster's Unabridged Dictionary (1950 edition) for the high water mark for fresh water rivers and lakes.

A similar statement is made in the Milwaukee County, Wisconsin zoning ordinance cited below as one of the more comprehensive flood plain regulations.

Comprehensive regulations

(1) Sacramento County, California, Zoning Ordinance (1950). The Sacramento ordinance provides the following uses in any Flood Zone:

Section 11 F. Flood Zone,
Within any "F" Flood Zone no building, structure or land shall be used and no building, or structure shall be erected, structurally altered or enlarged, unless otherwise provided for in this ordinance, except for the following uses:
A. USE.

1. All agricultural uses permitted in the 'A-l' Agricultural Zone.

2. The following uses, provided any required permit is obtained from the State Board of Reclamation and/or the United States Corps of Engineers in addition to building permit from the Planning Commission.

   a. Single family dwellings and accessory building including a private stable in accordance with the provisions for such buildings in the 'R-E' Rural Estate Zone.

   b. Gravel pits and/or gravel processing plans and gold dredging and appurtenant buildings and structures, provided that a special Use Permit, without conforming to the variance provisions of this ordinance, shall have been obtained from the Planning Commission.

3. Said 'F' Flood Zone as shown on the zoning map is intended to comprise all land covered by rivers, creeks and other streams, and land subject to overflow; land and water lying outside of the top (stream side) of any levee and land mainly covered by gravel left from gold dredging or other mining operations.

4. No lot, farm, or ranch or other parcel of land shall be reduced in area to less than thirty thousand (30,000) square feet.

The "R-E Rural Estate" Zone of Sacramento County contains the following relevant provisions:

One single-family detached dwelling on each lot.

A private stable and/or corral when located on a lot, or lots in one ownership, totaling an area of not less than thirty thousand (30,000) square feet.....

One of the significant features of the Sacramento County ordinance regulating the flood plain is the 30,000 square foot minimum lot size (almost three-quarters of one acre).
(2) Los Angeles County, California. Article 5 of the Los Angeles County Basic Zoning Ordinance (1951) contains unusually broad provisions concerning the regulation flood control. These are directed toward the prevention of floods, or the prevention of acts which would aggravate floods.

Article 5. Flood Control
SECTION 760. Regulations of Permittees.
The board of Supervisors may prescribe, by uniform rule or regulation, the minimum course of its excavations or other operations tending to displace the soil; and shall also have the power to prescribe any and all other rules and regulations, uniform in their operation, necessary for the carrying out of the purposes of this article.

SECTION 761. Rio Hondo and San Gabriel Rivers.
Every operator of any rock quarry, sand or gravel pit, rock crushing plant, or any apparatus for the excavation or manufacture of rock, sand or gravel, which quarry pit excavation plant, or apparatus is so located as to intercept or obstruct any of the flow of the Rio Hondo or San Gabriel Rivers, shall so conduct all such operations as to always provide a channel of sufficient capacity to bypass one thousand cubic feet of water per second in each river without the flow entering any such pit, excavation or quarry.

SECTION 762. Obstructions.
A person shall not place or cause to be placed in the channel or bed of any river, stream, wash, or arroyo, or upon any property over which the Los Angeles County Flood Control District has an easement for flood control purposes duly recorded in the office of the County Recorder of Los Angeles County, any wires, fence, building or other structure, or any rock, gravel, refuse, rubbish, tin cans or other matter which may impede, retard, or change the direction of the flow of water in such rivers, stream, wash or arroyo, or that will catch or collect debris carried by such water, or that is placed where the natural flow of the stream and flood waters would carry the same downstream to the damage or detriment of either private or public property adjacent to the said river, stream, wash, arroyo or channel.

This section does not supersede or modify the provisions of any other ordinance.
SECTION 763. Flood Hazard
Whenever the Board of Supervisors of the County of Los Angeles finds that the excavation or quarrying of any rock, sand, gravel, or other material in a particular area would create flood hazard or would be otherwise dangerous to the public safety, then before any person excavates or quarries in any part of such area, such person shall first obtain from the Chief Engineer of the Los Angeles County Flood Control District a permit to do so.

