

Los Angeles County Flood Control District

DESIGN MANUAL

DEBRIS DAMS AND BASINS



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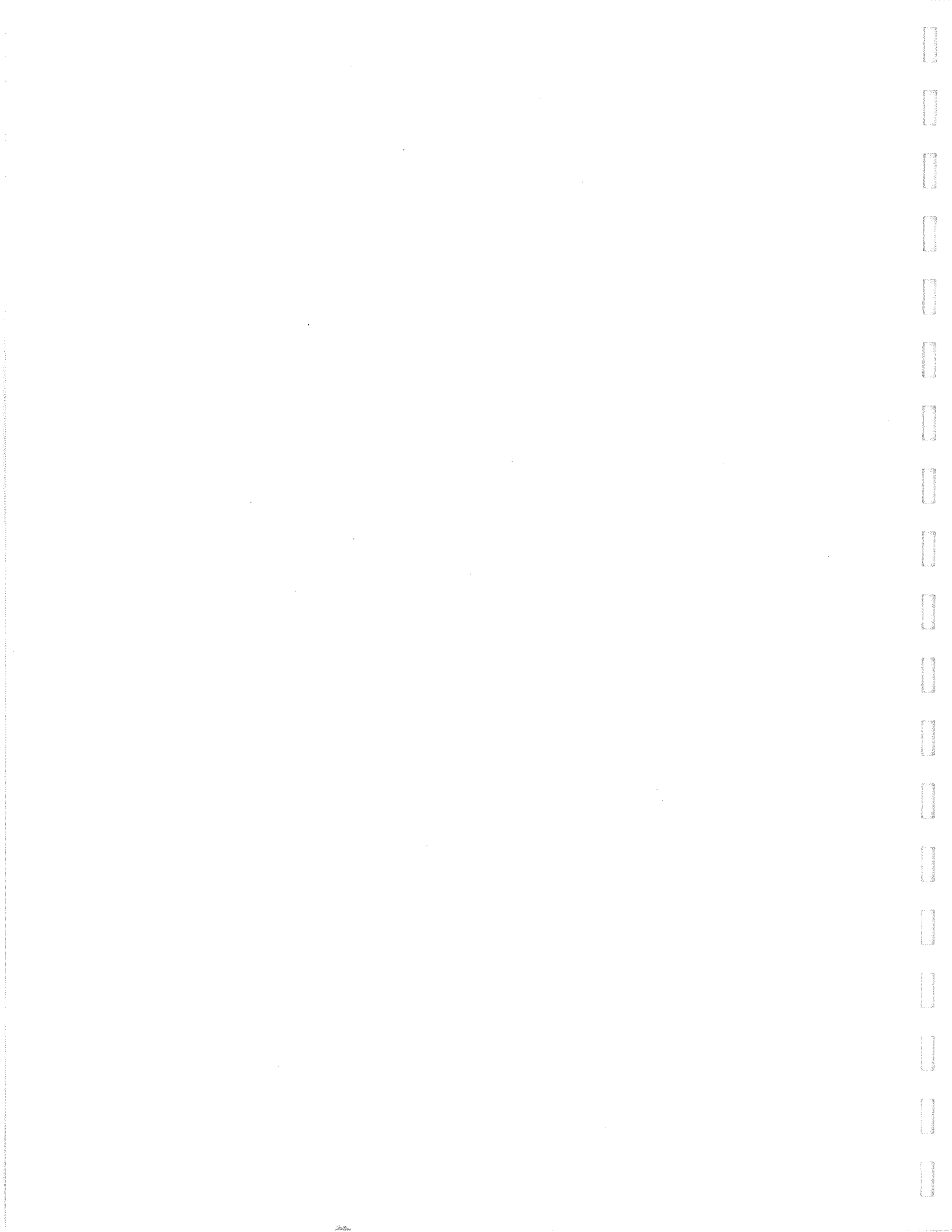
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CRITERIA FOR DESIGN OF DEBRIS DAMS AND BASINS

The following text and exhibits have been prepared as a guide for design, preparation of plans and specifications, and construction of debris dams and basins constructed by others for transfer to the District for maintenance.



