DETENTION BASIN DESIGN CRITERIA FOR SAN BERNARDINO COUNTY

The following design parameters and procedures are listed as guidelines to insure proper detention basin operation. When necessary, these guidelines may be modified if approved in writing by both the Flood Control District and Land Management Department.

I. Definitions

A. Regional Detention Basin

1. A basin which can be incorporated into the Flood Control District's existing or proposed drainage system,

2. Basin owned and operated by the Flood Control District, although it may be joint use, and

3. A basin which will reduce the downstream peak flow rate and the necessary downstream storm drain size.

B. Local Detention Basin

1. A basin which will not be incorporated into the Flood Control District's existing or proposed drainage system,

2. A basin owned by an individual or organization other than the Flood Control District, and

3. A basin which will reduce the downstream peak flow rate, but will not be considered in downsizing future downstream storm drains.

C. Joint Use Detention Basin: A regional or local detention basin which has an additional use such as football field, parking lot, golf course, lake or etc.

D. Temporary Detention Basin

1. A local detention basin used to reduce downstream peak flow rates until ultimate storm drain facilities can be constructed as part of a phased development, and

2. Generally the life of the basin shall not exceed 10 years.

SEE CHANGE PER ATTACHED MEMO

II. Basin Capacity and Outlet Drain

A. When a basin (regional, local, temporary or joint use) is to be used to mitigate downstream impacts due to increased flows generated by a development, the basin capacity and outlet size shall be such that the post-development peak flow rate generated by the site shall be less than or equal to 90% of the pre-development peak flow rate from the site for all frequency storms up to and including 100-year (i.e. the peak 2 year post-development flow rate is equal to or less than 90% of the peak 2 year pre-development flow rate from the site and etc. for all frequency storm events through 100-year).

1. Only 2, 10, 25 and 100-year storms need to be analyzed.

2. Additional studies shall be submitted where there exists more than one basin in the drainage area under review. The studies shall address the timing of the peak flow rates from the basins to ensure downstream flow rates are not increased.

B. When a basin (generally regional or regional joint use) is to be used to reduce the size of a master planned downstream drainage facility, the basin capacity and outlet size shall be such that the 100 year basin peak outflow rate is no greater than the downstream facility's design capacity.

1. Open channel design capacities shall be per the San Bernardino County Flood Control District Standard Plat 100 ("San Bernradino County Standards and Specifications"). A bulking factor is not necessary when the basin is designed to handle debris and the downstream channel is lined.

2. Pressure flow closed conduits shall be designed such that the hydraulic grade line is below the ground or street surface. In those reaches where no surface flow will be intercepted (now or in the future), a hydraulic grade line which encroaches on or is slightly higher than the ground or street surface will be acceptable.

3. Non-pressure flow closed conduit capacities shall be based on a flow depth no greater than 0.8 times the conduits diameter or height.

C. Where downstream erosion is a concern the duration of erosive flow velocities for all frequency storms shall not be substantially increased unless other forms of mitigation are provided. This can be accomplished by reducing the peak flowrate further than that required above. Refer to "Handbook of Hydraulics" by Horace Williams King and Earnest F. Brater, and "Open-Channel Hydraulics" by Ven Te Chow, Ph.d. for erosive flow velocities.

D. When there exists a potential for debris entering the basin, the basin capacity shall be increased or a desilting basin provided to accomodate the debris production generated from a 100-year storm four years after a burn (over the entire watershed), plus 20% due to maintenance uncertainties.

1. For all basins where a significant amount of debris accumulation is anticipated, a debris disposal area or areas shall be provided within a reasonable hauling distance.

2. "A New Method of Estimating Debris-Storage Requirements for Debris Basins" by Fred E. Tatum of the U.S. Army Corps of Engineers shall be used for determining the 100-year debris volume.

3. Local basins shall not be located in desert areas where there exists the potential for debris entering the basin (i.e., locations where flows are directed to the basin by natural drainage courses or earth graded channels which handle flows from undeveloped watersheds). It is recommended that the flows from the development be conducted to the basin in a hardlined facility (i.e. street or concrete channel), then outletted into the natural drainage course or earth channel.

