ATTACHMENT 7-A

Oro Grande Wash Detention Basin Study

ORO GRANDE WASH

DETENTION BASIN STUDY

INTRODUCTION

STUDY AREA: The Oro Grande Wash is the focus of this study. Oro Grande Wash and its 30-square-mile watershed is located in the Cities of Victorville and Hesperia and unincorporated areas to the southwest.

PURPOSE OF STUDY: To develop a planning level detention basin plan along Oro Grande Wash for the purpose of prioritizing basin construction.

EXISTING IMPROVEMENTS:

In 1969 the Corps of Engineers completed an improvement project on Oro Grande Wash consisting of approximately 5800 L.F. of an open concrete channel and reinforced concrete box. The improvements begin at the Mojave River as a reinforced concrete box and extend upstream under 8th Street south to Forest Avenue where it turns to parallel Hesperia Road. This reach is a highly developed commercial and residential area. The improvement continues upstream to Verde Street where the box transitions to a concrete rectangular channel. The channel continues upstream through Center Street.

The size of the box varies from 20' wide x 9.5' high at the Mojave River to 13' wide x 14' high at the upper end. The rectangular channel is 18' wide x 11.5' high.

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According to the Victorville Master Plan of Drainage, the existing improvement was designed for 5,000 cfs. The peak flow rates calculated for the MPD by Williamson and Schmid in accordance with the 1986 San Bernardino County Hydrology Manual indicates a full buildout (ultimate), full conveyance Q100 of 10,900 cfs at the Mojave River.

From the Corps of Engineers project upstream to Bear Valley Road, there are various levels of improvements ranging from earth graded/natural earth to rock lined trapezoidal channels. The cost estimate includes concrete channel improvements for this entire reach. However, it is recommended that some reaches be left as is, i.e. rock lined or natural trapezoidal channels coupled with an adequately designed designated flood plain. This approach would work well in areas where the wash has not been encroached upon by development. The golf course and possibly the park would be candidates for this plan.

Areas where encroachment exists such as the Mobile Home Park downstream of the I-15 freeway would require hardlined channel improvements.

From Bear Valley Road upstream to the California Aqueduct the wash is primarily natural and contained within a very broad and deep arroyo. A detailed hydraulic analysis was not done but it appears the major storm flows would be contained within the arroyo. The arroyo ranges in size from 20 feet deep and 700 feet wide near Bear Valley Road to 60 feet deep and 1500 feet wide at the California Aqueduct. The cost estimate includes concrete channel improvements for this reach. However, it is recommended that the wash be left natural with adequate flood plain established to preclude encroachment.

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HYDROLOGY: The hydrology calculated by the consulting engineering firm of Williamson & Schmid for the Victorville MPD was used to develop the various basin scenarios. Twenty-four hour, 100-year storm events were used to generate the peak flow rates and determine basin volumes.

The watershed was assumed to be fully developed, which yields higher 100-year flow rates than would be expected under existing conditions. As in the MPD, due to a fully developed watershed, debris and sediment deposition was considered negligible which may not be the case under existing conditions.

The final approved hydrology for Line A-01 full conveyance (Oro Grande Wash) from the Victorville MPD was entered into the computer. Using the AES computer software Flood Routing Analysis, Southern California Generation 2, Version 2.5A, several different basin combinations were tried. Seven scenarios were selected for further consideration and are identified as Alternates 1 through Alternate 7.

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COST ESTIMATES:

Excavation and Embankment Fill

Export or import of earth is included in the Excavation unit cost. Excavation is $3.00 per cubic yard and Embankment fill is $2.00 per cubic yard.

Concrete

For trapezoidal channels the unit cost for concrete is $200 per cubic yard. Inverts are 8" thick and sidewalls are 6" thick .

For rectangular channels, the unit cost for concrete is $300 per cubic yard. Inverts and walls are 12" thick.

Rectangular culverts, walls, inverts and roofs are all 12" thick and the unit cost is $450 per cubic yard. Culverts at road crossings will be 84' long, except the I-15 culvert which is handled separately. Concrete used on basin spillways will be 8" thick with a unit cost of $250 per cubic yard. Unit costs for concrete includes rebar and form work.

Right-of-Way

The required right-of-way is the channel top width plus 20' wide patrol/maintenance roads on both sides of the channel.

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Property values vary considerably from one end of the project to the other. To simplify these costs as much as possible and avoid time consuming and expensive land appraisals, the project was divided into two geographic parts. The area north of the California Aqueduct will have a property value of $45,000 per acre while the area south of the Aqueduct will be $15,000 per acre. Areas where City of Victorville or the County Flood Control District held easements, right-of-way costs were decreased by one half; $22,500 per acre north of the California Aqueduct and $7,500 per acre south of the Aqueduct. If property was owned outright by the City or District, right-of-way costs were not included for that area.

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Fencing

All channels and basins are assumed to be completely fenced. $7.50 per linear foot of fencing is used in the cost estimate.

UNIT COSTS

ITEM	UNIT COST
Excavation	$3.00 CY
Embankment Fill	2.00 CY
Concrete Lining (Trapezoidal Channel)	200 CY
Concrete Lining (Rectangular Channel)	300 CY
Concrete (Rectangular Culverts)	450 CY
Concrete (Basin Spillways)	250 CY
Right-of-Way (North of Calif. Aqueduct)	45,000 acre
Right-of-Way (South of Calif. Aqueduct)	15,000 acre
Fencing	7.50 L.F.
48" RCP	144 L.F.
96" RCP	249 L.F.
Contingencies (Engineering, Construction Management and Utility Relocations)	30%

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DESCRIPTION OF BASINS:

BASIN #1 is located upstream of the inlet to the existing concrete channel, downstream of Seneca Road. In all workable scenarios, except for alternate #7, some level of detention is required at this location, ranging from 5 A.F. to 97 A.F., to reduce peak flows to a level that the existing Corps facility is adequately sized. Consequently, Basin #1 is divided into four interlinking sub basins able to work separately or in any combination giving the flexibility needed to work with the seven separate alternatives.

BASIN #2 is located at the confluence of A-01 and A-04 (West Branch and East Branch) about 4000 feet upstream of Yates road. This particular basin works well since there is no unusual topography, minimal adjacent development, and the parcels are large. Flowby and flowthrough basins were both considered at this site.

Assessor Parcel # 475-321-06 is a 1320' x 660' undeveloped parcel well situated for a detention basin. Approximately 70% of the twenty-acre parcel appears to be located outside of and sufficiently away from Oro Grande Wash to be considered developable property.

At one time the location of Basin #2 was adjacent to and on the upstream side of Yates Road. However, due to the irregular shape of the area available, and the excessive depth of excavation needed, Basin #2 was determined less practical and moved to its present location.

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BASIN #3 is located on the upstream side (west) of Interstate 15 (I-15) and downstream of La Mesa Road. The District currently owns this parcel in fee title and it could be used as a flowby basin reducing the Q peak in Alternates 5 and 7 to a level the existing 5-72" CMP's under the freeway could handle without additional improvements. Preliminary cost estimate for replacing the freeway culverts is about $1,000,000. However, the City of Victorville has indicated a bridge or interchange is planned for La Mesa Road over the freeway which would severally restrict or eliminate the use of this parcel for a basin. Consequently, this basin is not included in any of the recommended alternatives.

BASIN #4 is a flowby basin located on Line A-09 just upstream of the confluence with Line A-01. Assessor Parcel # 475-762-16 is an existing undeveloped triangular shaped parcel which could be utilized as a basin. The parcel is located south and east of the intersection of North Star Avenue and El Evado Road. The basin would reduce the peak Q on Line A-09 from 940 cfs to 50 cfs and it would reduce the peak Q on Line A-01 by approximately 460 cfs, precluding the need for upsizing Line A-01. The basin was included in two of the selected alternatives.