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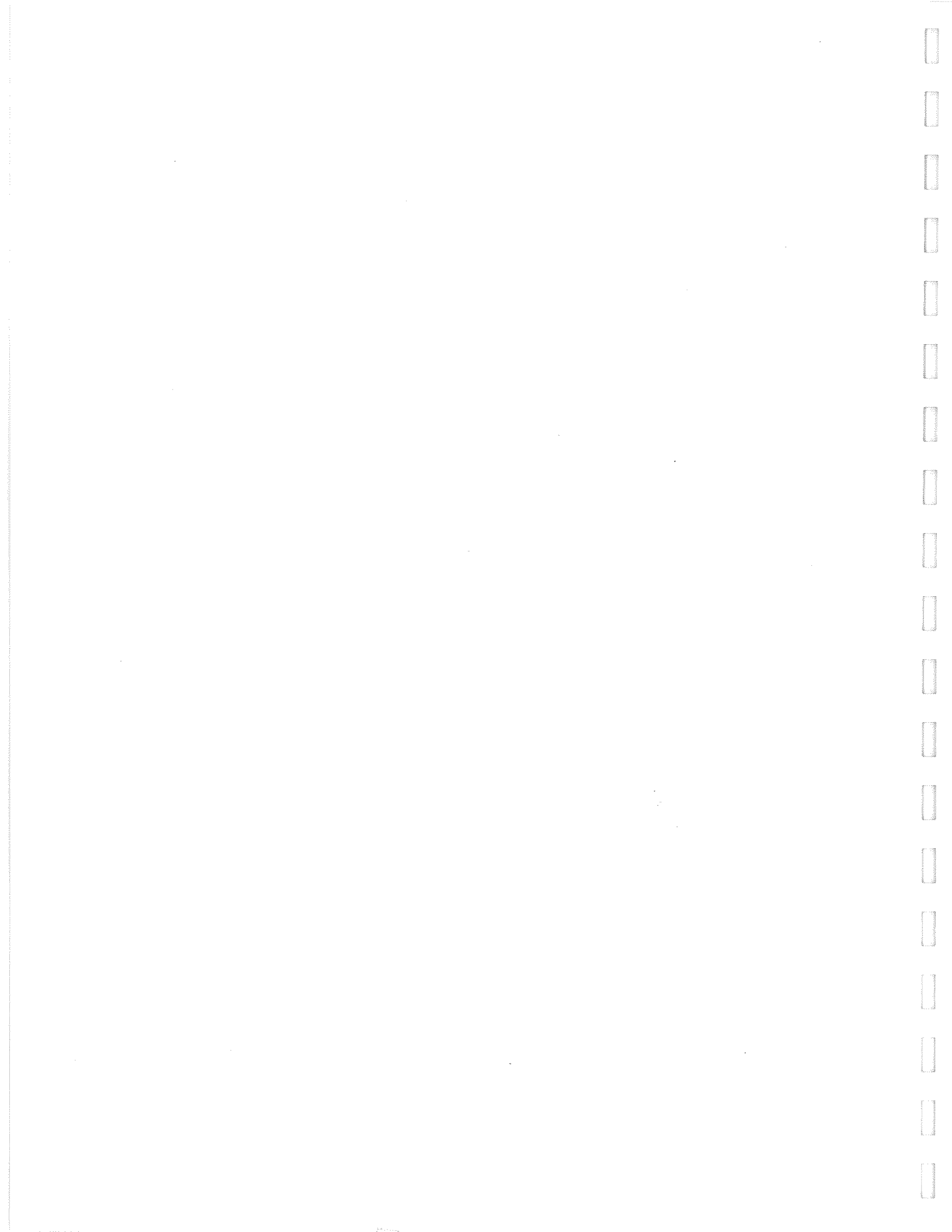


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SECTION A

DESIGN OF
DEBRIS DAMS AND BASINS



SECTION A

DESIGN OF DEBRIS DAMS AND BASINS

A-1 Basin Design

A-1.1 General

The volume of debris to be impounded shall be the amount generated from the watershed upstream of the selected site as indicated on the debris production curves.