4. Local detention basins shall not be fed by natural drainage courses or earth channels with undeveloped watersheds greater than 0.5 square mile.

5. The basin capacity for local detention basins fed by natural drainage courses or earth channels with undeveloped watershed less than 0.5 square mile, shall be enlarged to handle an additional 5 years of accumulated annual debris based on the attached figure 1.

6. Generally regional detention basins with undeveloped watersheds shall be flow-by basins or have a separate debris basin upstream of the detention basin.

7. The basin capacity for detention basins located in watersheds known to have a high risk of burning, shall be increased as determined by the Flood Control District.

E. Outlet Drain

1. The outlet pipe for all basins except temporary basins shall be a minimum 24" RCP (1350 D minimum) for local basins and a minimum 36" RCP (1350 D minimum) for regional basins. The outlet pipe or conduit shall be encased with cut-off collars per the "Los Angeles County Flood Control Design Manual - Debris Dams and Basins" or designed per "Section 242. Cut-and-Cover Conduit Detail" of the Bureau of Reclamation's publication "Design of Small Dams".

   a) Reinforced concrete collars generally from 2 to 3 feet high, 12 to 18 inches wide, and spaced from 7 to 10 times their height shall be provided.

   b) All joints for pipes not encased shall be rubber gasketed.

   c) The pipe shall be capable of withstanding H20 live loads plus the applicable dead loads.

   d) Erosion control measures shall be provided at the outlet of the basin outlet pipe.

   e) Temporary basin outlet pipes may be a minimum 24" C.M.P., 12 gauge with seep rings. Design considerations shall be as stated above.

2. A metered outlet structure may be necessary to provide the necessary flow attenuation for all frequency storms. "V"-shaped weirs and notched weirs are preferred over other alternates because they do not plug with debris and trash as easily as other designs.

3. All detention basin outlets should be sized so the basin will drain within 24 hours after the basin reaches its 100 year peak depth/volume. If the basin does not drain in 24 hours, further studies using longer duration storms will be necessary. The basin storage volume (capacity) may need to be increased to accomodate subsequent storms.

4. Trash racks shall be provided at the inlet to the basin outlet structure(s).

5. Anti-vortex devises shall be provided where warranted.

6. A depth gauge shall be provided on the basin outlet structure in order to monitor debris deposition and basin operation.

F. Analysis Methodology

1. Pre and post development peak flow rates shall be developed using the procedures outlined in the San Bernardino County's Hydrology Manual.

2. Basin inflow hydrographs shall be developed using the procedures outlined in the San Bernardino County's Hydrology Manual.

3. Basin outflow hydrographs shall be developed by the Modified Puls Method.

4. Channel hydrograph routing shall be calculated by the convex channel routing method or by moving the hydrograph utilizing travel time.

III. Water Surface Elevation and Depth

A. Local Basins

1. When feasible the 100 year design water surface elevation should be at or below existing natural ground. Generally no more than 50% of the basins 100 year storage depth should be above existing ground (i.e., 50% or more of the 100-year minimum storage depth must be below the lowest ground outside basin).

2. The necessary storage depth for debris plus the two year flow attenuation shall be below existing ground.

3. The basin's maximum water depth for 100-year design should be 6 feet or less.

4. When site conditions warrant and safety can be assured, the above depth requirements may be modified if the following conditions are met.

a) The detention basin is designed in accordance with the Los Angeles County Flood Control Distrit's "Design Manual - Debris Dams and Basins".

b) The basin embankment is constructed of material, or has a solid core, which does not allow seepage or piping to occur due to rodent holes.

B. Regional Basins

1. Depths shall be as approved by the Flood Control District.

2. Basins with heights greater than or equal to 25 feet and capacity greater than or equal to 15 Ac.ft., or a capacity greater than or equal to 50 ac. ft. and a height greater than or equal to 6 feet, shall be reviewed and approved by the State's Division of Safety of Dams. (See figure 2)

C. Joint Use Basins

1. Depths should be shallow and compatible with the secondary use.

2. Depths for parking lot, tennis court or other similar joint use basins should be no greater than 6 inches to 12 inches.

