Foothill Parkway Extension

Water Quality Assessment

Prepared For:

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Executive Summary

This report assesses the potential impacts that the Foothill Parkway Westerly Extension Project (project) may have on the water quality of nearby receiving water bodies. All project boundaries have been identified and defined in relation to the watersheds that contain them. During the study, it was determined that the project resides in the Santa Ana Watershed. The project area size, as compared to the watershed size, is relatively insignificant (less than 1 percent). While the project will create new impervious area, the negative impact it generates will be inconsequential when compared to the total watershed areas.

Also discovered during the study was that the Santa Ana River, which runs near the project area, is listed on the California Environmental Protection Agency (EPA) Section 303(d) list for water quality impairments from certain pollutants. However, as the report will illustrate, activities conducted during this project will not significantly contribute these listed pollutants to the water body.

The conclusion drawn from the study is that, by implementing certain pollution control measures called Best Management Practices (BMPs), any impacts arising from project activities will be mitigated.

1 Introduction

This report evaluates the potential impacts of the Foothill Parkway Westerly Extension Project (project) on adjacent water resources and their beneficial uses. It will examine the existing surface and ground water resources, assess the potential effects the project may have upon them, and support the project's final environmental report. Included in this technical review are a detailed analysis of all physical and regulatory aspects of the project, including:

- Environmental setting;
- Regulatory setting; and
- Water quality assessment.

1.1 Project Description

The proposed project is located in the southern portion of the City of Corona along the base of the Santa Ana Mountains. The roadway would generally extend westward from its existing terminus approximately 500 feet west of Skyline Drive to Green River Road for a distance of approximately two miles. Portions of Foothill Parkway have recently been completed as a four-lane divided roadway from I-15 to Skyline Drive. Green River Road near Paseo Grande is paved as a two-lane roadway. The remainder of Green River Road to State Route 91 (SR-91) is paved as a four-lane roadway.

In November 1985, the City of Corona adopted the proposed roadway as a four-lane arterial highway. The conceptual alignment for the Foothill Parkway Westerly Extension was again recognized and approved with the update of the City's *General Plan* and Circulation Element in 2004, as well as the 1990 *Riverside County Comprehensive General Plan* (RCCGP). The project is a collaborative effort by the City and County, with the City assuming the lead agency role. The proposed Foothill Parkway alignment varies in location from the previous conceptual alignment adopted in the 1980s. In order to meet minimum roadway design standards (e.g., turn lane requirements, spacing of intersections, local street access criteria, and design speed), the alignment location has been shifted north of the previous alignment.

The proposed project, at Skyline Drive, would veer to the west into unincorporated Riverside County and continue in an east/west direction along the City/County boundary. The alignment would then curve to the north and connect to Green River Road near Paseo Grande. A bridge structure is incorporated into the roadway design to protect the 108-inch Metropolitan Water District (MWD) feeder line located approximately 500 feet east of Paseo Grande. Roadway improvements will require right-of-way acquisition for new landscaping, curb, shoulders, travel lanes, and landscaped medians. The project also includes three new signalized intersections.

The typical cross-section for a secondary four-lane arterial is a four-lane, divided roadway with 81 feet of right-of-way. Roadway grades would vary from 0.6 percent to seven percent. Roadway right-of-way would vary in width from 81 feet to 102 feet, with an actual roadway width ranging from 68 to 78 feet. The reduced width is through Wardlow Wash to minimize impacts and maintain the alignment out of the Cleveland National Forest. Four travel lanes, two in each direction, would be provided. The outside lane width would be 20 feet (a 12-foot travel lane plus an 8-foot shoulder) and inside lane widths would be 12 feet.

The proposed project would extend and connect two existing local arterials to facilitate north/south local access to Foothill Parkway consistent with the *General Plan* Circulation Element. A roundabout will be provided at the intersection of Mangular Avenue and Chase Drive. Chase Drive will extend westward approximately 400 feet from Mangular Avenue as a two-lane undivided collector and form a "T" intersection with Foothill Parkway. Border Avenue (a two-lane undivided collector) will extend approximately 200 feet south of its existing terminus and connect to Foothill Parkway approximately 400 feet east of the Mabey Canyon Debris Basin.

Three signalized intersections will be constructed at Chase Drive, Border Avenue, and Paseo Grande. Under City standards, a secondary four-lane arterial would include dedicated turn lanes at key intersections to improve traffic flow. Turn pockets at Chase Drive, Border Avenue, and Paseo Grande would adequately accommodate projected turn movements.

Street lighting would be installed only at intersection locations. Curbs and gutters would be built on both sides of the street. Sidewalks would be built and extend from Border Avenue to the eastern project limit north of Foothill Parkway to minimize grading impacts and avoid intrusion onto United States Forest Service (USFS) property to the south. No sidewalks are proposed south of Foothill Parkway between Border Avenue and Paseo Grande. A retaining wall would be required at the end of Condor Circle.

2 Environmental Setting

The project proposes to accommodate street runoff by directing street surface flows during storm events to drainage facilities such as culverts and oversized drains. Several improvements to existing drainage facilities will be incorporated. The project proposes the construction of a storm water conveyance facility in Wardlow Wash, modifications to the Riverside County Flood Control and Water Conservation District (RCFC&WCD) Mabey Canyon Debris Basin, and incorporates drainage improvements to facilitate continued flows through culverts at Tin Mine and Mabey canyons.

At Wardlow Wash, two desilting basins would be constructed on the west side of the roadway. They would accept flows through a 7-foot by 7-foot reinforced concrete box (RCB), an 8-foot by 8-foot RCB, and 750 feet of riprap channel. Drainage at Tin Mine Canyon would be conveyed through a 12-foot by 10-foot RCB approximately 230 feet in length.

The proposed alignment follows along the axis of the embankment crest of the Mabey Canyon Debris Basin facility that was originally constructed in 1974. The roadway construction would involve placement of fill on the upstream side of the dam embankment and would completely cover the existing concrete spillway crest located on the eastern abutment. The proposed modifications would improve the basin while retaining the original debris storage volume capacity and level of flood protection. Improvements to offset modifications to the debris basin associated with the roadway construction include:

- Excavation within the existing basin right-of-way to retain the original storage volume by lowering the basin floor approximately five feet.
- Construction of an upgraded, low-level outlet consistent with other debris basin outlet structures constructed by RCFC&WCD.
- Construction of a new spillway consisting of a rectangular drop spillway inlet and underground box culvert with a new energy dissipater to allow emergency spills to flow underneath the roadway without a bridge structure.
- Construction of new access ramps that run to the bottom roadway and along the perimeter of the access roadway.

The project is located in a highly urbanized area and surrounded by various drainage channels. The project limits are within an urban MS4 (Riverside County Permit #R8-2002-0011) NPDES permitted area.

The climate of the region is classified as Mediterranean: generally dry in the summer with mild, wet winters. The average annual rainfall in the region is about 14 inches, most occurring between November and March. The rainy season as defined by the Santa Ana Regional Water Quality Control Board (RWQCB) is October 1 through May 1.

2.1 Watersheds

The project is located in the Santa Ana River Watershed, as shown in Figure 2-1, which covers 153.2 square miles. The river begins almost 75 miles away in the San Bernardino Mountains, crossing central Orange County before emptying into the Pacific Ocean. The Riverside County portion of the watershed includes portions of the cities of Beaumont, Calimesa, Canyon Lake, Corona, Hemet, Lake Elsinore, Murrieta, Moreno Valley, Norco, Perris, and Riverside.

Before reaching the Santa Ana River, discharges resulting from the project will first flow through four separate engineered flood control facilities:

- Mabey Canyon Debris Basin (which drains to Oak Street Channel);
- Oak Street Channel (a tributary to Temescal Wash);
- Temescal Wash (a tributary to the Santa Ana River); and
- Wardlow Wash (a tributary to the Santa Ana River).

The flow will reach the Santa Ana River via two distinct drainage paths that simultaneously drain down from the project site as shown in Figure 2-2:

- From the project site to Mabey Canyon Debris Basin to Oak Creek Channel to Temescal Wash to the Santa Ana River; and simultaneously
- From the project site to Wardlow Wash directly to the Santa Ana River.

Figure 2-1: Project Watersheds

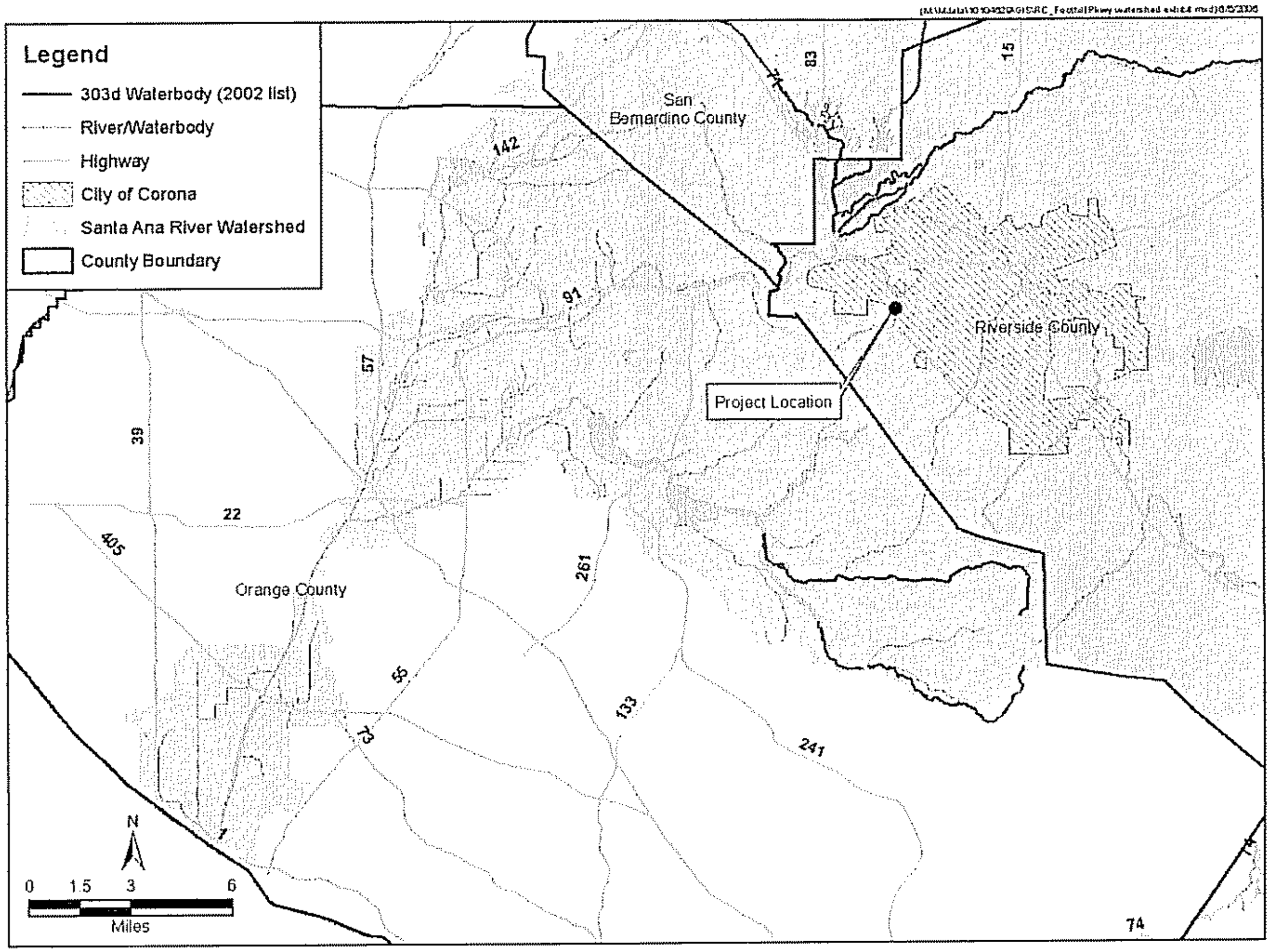
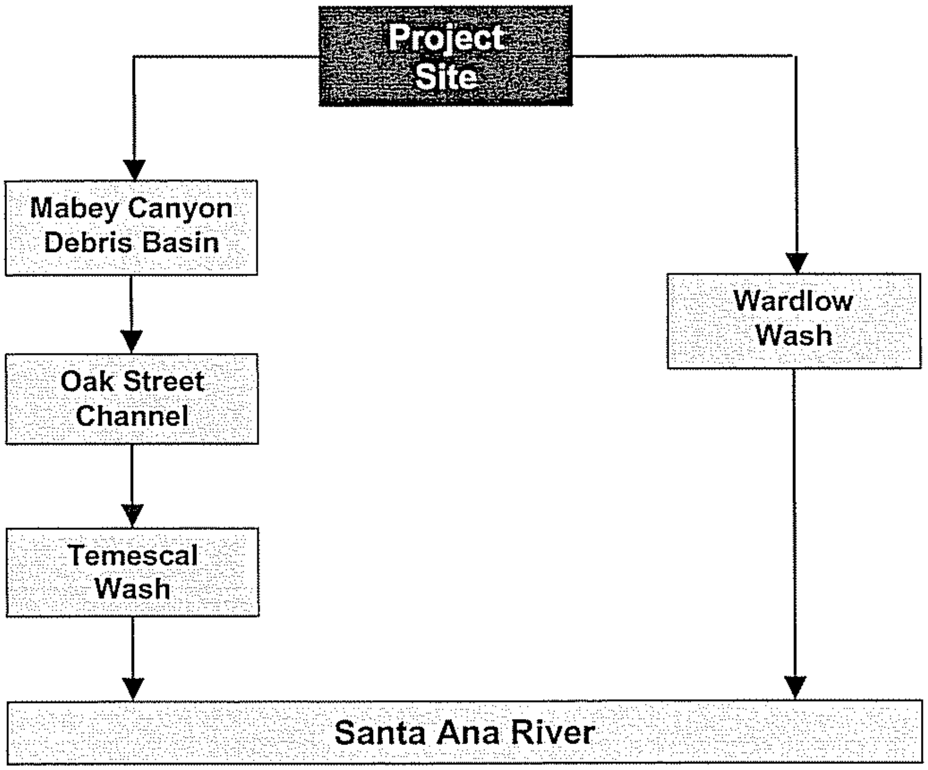


Figure 2-2: Project Drainage



2.2 Surrounding Land Uses

Most land use areas surrounding the project include three types of land uses:

- Open Space – vacant land that does not contain man-made fabricated impervious surfaces
- Residential Land – occupied land that includes single-family homes, condominiums, town homes, apartment complexes, and duplexes
- Vacant Land – unoccupied land that may contain structures or other man-made impervious surfaces

The surrounding land also contributes discharge to Temescal Wash and Wardlow Wash.

3 Regulatory Settings

Important agencies, regulations, and statutory authorities relevant to water quality as they relate to this project are described below.

3.1 Clean Water Act

The Clean Water Act (CWA) as amended by the Water Quality Act of 1987 is the major federal legislation governing water quality. The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." Important sections of the CWA include:

- Sections 303 and 304 – provide for water quality standards, criteria, and guidelines;
- Section 401 – requires an applicant for any federal project that proposes an activity that may result in a discharge to waters of the United States to obtain certification from the state that the discharge will comply with other provisions of the act;
- Section 402 – establishes the National Pollutant Discharge Elimination System (NPDES), a permitting system for the discharge of any pollutant (except for dredge or fill material) into waters of the United States. This permitting program is administered by the California Regional Water Quality Control Boards (RWQCBs); and
- Section 404 – establishes a permit program for the discharge of dredge or fill material into waters of the United States. This permit program is administered by the U.S. Army Corps of Engineers (USACOE).

Coordination with the respective agencies is ongoing to obtain the necessary permits for the project. The project will be required to comply with potential permit conditions to protect U.S. waters.

3.2 Porter-Cologne Water Quality Act

California's Porter-Cologne Water Quality Act is the basis for water quality regulation within the state. The Act requires a "Report of Waste Discharge" for any discharge of waste (liquid, solid, or otherwise) to land or surface waters that may impair a beneficial use of surface or groundwater of the state. The project does not require a waste discharge permit, because potential construction waste discharge that may impair a beneficial use of surface or groundwater will not be discharged to any land or surface waters.

3.3 State Water Resources Control Board and Regional Water Quality Control Board

The State Water Resources Control Board (SWRCB) administers water rights, water pollution control, and water quality functions throughout the state, while the RWQCBs conduct planning, permitting, and enforcement activities. The project area lies within the jurisdiction of the Santa Ana RWQCB (Region 8).

3.4 Beneficial Uses and Water Quality Objectives

The RWQCB is responsible for the protection of beneficial uses of water resources within its jurisdiction and uses planning, permitting, and enforcement authorities to meet this responsibility.

Every water body within the jurisdiction of RWQCB is designated with a set of beneficial uses that are protected by appropriate water quality objectives. There are no beneficial uses listed for the water bodies that are directly receiving discharge (Wardlow Wash and Temescal Canyon Wash). Beneficial uses apply to the largest tributary of each affected watershed. Following is a list of the different types of waters and their beneficial uses for the Santa Ana River as described by the Water Quality Control Plan (also referred to as the Basin Plan) for the Santa Ana River Basin.

- **AGR** – Agricultural Supply waters are used for farming, horticulture, or ranching. These uses may include, but are not limited to, irrigation, stock watering, and support of vegetation for range grazing.
- **GWR** – Groundwater Recharge waters are used for natural or artificial recharge of groundwater for purposes that may include, but are not limited to, future extraction, maintaining water quality or halting saltwater intrusion into freshwater aquifers.
- **REC 1** – Water Contact Recreation waters are used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses may include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and use of natural hot springs.
- **REC 2** – Non-contact Water Recreation waters are used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water would be reasonably possible. These uses may include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.
- **WARM** – Warm Freshwater Habitat waters support warm water ecosystems that may include, but are not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates.

- **WILD** – Wildlife Habitat waters support wildlife habitats that may include, but are not limited to, the preservation and enhancement of vegetation and prey species used by waterfowl and other wildlife.
- **RARE** – Rare, Threatened or Endangered Species waters support habitats necessary for the survival and successful maintenance of plant or animal species designated under state or federal law as rare, threatened, or endangered.

3.5 NPDES Program

The Santa Ana RWRCB has issued the NPDES Storm Water Permit (Order No. R8-2002-0011), adopted August 30, 2000, which covers the County of Riverside, (the "County") and the incorporated cities of Beaumont, Calimesa, Canyon Lake, Corona, Hemet, Lake Elsinore, Moreno Valley, Murrieta, Norco, Perris, Riverside, and San Jacinto. In compliance with this permit, the County has a Drainage Area Management Plan (DAMP) to address storm water pollution controls related to highway planning, design, construction, and maintenance activities throughout the county. The DAMP describes responsibilities, procedures, and practices the County uses to protect water quality by reducing or eliminating pollutants discharged from storm drainage systems owned or operated by its facilities, including the selection and implementation of Best Management Practices (BMPs). The proposed project will be expected to follow the guidelines and procedures outlined in the DAMP. All parties working on the project will be required to implement pollution prevention, treatment controls, and construction BMPs consistent with the requirements outlined in the DAMP.

3.6 Construction Activity Permitting

The project will result in disturbance of soil that will require compliance with the NPDES General Permit, Waste Discharge Requirements for Discharges of Storm Water Runoff Associated with Construction Activities (Order No. 99-08-DWQ). This Statewide General Construction permit regulates discharges from construction sites that disturb one (1) or more acres of soil. By law, all storm water discharges associated with construction activity where clearing, grading, and excavation results in soil disturbance of at least one (1) acres of total land area must comply with the provisions of this NPDES Permit, and develop and implement an effective Storm Water Pollution Prevention Plan (SWPPP). The project applicant must submit a Notice of Intent (NOI) to the SWRCB, to be covered by the NPDES General Permit, and prepare the SWPPP before beginning construction. Implementation of the plan starts with the commencement of construction and continues through the completion of the project. Upon completion of the project, the applicant must submit a Notice of Termination (NOT) to the SWRCB to indicate that construction is completed.

4 Water Quality Assessment

Water quality in the project area is assessed as part of the environmental review for the project. This section reports the findings of this review and identifies the beneficial uses and applicable water quality standards of the surface receiving water and the adjacent groundwater basin. This section also compares these water quality standards to the typical freeway runoff and identifies the pollutants of concern that might exceed the applicable water quality standards.

4.1 Receiving Surface Water Bodies

- As previously mentioned, the project will directly drain into one of the following engineered flood control channels: Mabey Canyon Debris Basin and Wardlow Wash, a concreted-lined channel.

Table 4-1 compares the size of the project to that of the watershed area.

Table 4-1: Project Area Comparison to Watershed Area

Existing Project Conditions Impervious Area	Project Increase in Impervious Area	% Increase in Impervious Area	Existing Conditions, % of Watershed	Project Impact, % of Watershed	Total Impact, % of Watershed
1.3 ac	22.9 ac	95%	< .001%	< .001%	< .001%

As summarized in Table 4-1, although the project will increase the impervious area by approximately 21.6 acres, the overall impact this represents to the Santa Ana Watershed is insignificant.

4.2 Groundwater

Currently, groundwater is being studied for the site. Information on groundwater will be forthcoming.

4.3 Water Quality Objectives

The Porter-Cologne Water Quality Control Act defines water quality objectives as "...the limits or levels of water quality constituents or characteristics which are established for reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area."