BASIN #5 is located downstream of Petaluma Road in back of the Mall of Victor Valley. Oro Grande Wash at this location is 20 to 30 feet deep and 200 to 600 feet wide at the top. The topography lends itself well to a detention basin. Both flowby and flowthrough basins were analyzed. The flowby was eliminated from consideration due to a lack of a "Peak" at this location; the peak being removed by upstream basin(s).

BASIN #6 is located downstream of Bear Valley Road and upstream of Petaluma Road. This location is one proposed in the Victorville MPD as a flowby basin with a capacity of 294 acre feet. Our analysis shows this site is not a cost-effective location for a detention basin. A majority of the site required for the basin is on high ground requiring as much as 35 feet of cut. Since this high ground is situated above and away from the Oro Grande Wash, its close proximity to the Mall of Victor Valley and fronting on Bear Valley Road, this site would be considered prime developable commercial property, and very expensive. Consequently, this site was not included in any of the selected detention basin alternatives.

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BASIN #7 is located on the south (upstream) side of Bear Valley Road. The topographic characteristics of Oro Grande Wash at this location appears to be suitable for a detention basin. The wash is a large incised arroyo in excess of 20 feet deep and 700 to 800 feet wide at the top. The area required for a basin would include the bottom of the arroyo and adjacent side slopes. Bear Valley Road crosses the wash in fill and is approximately 13 feet above to bottom of the arroyo. There is a 10' W x 8' H RCB which conveys Oro Grande flows under Bear Valley Road. Located about 200 feet to the east is an 8'W x 6'H RCB which conveys Line A-10C flows under Bear Valley Road.

Basin #7 was analyzed as both a flowby and flowthrough basin. Four of the seven alternates include Basin #7 as a flowththrough and one is included as a flowby.

The most cost effective and hydraulically efficient flowthrough basin at this site involved raising Bear Valley Road and using the road fill as a dam. This plan uses the existing undersized RCB's under Bear Valley Road to meter down the peak Q100, and excavating 194,000 C.Y. to create a basin with a capacity of 130 acre feet. In lieu of changing the grades along Bear Valley Road a 6' high structural wall could be constructed along the south line of Bear Valley Road with a properly located and sized notch to act as an emergency spillway. Lines A-01, A-10c and A-12 would be directed into the basin. Other options reviewed were taking lines A-10c and A-12 both together and individually into Line A-01 downstream of the basin. However, these options were not as efficient.

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A flowby basin was also used as an alternative. This design involves taking flows in excess of 500 cfs from Line A-10c and flows over 200 cfs from Line A-12 and routing these flows into Basin #7. The 500 and 200 cfs flowby would join Line A-01 downstream of the basin. Line A-01 would be conveyed through Basin #7 in a 108' RCP, contributing no flow to the basin. Line A-01 at this location is not suitable for a flowby basin since the peak has been flattened out by upstream basins.

BASIN #8 is located one-half mile upstream of Bear Valley Road. This basin was initially considered to operate in a series of basins in concert with basins 7 and 9. However, it was apparent up front that this concept would not be cost effective. Therefore, this basin was eliminated from further consideration.

BASIN #9 is located about 4,300 feet upstream of Bear Valley Road upstream of the future alignment of Amethyst Street. Locating the dam in this manner, the top of the dam embankment could also serve as future Amethyst Street thereby creating only one embankment across the arroyo instead of two. However, since the embankment would need to be as much as 40' to 60' wider at the top to accommodate Amethyst Street and an overflow spillway, it would require more embankment fill, maybe as much as 40,000 to 50,000 C.Y.

Oro Grande Wash at this location is a 40' to 50' deep arroyo, approximately 1,000 feet wide at the top. The area needed for the basin is on the bottom of the arroyo and the side slopes. Basin #9 is included in all seven alternates.

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BASIN #11 is located on the upstream side of the California Aqueduct crossing of the wash. Oro Grande Wash, at this location, is a well incised arroyo in excess of 60 feet deep and 1500 wide at the top. The Aqueduct spans the wash on top of an embankment filled to the top of the arroyo. Along the bottom of the arroyo at the base of the fill is a double 6' x 6' RCB which conveys Oro Grande flows through the embankment. The RCB does not have the capacity to handle the peak 100-year flow and any excessive flows will pond behind the aqueduct embankment. The double 6' x 6' RCB will reduce the peak Q100 inflow of 4816 cfs to an outflow of 1651 cfs, while ponding flows to a depth of over 26 feet. Capacity of the basin will be over 300 acre feet.

Basin #11 is included in all of the alternates since most of the improvements required to create a basin are existing and the only items left would be purchasing the right-of-way and fencing.

BASIN #12 is located on the east branch of Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company railroad fill. The east branch at this location is a 35 to 40 foot deep arroyo and 1000' +/- wide at the top. The railroad fill creates an embankment to the top of the arroyo. The area available for ponding in back of the embankment is sufficient to create a flowby basin with 300 acre foot capacity and inflow of 5597 cfs and flowby of 150 cfs. Basin #12 is included in all of the alternates.

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ANALYSIS OF ALTERNATIVES

GENERAL

Alternative basin/channel scenarios were developed along the Oro Grande Wash to determine the overall effectiveness at each basin. Channel design and cost estimating criteria was based on the Victorville MPD. For each of the alternatives, the maximum 100-year maximum allowable outflow for Basin #1 is about 4650 cfs, which is the capacity of the existing facility downstream of the basin. The seven most cost effective alternatives are listed below. Table 1 lists the estimated costs of each alternative.

ALTERNATE #1 utilizes Basins 1, 2, 9, 11 and 12, the least number of basins of the seven alternatives. The total estimated cost for this system of basins and channels is $29.8 million. See Figure 1.

BASIN #1 uses all of sub-basin A and 1/2 of sub-basin B in a flowby arrangement. Inflow of 5419 cfs is reduced to 4824 cfs outflow. Capacity of basin is 45 acre-feet. Cost is $1.3 million.

BASIN #2 is a flowthrough reducing inflow of 6939 cfs to an outfall of 4380 cfs and a capacity of 250 acre-feet. Cost is 3.0 million.

BASIN #9 is located upstream of the future alignment of Amethyst Street and operates as a flowthrough basin. The basin inflow is 3345 cfs and outflow is 1433 cfs and has a capacity of 311 acre-feet. Cost of basin $2.1 million.

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BASIN #11 is located on the upstream side of the California Aqueduct embankment and is a flowthrough basin. Inflow is 4816 cfs and outflow is 1671 cfs and has a capacity of 317 acre-feet. Cost of basin is $0.5 million.

BASIN #12 is located on the Eash Branch Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company Railroad embankment. The basin is a flowby with inflow of 5176 cfs and flowby of 750 cfs and a capacity of 301 acre-feet. Cost is $2.8 million.

ALTERNATE #2 utilizes basins 1,2,5,9,11 and 12.

BASIN #1 uses 1/2 of sub-basin A as a flowby. Inflow of 5028 cfs is reduced to 4619 cfs outflow. Capacity of basin is 15 acre-feet and a cost of $0.4 million.

BASIN #2 is a flowthrough reducing inflow of 5504 cfs to an outflow of 3883 cfs. Capacity is 250 acre-feet and the cost is $3.0 million.

BASIN #5 is a flowthrough basin with an inflow of 3971 cfs and outflow of 2360 cfs. Capacity of basin is 120 acre-feet and the cost is $1.2 million.