3. The allowable depth in most cases will be site specific and shall be approved by all agencies involved.

IV. Emergency Spillway

A. All detention basin spillways shall be designed to pass the fully developed 1000 year peak flow rate ($Q_{1000}=1.35\ Q_{100}$) or that peak flow rate required by the State's Division of Safety of Dams, whichever is greater.

B. Spillway outflows shall be adequately conveyed to a storm drain, drainage channel, street or an established watercourse.

C. Generally, all spillway structures shall be constructed of reinforced concrete. For temporary detention basins with an expected life less than 10 years the spillway may be constructed with grouted rock or other forms of approved protection designed to resist maximum design velocities.

D. When the spillway crest is more than 3 feet above the flowline of the facility the spillway outlets into, the spillway shall be constructed of reinforced concrete.

E. Generally the spillway crest shall be at, or above the basin's design 100 year high water line.

V. Freeboard to the Top of Embankment

A. Local and temporary basins shall have a minimum 1-foot of freeboard above the 1000-year HWL on the emergency spillway or 2-feet of freeboard above the 100-year HWL in the basin, whichever is more stringent.

B. Regional basins shall have a minimum 2-feet of freeboard above the 1000 year HWL on the emergency spillway. For basins with larger surface areas the freeboard shall be increased due to possible wave action. Also, a Seismic Seiche analysis shall be provided to determine necessary freeboard. Reference "Design of Small Dams" by the United States Department of Interior.

C. Joint use basins shall conform to the applicable local or regional freeboard requirements. For smaller basins such as parking lot and tennis court basins, the freeboard conditions may be reduced.

VI. Basin Embankment

A. Basin side slopes should be of 3H:1V or flatter on the wet side and 2H:1V or flatter on the dry side. Steeper slopes may be acceptable on a case by case basis if rock lined and recommended in the soils and geotechnical report. (See items C and D below for expanded requirements for report.)

B. Top Width of Levee

1. Regional and local basins - 15 feet minimum
2. Joint use - site specific
3. Refer to Section IX.C.

C. For design of the embankment abutments and adjacent slopes, a soils and geotechnical report shall be prepared by a soils and geotechnical engineer with a demonstrated expertise in earth fill dam design. The report shall be reviewed and approved by the Land Management Department and the San Bernardino County Flood Control District. The report shall include:

a) Site geology including bedding, foliation, fracture, joint, fault and land slide plane attitudes.

b) Seismic conditions including fault locations and potential seismic surface movements respective loadings and parameters of seismic shaking.

c) Potential impact of reservoir loading on geologic structure should be evaluated.

d) Detailed descriptions, locations, and logs of all field explorations.

e) Field and laboratory tests and analysis descriptions and results.

f) Ground water table elevation and analysis of near surface groundwater movement.

g) Recommended design parameters including, but not limited to the following for the dam and its natural abutments and slopes adjacent reservoir areas:

1. Lateral earth loadings
2. Shear strengths
3. Bearing capacities
4. Permeability
5. Slope stability analysis when saturated and during rapid drawdown conditions
6. Seive analysis
7. Sand equivalents
8. Liquefaction analysis and if appropriate; mitigation
9. Seismic Seiche analysis ___ 10. UBC Chapter 70

h) Special design and construction recommendations including, but not limited to the following:

1. Foundation preparation requirements

2. Suitability of materials for embankments (gradation, sand equivalent, etc.) and abutments

3. Compaction methods and minimum requirements

4. Seepage and piping control provisions

5. Potential for settlement

6. Seismic considerations

7. Minimum design factors of safety are:

	Without Seismic	With Seismic
Embankment, Abutment and Adjacent Slope Stability	1.5	1.1
Seepage - Piping	1.5	---

8. Necessity of impervious core or shear key

9. Erosion control of abutments.

D. Regional basins and local basins not meeting the depth and side slope requirements setforth previously shall be designed in accordance with the Los Angeles County Flood Control District's "Design Manual - Debris Dams and Basins".