There are two forms of water quality objectives:

- **Narrative** objectives present a general description of water quality that must be attained through pollutant control measures and watershed management. They also serve as the basis for the development of detailed numerical objectives. Narrative objectives apply for all water bodies. They are listed in Appendix A.
- **Numerical** objectives typically describe pollutant concentrations, physical and chemical conditions of the water, and toxicity of the water to aquatic organisms. Places where numerical limits are specified represent the maximum levels that will allow the beneficial use to continue unimpaired. In other cases, an objective may prohibit the discharge of specific substances, tolerate natural or "background" levels of certain substances or characteristics (but not increases over those values), or may express a limit, in terms of not impacting other beneficial uses. An adverse effect or impact on a beneficial use occurs where there is an actual or threatened loss or impairment of that beneficial use. No numerical objectives have been established for Temescal Wash or Wardlow Wash.

Federal water quality objectives are dictated by section 303(d) of the CWA and EPA water quality planning and management regulations, which require states to identify waters that do not meet, or are not expected to meet, water quality standards, even after technology-based or other required controls are in place. These water bodies are considered water quality-limited and are reported by states in their 303(d) List. The Channels that receive discharge from the project (Temscal Wash and Wardlow Wash,) are not 303(d) listed. The Santa Ana River, downstream of Temscal Wash and Wardlow Wash, is also not 303(d) listed.

4.4 Highway Runoff Quality Assessment

The California Department of Transportation (Caltrans) Storm Water Research and Monitoring Program has collected water quality data for the past several years from over 100 highway runoff-monitoring sites. The majority of this data is collected from highways in Southern California. A description of these sites and a summary of the monitoring data can be found in the Storm Water Monitoring and BMP Development Status Report (CTSW-RT-04-069.04.05). The Caltrans Storm Water Research and Monitoring Program is explained in Section 4.4 of this report. The results found that typical pollutants within Caltrans' right-of-way include Total Suspended Solids (TSS), copper, lead, and zinc. Based on the study, it can be assumed that these pollutants are to be expected from the project, since it consists of constructing a four-lane roadway.

4.5 Hydromodification

As previously illustrated in assessing the receiving surface water bodies, the impact of the project area in the watershed is considered de minimis. Since it is a relatively small linear project within a large watershed, and the increase in impervious area is less than one (1) percent of the watershed, the increase in runoff generated by the project is insignificant and will not result in potential hydromodification impacts. Furthermore, storm water runoff from the project drains to engineered flood control channels, one of which is concrete-lined, which better controls the discharge from the project and prevents erosion.

The project is in a highly urbanized area (see Section 2), and the hydrographs from the roadway project will "peak" and discharge to the flood conveyance channels before the peak discharge arrives from the large watershed. Therefore, no resulting increase in peak discharge to the downstream channels is expected.

In addition, the project has been evaluated to address hydrologic conditions of concern and hydromodification based on requirements of local MS4 permits. Consistent with Riverside County requirements, the project has been evaluated for the potential to cause a hydrologic change or condition of concern that could significantly impact downstream channels. It has been determined that the project will not cause a hydrologic condition of concern, since runoff from the project drains to engineered channel facilities. Furthermore, the increase in runoff volume caused by the project is insignificant and not expected to either cause erosion or impact downstream channels.

5 BMP Location and Sizing

Several DAMP-approved BMP devices can be implemented within Department roadway projects. Of those approved for implementation, the following BMPs are being considered for implementation with the project: biofiltration strips or swales, and a debris basin.

The type, selection, location, and sizing of the biofiltration strips and swales will be determined during the next design phase of the project.

The Maybey Debris Basin is an existing basin that will be modified to accommodate runoff from the project. Modifications include:

- Excavation within the existing basin right-of-way to retain the original storage volume through lowering the basin floor approximately five feet.
- Construction of a new low-level outlet upgraded to be consistent with other debris basin outlet structures constructed by RCFC&WCD.
- Construction of a new "emergency" spillway, which will consist of a rectangular drop spillway inlet and underground box culvert with a new energy dissipater. This type of facility will allow the emergency spillway to pass flow underneath the roadway without a bridge structure.
- New access ramps to the bottom of the roadway and a perimeter access roadway.

RBF has prepared a Foothill Parkway Feasibility Study on the Maybey Canyon Debris Basin. This study can be found in Appendix B.

Appendix A: Water Quality Objectives for Santa Ana River Watershed

When more than one objective is applicable, the stricter shall apply. In addition to these objectives, the following shall apply:

Inland surface water communities and populations, including vertebrate, invertebrate, and plant species, shall not be degraded as a result of the discharge of waste. Degradation is damage to an aquatic community or population with the result that a balanced community no longer exists. A balanced community is:

- Diverse;
- Able to sustain itself through cyclical seasonal changes;
- Includes necessary food chain species;
- Not dominated by pollution-tolerant species, unless that domination is caused by physical habitat limitations;
- May include historically introduced non-native species but does not include species present, because:
  - Best available technology has not been implemented;
  - Site-specific objectives have been adopted; or
  - Thermal discharges.

Algae

Waste discharges shall not contribute to excessive algal growth in inland surface receiving waters.

Ammonia, Un-ionized

Un-ionized ammonia (NH3 or UIA) is toxic to fish and other aquatic organisms. In water, UIA exists in equilibrium with ammonium (NH4+) and hydroxide (OH-) ions. The proportions of each change as the temperature, pH, and salinity of the water change.

The 1983 Basin Plan specified an UIA objective of 0.8 mg/L for water bodies designated WARM. The SWRCB directed the Regional Board to review the 0.8 mg/L objective because of concerns that it is not stringent enough to protect aquatic wildlife. The U.S. EPA concurred that this review was necessary. The Regional Board contracted with California State University, Fullerton to conduct a study of unionized ammonia in the Santa Ana River and to develop recommendations regarding the UIA objective. This study, which was conducted in 1985-87, was complemented by additional Regional Board staff analysis. The additional staff analysis focused on adjusting EPA's national criteria for WARM waters (published in 1984 and amended in 1992), using the recalculation procedure. With this procedure, cold and warm water species not found in the Santa Ana Region's WARM designated waters were deleted from the database used to derive the national criteria, and new criteria were calculated.

Un-ionized Ammonia (mg/liter N)		Temperature, C						
		0	5	10	15	20	25	30
pH	6.50	0.0006	0.0008	0.0012	0.0017	0.0024	0.0024	0.0024
	6.75	0.0010	0.0015	0.0021	0.0030	0.0042	0.0042	0.0042
	7.00	0.0019	0.0026	0.0037	0.0053	0.0074	0.0074	0.0074
	7.25	0.0033	0.0047	0.0066	0.0094	0.0132	0.0132	0.0132
	7.50	0.0059	0.0083	0.0118	0.0166	0.0235	0.0235	0.0235
	7.75	0.0115	0.0162	0.0229	0.0324	0.0458	0.0458	0.0458
	8.00	0.0133	0.0188	0.0265	0.0375	0.0530	0.0530	0.0530
	8.25	0.0133	0.0188	0.0265	0.0375	0.0530	0.0530	0.0530
	8.50	0.0133	0.0188	0.0265	0.0375	0.0530	0.0530	0.0530
	8.75	0.0133	0.0188	0.0265	0.0375	0.0530	0.0530	0.0530
	9.00	0.0133	0.0188	0.0265	0.0375	0.0530	0.0530	0.0530

Total Ammonia (mg/liter N)		Temperature, C						
		0	5	10	15	20	25	30
pH	6.50	2.27	2.12	2.01	1.93	1.88	1.31	0.928
	6.75	2.27	2.12	2.01	1.93	1.88	1.31	0.930
	7.00	2.27	2.12	2.01	1.93	1.89	1.32	0.933
	7.25	2.27	2.12	2.01	1.94	1.89	1.32	0.939
	7.50	2.27	2.13	2.02	1.95	1.90	1.33	0.949
	7.75	2.49	2.34	2.22	2.14	2.10	1.48	1.06
	8.00	1.63	1.53	1.46	1.41	1.39	0.987	0.713
	8.25	0.922	0.868	0.831	0.811	0.806	0.578	0.424
	8.50	0.524	0.496	0.479	0.472	0.476	0.348	0.262
	8.75	0.301	0.287	0.281	0.282	0.291	0.219	0.170
	9.00	0.175	0.170	0.170	0.175	0.187	0.146	0.119

Bacteria, Coliform

Fecal bacteria are part of the intestinal flora of warm-blooded animals. Their presence in surface waters is an indicator of pollution. Total coliform is measured in terms of the number of coliform organisms per unit volume. Total coliform numbers can include non-fecal bacteria; so additional testing is often done to confirm the presence and numbers of fecal coliform bacteria. Water quality objectives for numbers of total and fecal coliform vary with the uses of the water, as shown below.

Lakes and Streams

(MUN)	Less than 100 organisms/100 mL
(REC-1)	Log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period
(REC-2)	Average less than 2000 organisms/100 mL and not more than 10% of samples exceed 4000 organisms/100 mL for any 30-day period

Boron

Boron concentrations shall not exceed 0.75 mg/L in inland surface waters of the region as a result of controllable water quality factors.

Chemical Oxygen Demand (COD)

COD is a measure of the total amount of oxidizable material present in a sample, including stable organic materials not measured by the BOD test. Waste discharges shall not result in increases in COD levels in inland surface waters, which adversely affect beneficial uses.

Chloride

A safe value for irrigation is considered to be less than 175 mg/L of chloride. Excess chlorides affect the taste of potable water, so drinking water standards are generally based on potability rather than on health. The secondary drinking water standard for chloride is 500 mg/L.

Chlorine, Residual

Wastewater disinfection with chlorine usually produces a chlorine residual. Chlorine and its reaction products are toxic to aquatic life. To protect aquatic life, the chlorine residual in wastewater discharged to inland surface waters shall not exceed 0.1 mg/L.

Color

Color in water may arise naturally, such as from minerals, plant matter, or algae, or may be caused by industrial pollutants. Color is primarily an aesthetic consideration, although it can discolor clothes and food. The secondary drinking water standard for color is 15 color units. Waste discharges shall not result in coloration of the receiving waters that causes a nuisance or adversely affects beneficial uses. The natural color of fish, shellfish, or other inland surface water resources used for human consumption shall not be impaired.

Dissolved Solids, Total (Total Filterable Residue)

The Department of Health Services recommends that the concentration of total dissolved solids (TDS) in drinking water be limited to 1000 mg/L (secondary drinking water standard) due to taste considerations. For most irrigation uses, water should have a TDS concentration under 700 mg/L. Quality-related consumer cost analyses have indicated that a benefit to consumers exists if water is supplied at or below 500 mg/L TDS.

Filterable Residue, Total

See Dissolved Solids, Total.

Floatables

Floatables are an aesthetic nuisance as well as a substrate for algae and insect vectors. Waste discharges shall not contain floating materials, including solids, liquids, foam, or scum, that cause a nuisance or adversely affect beneficial uses.

Fluoride

Fluoride in water supply used for industrial or irrigation purposes has certain detrimental effects. Fluoride in optimum concentrations in water supply (concentration dependent upon the mean annual air temperature) is considered beneficial for preventing dental caries, but concentrations above approximately 1 mg/L, or its equivalent at a given temperature, are considered likely to increase the risk of occurrence of dental fluorosis.

Fluoride concentrations shall not exceed values specified in the table below in inland surface waters designated MUN as a result of controllable water quality factors.

Annual Average of Maximum Daily Air Temperature (°C) (mg/L):	Optimum Fluoride Concentration:
12.0 and below	1.2
12.1 to 14.6	1.1
14.7 to 17.6	1.0
17.7 to 21.4	0.9
21.5 to 26.2	0.8
26.3 to 32.5	0.7

Hardness (as CaCO3)

The major detrimental effect of hardness is economic. Any concentration (reported as mg/L CaCO3) greater than 100 mg/L results in the increased use of soap scale buildup in utensils in domestic uses, and in plumbing. Hardness in industrial cooling waters is generally objectionable above 50 mg/L. The hardness of receiving waters used for municipal supply (MUN) shall not be increased as a result of waste discharges to levels that adversely affect beneficial uses.

Inorganic Nitrogen, Total

See Nitrogen, Total Inorganic.

Metals

Metals can be toxic to human and animal life. In 1990, the Environmental Protection Agency (EPA) placed the Santa Ana River, Reaches 2, 3, and 4, and Chino Creek on the §304(l) list of "Waters Not Meeting Applicable Water Quality Standards" based on its review of data on certain metals in POTW discharges to the River.

The Santa Ana River dischargers and the Regional Board disagreed with and objected to EPA's §304(l) designation. To demonstrate whether or not the §304(l) designation is correct and what effects, if any, heavy metal levels may have on aquatic life in the

Region, the Santa Ana River Dischargers Association, and the Santa Ana Watershed project Authority agreed to conduct a Use-Attainability Analysis (UAA).

The purpose of a Use-Attainability Analysis is to evaluate the "physical, biological, chemical, and hydrological conditions of a river to determine what specific beneficial uses the waterbody can support." If local conditions preclude full attainment of an aquatic life beneficial use for reasons unrelated to water quality, federal and state authorities may allow variances from the generic water quality criteria.

The UAA began in February 1991 and concluded in March 1992. It provided detailed information on chemical, biological, and hydrologic conditions in the middle Santa Ana River aquatic system. Conclusions and recommendations were presented to the Board in June 1992. Data provided by the UAA was used to support the adoption of site-specific objectives for three metals, cadmium (Cd), copper (Cu), and lead (Pb) for the Santa Ana River (Reaches 2, 3, and 4) and the perennial portions of some tributaries (including Chino Creek, Cucamonga/Mill Creek, Temescal Creek, and creeks in the Riverside Narrows area).

In adopting these SSOs, the Regional Board found (RWQCB Resolution No. 94-1) that:

a. The Site-Specific Water Quality Objectives (SSOs) will protect the beneficial uses of the Santa Ana River.

b. The SSOs are conservative.

c. The SSOs, which represent higher water quality than presently exists, will not result in degradation of water quality.

d. Existing levels of cadmium, copper, and lead in the Santa Ana River do not contribute to toxicity in the Santa Ana River.

The toxicity of these metals varies with water hardness. No fixed hardness value is assumed; objectives are calculated using the hardness of the collected sample. The following equations represent the SSOs that apply to these waterbodies. These SSOs are expressed as the dissolved form of the metals, where TH is the total hardness (as $CaCO3$) in mg/L:

SSO for Cadmium:
Cd SSO = 0.85[e[0.7852*ln(TH)-3.490]]

SSO for Copper:
Cu SSO = 0.85[e[0.8545*ln(TH)-1.465]]

SSO for Lead:
Pb SSO = 0.25[e[1.273*ln(TH)-3.958]]

The SSOs for cadmium and copper are simply the hardness-dependent formulas for calculating the objective (national criteria), corrected by the dissolved-to-total (metal) ratio. The SSO for lead is the recalculated hardness-dependent formula, corrected by the dissolved-to-total ratio. The table below shows the site-specific objectives for cadmium, copper, and lead that would apply to a water sample with 200 mg/L total hardness (as CaCO3).

Metal	Calculated WQO	Recalculated Value	EPA Correction Factor	SSO
Cd	2.0	NA	0.85	1.7
Cu	21.4	NA	0.85	18.2
Pb	7.7	16.2	0.25	4.1

Toxicity testing performed as part of the Santa Ana River Use-Attainability Analysis (UAA) has demonstrated that the levels of dissolved metal shown below are safe and non-toxic in Santa Ana River water.

Cadmium	4 µg/L
Copper	37 µg/L
Lead	28 µg/L

There is also evidence that levels as much as 100% higher than those shown above do not result in chronic toxicity.

Methylene Blue-Activated Substances (MBAS)

The MBAS test is sensitive to the presence of detergents (see Surfactants). Positive results may indicate the presence of wastewater. The secondary drinking water standard for MBAS is 0.05 mg/L. MBAS concentrations shall not exceed 0.05 mg/L in inland surface waters designated MUN as a result of controllable water quality factors.

Nitrate

High nitrate concentrations in domestic water supplies can be toxic to human life. Infants are particularly susceptible and may develop methemoglobinemia (blue baby syndrome). The primary drinking water standard for nitrate (as NO3) is 45 mg/L or 10 mg/L (as N). Nitrate-nitrogen concentrations shall not exceed 45 mg/L (as NO3) or 10 mg/L (as N) in inland surface waters designated MUN as a result of controllable water quality factors.

Oil and Grease

Oil and grease can be present in water as a result of the discharge of treated wastes and the accidental or intentional dumping of wastes into sinks and storm drains. Oils and related materials have a high surface tension and are not soluble in water, therefore forming a film on the water's surface. This film can result in nuisance conditions because of odors and visual impacts. Oil and grease can coat birds and aquatic organisms, adversely affecting respiration and/or thermoregulation. Waste discharges shall not result in deposition of oil, grease, wax, or other materials in concentrations that result in a visible film or in coating objects in the water, or which cause a nuisance or adversely affect beneficial uses.

Oxygen, Dissolved

Adequate dissolved oxygen (D.O.) is vital for aquatic life. Depression of D.O. levels can lead to fish kills and odors resulting from anaerobic decomposition. Dissolved oxygen content in water is a function of water temperature and salinity. The dissolved oxygen content of surface waters shall not be depressed below 5 mg/L for waters designated WARM, or 6 mg/L for waters designated COLD, as a result of controllable water quality factors. In addition, waste discharges shall not cause the median dissolved oxygen concentration to fall below 85% of saturation or the 95th percentile concentration to fall below 75% of saturation within a 30-day period.

pH

The pH of inland surface waters shall not be raised above 8.5 or depressed below 6.5 as a result of controllable water quality factors.

Radioactivity

Radioactive materials shall not be present in the waters of the region in concentrations that are deleterious to human, plant, or animal life. Waters designated MUN shall meet the limits specified in the California Code of Regulations, Title 22, and listed here:

Combined Radium-226 and Radium-228	5	pCi/L
Gross Alpha particle activity	15	pCi/L
Tritium	20,000	pCi/L
Strontium-90	8	pCi/L
Gross Beta particle activity	50	pCi/L
Uranium	20	pCi/L

Sodium

The presence of sodium in drinking water may be harmful to persons suffering from cardiac, renal, and circulatory diseases. It can contribute to taste effects, with the taste threshold depending on the specific sodium salt. Excess concentrations of sodium in irrigation water reduce soil permeability to water and air. The deterioration of soil quality because of the presence of sodium in irrigation water is cumulative and is accelerated by poor drainage.

Solids, Suspended and Settleable

Settleable solids are deleterious to benthic organisms and may cause anaerobic conditions to form. Suspended solids can clog fish gills and interfere with respiration in aquatic fauna. They also screen out light, hindering photosynthesis and normal aquatic plant growth and development. Inland surface waters shall not contain suspended or settleable solids in amounts that cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.

Sulfate

Excessive sulfate, particularly magnesium sulfate (MgSO4) in potable waters can lead to laxative effects, but this effect is temporary. There is some taste effect from magnesium sulfate in the range of 400-600 mg/L as MgSO4. The secondary drinking water standard for sulfate is 500 mg/L. Sulfate concentrations in waters native to this region are normally low, less than 40 mg/L, but imported Colorado River water contains approximately 300 mg/L of sulfate.

Sulfides

Sulfides are generated by many industries and from the anaerobic decomposition of organic matter. In water, sulfides can react to form hydrogen sulfide (H2S), commonly known for its "rotten egg" odor. Sulfides in ionic form are also toxic to fish in. The dissolved sulfide content of inland surface waters shall not be increased as a result of controllable water quality factors.

Surfactants (surface-active agents)

This group of materials includes detergents, wetting agents, and emulsifiers. See also Methylene Blue-Activated Substances (MBAS). Waste discharges shall not contain concentrations of surfactants which result in foam in the course of flow or use of the receiving water, or which adversely affect aquatic life.

Taste and Odor

Undesirable tastes and odors in water may be a nuisance and may indicate the presence of a pollutant(s). The secondary drinking water standard for odor (threshold) is 3 odor units. The inland surface waters of the region shall not contain, because of controllable water quality factors, taste- or odor-producing substances at concentrations that cause a nuisance or adversely affect beneficial uses. The natural taste and odor of fish, shellfish or other regional inland surface water resources used for human consumption shall not be impaired.

Temperature

Waste discharges can cause temperature changes in the receiving waters that adversely affect the aquatic biota. Discharges most likely to cause these temperature effects are cooling tower and heat exchanger blowdown. The natural receiving water temperature of inland surface waters shall not be altered, unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses. The temperature of waters designated COLD shall not be increased by more than 5°F because of controllable water quality factors. The temperature of waters designated WARM shall not be raised above 90°F June through October or above 78°F during the rest of the year because of controllable water quality factors. Lake temperatures shall not be raised more than 4°F above established normal values as a result of controllable water quality factors.

Total Dissolved Solids

See Dissolved Solids, Total.

Total Filterable Residue

See Dissolved Solids, Total.

Toxic Substances

Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels that are harmful to human health. The concentrations of contaminants in waters that are existing or potential sources of drinking water shall not occur at levels that are harmful to human health. The concentrations of toxic pollutants in the water column, sediments or biota shall not adversely affect beneficial uses.

Turbidity

Turbidity is a measure of light scattered due to particulates in water. The secondary drinking water standard for turbidity is 5 NTU (nephelometric turbidity units).

Increases in turbidity that result from controllable water quality factors shall comply with the following:

Natural Turbidity	Maximum Increase
0-50 NTU	20%
50-100 NTU	10 NTU
Greater than 100 NTU	10%

All inland surface waters of the region shall be free of changes in turbidity that adversely affect beneficial uses.