SECTION 764. Flood Control Permit.
The Chief Engineer of the Los Angeles County Flood Control District may issue such permit upon the condition that the applicant before commencing any such excavation, and at such other times during such excavation as may be necessary shall erect such dikes, barriers, or other structures as will afford, in the opinion of the Chief Engineer of the Los Angeles Flood Control District, either the same protection as if no excavation should be made, or protection adequate to prevent the flow of the flood waters out of their natural channels.

SECTION 765. Application For Permit.
The Chief Engineer of the Los Angeles County Flood Control District may require the submission of plans and specifications showing the nature of the proposed excavation and dikes, barriers or other structures.

SECTION 766. Compliance with Permit.
No person may make any excavation within such area except after receiving and in conformity with such a permit.

SECTION 767. Permit No Guarantee.
The issuance of such a permit shall not constitute a representation, guarantee or warranty of any kind or nature by the County of Los Angeles or by the Los Angeles County Flood Control District, or by an officer or employee of either thereof of the practicability or safety of any structure or other plan proposed and shall create no liability upon, or a cause of action against such public body, officer or employee for any damage that may result from any excavation made pursuant thereto.

SECTION 768. Hazardous Area.
The board of Supervisors of the County of Los Angeles finds that the excavation or quarrying of any rock, sand, gravel or other material in the area described as follows: . . . . Would create a flood hazard and in other ways be dangerous to the public safety.
(3) Montgomery County, Dayton, Ohio, Zoning Resolution for the unincorporated territory of Montgomery County (1952). This proposed zoning ordinance lists a series of principal and accessory permitted uses subject to certain regulations as follows:

Article 16 - "F" Flood Plain District.
The following regulations and the regulations contained in Article 6 shall apply in the "F" Flood Plain Districts:

A. Principal Permitted Uses:
1. Agriculture, including greenhouses, customary agricultural buildings and structures.
2. Summer homes or cabins, for seasonal and not permanent or year-round occupancy, and which buildings need not abut upon a street.
3. Boat docks, private and commercial, including the selling or leasing of fishing equipment and bait.
4. Commercial kennels and riding stables; provided that any building in which animals are housed shall be at least two hundred (200) feet from any lot in any "R" District.
5. Public parks, playgrounds and community centers; private recreation area and facilities, including country clubs, golf courses, fishing lakes, and subject to prior approval of the Board of Health of Montgomery County, bathing beaches and bath houses.
6. Quarries, stripping of top soil, sand and gravel pits; provided that any building housing power or power-producing machinery or equipment shall be at least two hundred (200) feet from any lot in an "R" District.
7. Inns, other dining places.
8. Tourist or trailer camps for seasonal and not permanent or year-round occupancy, and subject to the provisions of Article 18, Section 1, A to F inclusive.
9. Circus, carnival or similar transient amusement enterprise.
10. The following, when approved by the Board in accordance with the provisions of Article 21, Section V, A and B.
   a. Outdoor rifle or skeet shooting range.
   b. Amusement parks, baseball, football stadium, or sports arena.
   c. Equipment and material storage yards, including petroleum or inflammable liquids storage adjoining railroads or principal highways.
   d. Public or privately owned airport or landing fields.
   e. Disposal of garbage or refuse by the County, Township or Municipality or agents thereof.
f. Any other use of the same general character but not including any use permitted or prohibited in the "M-1" or "M-2" Districts.

B. Accessory Uses:
1. Accessory uses and structures as permitted and regulated in the "B-1" District.
2. Any other use customarily accessory or incidental to the permitted principal uses; including the sale of food and refreshments.

Height Regulations. The regulations are the same as those in the "A-1" Districts.

Lot Area, Lot Frontage and Yard Requirements.

A. Minimum Requirements: The following requirements shall be observed subject to the modified requirements contained in Article 19, Section 1, Ato F inclusive.