Generally, the bottom of the basin shall be established at the average slope of the original stream bed. If extensive excavation below stream bed level is a design requirement, an inlet structure shall be provided at the upper end of the basin to prevent erosion of the stream bed upstream of the basin.

The cut slopes of the excavated basin shall be no steeper than that recommended by the soil engineer in his subsurface investigation report. Extensive cut slopes shall be protected against erosion from surface runoff from the surrounding area above by a "U" shaped protective gutter (Type B) around the perimeter of the cut area. (See Figure 1, page I-6).

The basin design shall include an access ramp to the bottom of the basin from the crest of the dam for debris removal purposes.

The sizing of the basin to contain the volume of debris to be impounded by the dam is accomplished by trial and error. The designer should be aware that certain dams as defined in the "Statutes and Regulations Pertaining to Supervision of Dams and Reservoirs" published by the State Department of Water Resources, Division of Safety of Dams, will fall under the jurisdiction of the State.

A-1.2 Basin Capacity

The required debris capacity for design of the basin shall be determined from the Debris Production Zones and the Debris Production Curves developed by the District and shown on pages I-1 through I-5. Because it is possible to have drainage area conditions which may affect the use of the curves, it is recommended that confirmation as to application of the curves be obtained from the District.

A-1.3 Debris Volume

The calculations for the debris volume shall be based on the assumption that the debris will be deposited in such a manner that the debris slope, sloping upstream from the spillway crest, will be equal to 50 per cent of the average slope of the original stream bed for the total length of the basin site.

SECTION A Continued

A-2 Earth Dam Design

A-2.1 General

The height of the dam is measured vertically from the spillway crest to the natural bed of the stream or watercourse at the downstream toe of the dam.

The stability of the earth dam under various conditions which may exist following construction is a prime concern in the design of the slopes for the dam's earth embankment. It has been the experience of the District that 3:1 slopes for the upstream and downstream faces of the dam are usually stable even under the most adverse conditions. Steeper slopes may be approved by the District if their stability is demonstrated to be adequate when analyzed in accordance with accepted design criteria for small dams.

An area of approximately 1,200 square feet (30 x 40) should be provided at the top of the dam for a shelter house and parking adjacent thereto.

A-2.2 Foundation and Abutments

Preparatory to construction of the earth dam, the ground shall be stripped of all vegetation and other organic material. In addition, any trash, debris, soft or compressible material or other objectionable material unsuitable for support of the dam, whether disclosed by the subsurface investigation or discovered during stripping shall be excavated as directed by the soil engineer and approved by the responsible agency's inspector.

A-2.3 Percolation Path at Dam Contact Areas

The horizontal length of the path of percolation between embankment and abutments and foundation shall be of such length as to be consistent with limitations for percolation and piping based upon existing local soil conditions and type of embankment material to be used. The District has found that, as a general rule, a minimum path of percolation ratio of 8 to 1 is satisfactory (8 represents the level length of path along the contact and 1 represents the corresponding head differential between the elevation of upstream end of path and the maximum elevation of the basin water surface). This condition should be satisfied for any horizontal plane through the embankment above the contact of the bottom of the basin and upstream slope of embankment.

A-2.4 Crest of Dam

The crest of the dam shall be 20 feet wide (measured parallel to the center line of the spillway) and shall have a minimum rising slope from the spillway walls to the abutment equal to 60 per cent of the average grade of the natural stream bed, unless otherwise approved by the District. (See Figure 2, page I-7). It shall be graded to form a "V" shaped surface 6 inches deep at the center and paved with 3 inches

SECTION A Continued

of asphaltic concrete. A 4-inch diameter hole shall be provided in the spillway wall for drainage at the low point of the "V" shaped crest of dam.