Preliminary Engineering Investigation

MABEY CANYON DEBRIS BASIN• FOOTHILL PARKWAY CROSSING FEASIBILITY

November 1999

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City of Corona

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Table of Contents

Section 1 - Introduction

1.1 General Background

The proposed Foothill Parkway roadway extension project involves the future construction of the Foothill Parkway from Lincoln Avenue to the intersection Paseo Grande and Green River, approximately 13,000 feet. The proposed roadway is classified as a secondary arterial highway which will provide a vital transportation link in the City of Corona consistent with the City's General Plan Circulation Element. The proposed roadway will consist of a four-lane road section that varies in right-of-way width from 81 feet to 102-feet. The general alignment of the roadway extension will follow along the southerly foothills of the City of Corona, skirting the limits of the existing residential developments and the National Forest. Each of the alternative alignments for the roadway which are being investigated cross Mabey Canyon Debris Basin. One of the proposed horizontal alignments of the roadway extension follows along the axis of the embankment crest for the existing Riverside County Flood Control and Water Conservation District (RCFC&WCD) **Mabey Canyon Debris Basin** facility which was originally constructed in approximately 1974. The roadway construction would involve placement of fill on the upstream side of the dam embankment and also completely covering the existing concrete spillway crest located on the easterly abutment. However, the proposed modifications to the debris basin would retain the original debris storage volume capacity and level of flood protection with new improvements for the basin. Improvements which would be included in the project in order to mitigate modifications to the debris basin from the roadway construction include:

1. Excavation within the existing basin right-of-way to retain the original storage volume through lowering the basin floor approximately 5-feet.

2. Construction of a new low-level outlet upgraded to be consistent with other debris basin outlet structures constructed by RCFC&WCD (ie. similar to Oak Street Basin or Lake View Dam).

3. Construction of a new spillway which will consist of a rectangular drop spillway inlet, similar to SCS, and underground box culvert with an energy dissipater. This type of facility will allow emergency spillway to pass flow underneath the roadway without a bridge structure.

4. New access ramps to the bottom of the roadway and perimeter access roadway.

The feasibility investigation of this study evaluated two potential alternatives for this particular roadway alignment in order to accommodate the existing debris basin. These alternatives consisted of either (1) roadway fill across the existing dam embankment as described above, or (2) constructing a bridge to span across the entire embankment without modifying or reconstructing any of the existing debris basin facilities. Preliminary construction cost estimates were prepared for both alternatives to determine the most cost effective solution. The documentation in this study provides the engineering analysis focusing primarily on the design and sizing of the replacement facilities to the debris basin if it is modified with the roadway fill alternative.

1.2 Existing Mabey Canyon Debris Basin Facility

The location of the existing Mabey Canyon debris basin location is divided between the City of Corona and the National Forest. The storage volume and size of the earthen embankment associated with the existing facility classifies it to be within the jurisdiction of the California Department of Division of Safety of Dams (DSOD). The characteristics of the existing Mabey Canyon debris basin based upon the most recent construction drawings are summarized in Table No. 1.

Table No. 1 - Summary of Existing Debris Facility Characteristics

Drainage Area	1.46 Sq. Mi.
Debris Capacity -N.G. to Spillway Crest	75,000 Cu Yd.
Debris Capacity -Debris Cone Slope 1.6%	70,000 Cu Yd.
Debris Capacity -Excavation for Embankment	85,000 Cu Yd.
Spillway Design Discharge (Q1,000)	3,100 C.F.S.
Channel Design Discharge (Q100)	1,160 C.F.S.
Embankment Crest Elevation	1146 Feet
Freeboard	2.5 Feet
Outlet Works Design Discharge	150 C.F.S.
Crest Width	20 Feet
Crest Length	480 Feet
Primary Outlet	5.0 ft. Dia Outlet Tower
Low-level Outlet Conduit	30"- diameter Pipe
Emergency Spillway Crest Elevation	1137.96

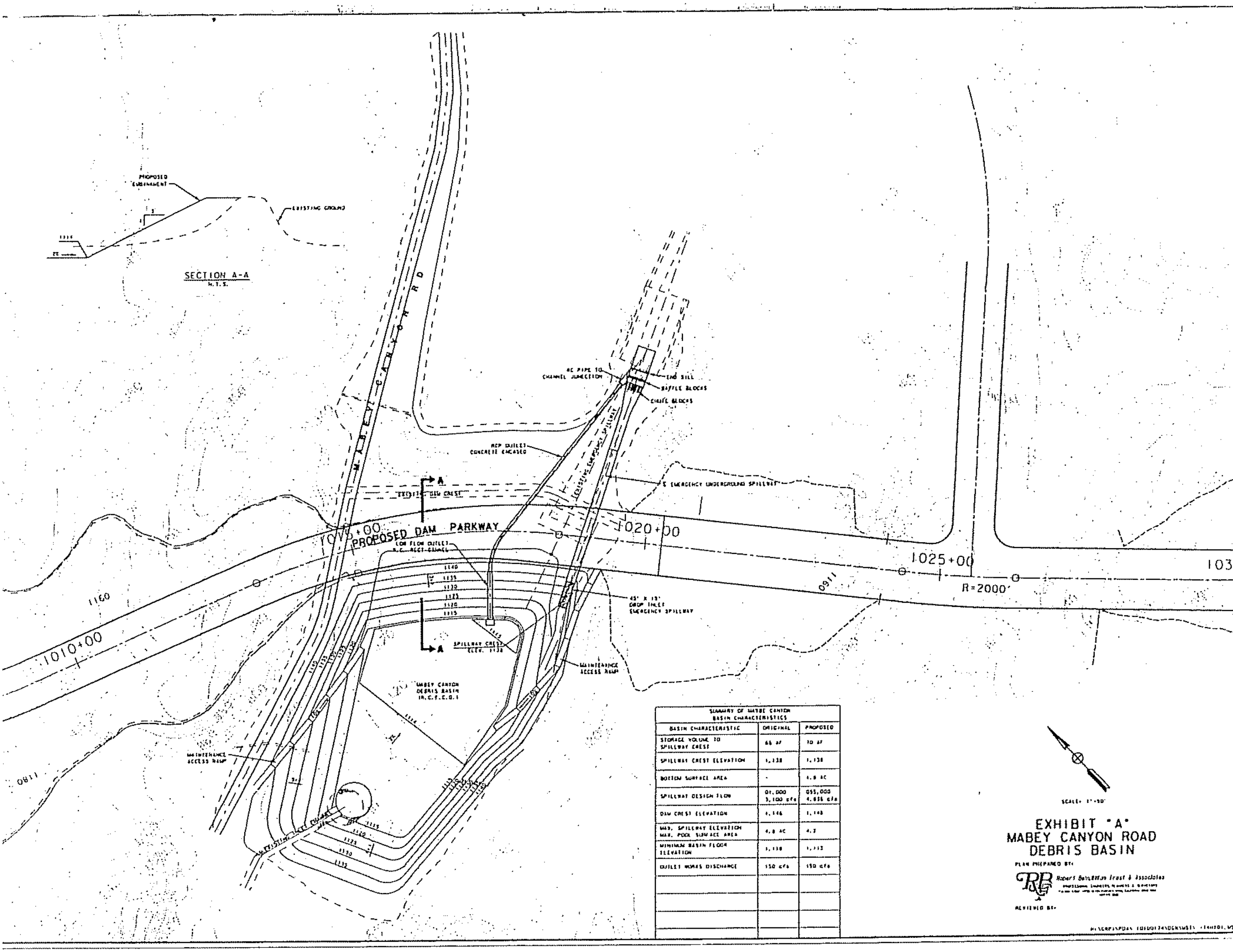
1.3 Summary Debris Modifications Characteristics

The proposed alternative which involves the placement of the roadway fill along the dam embankment axis will require modifications to the existing debris basin facilities. A preliminary design has been developed which retains the original debris storage requirements, including enhancing or upgrading the level of flood protection to be consistent with current DSOD requirements. The preliminary design of the modified debris facility includes the following characteristics for the dam:

Table No. 2 - Summary of Proposed Modified Debris Facility Characteristics	
Drainage Area	1.46 Sq. Mi.
Spillway Design Discharge (Q55,000)	4,840 C.F.S.
Channel Design Discharge (Q100)	1,160 C.F.S.
Embankment Crest Elevation	1146'
Freeboard	1.5-feet (DSOD minimum requirements)
Outlet Works Design Discharge	* maintain existing capacity
Embankment Crest Width	80 to 100 Feet
Spillway Geometry	45' x 15' Rectangular Weir (3 sides available for flow)
Embankment Crest Length	480 Feet
Primary Spillway Outlet	15' x 10' RCB
Low-level Outlet Conduit	30-inch (maintain existing or increase size as required)
Emergency Spillway Crest Elevation	1138'

1.4 Summary of Bridge Alternative

The feasibility of utilizing a bridge to span the existing Mabey Canyon Debris Basin without modifying the existing facility was originally evaluated as part of the *Precise Alignment Plan for the Foothill Parkway Extension* (1990). This study had developed an estimated construction cost for the bridge spanning the dam embankment abutment to be approximately **$4,320,000**. This cost was based upon 32,000 square feet of bridge deck area at a unit cost of $120/square foot.



SUMMARY OF MABEY CANYON BASIN CHARACTERISTICS		
BASIN CHARACTERISTIC	ORIGINAL	PROPOSED
STORAGE VOLUME TO SPILLWAY CREST	65 AF	30 AF
SPILLWAY CREST ELEVATION	1,138	1,138
BOTTOM SURFACE AREA	-	4.8 AC
SPILLWAY DESIGN FLOW	Q1,000 3,100 cfs	Q55,000 4,656 cfs
DAM CREST ELEVATION	1,146	1,148
MAX. SPILLWAY ELEVATION MAX. POOL SURFACE AREA	4.8 AC	4.7
MINIMUM BASIN FLOOR ELEVATION	1,110	1,113
OUTLET WORKS DISCHARGE	150 cfs	150 cfs

SCALE: 1"=50'

EXHIBIT "A"
MABEY CANYON ROAD DEBRIS BASIN

PLAN PREPARED BY:

Robert Bein, William Frost & Associates

REVIEWED BY:

Section 2 - Hydrology

2.1 *Original Spillway Design Hydrology*

The original spillway hydrology was developed through the application of the synthetic unit hydrograph procedure in 1970. The watershed has an estimated tributary drainage area of 1.460 square miles. The 1,000-year discharge utilized a 3-hour 1,000-year adjusted point rainfall of 7.83 inches from the published 1945 US Weather Bureau information report. The six- and three-hour thunderstorms were considered for design purposes, but the three-hour was the critical storm duration.

2.2 *Estimated Revised Spillway Hydrology*

The existing Mabey Canyon Debris Basin is currently classified as a jurisdictional dam by the State of California DSOD. The original design criteria at the time of construction only required the spillway to be design to accommodate a 1,000-year storm event. However, the hydrologic design requirements for the spillway have been changed by DSOD and modifications to existing dams require that they be upgraded to the current standards. The modified spillway will be required to accommodate a design flood with a return period of 55,000-years based on a hazard classification weighting system. The original Mabey Canyon debris basin emergency spillway was designed for 3,100 cfs, equivalent to a 1,000-year storm event. Using the Prado Dam rain gauge, the 24-hour precipitation for the 55,000-year event was extrapolated. Multiplying the 1,000-year storm event flowrate and the ratio of the 55,000-year event to the 1,000-year event precipitation, the peak 55,000-year storm event flowrate was estimated for this preliminary study. A more detailed hydrologic evaluation will be required if this alternative is pursued, however, this estimated value is adequate for cost comparisons of facility sizing The peak flow rate of the 55,000-year flood was estimated to be **4,840 cfs** at the site of Mabey Canyon Debris Basin.

Section 3 - Proposed Debris Basin Modifications

3.0 Debris Basin Storage

The roadway alignment across the axis of the dam embankment would result in earthen roadway fill into the basin storage volume, reducing the available storage if not corrected. However it is proposed not to modify the available debris storage. This will be accomplished through the lowering of the debris basin floor by five-feet and grading the side-slopes around a portion of the perimeter. The grading would also be extended to the limits of the existing right-of-way boundary for the existing basin. The proposed grading illustrated on the conceptual layout and grading plan for the Mabey Canyon Debris Basin **has the same storage volume as the original design condition of the basin.**

3.1 Basin Geometry and Configuration

The proposed modifications to the existing debris basin will consist of an earthen dam with crest elevation 1146 feet, crest length of approximately 450 feet and a crest width varying between 80 and 100 feet. The dam would have a downstream side slope of 3:1 and an upstream side slope of 3:1. The maximum height of the dam would be 33 feet (1146-1113). The flow outlet works would include (1) a low level outlet to function as the primary outflow structure, and (2) a rectangular drop inlet spillway to allow flood to overspill with a conveyance capacity of 55,000-year flood. The low level outlet is a reinforced concrete rectangular channel along the upstream embankment, perpendicular to the dam axis. The rectangular channel is topped with grates. The spillway system includes a 15 foot wide by 45 feet long drop inlet with a weir crest elevation of 1138 feet.

3.3 Basin Inlet/Outlet Requirements

Basin Inlet - The tributary drainage to the debris basin is delivered through the natural floodplain in the canyon, without any significant engineered drainage improvements along the canyon drainage course. The inlet into the debris basin would utilize the existing 18- feet wide engineered trapezoidal channel to collect the natural drainage and convey it to the bottom of the incise debris basin floor. The existing debris basin currently operates in this fashion and appears to be adequate. Significant flood events would potentially extend the channel, however the overflow would still be delivered into the basin through the 4:1 or 5:1 incised basin slopes. The inlet channel invert is lined with 2.5 feet layer thickness of 1/2 ton grouted rip-rap. The sides of the channel are vertical, with landing mats extending 5 feet above the channel invert. This facility would assist in minimizing the potential erosion associated with the uncontrolled flow encountering the incised side slopes of the incised debris basin pit.

Low-level outlet - The low-level outlet will consist of a concrete rectangular channel embedded in the dam embankment slope that extends from the basin floor to the spillway crest elevation. The constant height concrete channel would be covered with a steel grate and terminate on the downslope into the outlet conduit which has been assumed as the same size, 30-inch diameter, as the existing condition.

Primary Spillway -The spillway structure consists of a box drop inlet and an underground concrete culvert through the dam embankment. The preliminary geometry for drop inlet was sized to be 45 feet long and 15- feet wide to accommodate the 55,000-year flood peak flow (estimated to be 4,840 cfs). These dimensions are similar to a facility currently being designed by RBF in Ventura County which has a design flow requirement of approximately 5,000 cfs. An initial estimate of the required underground culvert through the embankment to convey the spillway flow would be 15- feet wide and 10- feet deep, exiting at the downstream toe of the dam. An energy dissipater would be required at the culvert outlet with a stilling basin and baffle blocks.

Section 4 - Reference Debris Basin Facility Designs

4.1 Existing Spillway Facility Configuration

The existing spillway for the Mabey Canyon Debris Basin consists of a reinforced concrete rectangular open channel sloping chute spillway which varies in width from 62-feet at the crest to 20-feet at the downstream outlet channel. The length of the spillway is approximately 262-feet from the crest to the downstream outlet location. The vertical profile of the spillway includes a 20-foot vertical curve at the crest in order to increase the profile to a maximum slope of $S_o = 0.50$ on the face dam. The difference in elevation between the spillway crest and the crest of the dam embankment is approximately 9.12-feet. If the minimum residual freeboard required by DSOD then the maximum available design head at the existing spillway crest is 7.62-feet.

4.2 Proposed Replacement Spillway Discussion and Cost Estimate

The proposed dam modifications and spillway replacement would allow the proposed roadway to be constructed along the crest of the existing dam embankment while maintaining the operation of the debris basin. The modifications to the existing debris basin are designed to (1) maintain the existing debris storage volume that current exists through lowering of the basin floor approximately 5-feet and enlarging the geometry to compensate for fill in the basin, and (2) increase the hydraulic capacity of the emergency spillway to current DSOD design standards. The proposed roadway construction would result in fill within the basin storage area and filling of the open channel spillway crest. The proposed modifications which would compensate for these changes include:

- Elimination of the existing 5-foot diameter low-level outlet tower for Mabey Canyon debris basin is similar to the LACFCD standard debris basin tower design. The tower does not currently have a bridge or catwalk to access the tower for maintenance when water is contained in the basin. The tower would be removed because of the roadway fill in the basin at this location. The tower would be replaced with an intake structure embedded into the face of the dam embankment that RCFC&WCD has utilized on more recent debris basin facilities, similar to the Oak Street basin and Lakeview dam. Preliminary design has utilized the same dimensions to develop a construction cost estimate. The facility consists of a shallow reinforced concrete rectangular channel (8' x 3' RCC) extending from the floor of the basin to an elevation similar to the spillway crest. The constant depth channel would have a grate covering the entire channel opening and at the base it would connect into the outlet pipe.

- A concrete rectangular drop inlet spillway would replace the conventional open channel chute spillway. The hydraulic requirements of this facility are discussed in more detail below. The approximate dimensions of the replacement spillway wou'ld be 45' x 15' rectangular opening in which flow drops into the outlet channel on three sides of the inlet similar to a horseshoe weir type structure.

• The existing open channel spillway chute will be replaced with a 15'x 12' underground box culvert that extends through the dam embankment. The foundation of the spillway and outlet box conduit will have to be founded into bedrock or the differential in depth between bedrock and the invert will have to utilize lean concrete.

The existing soils reports originally prepared by Leroy Crandall and Associated is not clear on the exact depth to the sandstone bedrock in the middle portion of the canyon, however, it appears that the sandstone is shallow at the abutments.

• The roadway fill will extend into the existing basin storage area and become part of the dam embankment to impound water. This condition will necessitate that this portion of the roadway fill be constructed identical to a dam embankment. The construction will require that the extension into the basin floor have the foundation excavated. The original soils report had the foundation excavated ten feet below the existing ground. The construction of the embankment would be similar to the proposed raising of Prado Dam in which additional fill is being placed onto the existing dam.

• The existing basin incised pit are would be expanded up to the limits of the existing property ownership boundaries in order to maximize the storage volume.

• The spillway outlet channel will terminate into a new energy dissipator at the downstream end of the concrete rectangular channel. The conceptual design for estimating purposes has utilized an SAF basin because of the relatively high velocities. The low-level conduit would also outlet into the same energy dissipator.

Some representative negative discussion items regarding the use of the rectangular drop inlet include the potential clogging of the underground spillway conduit. Although this appears to be a substantial argument, the underground conduit has more than the required flow capacity and is designed as a supercritical channel. Floating debris could potential lodge in the conduit, but it would have to be very large considering the size of the conduit. Experience with Ventura County Flood Control District has indicated that has not been a problem.

A preliminary construction cost estimate has been prepared to evaluate the rough order magnitude of costs associated with the modifications to this facility. The backup for the cost calculations have been included in the technical appendix. This analysis indicates that the estimate construction cost would be approximately **$2,850,000**.

4.3 SCS Rectangular Drop Inlet Spillway Design Criteria

The hydraulic evaluation and criteria for a rectangular drop-inlet type spillway is outlined in several references, with the Soil Conservation Service (SCS) being the primary source. The references which have published hydraulic design criteria include the following:

Section 14 - Chute Spillways - Engineering Handbook, U.S. Department of Agriculture, Soil Conservation Service (1977)

Hydraulic Design of Energy Dissipators for Culverts and Channels - Hydraulic Engineering Circular No. 14, U.S. Department of Transportation, Federal Highway Administration (September 1983). Pages IX-B-1 to IX-B-12.

The rectangular box inlet spillway is designed for free-flow conditions at the crest of the box section which will allow three of the sides to function as a weir, reducing the overall length of the facility from the conventional spillway weir crest length. The corresponding rectangular channel section at the base of the drop is designed so the hydraulics will not submerge or influence the operation at the crest of the structure. The advantages of this type of facility include (1) reduced size of spillway channel width, (2) eliminates need for an open channel spillway chute, (3) dissipate a portion of the energy from the spillway crest height which reduces the velocity in the outlet channel, (4) the increased facility crest length through the use of the three side can reduce the required design head height, and (5) width of the structure does not have to be any greater than the requirements for the downstream channel.

The basic hydraulic design procedure adopted for this type of facility based upon the references discussed is as follows:

1. **Calculate theoretical design head, H_e**

   The crest hydraulics follow the basic weir equation and the weir coefficient assumed for a rounded edge of the weir crest has a six-inch radius. The following equation is indicated in the USDA reference on page 2.58.

   $$Q = 3.1(2B + W + 2)H_e^{3/2}$$

   Utilizing the weir equation outlined above, then the length of the open rectangular section can be determined or the design head requirements. This represents the theoretical maximum weir flow without any corrections for (1) head, (2) box inlet shape, (3) approach channel width, and (4) adjacent channel side slopes through the dike effect.

2. **Minimum width (W) to prevent submergence from side nappe impingement**

   $$Q \leq 5.5(W_{\min} + 1.0)^{5/2}$$

   Where this equation will determine the minimum width of the weir crest or channel section and can be checked with the proposed dimensions.