1. For summer houses or cabins, the minimum requirements are as follows:

Lot Area - 6,000 sq. ft.
Lot Frontage - 50 ft.
Side Yard each - 5 ft.
Front Yards - 10 ft.
(The front yard depth shall be measured from the established right-of-way lines as shown on the Official Thorofare Plan.)
Rear Yards - 10 ft.
Lot Coverage - 10% Maximum

2. For other permitted uses, the minimum requirements are the same as in each district where such use is first permitted.

(4) Milwaukee County Zoning Ordinance (1951). In 1951, a special section was enacted to create "upland, valley and channel districts" and to provide for restrictions along streams. Originally, the "valley" district was known as the "Flooddistrict, and the "upland" district was called "non-flood". For public relation reasons the names were changed. The key regulation in the Milwaukee County ordinance is contained in (4) below, stating that no structures can be
built or moved unless the land is such that the main floor will be at least three feet above the high water mark shown on the maps. Relevant features of the ordinance provision are reproduced below.

RESTRICTIONS ALONG STREAMS

(1) Creation of Upland, Valley and Channel Districts:

For the purpose of promoting the public health, safety, convenience, morals, comfort and general welfare by regulating and restricting areas along or in natural water courses, channels, streams, and creeks...outside of the limits of incorporated cities and villages, is hereby divided into three (3) districts as follows:

F-1 -- Upland Districts
F-2 -- Valley Districts
F-3 -- Channel Districts

...

(3) F-1 -- Upland District:

In the F-1 Upland District any construction or use not inconsistent with this ordinance is permitted.

(4) F-2 -- Valley District:

In the F-2 Valley District no building or structure will be erected, and no existing building or structure shall be moved unless the ground upon which said building or structure is to be erected and ten (10) feet beyond the limits of said building or structure shall, prior to or at the time of construction, be raised to such level that the main floor of said building or structure shall be not less than three (3) feet above the high water level, as shown on the maps above referred to. No basement floor or other floor shall be constructed below or at lower elevation than the main floor.

(5) F-3 -- Channel District:

In the F-3 Channel District no building or structure, retaining or revetment wall, except bridges or dams, and no fillings of earth, ashes, rubbish, rubble, concrete, masonry, or any kind of dump shall be placed. The boundaries of the F-3 Channel District shall be such lines as shall be officially determined by description and adopted as part of this ordinance by the County
Board and the respective Town Boards of the towns in which such water courses, channels, streams or creeks lie. The location of such channel lines may be determined from time to time by ordinance of the County Board amending this section of this ordinance by addition thereto of the proper description of such channel line. With approval thereof by the proper Town Board, the said channel lines shall be deemed to be established for the purpose of this ordinance at the date of the final approval of such amendatory ordinance by the County Board.

The statement of purposes of the Milwaukee County ordinance has already been cited on page 2 of this report.

The Milwaukee County experience

PLANNING ADVISORY SERVICE requested comments on the progress made on flood plain zoning from Ray E. Behrens, Planning Director and Supervising Engineer of the County of Milwaukee Regional Planning Department. The following material is his answer to our request:

You request comments with respect to any new development in connection with our Valley zoning. About all which can be reported with respect to this zoning is that it apparently is operating satisfactorily. Several permits have been issued in the Valley District and plot plans submitted have included the necessary information with respect to the elevation of the lowest floor of the structure.

In this connection we have found it necessary to have available a list of bench marks along the stream valleys to enable the surveyors to obtain accurate elevations from points close at hand. This obviates the necessity of burdening the property owners with additional expenditures due to the necessity of running rather long lines of levels.

We had one incident which would tend to prove that the ordinance has teeth. A party took out a zoning permit and on his permit was written the elevation of the lowest floor to which the structure could be erected. After construction was under way we were notified that a basement was being placed on the property and upon checking found that no attention whatsoever had been given to the information contained on the permit with respect to elevation. After a considerable amount of discussion the owner decided to remove the foundation and fill up his excavation. This has been done.
We feel that the Ordinance as drafted should accomplish the desired results, although we would recommend increasing the amount of fill required around the borders of the basement. We indicate a minimum of 10 feet whereas I believe we will before long amend this to provide not less than 25 feet of fill.