A-2.5 Protection for Dam Slopes

A-2.5.1 Upstream Face

The upstream face of the earth dam shall be protected with a 6-inch thick (measured normal to slab) reinforced concrete facing slab unless otherwise approved by the District. The reinforcement for the concrete slab shall be No. 5 reinforcing bars at 18-inch centers in both directions placed in the center of the slab. The reinforcement shall be continuous through all construction joints and shall be spliced by lapping 20 bar diameters. Construction joints shall be parallel or at right angles to the center line of spillway and shall be spaced not more than 50 feet nor less than 10 feet apart. The slab shall be extended on the same slope to a depth of 5 feet below the bottom of the basin as well as to the bottom of the outlet works excavation. The slab shall also be extended into the abutments for a minimum of 2 feet. (See Figure 3, page I-8).

A-2.5.2 Downstream Face

The downstream face of the dam shall be protected from erosion by placing some type of protective covering such as planting or matting.

A-2.5.3 Slope Protection Gutter

"U" shaped gutters (Type B) shall be placed at the re-entrant contact of two planes of fill or the intersection of compacted fill and natural ground. (See Figure 1, page I-6).

A-3 Access to Dam and Basin

A 28-foot wide access road (two 12-foot lanes and 4-foot wide gutter) with adequate wearing surface, cross drains, and gutters shall be provided from the nearest public street into the basin area to permit removal and hauling of storm deposited debris. The access road shall be cross sloped towards the 4-foot wide gutter. The road grade downstream of the crest of dam shall not exceed 10 per cent; however, if such grade for some valid reason is not practicable, a grade of 15 per cent shall not be exceeded. Grades steeper than 10 per cent shall be paved with 3-inch A. C. The access ramp into the basin from the crest of dam shall be 20 feet wide on a grade not to exceed 10 per cent. No paving or gutter will be required for this portion of the access road.

SECTION A Continued

A-4 Access Road Gutter

The 4-foot wide drainage gutter for the access road shall be constructed of gunite, concrete, or A. C. The 4-foot wide gutter shall be so shaped as to be maintainable by use of mechanized equipment and be without a sharp drop so as to be safe and drivable for traveling vehicles. Details of an A. C. access road gutter are shown in Figure 1, page I-6.

A-5 Earthwork for Debris Dams and Basins

The earthwork for debris dams and basins shall be in accordance with Section 300-6 of the Standard Specifications for Public Works Construction, 1973 Edition.

A-6 Gage Board Pipe Supports

On the upstream side of dam on the same side as the access road, 2-1/2 inch diameter galvanized standard pipes shall be embedded in the facing slab for future installation of gage boards by the District. The pipes shall be 5 feet 6 inches long and project 4 feet 7 inches above the surface of the facing slab. They shall be placed in a straight line, usually parallel to the center line of the spillway, and so placed as to have a difference of 4 vertical feet between the pipes at the surface of the facing slab. The lowest pipe shall be set at an elevation one foot below the elevation of the bottom of the debris basin and the uppermost pipe at an elevation within 4 feet of the elevation of the crest of dam at the spillway wall. Details of a gage board pipe installation are shown in Figure 4, page I-9.

A-7 Debris Barrier

A-7.1 General

A debris barrier shall be provided upstream of the spillway to prevent large debris from entering and clogging the spillway and/or the conduit downstream of the spillway. This is usually achieved by placing a series of vertical members in the concrete facing slab so as to form a protective screen around the spillway entrance. A typical layout is shown on Figure 2, page I-7.

The debris barrier shall be designed considering the barrier to be 100 per cent plugged and acting as a submerged sharp crested weir. The freeboard between the crest of dam and basin water surface upstream of the debris barrier shall be a minimum of two feet.

SECTION A
Continued

A-7.2 Location and Spacing of Barrier

The debris barrier shall be placed upstream of the spillway and no closer than six feet from the intersection of the spillway invert slab and the concrete facing slab.

The top of the barrier members shall be placed one foot below the basin water surface elevation required to pass the design Q (burned and bulked) through the spillway.

The barrier members may be spaced up to four feet apart but in no case shall be more than two-thirds of the width of the conduit at the downstream end of the spillway.

A-7.3 Design of Barrier Member

The debris barrier shall be assumed to be 100 per cent plugged and the members designed for an equivalent fluid pressure of 62.5 psf. The loading can be considered as temporary and the allowable stresses increased by one-third.