3. **Check design head (H_e) and minimum weir dimensions to prevent submergence**

   $$H_e \leq 0.49W + 0.04B + 0.51$$

4. **Check correction to weir equation for the approach channel effect**

$$K = \frac{W_c + 0.8Z_cH_e}{W + 1.0}$$

The value of "K" determined in the equation is applied to design charts in the USDA publication to evaluate the amount of adjustment or correction

5. **Check the effect for the proximity of adjacent side slopes or dike**

6. **Calculate minimum required depth of inlet or drop height to prevent submergence (D_r)**

The following two parameters are calculated to utilize design charts.

$$\frac{B + 0.5}{W + 1.0}$$

$$\gamma = \frac{H_e}{W + 1.0}$$

From the USDA design charts a value for ζ can be determined. The following equation can then be applied to calculated the minimum drop height.

$$\varsigma = \frac{W^{2/3}}{(W + 1.0)^{5/3}} D_r$$

7. **Check correction factor to weir coefficient for design head**

8. **Check correction factor to weir coefficient for box inlet shape**

9. **Check correction factor to weir coefficient for box inlet shape**

10. **Check correction factor to weir coefficient for dike effect**

11. **Calculate hydraulics of box culvert entrance at end of weir**

Analyze the hydraulics of the culvert entrance where the weir crest ends and the box conduit or covered portion of the conveyance channel enters the dam embankment. It is desired that the entrance to the covered portion of the channel not become submerged to eliminate potential influence to the hydraulic operation of the weir crest.

12. **Calculate minimum slope for spillway collection trough**

The base of the rectangular drop inlet for the length of the weir will function as a side-channel spillway trough to collect the flow along the length of the weir. The flow collected in the trough will vary over the length of the structure, increasing toward the face of the dam. The hydraulics will be similar to the procedure for a side-channel spillway. The longitudinal slope of the trough should be steeper than the critical slope to ensure that a backwater condition will not occur with no influence from the downstream conduit to effect submergence of the weir crest. Generally the minimum required drop height will be utilized at the beginning or upstream end of the weir which sets the invert elevation of the trough at this location. The downstream elevation of the trough is generally based upon the hydraulic requirements of the box entrance where the conduit enters the embankment of the dam. This minimum depth can be determined by either calculating the specific energy for critical depth or inlet control requirements for the box section, which should be similar. This will ensure that the box entrance will not be submerged. The slope calculated utilizing these two elevations should be checked to ensure that it exceeds the critical slope (S_c)

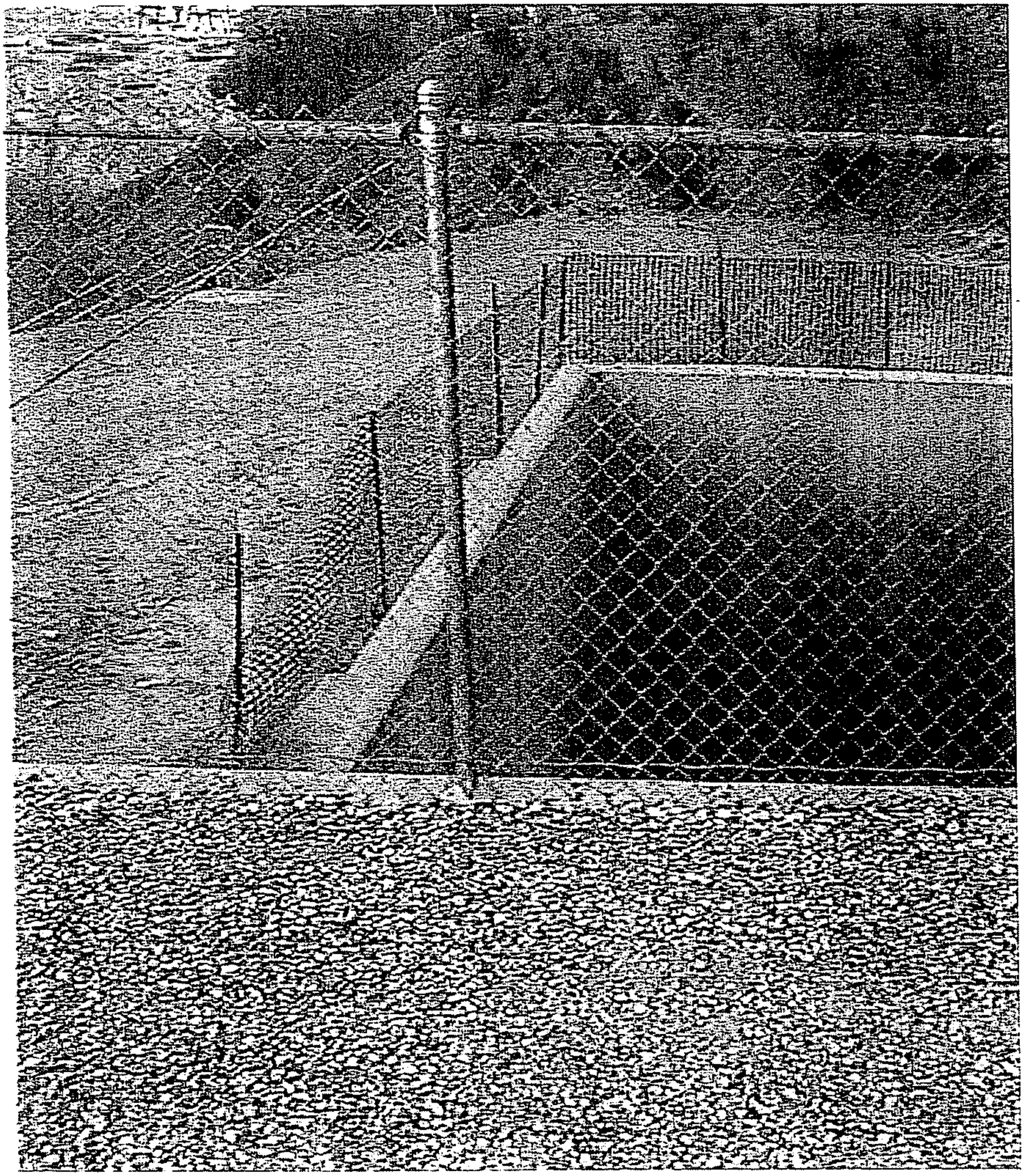
The appendix to this report provides some of the design charts from both the SCS and FHWA regarding rectangular drop inlet facilities

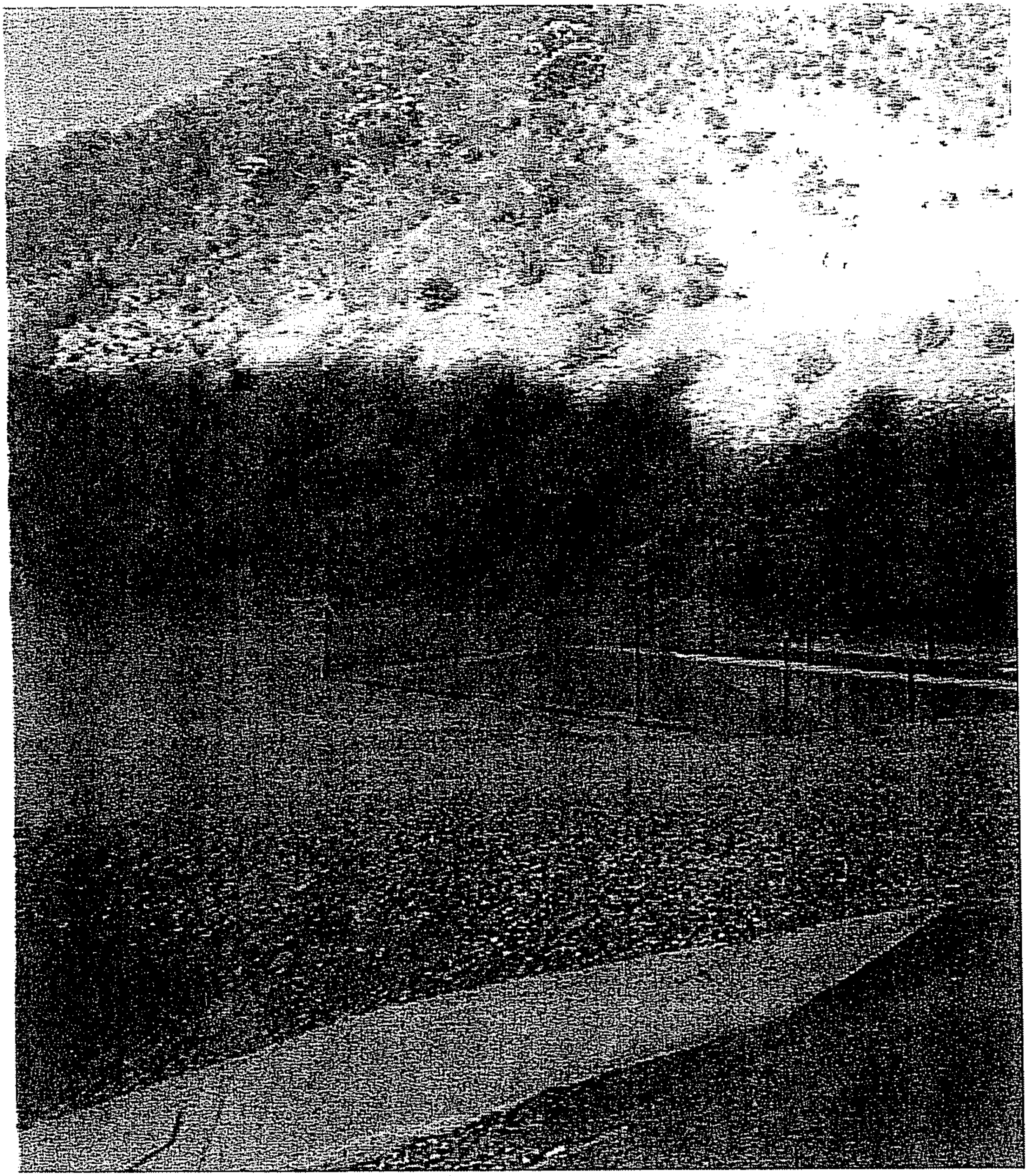
4.4 Design Example - Lang Creek Detention Basin (Thousand Oaks, CA)

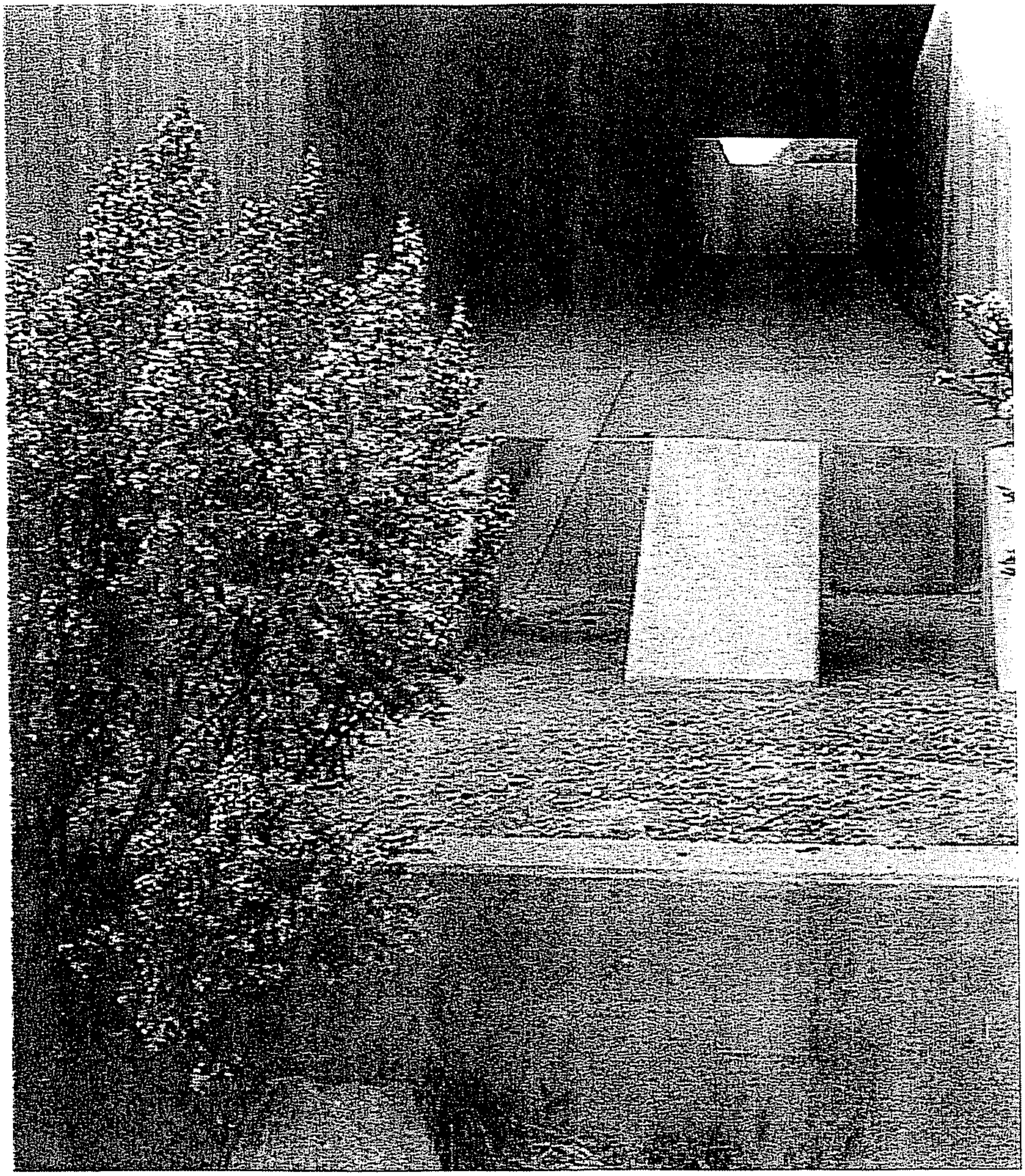
The **Lang Creek Detention and Debris Basin** is a facility for which RBF is currently under contract with the Ventura County Flood Control District to prepare the final design. The PS&E, which are currently 100% complete, have been reviewed by DSOD. This proposed facility will be located in the City of Thousand Oaks within the Lang Ranch and will drain a tributary watershed of 3.49 square miles. The earthen dam embankment will be 345 feet in length and have a maximum crest to toe height of 66.5 feet. The basin will have an available storage volume at the spillway crest of 414 acre-feet. The emergency spillway facility will utilize a rectangular drop inlet structure to accommodate a 12,000-year spillway design flow of 5,000 cfs. The spillway geometry will have a 45' x 15' rectangular weir with an overall drop height at the structure of 22-feet and ultimately discharging into a 15' x 10' RCB which continues though the dam embankment to the downstream outlet. The layout drawings including cross sections have been included in the technical appendix to provide a better understanding of the facility requirements.

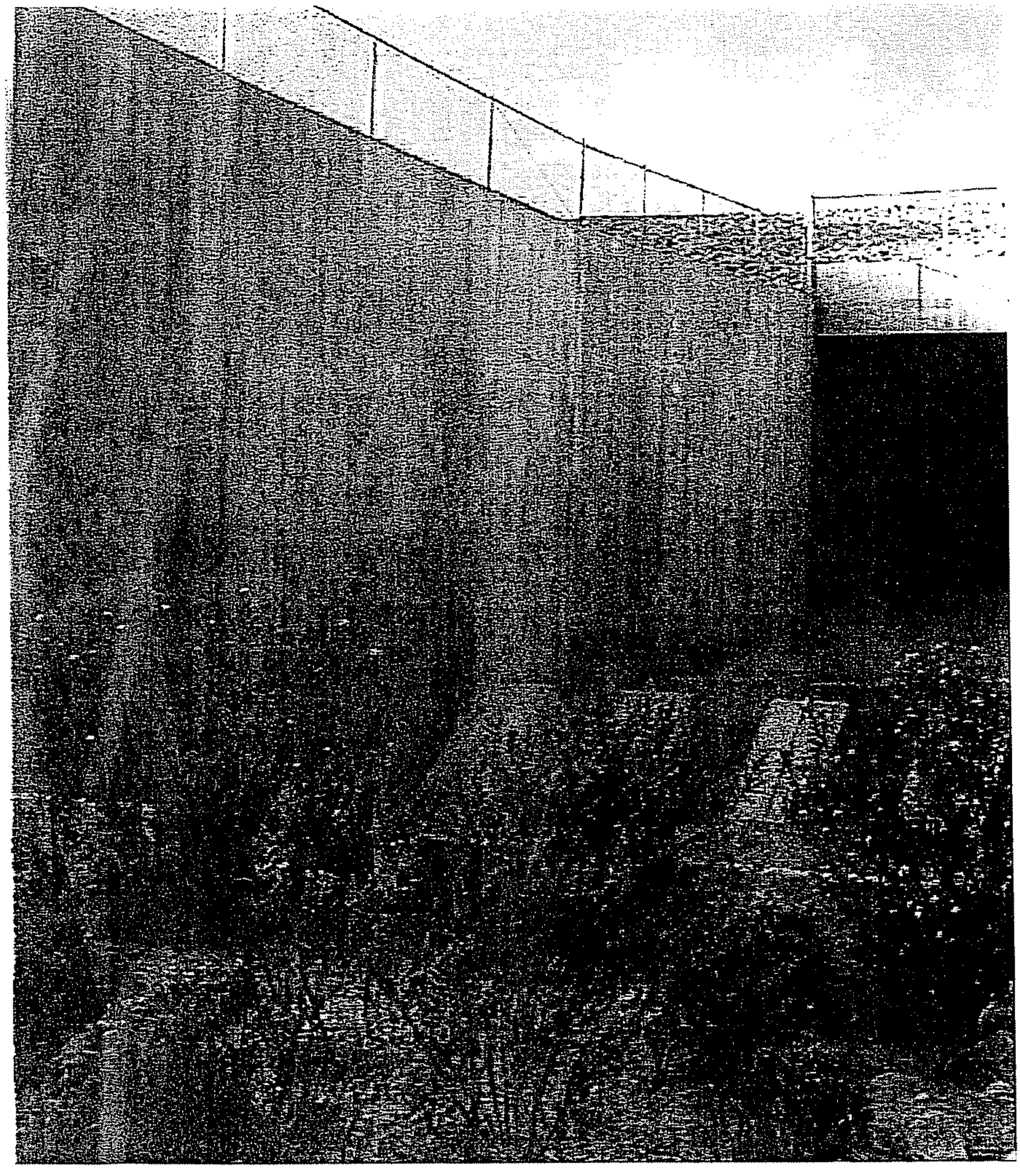
4.5 Ventura County Flood Control District Existing Facilities

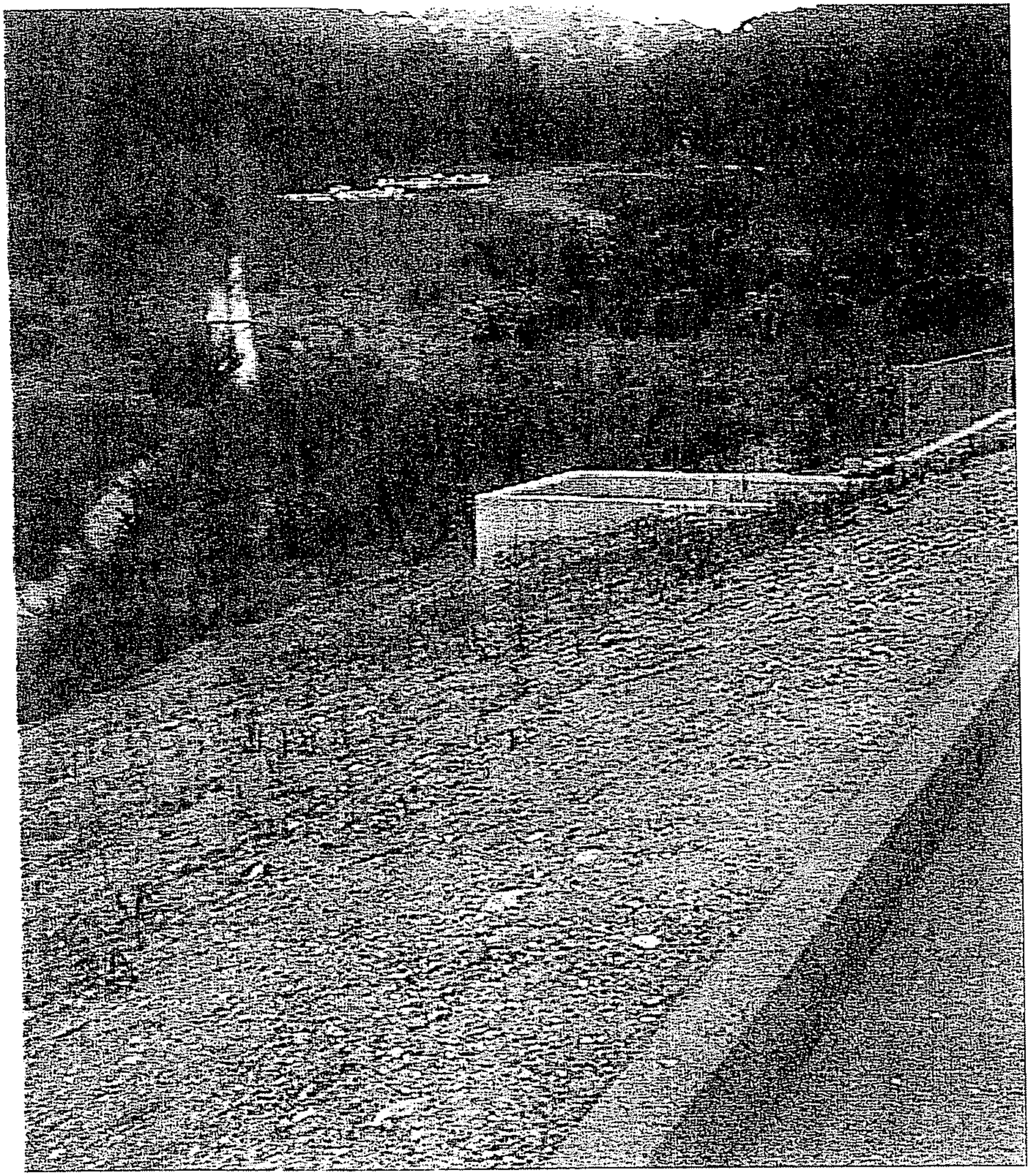
Ventura County Flood Control is an example of one agency that has utilized the rectangular drop spillway for all debris and detention facilities designed and constructed in the last twenty years. This is the standard facility that is required on all detention or debris basin embankments. Photographs were collected during a field investigation of two representative facilities that have this type of spillway. The Arrundell-Baranca debris basin is very similar in design to the Mabey Canyon facility with an incised pit constructed and a downstream earthen embankment to provide the required storage.