VII. Basin Floor

A. A low flow channel shall be provided from the basin inlet(s) to the basin outlet.

1. Where basin slopes exceed 2% or produce erosive flow velocities the low flow channel should be protected from erosion with reinforced concrete, rock lining or other form of approved erosion protection.

2. Joint use basins

a) A low flow channel or conduit should be provided to conduct minor flows around the dual use facilities wherever possible. Low flow channels may not be necessary for parking lot basins or other similar joint uses.

b) Low flow channel may be grass lined if there exists a maintenance program which includes mowing and maintenance of turf in good condition and velocities of flow through the various stages of discharge are low enough to be nonerosive.

B. Earth basin floors shall slope at a minimum 0.5% grade to the low flow channel.

C. Earth basin floors shall have a minimum grade of 0.5% from the inlet to the outlet.

VIII. Inlet Structures

A. Where storm drains enter the basin, energy dissipators and/or erosion protection shall be provided. Plans must be approved by the San Bernardino County Flood Control District Permit Section before plan approval if the basin is to be operated and maintained by the Flood Control District.

B. Where natural drainage courses or channels enter the basin some form of invert stabilization such as a reinforced concrete spillway shall be provided.

C. Energy dissipators may be required when the inletting flow velocities exceed 5 fps.

D. Inletting storm drains shall be a minimum 24" RCP (1350 D).

IX. Access

A. Access to any type of detention basin area shall be provided by a roadway capable of handling two way traffic (from a public street or public access to the parcel upon which the basin is constructed).