BASIN #9 is located upstream of the future alignment of Amethyst Street and operates as a flowthrough basin. The basin inflow is 3345 cfs and outflow is 1433 cfs and has a capacity of 311 acre-feet. Cost of basin is $2.1 million.

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BASIN #11 is located on the upstream side of the California Aqueduct embankment and is a flowthrough basins. Inflow is 4816 cfs and outflow is 1671 cfs and has a capacity of 317 acre-feet. Cost of basin is $0.5 million.

BASIN #12 is located on the East Branch Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company Railroad embankment. The basin is a flowby with inflow of 5176 cfs and flowby of 750 cfs and a capacity of 301 acre-feet. Cost is $2.8 million.

ALTERNATE #3 utilizes basins at 1, 5, 7, 9, 11, and 12.

BASIN #1 uses sub-basins A and B and 3/4 of sub-basin C in a flowby arrangement reducing inflow of 6608 cfs to 4613 cfs outflow and a capacity of 97 acre-feet. Cost is $2.2 million.

BASIN # 5 is a flowthrough reducing inflow of 2808 cfs to 2117 cfs outflow and a capacity of 120 acre-feet. Cost is $1.2 million.

BASIN #7 is a flowthrough with inflow of 3999 cfs and an outflow of 2811 cfs capacity is 130 acre-feet and cost is $1.8 million.

BASIN #9 is located upstream of the future alignment of Amethyst Street and operates as a flowthrough basin. The basin inflow is 3345 cfs and outflow is 1433 cfs and has a capacity of 311 acre-feet. Cost of basin $2.1 million.

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BASIN #11 is located on the upstream side of the California Aqueduct embankment and is a flowthrough basin. Inflow is 4816 cfs and outflow is 1671 cfs and has a capacity of 317 acre-feet. Cost of basin is $0.5 million.

BASIN #12 is located on the Eash Branch Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company Railroad embankment. The basin is a flowby with inflow of 5176 cfs and a flowby of 750 cfs and a capacity of 301 acre-feet. Cost is $2.8 million.

ALTERNATE #4 includes basins 1, 2, 7, 9, 11 and 12 basin.

BASIN #1 uses 1/2 of sub-basin A in a flowby arrangement. Inflow of 4971 cfs is reduced to 4559 cfs flowby and a capacity of 11 acre-feet. Cost is $0.40 million.

BASIN #2 operates as a flowby basin. Inflow is 5449 cfs, flowby is 3141 cfs and the basin has a capacity of 194 acre-feet. Cost of basin is $3.3 million.

BASIN #7 is located on the upstream side of Bear Valley Road. There are two main laterals, Lines A-10C and A-12, which join Oro Grande Wash at this location. In this alternate Basin 7 will operate as a flowby basin on Lines A-10c and A-12 only. The Q100 for Line A-10C is 2610 cfs, of that the first 500 cfs would bypass the basin and join Oro Grande Wash downstream of Bear Valley Road. Flows in excess of 500 cfs would be conveyed into the basin. The Q100 for Line A-12 is 1451 cfs, of that the first 200 cfs would bypass the basin and join Oro Grande Wash downstream of Bear Valley Road. Flows in excess of 200 cfs would be conveyed into the basin.

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Basin 7 will reduce downstream peak flow from 4200 cfs to 2089 and have a capacity of 120 acre-feet. Cost is $3.5 million.

BASIN #9 is located upstream of the future alignment of Amethyst Street and operates as a flowthrough basin. The basin inflow is 3345 cfs and outflow is 1433 cfs and has a capacity of 311 acre-feet. Cost of basin $2.1 million.

BASIN #11 is located on the upstream side of the California Aqueduct embankment and is a flowthrough basin. Inflow is 4816 cfs and outflow is 1671 cfs and has a capacity of 317 acre-feet. Cost of basin is $0.5 million.

BASIN #12 is located on the East Branch of the Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company Railroad embankment. The basin is a flowby with inflow of 5176 cfs and flowby of 750 cfs and a capacity of 301 acre-feet. Cost is $2.8 million.

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ALTERNATE #5 includes basins 1, 4, 5, 7, 9, 11 and 12.

BASIN #1 uses sub-basins A and B and 1/3 of sub-basin C in a flowby arrangement. Inflow of 6251 cfs is reduced to 4614 cfs and a capacity of 78 acre-feet. Cost is $2.1 million.

BASIN #4 is a flowby basin on Line A-09. Q100 is 941 cfs with 50 cfs flowby and into Oro Grande Wash and excess into the basin. Capacity of the basin is 45 acre-feet and a cost of $0.8 million.

BASIN #5 is a flowthrough reducing an inflow of 2808 cfs to 2117 cfs outflow and a capacity of 120 acre-feet. Cost is $1.2 million.

BASIN #7 is a flowthrough with inflow of 3999 cfs and outflow of 2811 cfs. Capacity is 130 acre-feet and cost is $1.8 million.

BASIN #9 is located upstream of the future alignment of Amethyst Street and operates as a flowthrough basin. The basin inflow is 3345 cfs and outflow is 1433 cfs and has a capacity of 311 acre-feet. Cost of basin $2.1 million.

BASIN #11 is located on the upstream side of the California Aqueduct embankment and is a flowthrough basin. Inflow is 4816 cfs and outflow is 1671 cfs and has a capacity of 317 acre-feet. Cost of basin is $0.5 million.

BASIN #12 is located on the East Branch of the Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company Railroad embankment. The basin is a flowby with inflow of 5176 cfs and flowby of 750 cfs and a capacity of 301 acre-feet. Cost is $2.8 million.

ALTERNATE #6 includes basins 1, 2, 5, 7, 9, 11 and 12.

BASIN #1 uses a portion of sub-basin A in a flowby arrangement. Inflow of 4807 cfs is reduced to 4621 cfs flowby and a capacity of 5 acre-feet. Cost is $0.4 million.

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BASIN #2 is a flowthrough with 5152 cfs inflow reduced to an outflow of 3577 cfs. Capacity is 250 acre-feet at a cost of $3.0 million.

BASIN #5 is a flowthrough reducing an inflow of 2808 cfs to an outflow of 2117 cfs. Capacity is 120 acre-feet and a cost of $1.2 million.

BASIN #7 is a flowthrough with inflow of 3999 and an outflow of 2811 cfs . Capacity is 130 acre-feet and cost is 1.8 million.

BASIN #9 is located upstream of the future alignment of Amethyst Street and operates as a flowthrough basin. The basin inflow is 3345 cfs and outflow is 1433 cfs and has a capacity of 311 acre-feet. Cost of basin $2.1 million.

BASIN #11 is located on the upstream side of the California Aqueduct embankment and is a flowthrough basin. Inflow is 4816 cfs and outflow is 1671 cfs and has a capacity of 317 acre-feet. Cost of basin is $0.5 million.

BASIN #12 is located on the East Branch of the Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company Railroad embankment. The basin is a flowby with inflow of 5176 cfs and flowby of 750 cfs and a capacity of 301 acre-feet. Cost is $2.8 million.

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ALTERNATE #7 includes basins 2, 4, 5, 7, 9, 11 and 12.

BASIN #2 is a flowthrough basin with inflow of 4677 cfs and an outflow of 3416 cfs. Capacity is 248 acre-feet and the cost is $3.0 million.

BASIN #4 is a flowby basin on Line A-09 with inflow of 941 cfs and flowby of 50 cfs. Capacity is 45 acre-feet and a cost of $0.8 million. Basin 5 is a flowthrough basin with inflow of 2808 cfs and outflow of 2117 cfs. Capacity is 116 acre-feet and cost is $1.8 million.