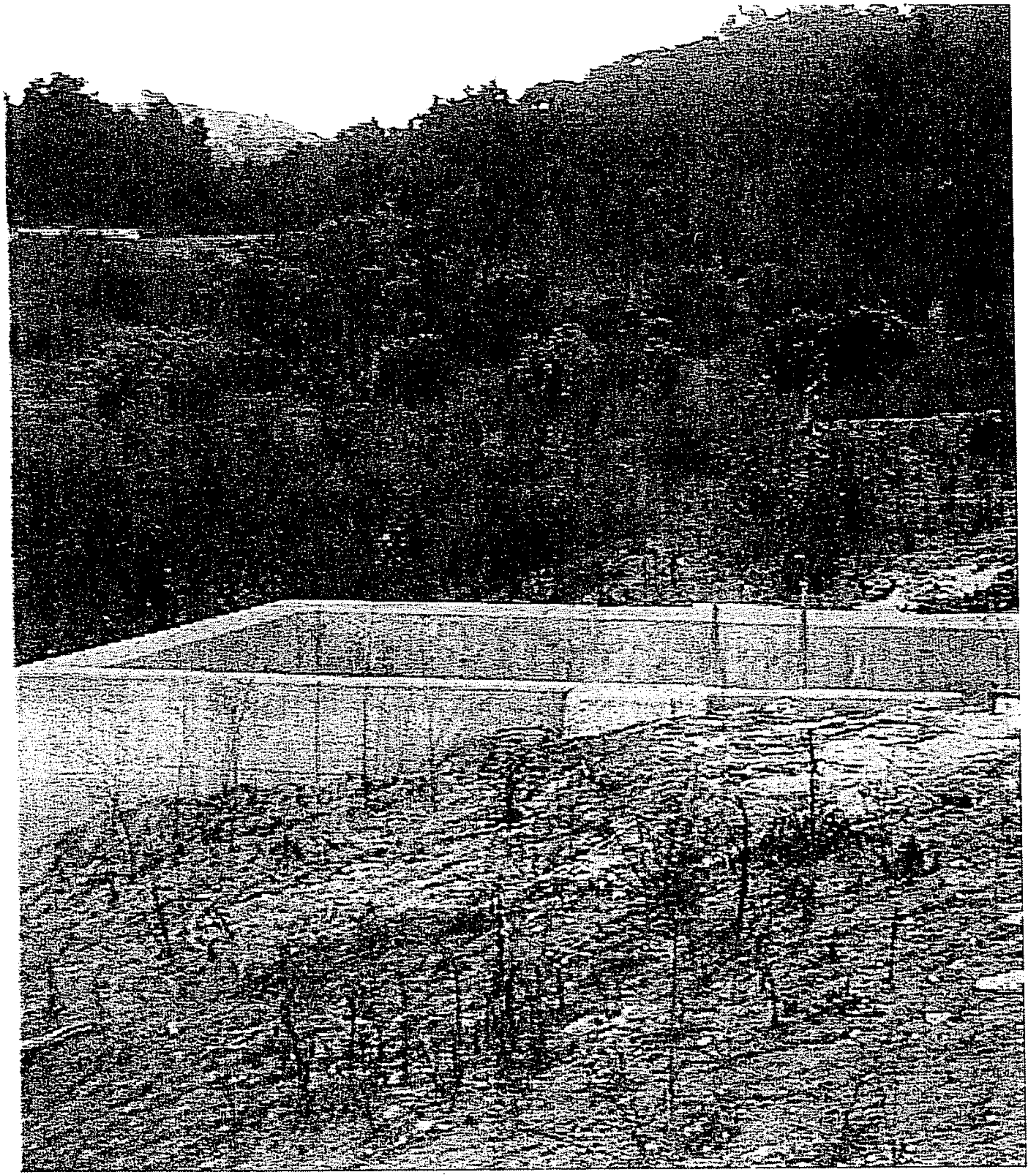












Section 5 - Summary

5.1 Discussion of Dam Modification Recommendations

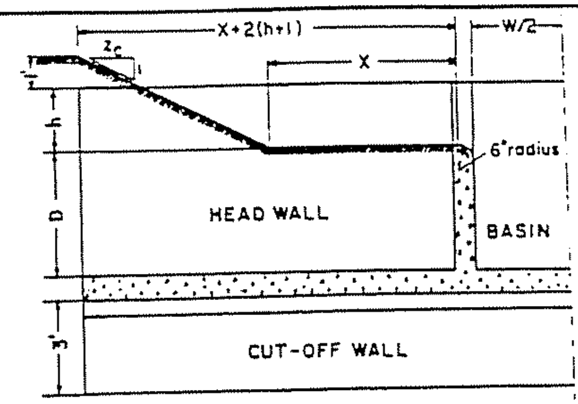
This preliminary investigation was intended to provide the conceptual evaluations of roadway alternatives impacting the existing RCFC&WCD regional debris basin. The analysis has been prepared only at a conceptual level without detailed hydraulics, although the size of this facility is similar to another regional basin recently designed by RBF. Two alternatives have been identified to accommodate a proposed alignment of the Foothill Parkway extension in the City of Corona that impact the existing RCFC&WCD Mabey Canyon Debris Basin. The alternatives either involve the (1) construction of bridge to span the entire debris basin with minimum impacts of bridge columns on the facility, or (2) modification / reconstruction of the debris basin and spillway to allow the roadway to cross the embankment crest. The estimated construction cost associated with the bridge span alternative is approximately **$4,320,000**, while the estimated cost for the earthen fill across the dam with the spillway reconstruction is **$2,850,000**. Strictly based upon a comparison of the costs this is a **35% differential** and based upon the levels of the estimates appears that it would be economically justified. Additional preliminary design should be conducted regarding the geotechnical conditions at the dam location to ensure the excavation and foundation requirements. Foundation requirements are critical in the design of the dam and DSOD scrutinizes this information in depth. Significant cost additions may occur because of foundation requirements for both the earthen embankment and the concrete spillway / outlet structures but this will require more geotechnical analysis to verify. Permitting requirements through jurisdictional agencies, particularly DSOD, would be significant time period, close to a year. In addition, detailed hydraulics of the proposed facility modifications will need to be submitted to RCFC&WCD for further review, provided that the concept outlined herein is acceptable.

TECHNICAL APPENDIX NO. 1

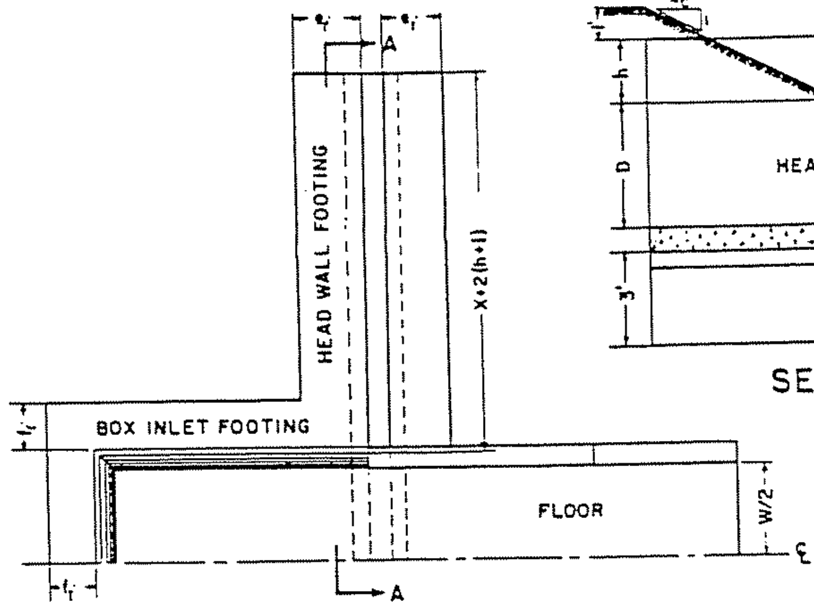
Spillway Reference Documentation

Mabey Canyon Debris Basin

CHUTE SPILLWAYS: ROUNDED-RECTANGULAR WEIR BOX INLET; General layout

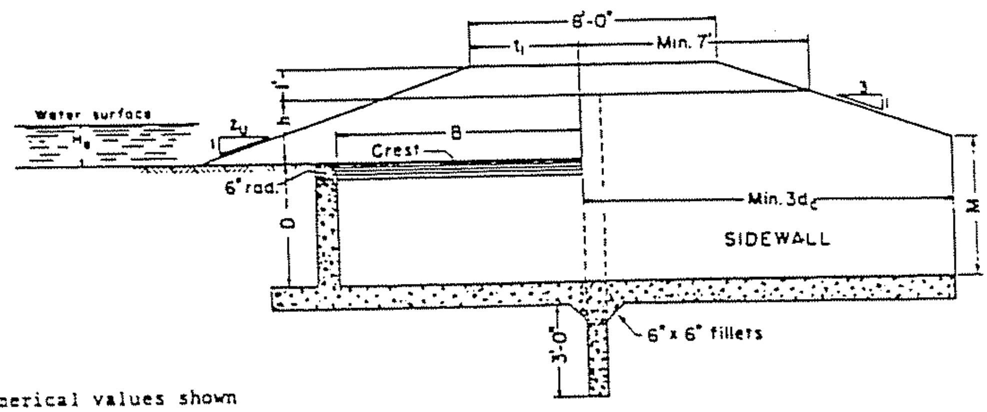


SECTION A-A



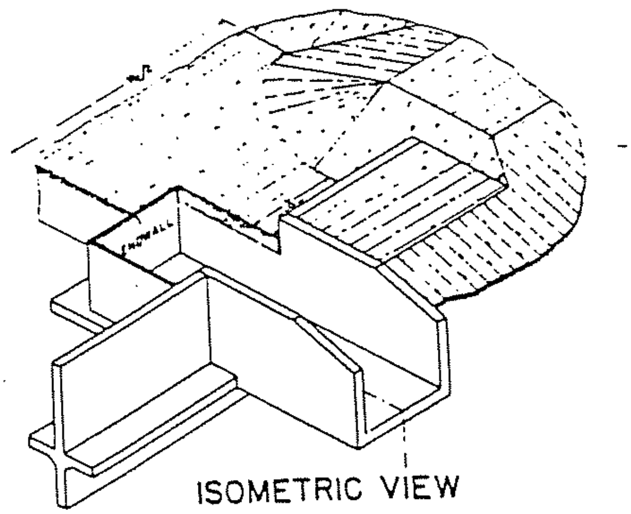
HALF-PLAN

Note -
Hydraulic formulas are given on sheet 4.
Capacities for this structure with a wide approach channel and no dike effect, are given on sheets 5,6, and 7.



Numerical values shown are suggested minimums.

SECTION ALONG CENTER LINE

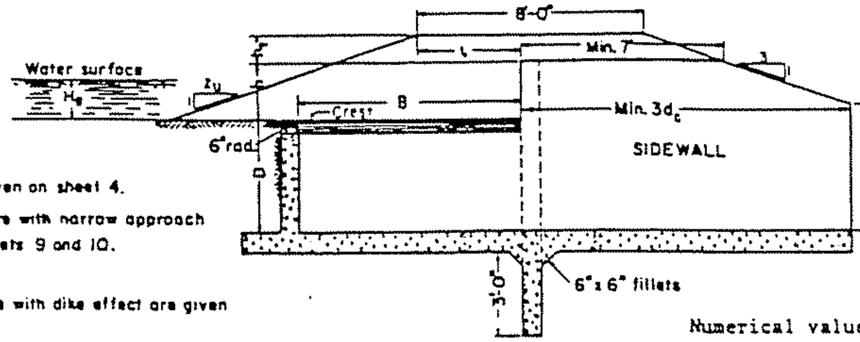


ISOMETRIC VIEW

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN SECTION	STANDARD DWG. NO. ES- 91 SHEET 1 OF 24 DATE 3-1-55

Revised 10/77

... RECTANGULAR WEIR BOX INLET; Effect of narrow channel and dike on discharge



Note -

Hydraulic formulas are given on sheet 4.

Capacities for this structure with narrow approach channel are given by sheets 9 and 10.

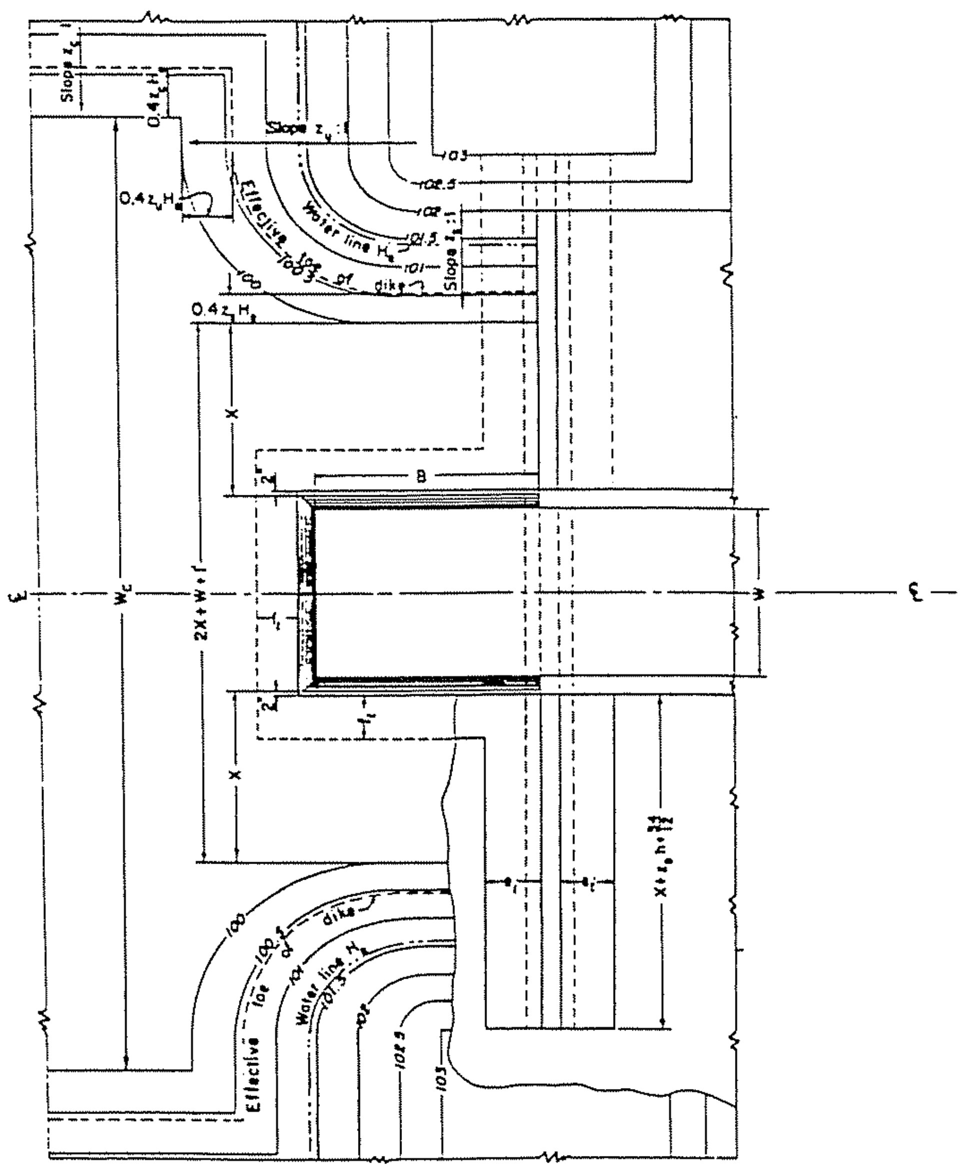
Capacities of this structure with dike effect are given by sheets 11, 12, and 13.

Required depths of box inlets are given by sheets 5, 6 and 7.

(See sheet 1 for isometric view)

Numerical values shown are suggested minimums.

SECTION ALONG CENTER LINE



PLAN

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN SECTION	STANDARD DWG. NO. ES- 91 SHEET 2 OF 24 DATE 1-1-55

Revised 10/77

CHUTE SPILLWAYS: ROUNDED-RECTANGULAR WEIR BOX INLETS; Definition of symbols

DEFINITION OF SYMBOLS

B = Inside length of the box inlet measured from the downstream face of the endwall to the upstream face of the headwall in ft

D = Depth (i.e., distance from the crest to the floor) of the box inlet in ft

D_r = Required depth of box inlet to prevent submergence at the crest when the discharge is Q in ft

h = Height of sidewalls above the crest of the box inlet in ft

h_t = Height of embankment above the top of sidewalls in ft

H_e = Specific energy head above the crest of the inlet corresponding to any discharge Q the inlet is capable of conveying in ft

i = Indices used for β, η, $\bar{\eta}$, τ, and T

K = $\frac{Q_K}{Q}$

L = Length of developed crest = 2 B + W + 2

M = Height of sidewall above the floor of the box inlet at the junction with the vertical curve section in ft

q = Discharge per unit width W or $q = \frac{Q}{W}$ in cfs/ft

Q = Discharge corresponding to the head H_e of a box inlet having no narrow approach channel or dike effect in cfs

Q_r = Design discharge in cfs

Q_{fr} = Required capacity without freeboard in cfs

Q_{si} = Capacity of inlet in cfs

Q_{mi} = Capacity of inlet without freeboard in cfs

Q_{mh} = Capacity of inlet without freeboard at the crest in cfs; the discharge $Q = Q_{mh}$ when $H_e = h$

Q_{mM} = Capacity of inlet without freeboard at the origin of the upper vertical curve in cfs

$(Q_K)_{mh}$ = Capacity without freeboard of a box inlet at the crest when a narrow approach channel is considered in cfs; the discharge $Q = (Q_K)_{mh}$ when $H_e = h$

Q_K = Discharge corresponding to the head H_e of a box inlet having a narrow approach channel in cfs

Q_λ = Discharge corresponding to the head of H_e of a box inlet having dike effect in cfs

$(Q_K)_{mi}$ = Capacity without freeboard of a box inlet and narrow approach channel of width W_c and downstream end section having a sidewall height M in cfs

$(Q_\lambda)_{mh}$ = Capacity without freeboard of a box inlet at the crest when a narrow channel and dike are considered in cfs; the discharge $Q_\lambda = (Q_\lambda)_{mh}$ when $H_e = h$

$(Q_\lambda)_{mi}$ = Capacity without freeboard of a box inlet when a narrow channel and dike effects are both considered as well as the downstream section having a sidewall height M in cfs

t_1 = That portion of the top width of the embankment covering the headwall upstream from the upstream face of the headwall in ft

W = Width of inlet in ft

W_c = Bottom width of the approach channel for the box inlet in ft

z_c = Side slope (horizontal distance per vertical foot) of approach channel

z_s = Side slope (horizontal distance per vertical foot) of dike covering the headwall in the direction towards the crest of the box inlet (see sheet 2)

z_u = Side slope (horizontal distance per vertical foot) of dike covering the headwall in an upstream direction. (see sheet 2)

X = Distance of the toe of the dike covering the headwall from the crest of the box inlet in ft

Z = Vertical drop from the crest of the inlet to the floor of the SAF outlet in ft

β = An incremental length of distance B + 0.5 in ft (see figure, sheet 20)

κ = Ratio $\frac{W_c + 0.8\, z_c H_e}{W + 1}$

λ = $\frac{Q_\lambda}{Q}$

τ = See formula sheet 4 or sheets 11 and 13

T = Values read on chart, sheets 11, 12, and 13

η = Distance between effective toe of dike covering the headwall and the crest of the inlet in ft

$\bar{\eta}$ = Average distance of effective toe of dike covering the headwall from the crest of the box inlet in the incremental length β in ft

Ψ = $\frac{W^{2/3}}{1.2\, g^{1/3}\, Q^{2/3}} D_r$ where $\Psi > 1$ (see equations, sheet 4)