B. Access shall be maintained under all weather conditions.

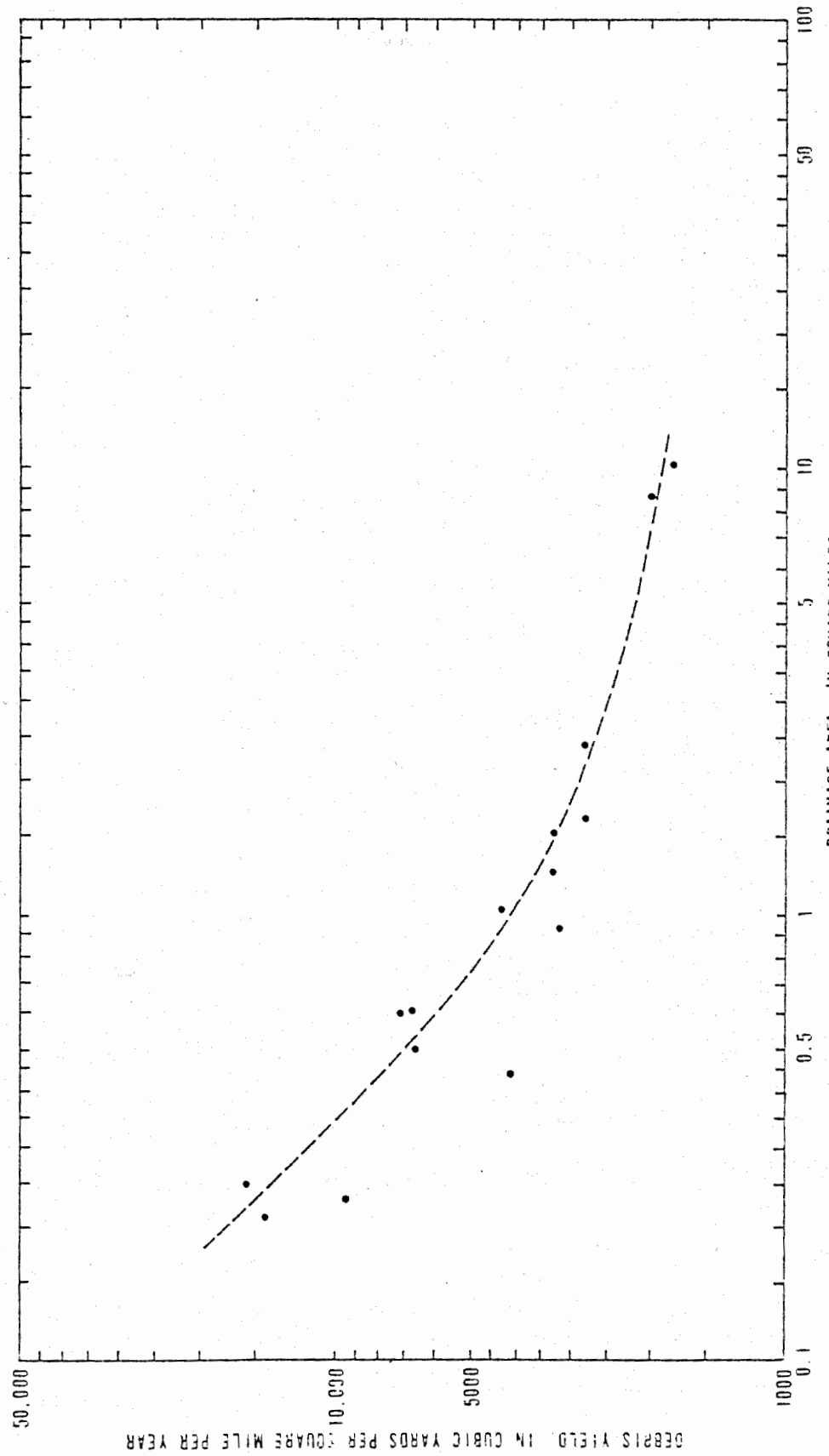

FIGURE 1.--Long-term sediment yields at selected sites in Los Angeles County, California.

C. A 15-foot wide roadway shall be provided along the top of embankment, across the spillway and around the basin. The intent of this criteria is to have continuous access around, and to, the basin for maintenance purposes. Under certain circumstances where it can be shown the recommended top width is not necessary for structural safety and maintenance, the criteria may be modified. Approval will be required by both the Land Management Department and the Flood Control District.

1. If access across the spillway is not provided minimum 40' X 60' turn arounds shall be provided on both sides of the spillway.

2. If there exists adequate access for maintenance, this requirement may be amended for local, temporary or joint use basins.

D. Access ramps shall be provided to the basin floor.

1. Minimum of one - 15 foot wide ramp for local basins.
2. Minimum of two - 15 foot wide ramps for regional basins.

E. The maximum roadway or access ramp slope shall be 10%.

F. The minimum access and roadway inside turning radius shall be 35 feet.

X. Fencing

A. All basins shall be fenced with 6-foot chain link fencing per Cal Trans standards or other approved barrier unless otherwise approved by the Land Management Department and the Flood Control District. Joint use basin fencing will be site specific and must meet the needs of all agencies utilizing the basin.

B. All regional basin chain link fencing shall have a 1 foot wide painted horizontal orange stripe at the mid height of the fence.

C. Access to the basins shall be gated and locked.

XI. Rights-of-Way

A. Sufficient rights-of-way shall be provided for the construction and economical maintenance of the basin(s), (including all fill and cut slopes) and shall include sufficient area to provide for an access road from a dedicated public street to the basin.