BASIN #7 is a flowthough basin with inflow of 4000 cfs and outflow of 2811 cfs. Capacity is 130 acre-feet and a cost of $1.8 million.

BASIN #9 is located upstream of the future alignment of Amethyst Street and operates as a flowthrough basin. The basin inflow is 3345 cfs and outflow is 1433 cfs and has a capacity of 311 acre-feet. Cost of basin $2.1 million.

BASIN #11 is located on the upstream side of the California Aqueduct embankment and is a flowthrough basin. Inflow is 4816 cfs and outflow is 1671 cfs and has a capacity of 317 acre-feet. Cost of basin is $0.5 million.

BASIN #12 is located on the Eash Branch Oro Grande Wash on the upstream side of the Southern Pacific Transportation Company Railroad embankment. The basin is a flowby with inflow of 5176 cfs and flowby of 750 cfs and a capacity of 301 acre-feet. Cost is $2.8 million.

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CONCLUSIONS

Based on the results of this study, none of the alternatives described in this report can be excluded solely on the basis of cost. Considering the preliminary methods used for computing the quantities and costs, the margin of error would probably exceed the difference in cost for each of the alternatives.

One reason all the alternatives are generally the same cost is that the cost for additional storage (flow attenuation) is offset by the reduced cost of the downsized connecting channels. The study has shown that a minimum amount of storage is required to sufficiently reduce the outflow at Basin #1, but the storage locations can very to some extent. Basins 9, 11, and 12 have all been included in each alternative due to the fact that each of these basins can provide flow attenuation along Oro Grande Wash very cost-effectively. The remaining basins, which individually may be optional, provide flow attenuation for water courses tributary to the Oro Grande Wash.

Since the purpose of this study is to identify one or two basins for the purpose of initiating final design, right-of-way acquisition and construction; the basins must be prioritized. Generally, the highest priority basin should provide the greatest reduction in flood damage per unit cost of construction. Of course, other factors should also be considered such as funding, future development, environmental considerations, public opinion, etc.

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Table No. 1

COST COMPARISONS - ORO GRANDE BASIN ALTERNATE PLANS

(in millions of dollars)

	Alt. #1	Alt. #2	Alt. #3	Alt. #4	Alt. #5	Alt. #6	Alt. #7
Basin #1	1.3	0.4	2.2	0.4	2.1	0.4	-
Basin #2	3.0	3.0	-	3.3	-	3.0	3.0
Basin #4	-	-	-	-	0.8	-	0.8
Basin #5	-	1.2	1.2	-	1.2	1.2	1.2
Basin #7	-	-	1.8	3.5	1.8	1.8	1.8
Basin #9	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Basin #11	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Basin #12	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Basin Sub-Total	9.7	10.0	10.6	12.6	11.3	11.8	12.2
Channel Costs	20.1	18.7	18.1	16.9	17.5	17.2	16.8
Alternate Total	29.8	28.7	28.7	29.5	28.8	29.0	29.0

Table No. 2
BASIN PEAK INFLOW / OUTFLOW
(in cfs)

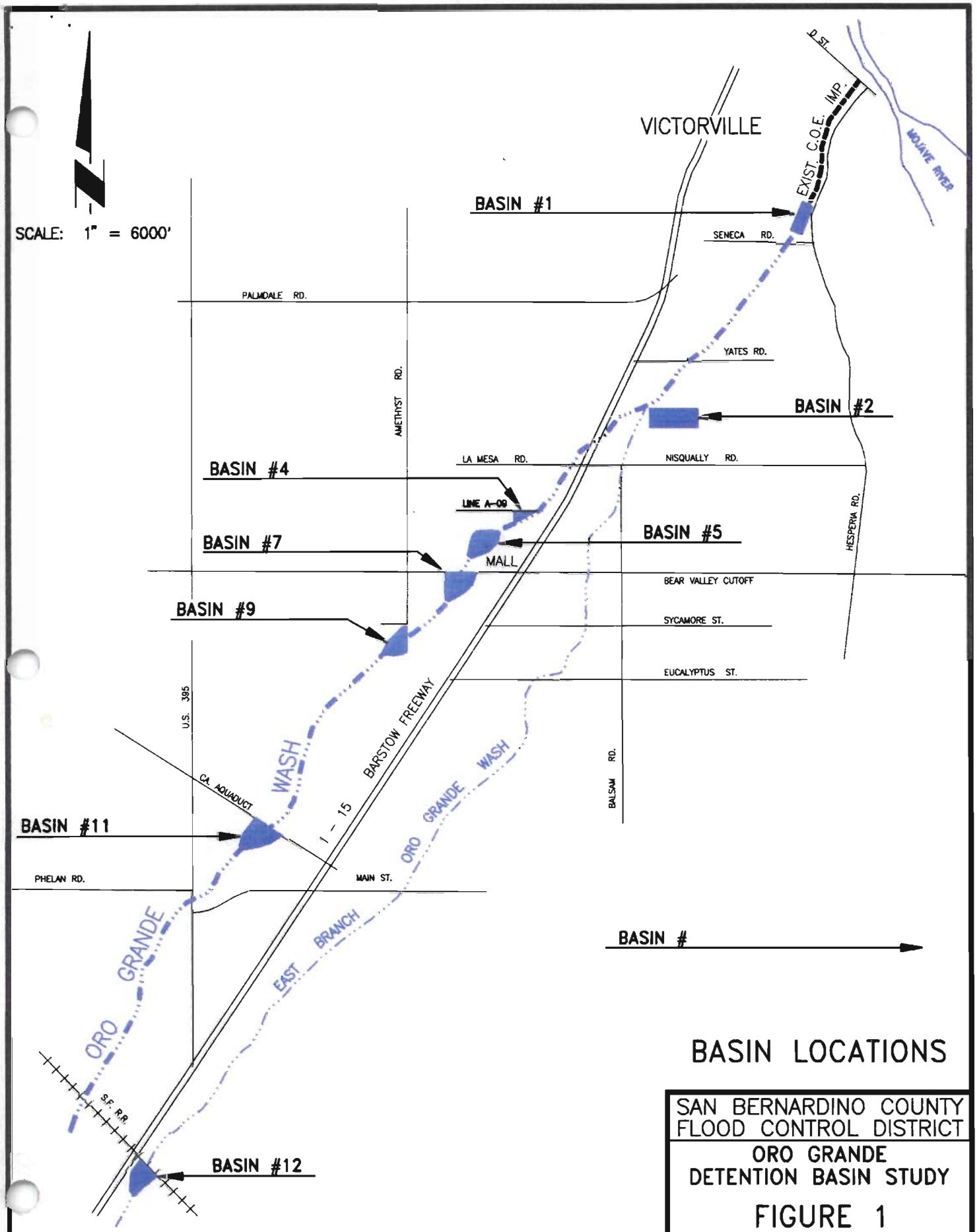
	Full Conveyance	Alt. #1	Alt. #2	Alt. #3	Alt. #4	Alt. #5	Alt. #6	Alt. #7
Mojave River	10872	5000	5000	5000	5000	5000	5000	5025
Basin #1	10801	5419/4824	5028/4619	6608/4613	4971/4559	6251/4614	4807/4621	4702
Basin #2	10091	6939/4380	5504/3883	5152	5449/3141	4726	5152/3577	4677/3416
Basin #3	7498	5127	3411	3024	3337	2560	3024	2560
Basin #4	7036	4528	2724	2262	2555	2262/2208	2262	2262/2208
Basin #5	6960	3971	3971/2360	2808/2117	2086	2808/2117	2808/2117	2808/2117
Basin #7	6960	3999	3999	3999/2811	3999/2089	3999/2811	3999/2811	3999/2811
Basin #9	5582	3345/1433	3345/1433	3345/1433	3345/1433	3345/1433	3345/1433	3345/1433
Basin #11	4816	4816/1671	4816/1671	4816/1671	4816/1671	4816/1671	4816/1671	4816/1671
Basin #12	5176	5176/750	5176/750	5176/750	5176/750	5176/750	5176/750	5176/750