γ = Ratio $\frac{H_e}{W + 1}$

δ = Ratio $\frac{W^{2/3}}{(W + 1)^{5/3}} D_r$

μ = Values read from graph, sheets 11, 12, and 13

REFERENCE

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FORMULAS

The relationship of the discharge-head over the crest for a rounded-rectangular weir box inlet having a wide approach channel and no dike effect is

$$Q = 3.1\ (2\ B + W + 2)\ H_e^{3/2} \qquad \text{when}$$

$$0 < H_e \leq 0.49\ W + 0.04\ B + 0.51; \quad (W \geq 4\ \text{ft}) \qquad \text{and}$$

$$0 < Q \leq 5.5\ (W + 1)^{5/2} \qquad \text{and}$$

$$\Psi^3 - 3\ \Psi + 2\left[\frac{W + 1}{2\ B + W + 2}\right]^2 = 0 \qquad \text{where}$$

$$\frac{W^{2/3}\ D_{\Psi}}{1.2\ g^{1/3}\ Q^{2/3}} = \Psi > 1$$

These relations are expressed in graphical form by sheets 5, 6, and 7 where

$$\xi = \frac{W^{2/3}}{(W + 1)^{5/3}}\ D_{\Psi} \qquad \text{and} \qquad \gamma = \frac{H_e}{W + 1}$$

values of $H_e^{3/2}$, $(W + 1)^{5/2}$, and $\frac{W^{2/3}}{(W + 1)^{5/3}}$ are given on sheet 8. When $H_e > 0.49\ W + 0.04\ B + 0.51$, no algebraic relationship is given. The last two relations are a requirement of the value of D to prevent submergence of the crest. The relationship of the discharge-head over the crest of a rounded-rectangular weir box inlet having a narrow channel effect but no dike effect is

$$Q_K = K\ Q$$

where the value of K is obtained from sheets 9 and 10. The value of Q_K may be obtained from sheets 9 and 10 without determining the value of K. The value of κ is

$$\kappa = \frac{W_c + 0.8\ z_c\ H_e}{W + 1}$$

The discharge-head relationship of a rounded-rectangular weir box inlet having a narrow channel and dike effect is given in graphical form by sheets 11, 12, and 13.

$$Q_\lambda = \lambda\ Q$$

The effective toe of the dike is a distance of $0.4\ z_s\ H_e$ (or $0.4\ z_u\ H_e$) from the toe of the dike. At the headwall the effective toe of the dike is a distance η_o from the crest of the spillway or

$$\eta_o = X + 0.4\ z_s\ H_e \qquad \text{and} \qquad \bar{\eta}_i = \frac{\eta_{i+1} + \eta_i}{2}$$

and

$$\beta_1 + \beta_2 + \cdots + \beta_i + \cdots + \beta_n = B + 0.5$$

where the subscript n is equal to the integer designating the number of increments considered in the length B + 0.5. The increments β are numbered by subscripts in an upstream direction. The subscripts of η pertain to the end sections of β and are numbered in an upstream direction starting with the subscript o at the headwall. The subscript of $\bar{\eta}$ equals the subscript of β when $\bar{\eta}$ is associated with the same incremental length β.

$$\tau_1 = \frac{\beta_1}{W + 1} \qquad \text{and} \qquad \tau_i = \tau_{i-1,i} + \frac{\beta_i}{W + 1} \qquad \text{where} \qquad i \geq 2$$

The value of $\tau_{i-1,i}$ is read from sheets 11, 12, and 13 at T_{i-1} and $\frac{\bar{\eta}_i}{W + 1}$. The values of μ are used to determine the head over the crest at the various sections along the length B + 0.5 and to determine the location of the effective toe of the dike. The head over the crest at section i is

$$H_{e,i} = H_e\ \frac{\mu_{i,i+1}}{\mu_i} \times \frac{\mu_{i+1,i+2}}{\mu_{i+1}} \times \cdots \times \frac{\mu_{n-1,n}}{\mu_{n-1}}$$

The actual discharge Q_λ is

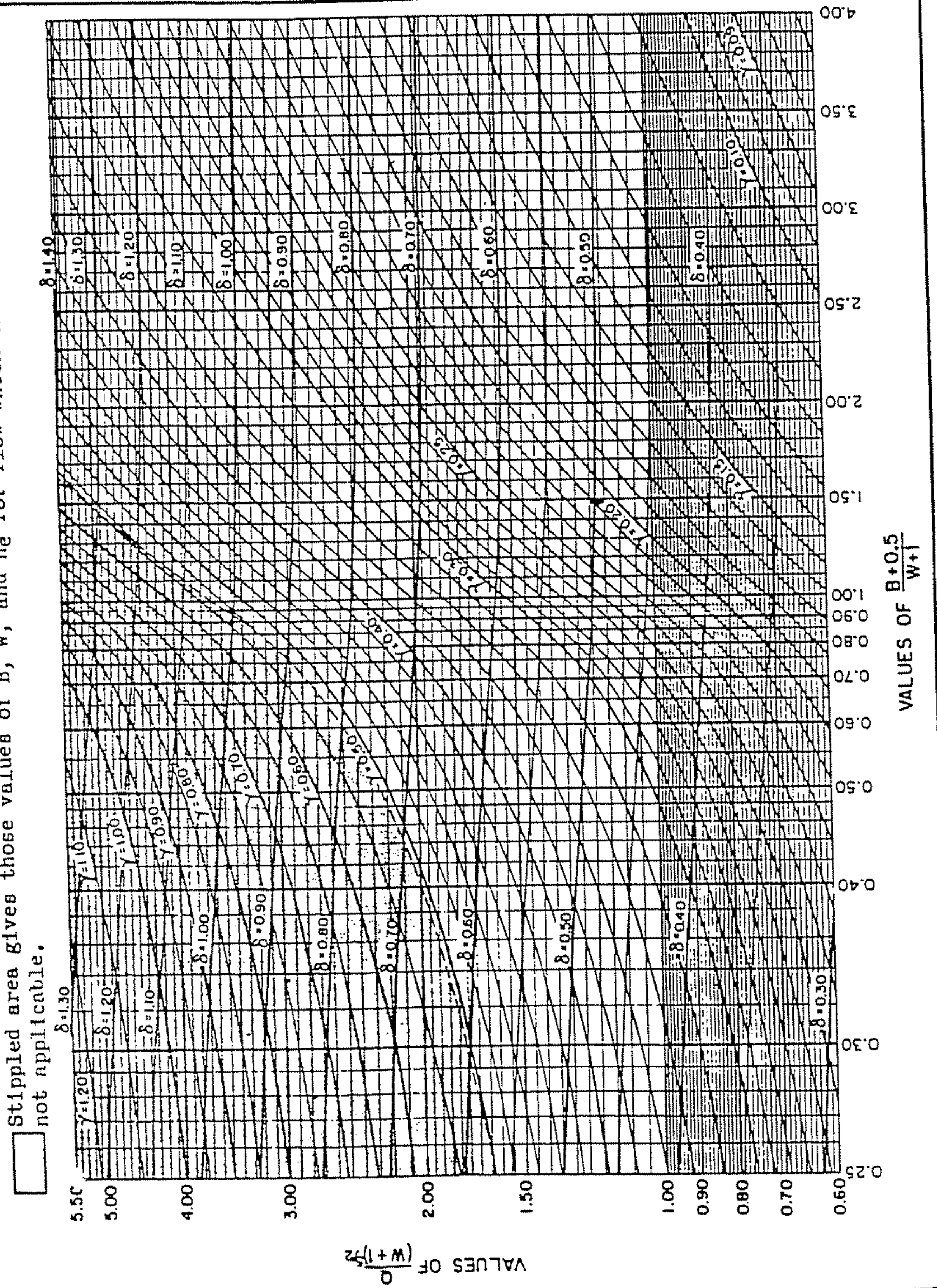
$$T_n + 3.09 = \frac{Q_\lambda}{(W + 1)\ H_e^{3/2}}$$

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN SECTION	STANDARD DWG. NO. ES- 91 SHEET 4 OF 24 DATE 6-4-55

CHUTE SPILLWAYS: The discharge-head relationship for a ROUNDED-RECTANGULAR WEIR box inlet with free-flow conditions at the crest and no dike or narrow channel effects.

$\delta = \frac{W^{2/3}}{(W+1)^{5/3}} D_r$

$\gamma = \frac{H_e}{W+1}$



REFERENCE
This chart was developed by Paul D. Doubt of the Design Section.

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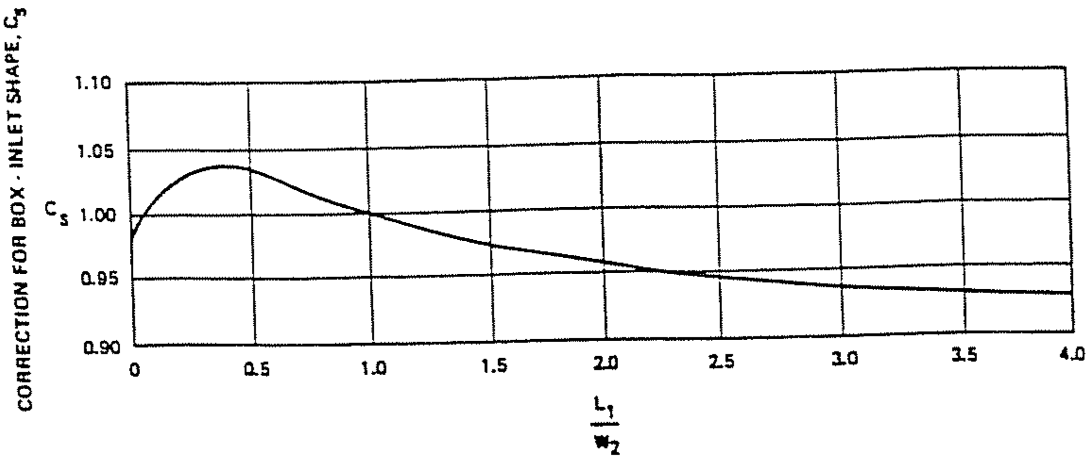


FIGURE IX - B - 3 CORRECTION FOR BOX - INLET SHAPE, WITH CONTROL AT BOX - INLET CREST ($\frac{W_1}{L_c} \geq 3$).

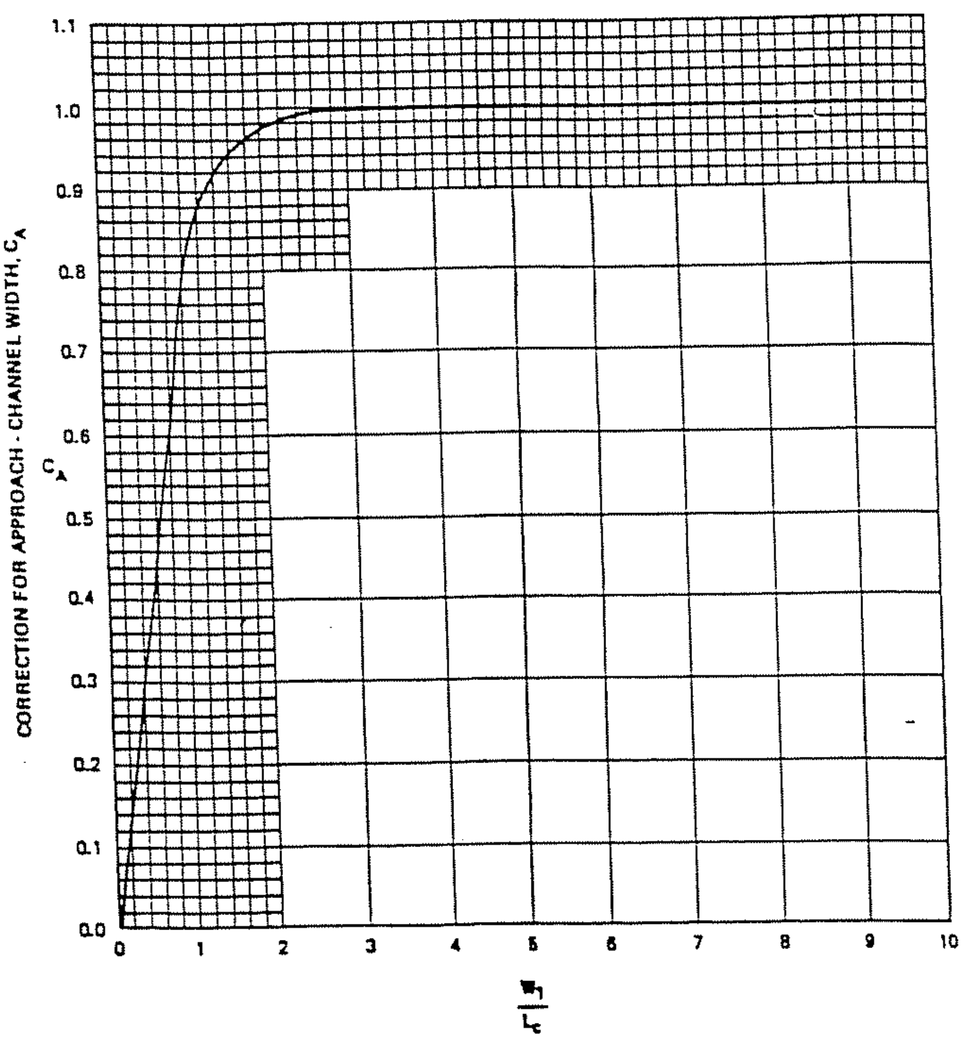


FIGURE IX - B - 4 CORRECTION FOR APPROACH - CHANNEL WIDTH, WITH CONTROL AT BOX - INLET CREST

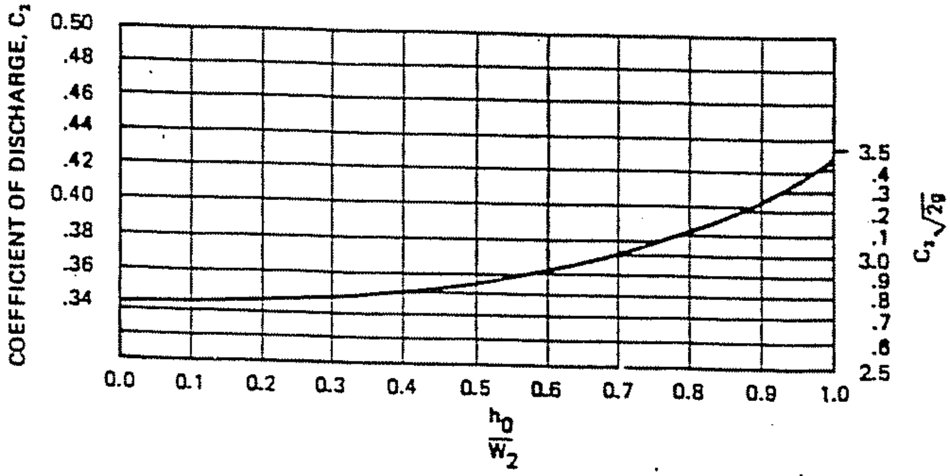


FIGURE IX - B - 5 COEFFICIENT OF DISCHARGE, WITH CONTROL AT HEADWALL OPENING

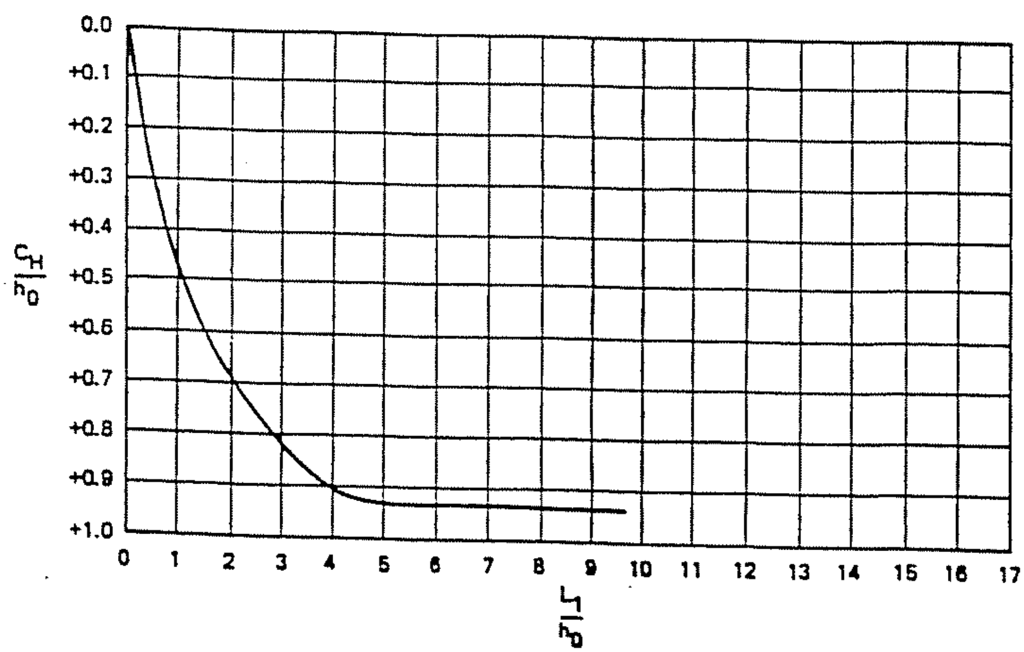


FIGURE IX - B - 6 RELATIVE HEAD CORRECTION FOR $h_0/W_2 \geq 1/4$, WITH CONTROL AT HEADWALL OPENING

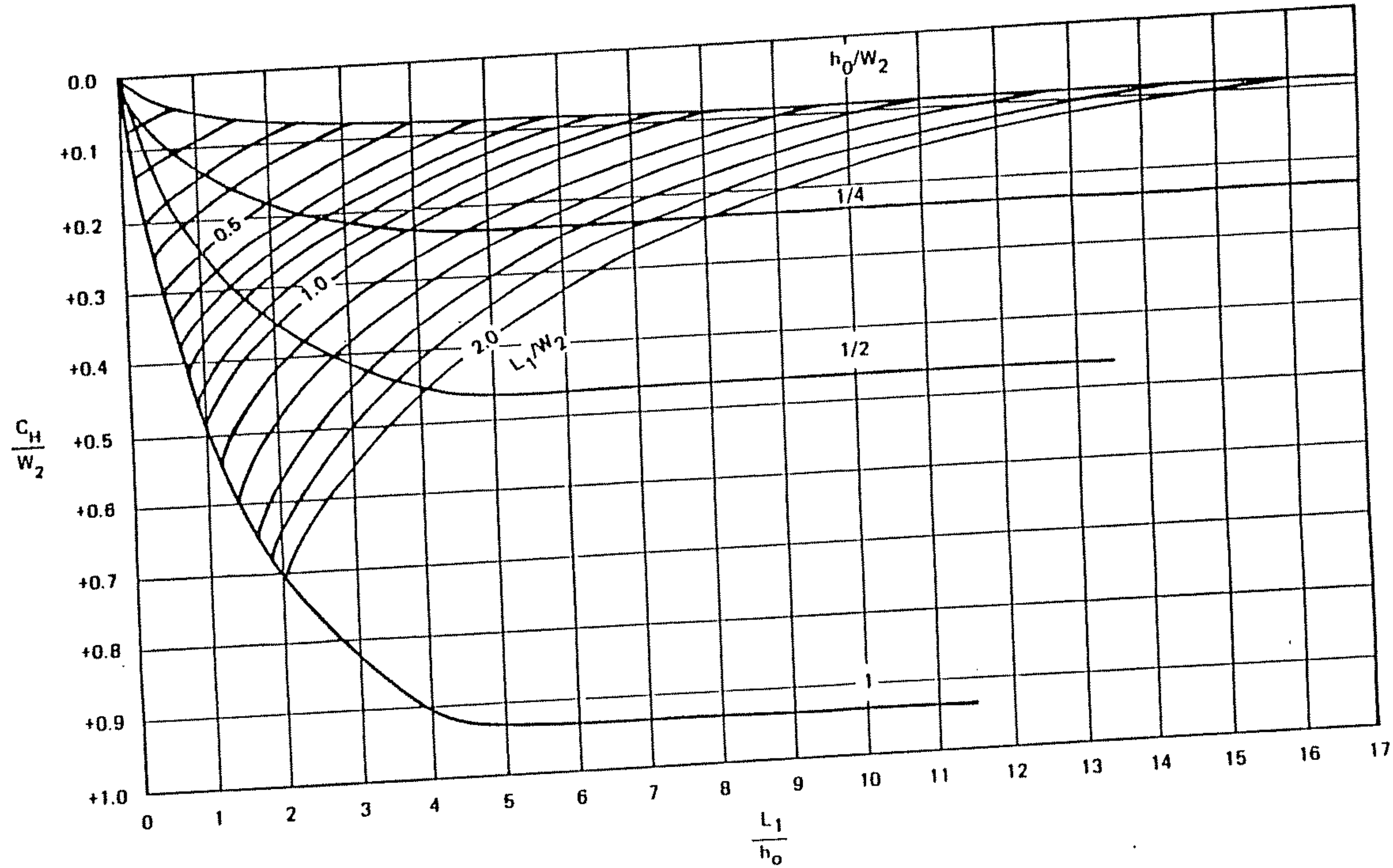


FIGURE IX-B-7 RELATIVE HEAD CORRECTION, WITH CONTROL AT HEADWALL OPENING

TABLE IX-B-1. CORRECTION FOR DIKE EFFECT, C_E
(Control at Box-Inlet Crest)

$\frac{L_1}{W_2}$	W_4/W_2						
	0.0	0.1	0.2	0.3	0.4	0.5	0.6
0.5	0.90	0.96	1.00	1.02	1.04	1.05	1.05
1.0	.80	.88	.93	.96	.98	1.00	1.01
1.5	.76	.83	.88	.92	.94	.96	.97
2.0	.76	.83	.88	.92	.94	.96	.97

DESIGN PROCEDURE

1. Select h_o.

2. Select L_1, W_2, and L_c.

3. Calculate y_o for the crest, equation IX-B-1

4. Calculate h_o/W_2 and determine coefficient of discharge, C_2; figure IX-B-5.

5. Calculate L_1/h_o and determine relative head correction, C_H; figure IX-B-6.

6. Calculate y_o for the headwall opening; equation IX-B-2.

7. Compare the values of y_o obtained from steps 3 and 6. The larger value controls. If crest controls, adjust y_o from step 3:

   a. Calculate y_o/W_2 and determine correction for head, C_1, figure IX-B-2

   b. Calculate L_1/W_2 and determine correction for box-inlet shape, C_S, figure IX-B-3.

   c. Calculate W_1/L_c and determine correction for approach channel width, C_A, figure IX-B-4.

   d. Calculate W_4/W_2 and determine correction for dike effect, C_E, table IX-B-1.

   e. Determine adjusted y_o for crest from corrections found in steps a through e.