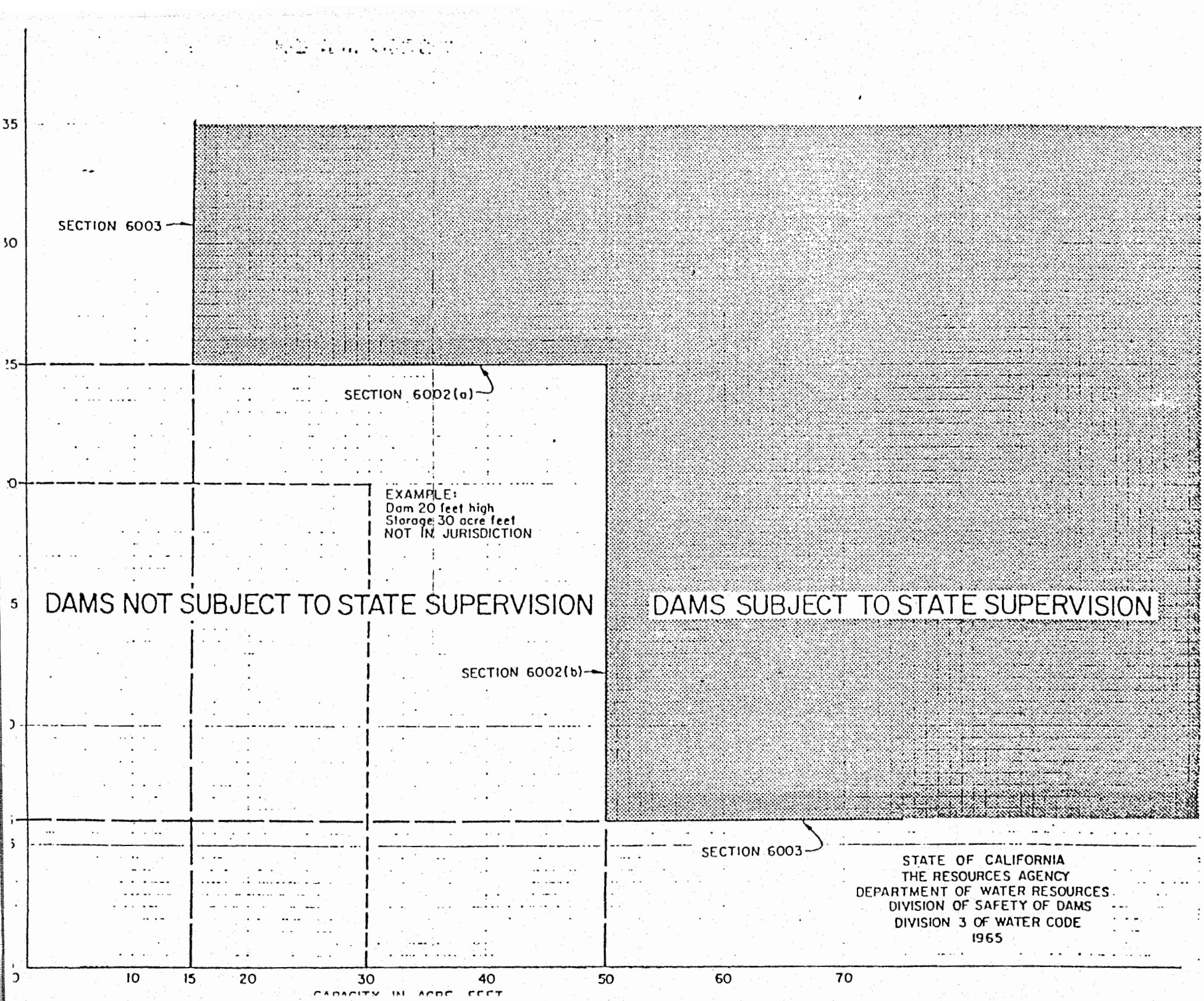
SECTION 6003
SECTION 6002(a)
EXAMPLE:
Dam 20 feet high
Storage 30 acre feet
NOT IN JURISDICTION
DAMS NOT SUBJECT TO STATE SUPERVISION
DAMS SUBJECT TO STATE SUPERVISION
SECTION 6002(b)
SECTION 6003
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF SAFETY OF DAMS
DIVISION 3 OF WATER CODE
1965
10
15
20
30
40
50
60
70

FIG. 2

B. Regional basins shall be dedicated to the District in fee title.

C. Local basins shall be covered by an adequate San Bernardino County Drainage Easement.

XII. References to be Used in Design.

"A New Method of Estimating Debris - Storage Requirements for Debris Basins," Tatum, U.S. Army Engineer District, Los Angeles, CA, 1963

"Design of Small Dams", U.S. Bureau of Reclamation, 1977

"Handbook of Hydraulics", King and Brater, McGraw Hill Book Company, 1954

"Los Angeles County Flood Control Manual - Debris Dams and Basin", Los Angeles County Flood Control District