Summary of flood plain zoning

The variety of types of restrictions result from the variety of situations to which these restrictions apply. For instance, many types of "flood" are encountered, ranging in severity from the 17 lives lost and the $2.5 billion damage of the 1951 floods of the Kaw and Missouri Rivers at Kansas City, to the minor overflows that sometimes come when the ice is breaking up on small streams. However, an inch of water covering the land on which a house is located can cause serious damage to the house.

The ordinances reviewed here have ranged from those which prohibit all structures on the flood plain to those which either allow numerous uses (but only those uses listed) or those which apply certain restrictions to buildings in the danger area. Where it is deemed wise to allow some use of the flood plain, either because of the need for the space or the relatively minor nature of the floods, there are a number of logical uses that can be permitted. Here are some of them as indicated in the various ordinances which have been reviewed:

1. Agricultural uses

   farming

   grazing

   livestock raising

2. Recreational uses

   public recreation areas (including parks and playgrounds)

   private recreation areas (including private parks, picnic grounds, golf courses, fishing lakes, boat docks, seasonal eating places)

3. Utilities

   public utilities equipment (including bridges, etc.)

   railroads
4. Storage uses

storage of equipment and materials (not including inflammable liquids such as petroleum)

5. Temporary human occupancy

summer homes and cabins

temporary construction workers housing

6. Permanent animal occupancy

kennels

stables

7. Fences

8. Other more or less open space uses in which the value of structures per acre does not exceed a maximum figure which may be determined in view of existing local conditions (including billboards and signs, circuses, stadia, race tracks, etc.).

SUBDIVISION REGULATIONS OF FLOOD PLAINS

Subdivision regulations may provide that land subject to inundation cannot be platted, or they may provide conditions that must be fulfilled before subdivision will be allowed. Requirements may vary as the situation varies. In some areas, the problem may be one of poor drainage, swampy land and sheet overflow of small rivers. Such situations do not lead to the dramatic floods of the 1951 Kansas City variety, but do create areas in which homes are subject to damage and a whole area subject to unhealthy conditions.

The subdivision ordinance of Claremont, California (1952) provides that flood areas and natural water courses must be shown on the final map of the plat, and also that land subject to inundation shall not be platted for residential uses:

(map provisions)

(a) FLOOD WATER. If any portion of the land within the subdivision shown on any final map is subject to inundation or flood hazard by storm waters, such fact and portion shall be clearly shown on such final map by a prominent note on each sheet of such map whereon any such portion shall be shown.
(b) OVERFLOW, PONDING. If any portion of such land is subject to sheet overflow or ponding of local storm water, the Planning Commission shall so inform the State Real Estate Commissioner.

(c) NATURAL WATER COURSES. In the event that a dedication of right of way for storm drainage purposes is not required, the City Council may require that the location of any water course, channel, stream or creek be shown on the final map.

(areas subject to inundation)

LAND SUBJECT TO INUNDATION. Land subject to flooding and land deemed by the Planning Commission to be uninhabitable shall not be platted for residential occupancy, nor for such other uses as may increase danger to health, life or property, or aggravate the flood hazard, but such land within the plat shall be set aside for such uses as shall not be endangered by periodic or occasional inundation, or shall not produce unsatisfactory living conditions.

(drainage provisions)

STORM DRAINS: FLOOD CONTROL. Easements for storm drains and flood control shall be provided within the subdivision when deemed necessary by the City Engineer and/or City Council.

The subdivision ordinance of Redwood City, California, (1949) contains several provisions similar to those of Claremont. In addition there is a provision relating to storm drainage, as follows:

The subdivider shall, subject to riparian rights, dedicated a right-of-way for storm drainage purposes conforming substantially with the lines of any natural water course or channel, stream or creek that traverses the subdivision, or at the option of the subdivider provide by dedication further and sufficient easements or construction, or both, to dispose of such surface and storm waters. The subdivider may be required to cover or otherwise improve any such drainage channel through such rights-of-way.