8. Calculate y_c; equation IX-B-3

9. Calculate y_{c3}; equation IX-B-4

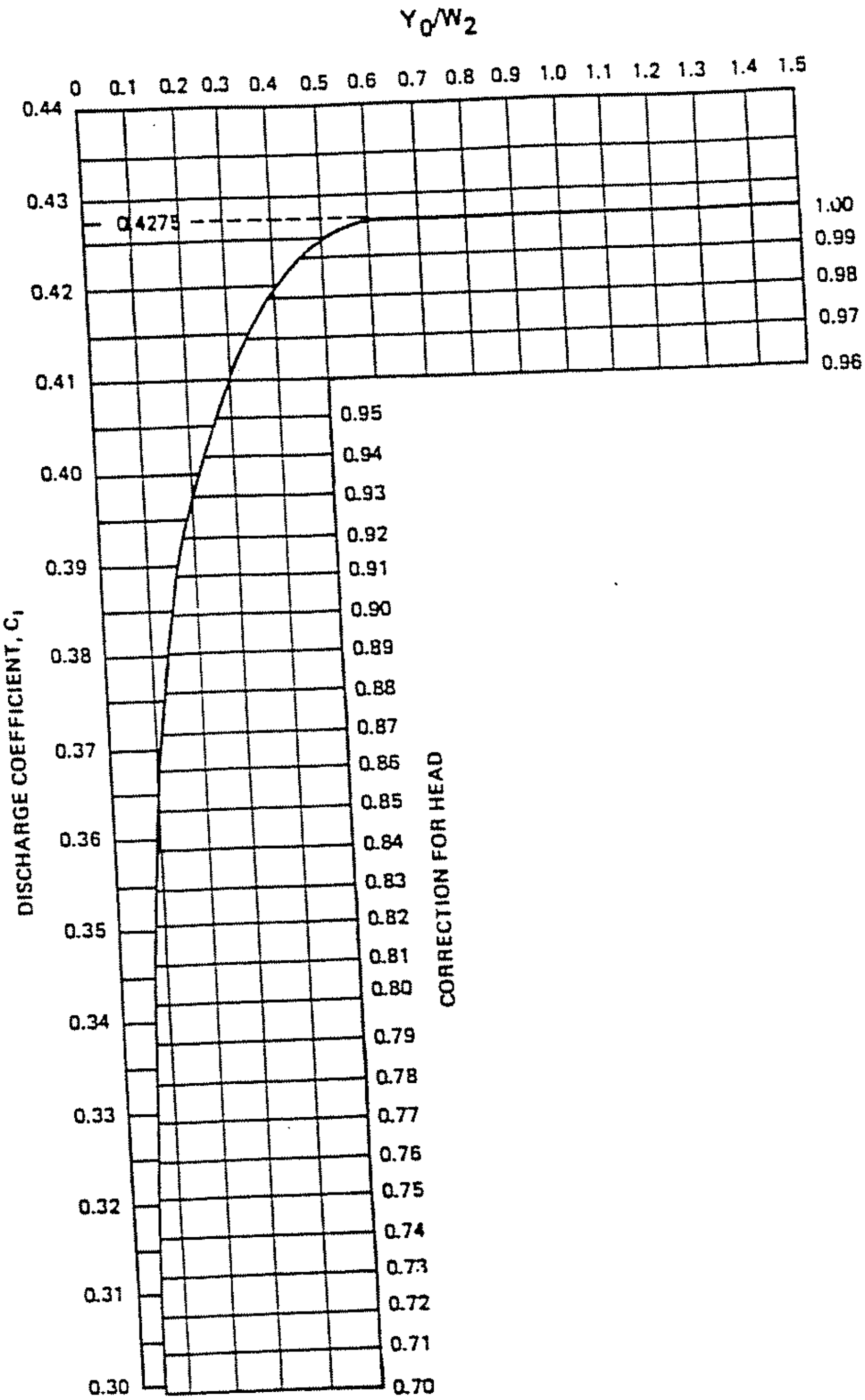


FIGURE IX - B - 2. DISCHARGE COEFFICIENT AND CORRECTION FOR HEAD, WITH CONTROL AT BOX - INLET CREST

TECHNICAL APPENDIX NO. 2

Construction Cost Estimate - Alternative No. 2

Basin Modification

Mabey Canyon Debris Basin

MABEY CANYON DEBRIS BASIN COST ESTIMATE				
Item No.	Item Description	Approx. Quantity	Unit Prices (In Figures)	Item Totals (In Figures)
1	Mobilization	Lump Sum		$60,000
2	Excavation Safety Measures	Lump Sum		$5,000
3	Diversion, Control and Removal of Water	Lump Sum		$150,000
4	Clearing and Grubbing	Lump Sum		$20,000
5	Erosion Control	Lump Sum		$25,000
6	Excavation	36,400 C.Y.	$3.00 C.Y.	$109,200
7	Dam Embankment Fill	32,000 C.Y.	$7.00 C.Y.	$224,000
8	6" Perforated A.C. Subdrain Pipe	400 L.F.	$9.00 L.F.	$3,600
9	Concrete V-Ditch	800 L.F.	$15.00 L.F.	$12,000
10	15' x 10' RCB	350 L.F.	$1900.00 L.F.	$665,000
11	Reinforcing Steel and Concrete for Rectangular Structure	85 C.Y.	$550.00 C.Y.	$46,750
12	Energy Dissipator	10 C.Y.	$550.00 C.Y.	$5,500
13	48" Outlet Conduit	490 L.F.	$250.00 L.F.	$122,500
14	RC Rectangular Open Channel	47 C.Y.	$550.00 C.Y.	$25,850
15	AC Paved Access Ramp	840 S.Y.	$13.00 S.Y.	$10,920
16	Concreted Rock Riprap	300 C.Y.	$100.00 C.Y.	$30,000

MABEY CANYON DEBRIS BASIN COST ESTIMATE				
Item No.	Item Description	Approx. Quantity	Unit Prices (In Figures)	Item Totals (In Figures)
17	Rock Riprap	300 C.Y.	$80.00 C.Y.	$24,000
18	5' High Chain Link Fence	1,500 L.F.	$12.00 L.F.	$18,000
19	15' Wide Single Leaf Gate	2 Each	$800.00 Each	$1,600
20	Vegetative Erosion Control Planting	2.0 Acres	$3,500.00 Acre	$7,000
21	Ladder	20 L.F.	$50.00 L.F.	$1,000
22	Existing Facilities Remove Concrete	500 C.Y.	$60.00 C.Y.	$30,000
23	Filter Material	60 C.Y.	$45.00 C.Y.	$2,700
24	Grouted Foundation to Bedrock	3,000 C.Y.	$85.00 C.Y.	$255,000
25	Concrete Low-Flow Outlet 8' x 3' RCC with Grate	80 L.F.	$350.00 L.F.	$28,000
26	Cobble Facing	2,200 C.Y.	$70.00 C.Y.	$154,000
27	Concrete Overpour	1 Each	$3,800 Each	$3,800
28	Foundation and Spillway Excavation	45,000 C.Y.	$9.00 C.Y.	$405,000
29	Construction Surveys	Lump Sum		$30,000
	SUBTOTAL			$2,475,420
	15% CONTINGENCY			$371,313
	TOTAL			$2,846,733

MABEY CANYON COST ESTIMATE

10) 15'x10' RCB

350 L.F x $1,900 = $665

using caltrans 14'x11' RCB, 20' max cover

119 CF/LF concrete CY/27 CF x $350/CY/LF = $1,542/LF

873 LB/LF Steel x $0.35/LB/LF = $305/LF

$1,848/LF

11 Reinf. Steel & Concrete for Rectangular Drop Structure

15' W x 45' L assumed 15' Deep

end 15'H x 15'W x 1' /27 = 8.3 CY

45 L.F x (15'W + 2(15'H)) x 1' /27 = 75 C.Y

83.3 CY

12 Energy Dissipator

12 / 3' $\frac{1}{2}$(3'H x 12'L x 2'W)/27 = 1.3 C.Y x 5 = 6.6 CY

3 / 3.5 [3(0.5)(2') + 3(3)(0.5)(2)]/27 = 0.4 C.Y x 6 = 2.6 CY

9.3 CY

14 RC Open Channel 30' / 10'

25 L.F x (50' x 1'T) /27 = 46.3 C Y.

25 Concrete Low-Flow Outlet 8'x3'

1'T (8'W + 4'(2)) = 16 CF/27 = 0.59 CY/LF x $350 CY/LF

= $325/L.F

Grate

assumed $25/LF.

80 L.F

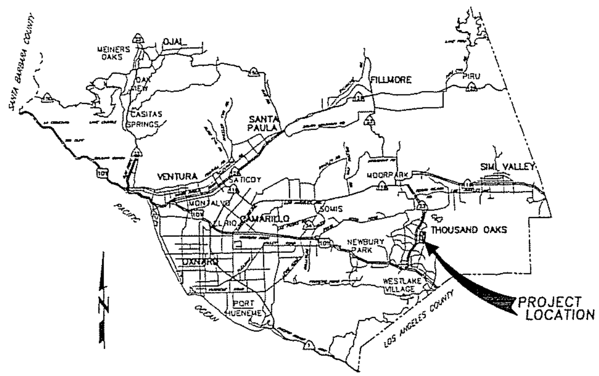
TECHNICAL APPENDIX NO. 3

Sample Rectangular Drop Inlet Spillway Plans

Lang Creek Detention Basin - VCFCD

Maybe Canyon Debris Basin

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
VENTURA COUNTY FLOOD CONTROL DISTRICT
ZONE 3
LANG CREEK DAM & DETENTION BASIN



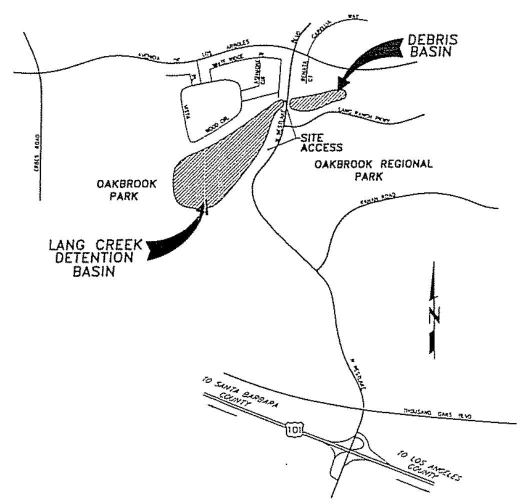
VICINITY MAP
N.T.S.

GENERAL NOTES

1. ELEVATIONS SHOWN ARE IN FEET, NATIONAL GEODETIC SURVEY SEA LEVEL DATUM OF 1929.
2. STATIONS SHOWN ON DRAWINGS ARE ALONG CENTERLINE OF STRUCTURE.
3. E.G.L. AND H.G.L. ARE SHOWN FOR FUTURE REFERENCE BY THE DISTRICT ONLY.
4. NUMBERS IN ◯ INDICATE BID ITEMS UNDER WHICH PAYMENT WILL BE MADE.
5. LETTER AND NUMBER IN ⊖ INDICATE THE DETAIL CALL-OUT AND SHEET ON WHICH REFERENCE DETAIL IS SHOWN.
6. NUMBERS IN △ REFER TO NOTES ON SAME SHEET UNLESS OTHERWISE NOTED.
7. TREES DESIGNATED BY ⊘ SHALL BE REMOVED. ALL OTHERS SHALL BE PROTECTED IN PLACE.
8. TOPOGRAPHY AND CROSS SECTIONS FOR THIS PROJECT WERE TAKEN FROM SURVEY PERFORMED IN 4/96.
9. SOIL TESTING BORINGS FOR THE PROJECT WERE MADE IN 7/93-8/87, AND THEIR LOCATION IS MARKED BY THE SYMBOL ⊘. SUBSURFACE SOIL INVESTIGATION RESULTS ARE FURNISHED FOR INFORMATION ONLY.
10. EXISTING IMPROVEMENTS WITHIN THE RIGHT OF WAY AND WORK AREAS SHALL REMAIN AND SHALL BE PROTECTED UNLESS OTHERWISE NOTED. DAMAGED IMPROVEMENTS SHALL BE REPLACED IN KIND TO A CONDITION EQUAL TO OR BETTER THAN THAT WHICH EXISTED PRIOR TO CONSTRUCTION.
11. UTILITIES ARE SHOWN AS KNOWN TO EXIST AT TIME OF SURVEY. UTILITIES MAY HAVE BEEN OMITTED, MISPLACED, AND/OR RELOCATED. CONTRACTOR SHALL EXERCISE CARE IN EXCAVATION AND SHALL PROTECT ALL UTILITIES.
12. SYMBOL ▲ INDICATES THE LOCATION OF THE HORIZONTAL AND VERTICAL CONTROL POINTS WHICH WILL BE FURNISHED BY THE AGENCY FOR THE CONTRACTOR'S USE.
13. CONTRACTOR SHALL NOTIFY UTILITY OWNERS A MINIMUM OF 48 HOURS PRIOR TO STARTING WORK IN AREAS AFFECTING THEIR FACILITIES:

PACIFIC BELL TELEPHONE CO.	TEL. NO. (805) 583-6600	MR. JOHN UELTSCHI
SOUTHERN CALIFORNIA EDISON CO.	TEL. NO. (805) 654-7291	CUSTOMER SERVICES PLANNER
SOUTHERN CALIFORNIA GAS CO., DISTR.	TEL. NO. (805) 647-6790	MR. RON SHIRLEY

UNDERGROUND SERVICE ALERT
1-800-422-4133
CALL USA/SC
FOR UNDERGROUND LOCATION 2 WORKING DAYS BEFORE YOU DIG.
FOR BEST RESPONSE, PROVIDE AS MUCH NOTICE AS POSSIBLE, UP TO TEN (10) WORKING DAYS.



GENERAL PLAN
N.T.S.

BENCH MARK

IN THE CITY OF THOUSAND OAKS, "OAKS 1993" APPROXIMATELY 0.1 MILE ALONG CAMSEROUCH ROAD FROM ITS INTERSECTION WITH CAMINO MANZANAS, SOUTHWESTERLY FROM THE CENTER OF CAMSEROUCH ROAD 100 FEET ALONG AN 8 FOOT WIDE SERVICE ROAD, THENCE NORTHWESTERLY 80 FEET, NORTHWESTERLY 10 FEET FROM A PRICKLY PEAR CACTUS, BRASS DISK EPOXIED IN THE TOP OF THE FIRST LARGE ROCK OUTCROPPING.
HCS PUB 1993/NAVD 88 ELEVATION = 243.481 (METERS)

INDEX TO SHEETS

INDEX OF STANDARD PLANS USED BY REFERENCE

S.P.P.W.C. STANDARD PLANS

600-0	CHAIN LINK FENCE & GATE
110-1	COMMERCIAL DRIVEWAY

BASIS OF BEARING

THE BEARING OF S 33°23' 33"W OF THE LINE BETWEEN THE 1 1/2" I.P. AND TAG "LS 4143" AT THE CENTERLINE INTERSECTION OF WESTLAKE BOULEVARD AND LANG RANCH PARKWAY AS SHOWN ON THE RECORDER OF VENTURA COUNTY, AND THE 1 1/2" I.P. AND TAG "LS 4143" AT THE SOUTHERLY TERMINUS OF THAT CERTAIN CURVED CENTERLINE OF WESTLAKE BOULEVARD SHOWN ON SAID RECORD OF SURVEY AS HAVING A RADIUS OF 1150 FEET AND A CENTRAL ANGLE OF 15°18'43" AND AN ARC LENGTH OF 300.98 FEET, AS ESTABLISHED BY THE NORTH AMERICAN DATUM OF 1983, EPOCH 1991.35, WAS USED AS THE BASIS OF BEARINGS FOR THIS MAP.

Robert Bein, William Frost & Associates
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

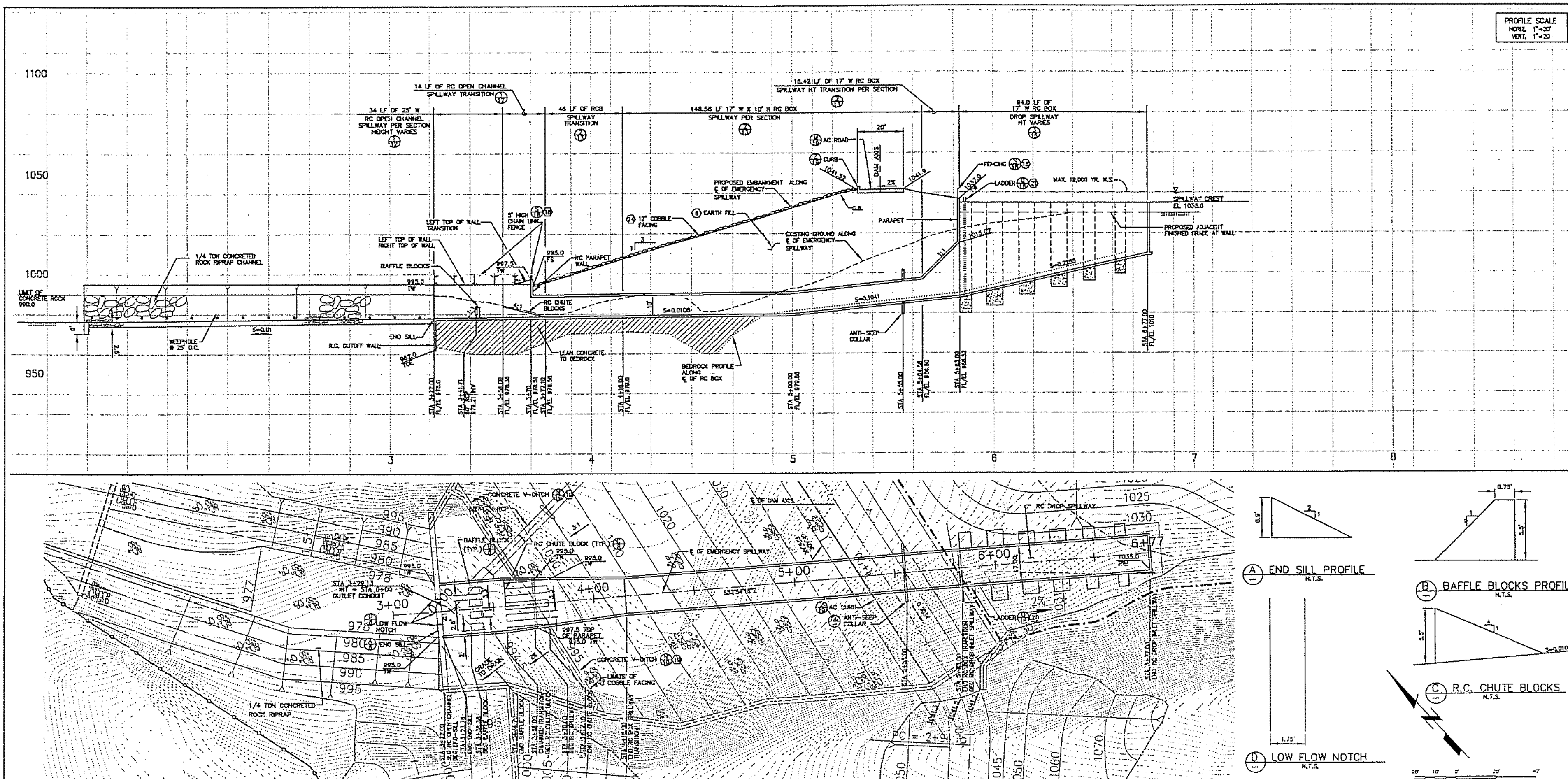
COUNTY OF VENTURA - PUBLIC WORKS AGENCY
VENTURA COUNTY FLOOD CONTROL DISTRICT

PROJ. NO. 21000

LANG CREEK DAM & DETENTION BASIN
GENERAL PLAN

SHEET 1 OF 32

H:\GIP13\VDA1A\DWG\33775\0697PH16\A01001.DWG 11/24/99 8:13 am



Robert Bein, William Frost & Associates
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

DESIGNED DLO | DRAWN CHO EC | CHECKED BMP
PROJ. ENG. BRUCE W. PHILLIPS
REG. NO. R.C.E. 18535 DATE 3/31/01

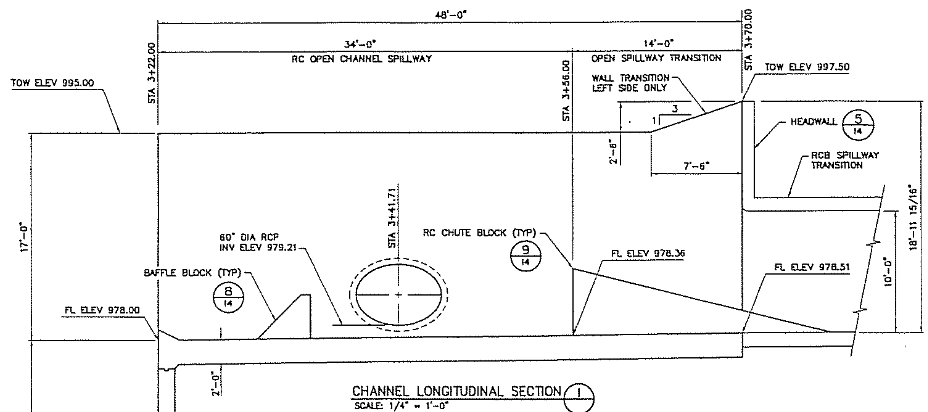
COUNTY OF VENTURA - PUBLIC WORKS AGENCY
VENTURA COUNTY FLOOD CONTROL DISTRICT

21000

LANG CREEK DAM & DETENTION BASIN

EMERGENCY SPILLWAY
PLAN AND PROFILE

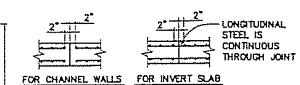
SHEET 8 OF 32



CHANNEL LONGITUDINAL SECTION (1)
SCALE: 1/4" = 1'-0"