"Open-Channel Hydraulics", Ven Te Chow, Ph.d., 1959

"San Bernardino County Hydrology Manual", San Bernardino County, May 1983

"San Bernardino County Standards and Specification", San Bernardino County Department of Transmportation/Flood Control/Airports

INTEROFFICE MEMO

1853

County of San Bernardino

DATE September 4, 1987 PHONE 2515

FROM ROBERT W. CORCHERO, Chief
Water Resources Division

TO CHARLES L. LAIRD, Acting Director
Transportation/Flood Control File: 1(FC)-53

SUBJECT SAN BERNARDINO COUNTY DETENTION BASIN DESIGN CRITERIA

As requested the subject criteria was reviewed with respect to the determination of pre-development peak flow rates. According to the existing criteria the County can be 85% confident that the calculated peak flow rate will equal or exceed the peak flow rate at a given concentration point if adequate streamflow data was available. Therefore, the County can only be about 15% confident a detention basin outflow will not adversely affect downstream properties (not considering erosion).

The County should be at least 50% confident a detention basin outflow will not adversely impact properties downstream of the basin. Based on the calibration study of the county's hydrology method the input parameters (procedures) described in the Manual should be modified as follows:

a) 10 year peak flow rates should be calculated using 5-year rainfall,

b) 25-year peak flow rates should be calculated using 10-year rainfall, and

c) 100-year peak flow rates should be calculated using 25-year rainfall and AMC II.

If these design parameters are used for determining the pre-development peak flow rates, the basin outflow metered to 90% of these calculated pre-development peak flow rates and the post-development peak flow rates to the basin calculated in accordance with County Hydrology Manual, the County will be over 50% confident the resulting basin design will not adversely affect adjacent or downstream properties (not considering erosion).

The desired confidence level for detention basin outflow is a policy decision. Once the desired confidence level is determined the required input rainfall amounts can be developed to calculate the peak flow rate at the corresponding confidence level. I have discussed this policy issue with John Pederson of the U.S. Army Corps of Engineers, Ron Moore of the Soil Conservation Service and Al Nessinger of Orange County. Al Nessinger pointed out by using basin inflow hydrographs based on a 85% confidence level

and by creating adequate storage to reduce the peak flow rate from the basin to 90% of pre-development condition based on a 50% confidence level, the resulting confidence level that downstream conditions have not changed will be greater than 50%. Also, the rainfall pattern used in the hydrograph method was chosen to be the most severe test on basin design. When these facts are combined with criteria of using multi-day storms, the resulting basin design should be adequate to ensure downstream properties will not be subject to increased peak flow rates. Ron Moore felt the revised criteria better fit the actual pre-development conditions in the field. John Pederson and Al Nessigner both felt the criteria should be tested against actual occurrences in gaged watershed. Attached is page 2 of the design criteria with the proposed changes shown in bold type.

Should you have any questions, please call.

RWC:mjs
Attachment

cc: Ken Miller

II. Basin Capacity and Outlet Drain

A. When a basin (regional, local, temporary or joint use) is to be used to mitigate downstream impacts due to increased flows generated by a development, the basin capacity and outlet size shall be such that the post-development peak flow rate generated by the site shall be less than or equal to 90% of the pre-development peak flow rate from the site for all frequency storms up to and including 100-year (i.e.) the peak 2 year post-development flow rate is equal to or less than 90% of the peak 2 year pre-development flow rate from the site and etc. for all frequency storm events through 100 year).

1. Only 2, 10, 25 and 100-year storms need to be analyzed.

2. Post-development peak flow rates shall be calculated in accordance with the "San Bernardino County Hydrology Manual".

3. Pre-development peak flow rates shall be calculated in accordance with the "San Bernardino County Hydrology Manual" with the following exceptions.

   a) 10-year peak flow rates shall be calculated using 5-year rainfall.

   b) 25-year peak flow rates shall be calculated using 10-year rainfall.

   c) 100-year peak flow rates shall be calculated using 25-year rainfall and AMC-II.

4. Additional studies shall be submitted where there exists more than one basin in the drainage area under review. The studies shall address the timing of the peak flow rates from the basins to ensure downstream flow rates are not increased.