The barrier member shall be assumed to be restrained laterally by the concrete facing slab and the embedment length shall be determined by use of the following formula developed by E. Czerniak:

$$L = 1.85 \sqrt[3]{\frac{M_o}{R}}$$

where:

L = Length embedment in feet

R = 300 psf/ft. depth (a constant)

$$M_o = \frac{M}{d}$$

M = Moment applied to barrier in foot pounds

d = Diameter of pipe encasement in feet

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SECTION A
Continued

A-7.4 Selection of Barrier Member

The barrier member shall be selected so that the required section modulus is satisfied along the weak axis and may be of a structural steel shape, pipe, or square tubing. If a hollow member is selected, it shall be filled with concrete.

A-8 Right of Way

A-8.1 General

Sufficient right of way shall be provided for the construction and economical maintenance of the dam and basin and shall include sufficient area to provide for an access road from a dedicated public street to the basin.

A-8.2 Right of Way Limits

Right of way for the basin shall include the area encompassed by the contact points of the debris surface contours with the existing ground based on a theoretical debris slope, sloping upstream from the spillway crest, of 75 per cent of the average slope of the original stream bed for the total length of the basin site. In general, the contours of the theoretical debris surface shall be assumed as straight lines at right angles to the center line of the spillway and/or the basin and stream bed, depending on the shape of the basin involved.

The right of way for the access road from a dedicated street shall be wide enough to provide for a 28-foot wide road as described in Section A-3.

A-9 Fencing

Adequate fencing, enclosing the limits of the debris basin, shall be provided to discourage unauthorized persons from entering the area. Said fencing shall conform to District Standard Drawing No. 2-D 178 (see page I-29).

A-10 Debris Disposal Area

A debris disposal area, of sufficient storage capacity subject to District approval, shall be provided within an economical hauling distance from the debris basin.

SECTION B

SUBSURFACE INVESTIGATION REPORT



SECTION B
SUBSURFACE INVESTIGATION REPORT

B-1 Field Investigation

Prior to District approval of plans and specifications for a proposed debris basin, a subsurface investigation shall be made to obtain and present sufficient information about the soil, ground water, and foundation conditions on the project for the proper design of structures with minimum construction problems and low operation and maintenance costs. The subsurface investigation shall be planned and supervised by a registered civil engineer experienced in soil mechanics.

B-2 Subsurface Report

B-2.1 General

The original and one copy of the subsurface investigation report prepared by the soil engineer in accordance with the following requirements shall be furnished to the District at time of submittal of plans for the debris basin. The report shall contain findings and supporting information regarding the following items:

1. The types of materials to be encountered in the proposed excavations or borrow site.
2. Anticipated excavation problems.
3. Location and extent of required overexcavation.
4. Slope and excavation stability.
5. Bearing capacity and settlement characteristics of subgrade materials.
6. Suitability of excavated materials (including bedrock) for use as fill, backfill, and bedding.
7. Required relative compaction of fill and backfill materials.
8. Compaction characteristics of the predominant soil.
9. Substances in the ground water or in the native soils deleterious to concrete, steel, or other construction materials.

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SECTION B
Continued

B-2.2 Detailed Recommendations

Specific, detailed recommendations with supporting data shall be included for such items as, but not limited to, stability of cut slopes; excavation in bedrock; necessary depth of stripping or overexcavation in areas to be covered by fills to minimize settlement; subdrains or toe drains and the gradation requirements for required filter and drain materials; stability of proposed dam embankment under the various conditions that may exist following construction, with due allowance for seismic loading and seepage; inlet structures as needed to prevent unacceptable erosion of stream bed material upstream of the basin; stability of natural slopes; erosion prevention treatments, including plants, drainage devices, or erosion resistant covers for cut and fill slopes, including the downstream face of the dam, and for the crest of the dam.

Field observations of items which can affect the construction operations, such as surface water flow, springs and seeps, bedrock outcroppings, trash dumps, existing wells or tunnels, large concrete blocks, etc., shall be recorded in the report.