LEGEND:

xxxx	indicates peak flow without a basin
xxxx/yyyy	xxxx indicates peak basin inflow yyyy indicates peak basin outflow

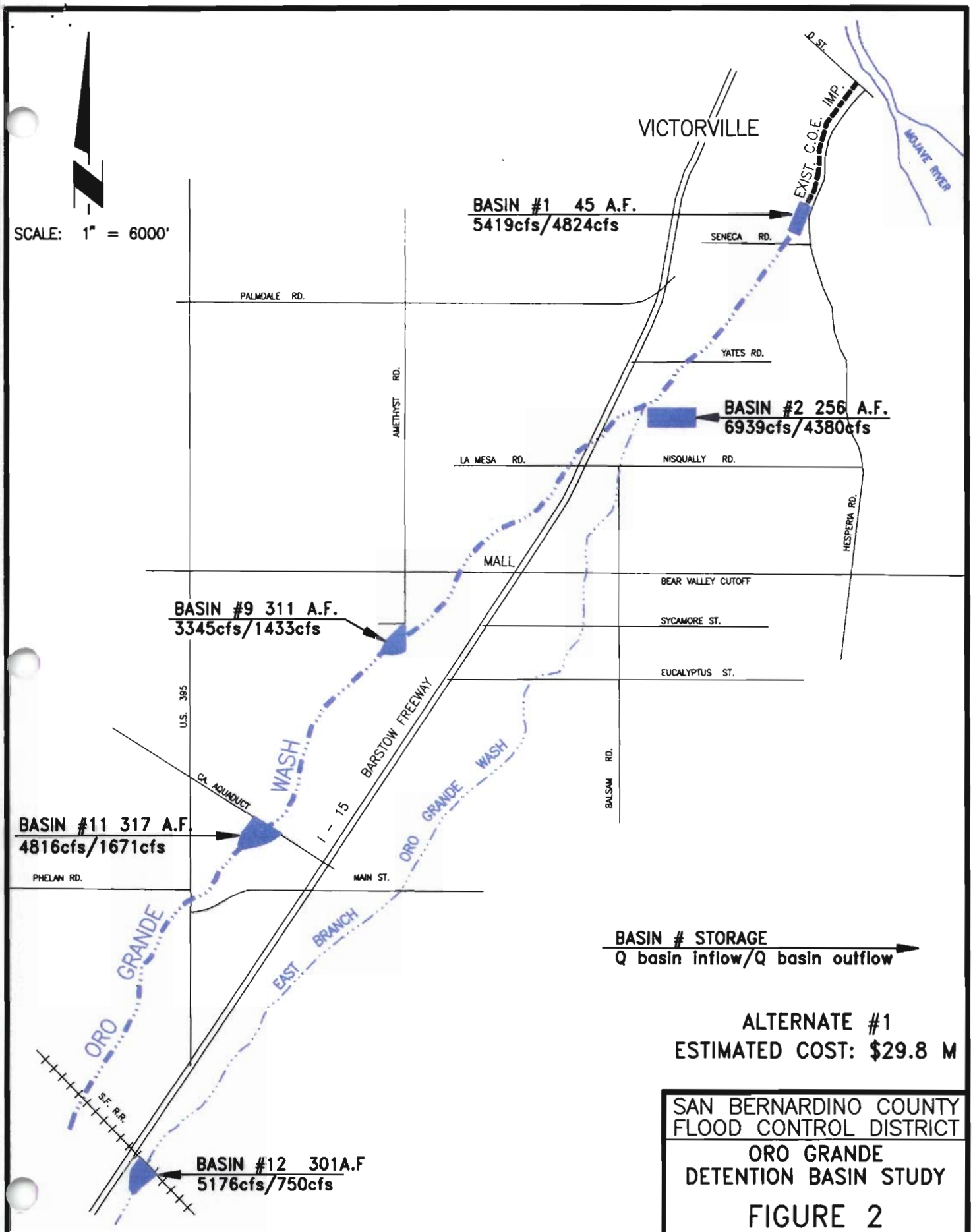
Table No. 3
BASIN VOLUME
(in acre-feet)

	Alt. #1	Alt. #2	Alt. #3	Alt. #4	Alt. #5	Alt. #6	Alt. #7
Basin #1	45	15	97	11	78	5	-
Basin #2	256	250	-	194	-	250	250
Basin #4	-	-	-	-	45	-	45
Basin #5	-	120	120	-	120	120	120
Basin #7	-	-	130	120	130	130	130
Basin #9	311	311	311	311	311	311	311
Basin #11	317	317	317	317	317	317	317
Basin #12	301	301	301	301	301	301	301



BASIN LOCATIONS

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT			
ORO GRANDE DETENTION BASIN STUDY			
FIGURE 1			
DATE: OCT 95	SYS. NO: 4-106	ACAD FILE: 4106BASN	S.B.C.F.C.D. FILE: PM-D1-24