TRANSVERSE CONSTRUCTION JOINT DETAILS

NOT TO SCALE

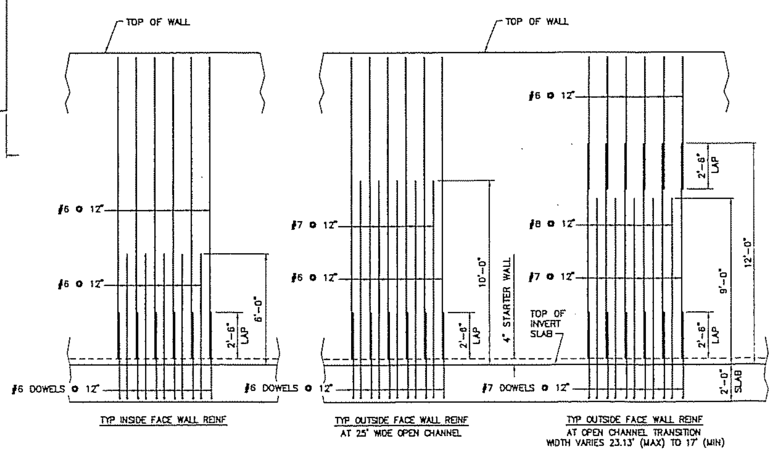


RECTANGULAR CHANNEL DESIGN DATA

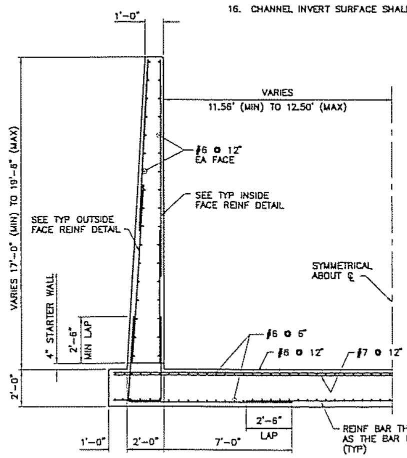
LOADS:
EXTERNAL 62.5 pcf
INTERNAL 40 pcf
(WITH NO BACKFILL)
ALLOWABLE STRESSES:
f'_c = 4,000 psi
f_c = 1,460 psi
f_s = 24,000 psi
n = 8.8

STRUCTURAL NOTES:

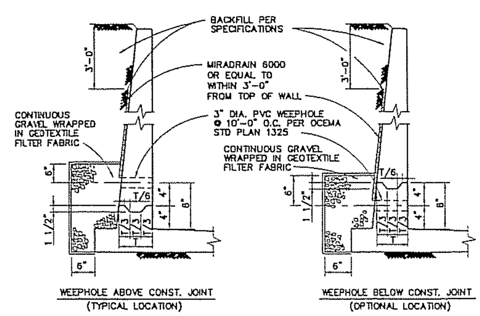
1. DIMENSIONS FROM FACE OF CONCRETE TO STEEL SHALL BE 2" CLEAR UNLESS OTHERWISE SHOWN.
2. CONCRETE DIMENSIONS SHALL BE MEASURED HORIZONTALLY OR VERTICALLY ON THE PROFILE, AND PARALLEL TO OR AT RIGHT ANGLES (OR RADIALLY) TO CENTERLINE OF CONDUIT ON THE PLAN EXCEPT AS OTHERWISE SHOWN.
3. JOINT FINISH FOR CHANNEL FACE SHALL BE CHAMFERED 0.5" ON WALLS AND ROUNDED WITH EDGER TOOL ON INVERT.
4. TRANSVERSE CONST. JOINTS SHALL NOT BE PLACED WITHIN 30" OF INLETS.
5. TRANSVERSE CONST. JOINTS IN WALLS & SLABS SHALL BE IN THE SAME PLANE. NO STAGGERING OF JOINTS WILL BE PERMITTED. TRANSVERSE CONST. JOINTS SHALL BE NORMAL OR RADIAL TO THE CENTERLINE OF CONST.
6. THE LONGITUDINAL & TRANSVERSE REINFORCING STEEL SHALL TERMINATE 2" FROM THE CONCRETE SURFACES UNLESS OTHERWISE SHOWN ON DETAIL.
7. EXPOSED EDGES OF CONCRETE MEMBERS SHALL BE ROUNDED OR BEVELED.
8. NO SPLICES IN TRANSVERSE STEEL REINFORCEMENT WILL BE PERMITTED, OTHER THAN THOSE SHOWN ON THE DRAWING, WITHOUT APPROVAL OF THE ENGINEER. NO MORE THAN TWO SPLICES WILL BE PERMITTED IN ANY LONGITUDINAL BAR BETWEEN TRANSVERSE JOINTS. SPLICES SHALL BE STAGGERED
9. LONGITUDINAL AND TRANSVERSE STEELS SHALL BE LAPPED 24 AND 45 BAR DIAMETERS AT SPLICES, RESPECTIVELY.
10. TRANSVERSE JOINTS SHALL BE SPACED NOT TO EXCEED 50' NOR BE LESS THAN 10', MEASURED ALONG THE CENTERLINE OF CONST. EXCEPT AS OTHERWISE SHOWN ON THE DRAWINGS.
11. TRANSVERSE JOINTS SHALL BE PLACED AT THE JUNCTION OF RECTANGULAR OPEN CHANNEL SECTION WITH CLOSED CONDUIT SECTIONS.
12. ALL RECTANGULAR OPEN CHANNEL SHALL BE FENCED IN ACCORDANCE WITH STANDARD DWG. 1413, EXCEPT AS OTHERWISE SHOWN ON THE DRAWINGS.
13. UNLESS OTHERWISE SHOWN ON THE DRAWINGS, IN CURVE SECTIONS, THE MAXIMUM SPACING OF BARS SHALL NOT EXCEED THAT SHOWN ON THE TYPICAL SECTIONS. STEEL SHALL BE PLACED RADIALLY FROM THE MAX. SPACING.
14. AT THE BEGINNING AND ENDING OF ALL POURS, A COMPLETE CURTAIN OF REINFORCEMENT COMPOSED OF B1, B4 & B7 BARS SHALL BE PLACED 3" FROM TRANSVERSE CONST. JOINT.
15. ELEVATION OF WEEPHOLE ABOVE INVERT SALL BE UNIFORM THROUGH ENTIRE REACH OF PROJECT.
16. CHANNEL INVERT SURFACE SHALL BE GIVEN A STEEL TROWEL FINISH.



VERTICAL WALL REINF DETAIL
SCALE: 3/8" = 1'-0"



CHANNEL HALF SECTION
SCALE: 3/8" = 1'-0"



LONGITUDINAL CONSTRUCTION JOINT AND DRAINAGE DETAIL
NOT TO SCALE

1 1/2 0 1 2
3 inches on original drawing

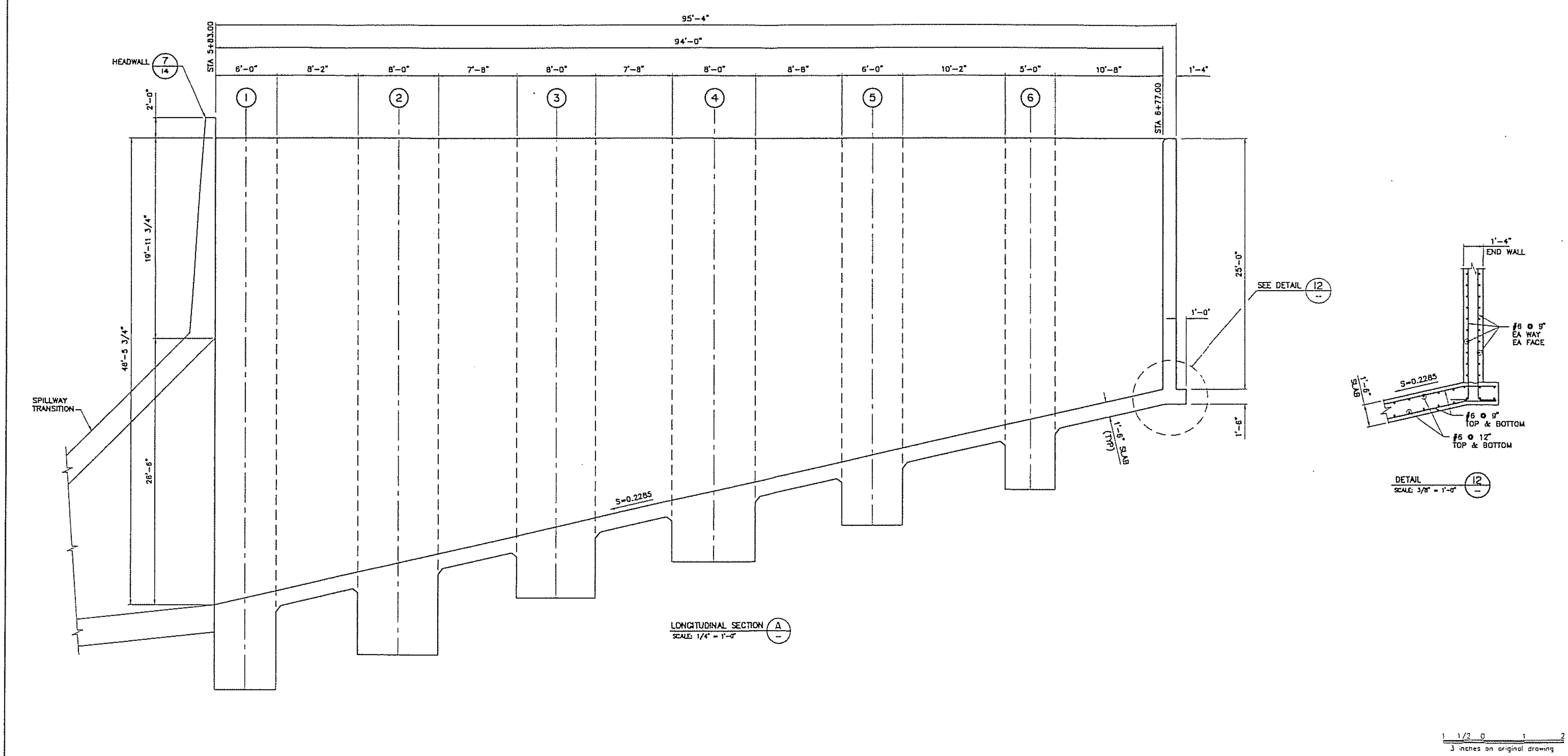
Robert Bein, William Frost & Associates
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

DESIGNED MSB | DRAWN DF | CHECKED SMS
PROJ. ENG. BRUCE M. PHILLIPS
REG. NO. R.C.E. 28635 DATE 3/31/01

COUNTY OF VENTURA - PUBLIC WORKS AGENCY
VENTURA COUNTY FLOOD CONTROL DISTRICT

LANG CREEK DAM & DETENTION BASIN
RC OPEN CHANNEL SPILLWAY STRUCTURAL SECTIONS, DETAILS & NOTES

SHEET 12 OF 32



Robert Bein, William Frost & Associates
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

DESIGNED MSB | DRAWN SJF | CHECKED SMS

PROJ. ENG. BRUCE M. PHILLIPS

REG. NO. R.C.E. 38625 DATE 3/31/01

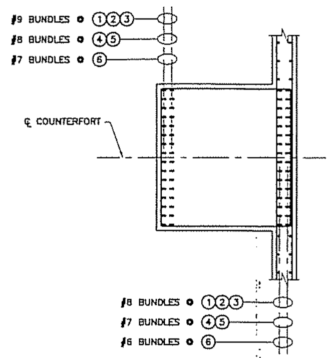
COUNTY OF VENTURA - PUBLIC WORKS AGENCY

VENTURA COUNTY FLOOD CONTROL DISTRICT

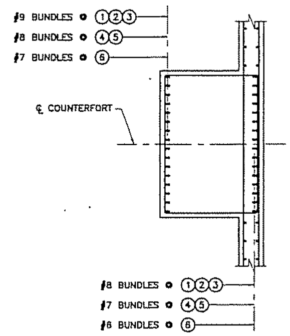
LANG CREEK DAM & DETENTION BASIN

DROP SPILLWAY STRUCTURAL SECTIONS & DETAILS 1

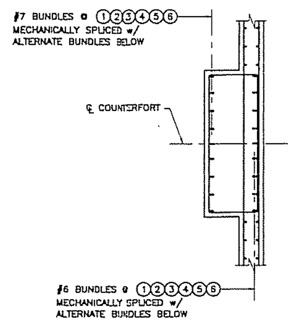
SHEET 16 OF 32



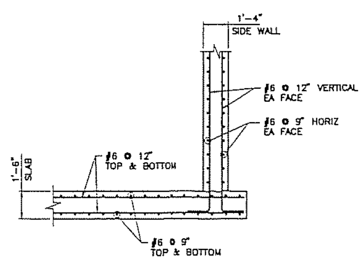
SECTION (J)
SCALE: 3/8" = 1'-0"



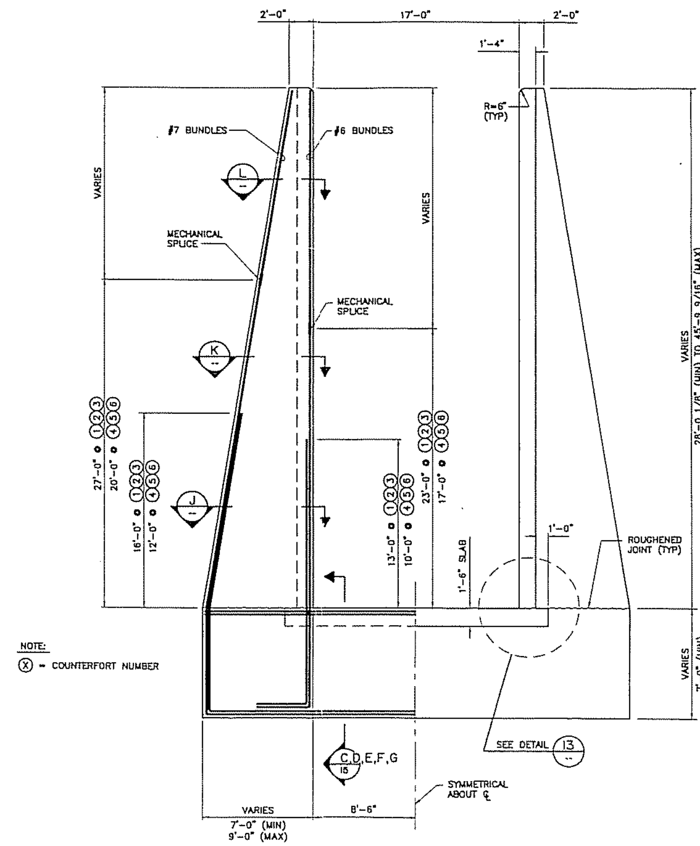
SECTION (K)
SCALE: 3/8" = 1'-0"



SECTION (L)
SCALE: 3/8" = 1'-0"



DETAIL (13)
SCALE: 3/8" = 1'-0"



NOTE:
(X) = COUNTERFORT NUMBER

SECTION (B)
SCALE: 1/4" = 1'-0"

1 1/2 0 1 2
3 inches on original drawing

NOTES:

1. SEE STRUCTURAL NOTES ON SHEET XX.
2. THE LENGTH OF LAP SPLICES FOR BUNDLED BARS MUST BE EQUAL TO THE REQUIRED LAP LENGTHS FOR INDIVIDUAL BARS OF THE SAME SIZE, BUT INCREASED BY 33%.
3. VERTICAL BARS SHALL BE ADJUSTED FOR ALL WALL HEIGHT TRANSITIONS.

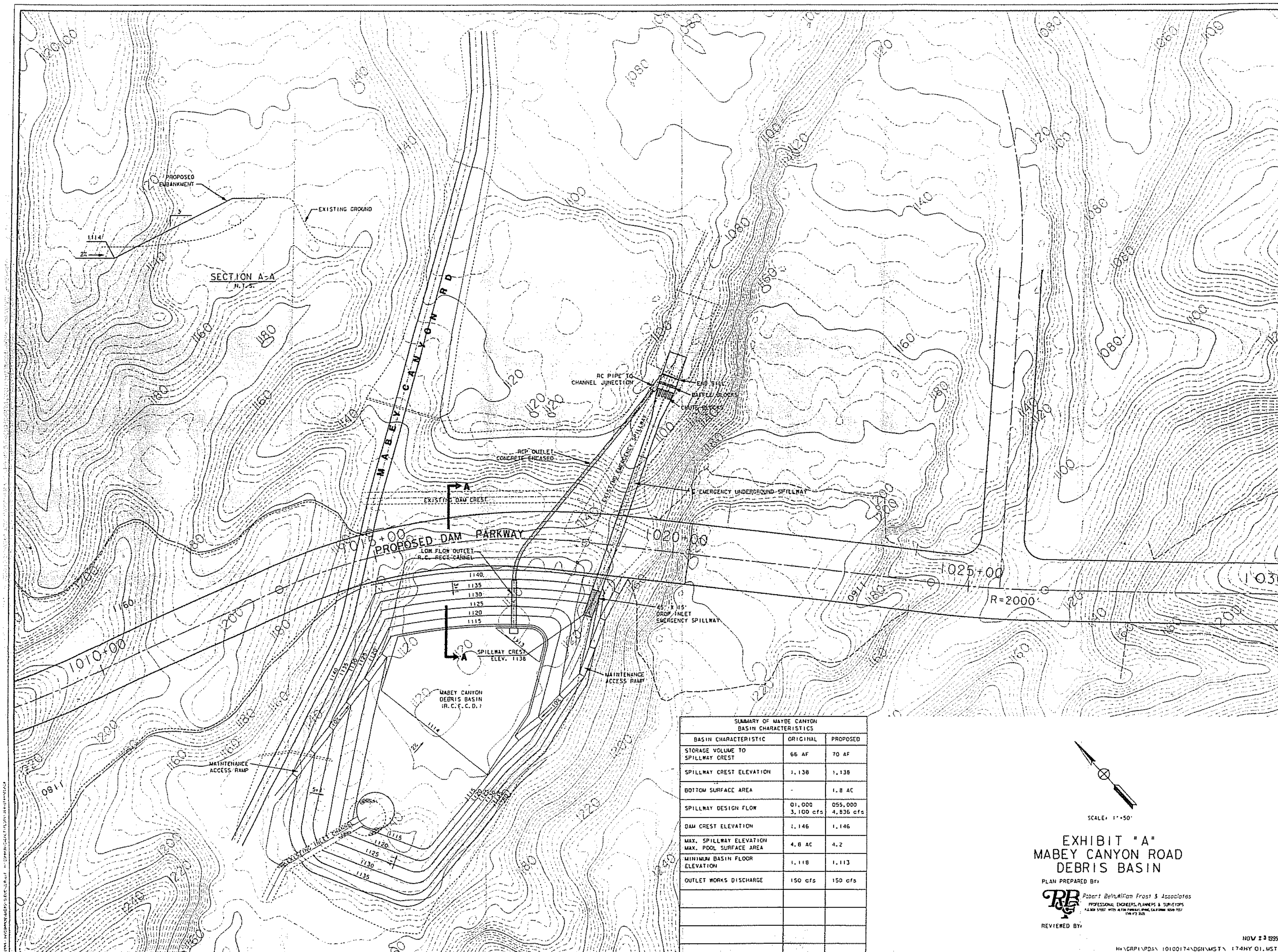
Robert Bein, William Frost & Associates

DESIGNED MSB | DRAWN GIF | CHECKED SMS
PROJ. ENG. BRUCE M. PHILLIPS
REG. NO. R.C.E. 38635 DATE 3/21/01

COUNTY OF VENTURA - PUBLIC WORKS AGENCY
VENTURA COUNTY FLOOD CONTROL DISTRICT

LANG CREEK DAM & DETENTION BASIN
DROP SPILLWAY STRUCTURAL SECTIONS & DETAILS 2

SHEET 17 OF 32



SUMMARY OF MAYBE CANYON BASIN CHARACTERISTICS		
BASIN CHARACTERISTIC	ORIGINAL	PROPOSED
STORAGE VOLUME TO SPILLWAY CREST	66 AF	70 AF
SPILLWAY CREST ELEVATION	1,138	1,138
BOTTOM SURFACE AREA	-	1.8 AC
SPILLWAY DESIGN FLOW	01,000 3,100 cfs	055,000 4,836 cfs
DAM CREST ELEVATION	1,146	1,146
MAX. SPILLWAY ELEVATION MAX. POOL SURFACE AREA	4.8 AC	4.2
MINIMUM BASIN FLOOR ELEVATION	1,118	1,113
OUTLET WORKS DISCHARGE	150 cfs	150 cfs

EXHIBIT "A"
MABEY CANYON ROAD DEBRIS BASIN

PLAN PREPARED BY:

Robert Bein, William Frost & Associates
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

REVIEWED BY:

NOV 23 1999

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