The subdivision regulations of Modesto (1952) and Palo Alto (1950), both in California, contain provisions which are identical to the Redwood provisions, except for the omission of the last sentence.

Providing adequate drainage before platting of areas subject to flooding is required in the subdivision regulation of Lubbock, Texas (1952):
F. Flood Areas. Areas within the jurisdiction of the City Planning Commission subject to flood conditions as established by the City Engineer of Lubbock will not be considered for subdivision purposes until adequate drainage has been provided.

A SUGGESTED PROGRAM FOR FLOOD PLAIN REGULATION AND REHABILITATION

Some fortunate communities will be able to prevent much of the costly and unnecessary development which has occurred on the flood plains of other communities. This protection can be achieved through the zoning ordinance and through subdivision regulations. Other communities may not realize the possible magnitude of their problem until the floods have come and caused a certain amount of havoc. The programs that cities in either situations may carry out will vary, and two such programs are suggested below.

(1) Before the flood*

Locating and mapping the danger areas
Discovering what areas are subject to floods and what kinds of floods these are, may be comparatively simple. In some cases, it may only be a matter of preventing building from extending below the high water mark of a lake or river. In other cases, it may involve a study by the unit hydrograph method of the possible floods and extent of the damage that might occur in the 10-year, 50-year, or even 500-year flood.

Integrating the flood danger areas with the master plan
The zoning ordinance and subdivision regulations should be based on a comprehensive plan of land use which is based on an understanding of the future growth and development of the community in specific terms. While the uses permitted on the flood plain may be basically open space uses, there is no reason why they should be at variance with the uses permitted on land adjacent to the flood plain. For example, quarrying may be a logical flood plain use, but quarrying should not be permitted to become a nuisance to adjacent residential areas merely because it is located on the flood plain.

* "Flood" here is taken to mean not only the worst disasters, but simple "ponding", "sheet overflow of stream", and such other localized drainage problems which do not involve direct threats to life or destruction of homes.
Preparing special provisions in the zoning ordinance and subdivision regulations in flood danger areas.
Where possible, zoning ordinance regulations should designate illogical flood plain uses as non-conforming uses which can be amortised in time. The reconstruction and improvement of damaged buildings should not be permitted.

(2) After the flood

Some communities have let themselves expand into the path of future floods. Many buildings or properties will be damaged or ruined before these communities have learned to minimize flood hazards. The suggested program which follows would take effect after the flood, although there is no reason why it might not be worked out in detail beforehand. The recommended steps to be taken are as follows:

Survey
A complete survey of the damaged area which would include a land-use map of the area before the flood, a detailed map showing the extent of damage on each piece of property, and an appraisal by competent architects and engineers as to the feasibility and cost of restoration of each building utility.

Reconstruction policy
A carefully worked out and clearly stated policy regarding reconstruction in the flood damaged area, particularly in relation to the exposure of human lives to the danger from floods.

Analysis of the flood
An engineering analysis of the flood which has occurred by the unit hydrograph method, or some other suitable method. This would involve a careful analysis of the frequency and damage of all floods, the possibility of a repetition of the recent flood, and an analysis of the possibilities and consequences of worse floods.

Land use plan for the flood plain
A carefully worked out flood plain land use plan, coordinated with land use plans for the entire city, showing the future use of the damaged area in accordance with the policy developed.

Flood plain zoning
The preparation of an amendment to the zoning ordinance to carry out the policies and plan.
Conservation, rehabilitation, slum clearance, and public housing

(1) Preparation of a housing code (if not already in existence) which would allow the condemnation buildings unsuitable for human habitation. (A recommended code is the Model Housing Code of the American Public Health Association, 1790 Broadway, New York 19, New York, 50¢.)

(2) A study of the possibilities of financing rehabilitation, etc., recommendations for obtaining grants, private loans, bond monies for such purposes.

(3) Recommendations for state enabling statutes to allow the City and others in the state to take appropriate measures for conservation rehabilitation, slum clearance, and public housing, where these statutes do not already exist. If they are already on the books, they will be useful in dealing with flooded areas in line with the over-all plans for urban redevelopment.