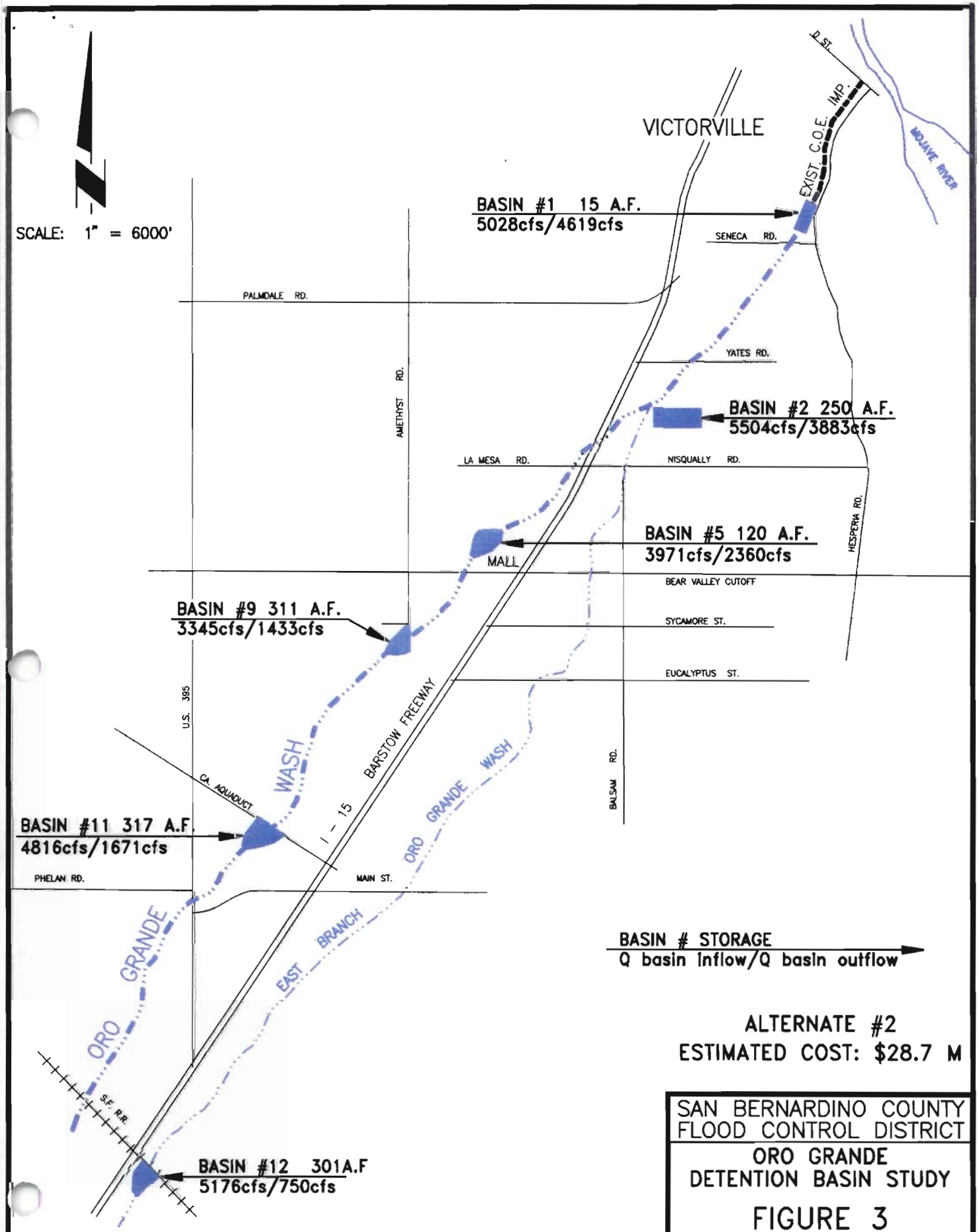
ALTERNATE #1
ESTIMATED COST: $29.8 M

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

ORO GRANDE
DETENTION BASIN STUDY

FIGURE 2

DATE:	SYS. NO:	ACAD FILE:	S.B.C.F.C.D. FILE:
OCT 95	4-106	4106BASN	PM-D1-24



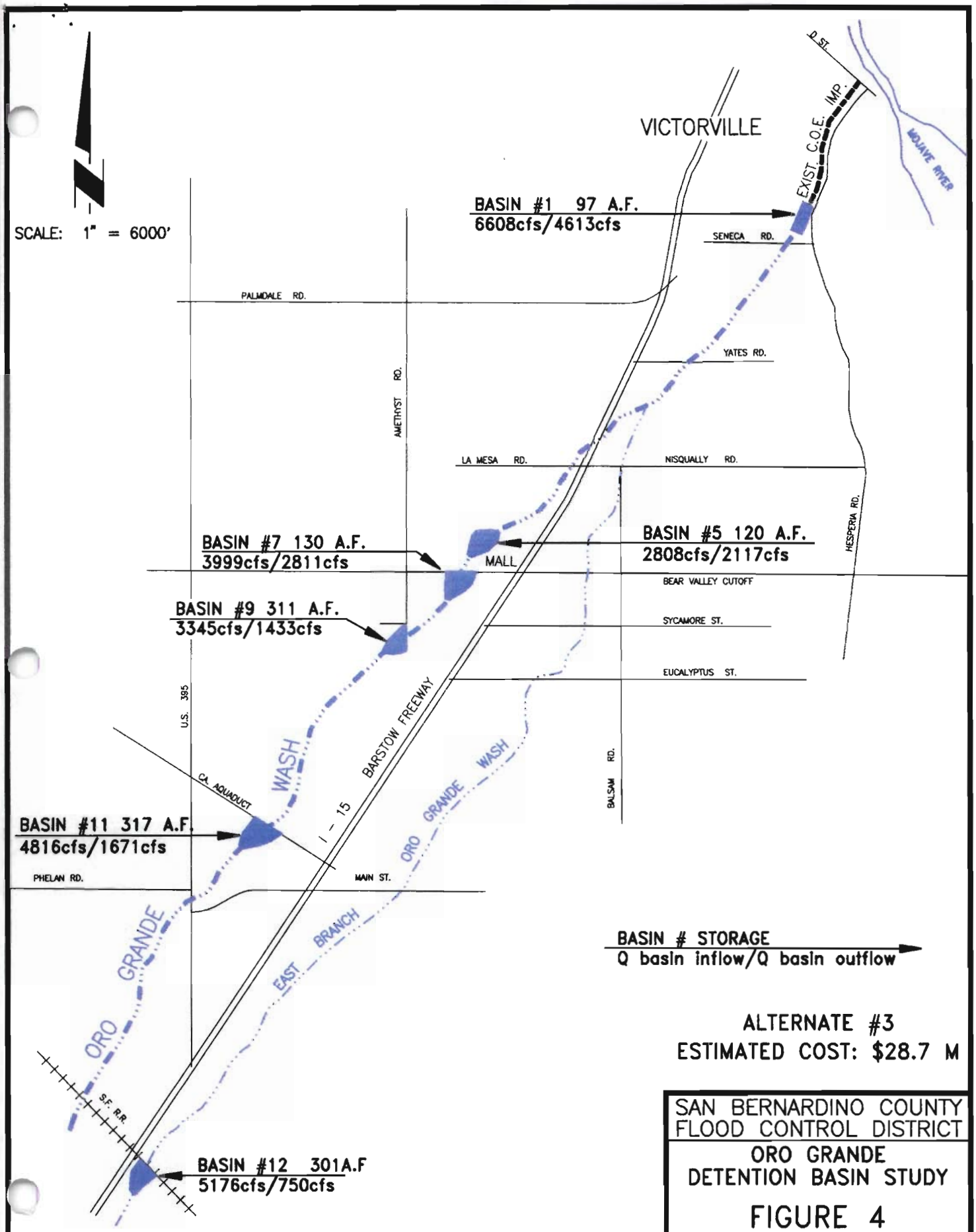
ALTERNATE #2
ESTIMATED COST: $28.7 M

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

ORO GRANDE
DETENTION BASIN STUDY

FIGURE 3

DATE:	SYS. NO:	ACAD FILE:	S.B.C.F.C.D. FILE:
OCT 95	4-106	4106BASN	PM-D1-24



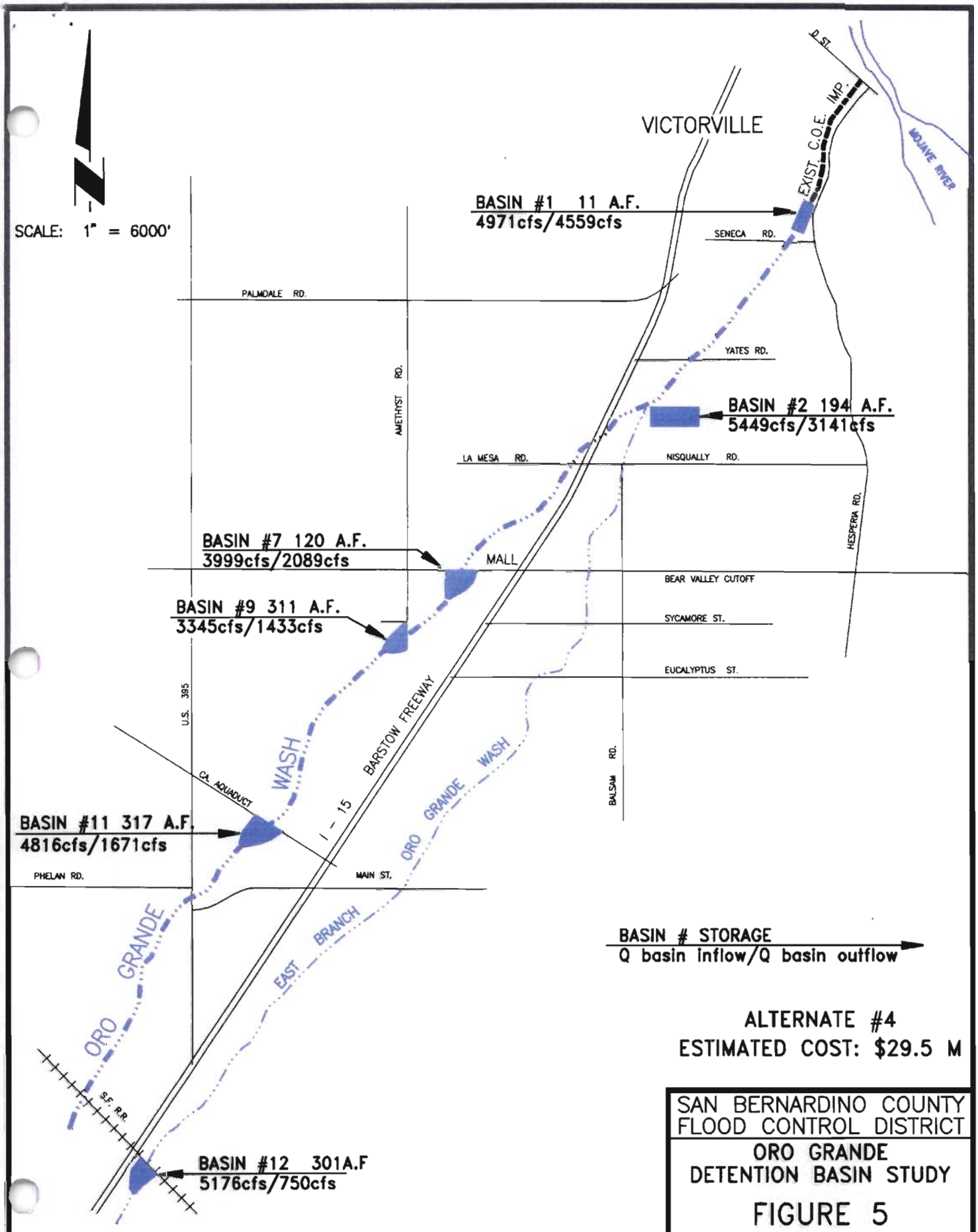
ALTERNATE #3
ESTIMATED COST: $28.7 M