All field, laboratory, and office information shall be submitted on 8-1/2" x 11" sheets or on sheets folded to that size.

B-3 Exploratory Borings

B-3.1 Location and Number of Borings

Borings shall be drilled at least at the following locations:

1. Proposed dam foundation.
2. Each dam abutment.
3. Along alignment of outlet pipe.
4. Borrow area.
5. Proposed inlet structure and outlet tower, etc.
6. Proposed cut slopes for access road and basin.

A boring may be located to furnish information for more than one of the areas listed above. On the other hand, it may be necessary to drill borings at locations not listed above but which are necessary to provide complete subsurface information.

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SECTION B
Continued

It may be possible to reduce the number of borings needed by the use of supplemental information obtained by seismic or electrical resistivity methods. However, it will not be permissible to replace the drilling of borings entirely with geophysical methods.

B-3.2 Depth of Borings

The minimum boring depth shall be as follows unless firm bedrock is encountered at shallower depths:

1. Borings in the foundation of the proposed dam shall be drilled to firm material, bedrock, or to a minimum depth equal to the height of the dam at the crest. If soft or loose materials are found at this depth, drilling shall be continued until firm material is reached.
2. Borings at the abutments shall extend to firm material suitable for support of the dam.
3. Borings in borrow areas or in proposed cut slope areas shall extend at least five feet below the proposed excavation line.
4. Borings at locations for structures shall extend at least five feet below structure subgrade. If water is encountered, the boring shall be drilled at least ten feet below structure subgrade.

B-3.3 Type of Borings

The word "boring" as used herein shall include borings by drill rigs, holes, pits, or tunnels dug by hand-held equipment or by equipment such as bulldozer, backhoe, or clam bucket.

Borings shall be drilled dry, if possible, by using buckets, augers, or similar tools to facilitate examining, sampling, and logging the materials as encountered. The use of drilling mud should be avoided if casing can be used. Continuous flight helical augers may be used only as the last resort to drilling where other methods have failed.

SECTION B
Continued

B-4 Logs of Borings and Location Map

B-4.1 General

The logs of borings shall include Unified Soil Classification System descriptions and group symbols as shown in District Drawing No. 2-D 413 (see page I-31) and shall include pertinent notes about water elevations, seepage, approximate per cent rock encountered, ease of drilling, type and depth of soil or rock sample, caving, running sands, trash, and any other useful information. Pertinent information as indicated in Column 6 on Drawing No. 2-D 413 shall be included. Descriptions and group symbols shall be consistent with results of laboratory classification tests. The elevation of proposed excavation subgrade, etc., shall be shown graphically on the log. Exploratory borings shall be identified with a numbering sequence increasing upstream.

The boring locations shall be shown on a recent topographic map to a scale not less than 1" = 100'. Boring locations may be referenced in terms of coordinates if such a system is available or by offsets and the stationing along the center line of the basin or spillway. The elevation of the ground surface at each boring location, the date each boring was drilled, and method of drilling shall be included.

B-4.2 Ground Water

The logs of borings shall indicate the depth at which ground water was encountered. Any change in the ground water level during drilling shall be noted. If water was not encountered, a statement to that effect shall be included.

B-5 Samples

Samples representing each type of material encountered shall be obtained in each boring. Both undisturbed and bulk soil samples of each type of material shall be obtained if reasonably possible. In cases where all or most of the soil in a boring is of one type, there shall be no less than two representative undisturbed and bulk soil samples taken from each boring. When very firm soil or a large rock mass (not boulders) is encountered within the proposed excavation for a structure or cut which cannot be penetrated by normal soil boring equipment, core samples shall be obtained.

SECTION B
Continued

Samples of any ground water encountered shall be obtained for chemical analysis. Samples of any surface water flowing at the site shall also be obtained.

Soil and bedrock samples shall not be discarded until after notification to the District's Materials Engineering Division either in writing or by telephone at 226-4285. District personnel may elect to examine the samples and possibly store them on District premises.

B-6 Laboratory Analyses

B-6.1 Required Analyses

Laboratory analyses shall be made on the soil samples as indicated in the following table:

(See next page for table)