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

ORO GRANDE
DETENTION BASIN STUDY

FIGURE 4

DATE:	SYS. NO:	ACAD FILE:	S.B.C.F.C.D. FILE:
OCT 95	4-106	4106BASN	PM-D1-24



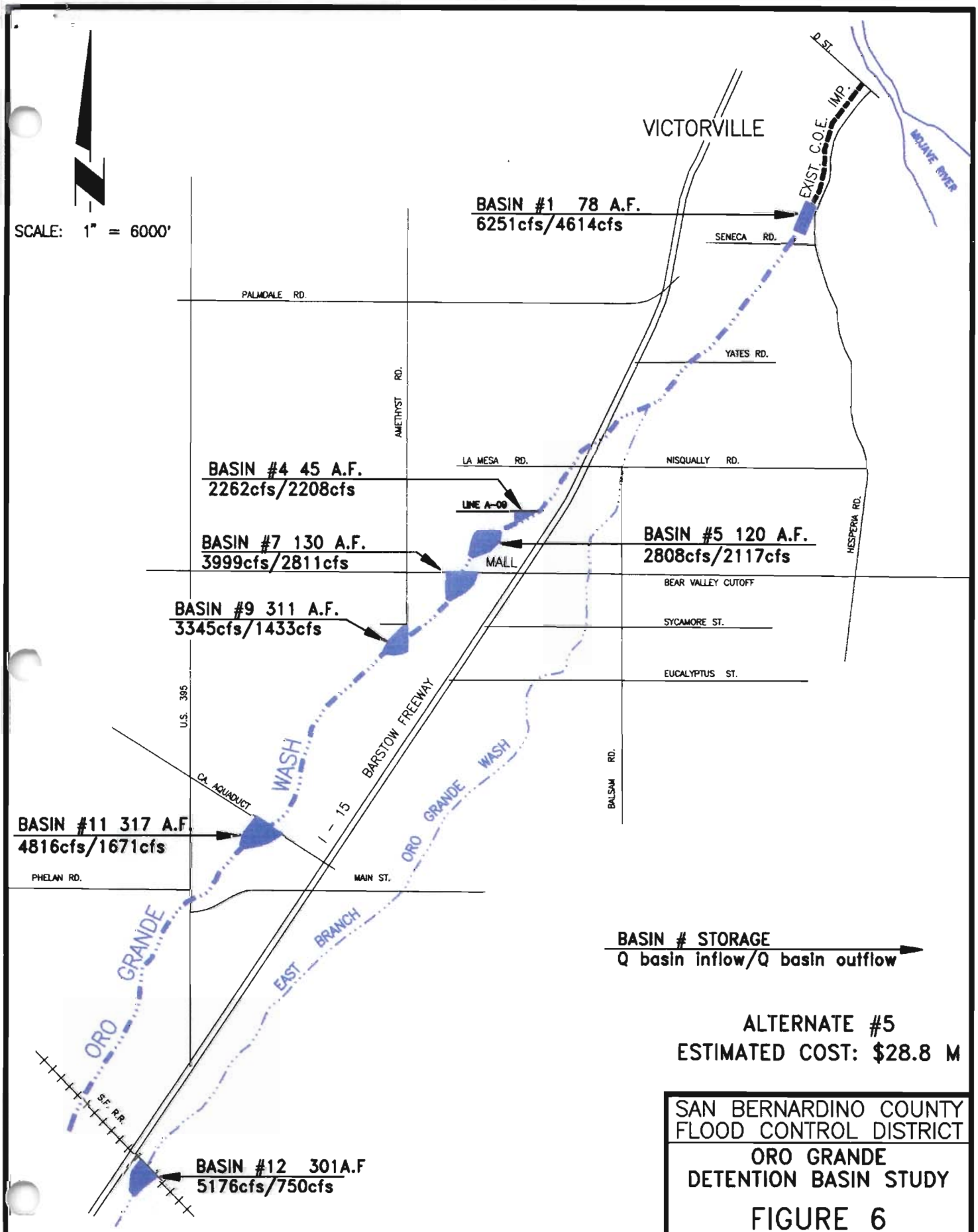
ALTERNATE #4
ESTIMATED COST: $29.5 M

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

ORO GRANDE
DETENTION BASIN STUDY

FIGURE 5

DATE:	SYS. NO:	ACAD FILE:	S.B.C.F.C.D. FILE:
OCT 95	4-106	4106BASN	PM-D1-24



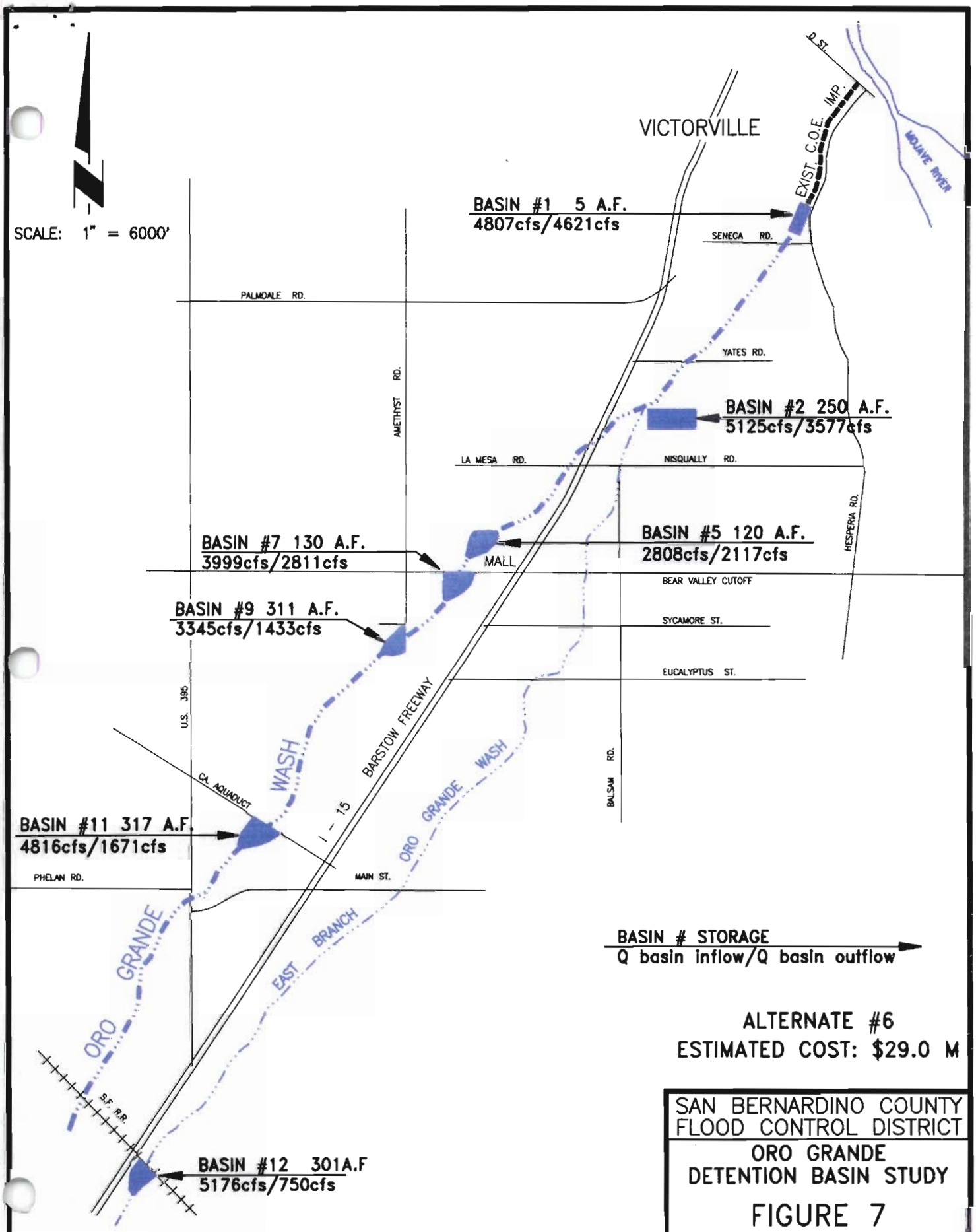
ALTERNATE #5
ESTIMATED COST: $28.8 M

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

ORO GRANDE
DETENTION BASIN STUDY

FIGURE 6

DATE:	SYS. NO:	ACAD FILE:	S.B.C.F.C.D. FILE:
OCT 95	4-106	4106BASN	PM-D1-24



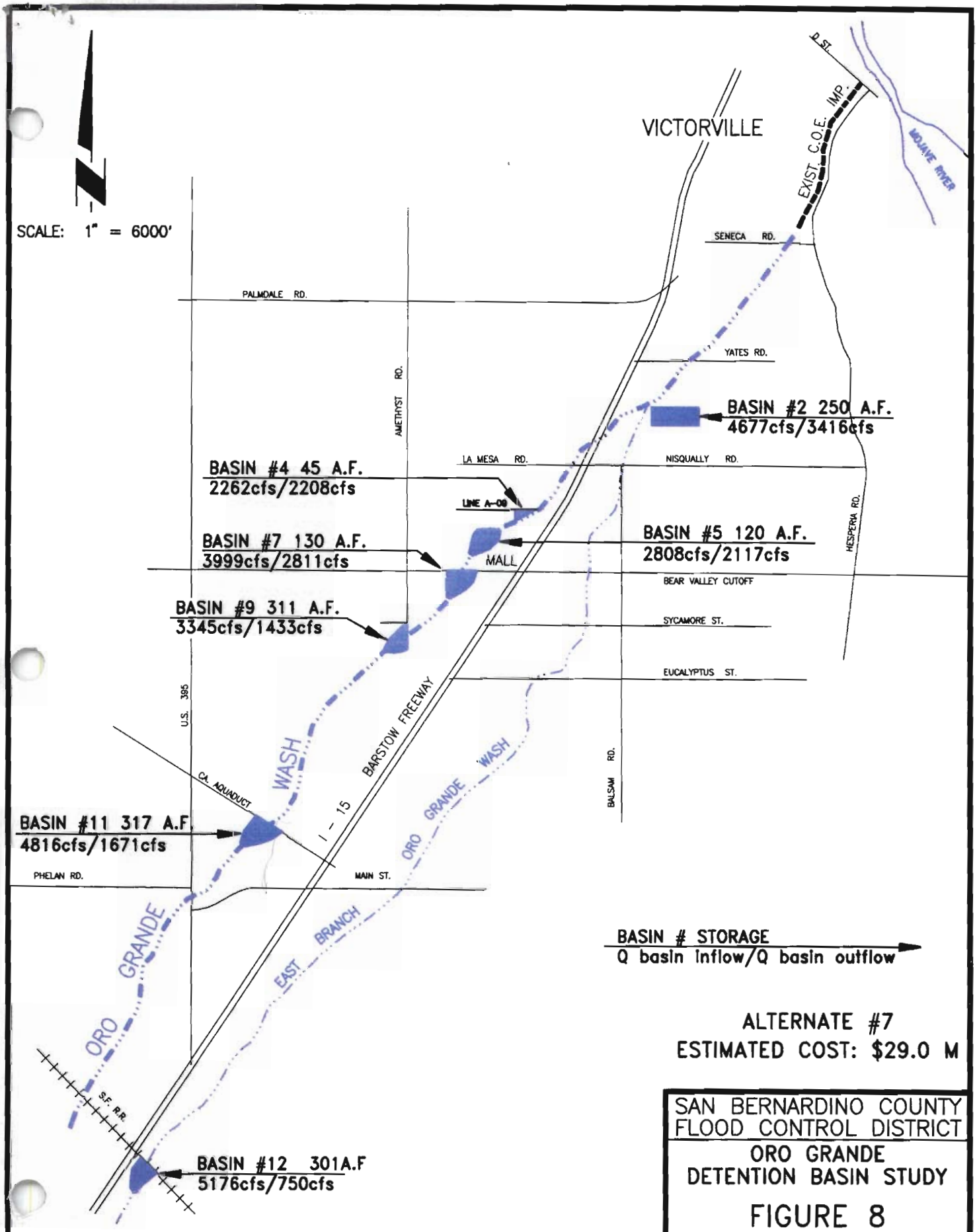
ALTERNATE #6
ESTIMATED COST: $29.0 M

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

ORO GRANDE
DETENTION BASIN STUDY

FIGURE 7

DATE:	SYS. NO:	ACAD FILE:	S.B.C.F.C.D. FILE:
OCT 95	4-106	4106BASN	PM-D1-24



SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

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DETENTION BASIN STUDY

FIGURE 8

DATE:	SYS. NO:	ACAD FILE:	S.B.C.F.C.D. FILE:
OCT 95	4-106	4106BASN	PM-D1-24