A

Brief History

Of the

Orange County Flood Control District

American Society of Civil Engineers

Los Angeles Section
Orange County Branch
History & Heritage Committee

Prepared By
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January, 2000

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Historic Civil Engineering Landmark Nomination

To: Committee on History and Heritage
American Society of Civil Engineers
1015 15th Street, NW, Suite 600
Washington, D.C. 20005

Date: _____ ASCE Section: **Los Angeles Section**

This is to nominate the following for designation as a Local/State Historic Civil Engineering Landmark: **Orange County Flood Control District**

Located at: **300 N. Flower Street' Santa Ana** County: **Orange** State: **California**

The proposed landmark's owner: **The Orange County Board of Supervisors**

In support of this nomination the following information is provided:

1. Date of construction (and other significant dates): **May 23, 1927- until the present time.**

2. Names of key civil engineers and other professionals associated with project: **Joseph B. Lippincott, Paul Bailey, M.N. Thompson, P. H. Budd, George Osborne, Murray Storm, Carl Nelson, William Zaun, see attached report for detailed information.**

3. Historic (international, national, state, or local) significance of this landmark: **The development of Orange County would have been impossible without the facilities of the Orange Control Flood Control District. See attached report for more information.**

4. Comparable or similar projects, both in the United States and other countries: **Los Angeles Flood Control District, Miami Conservancy District, see attached report**.

5. Unique features or characteristics which set this proposed landmark apart from other civil engineering projects: **See attached report.**

6. Contribution which this structure or project made toward the development of (1) civil engineering profession; (2) the nation or a large region thereof (part 2 is necessary for an NHCEL): **See attached report.**

7. A list of published references concerning this nomination: **See Bibliography in attached report**.

8. A list of additional documentation in support of this nomination (Please list all enclosed documents, publications, photographs, and supporting historical

evidence. One 35-mm color slide and one 5" x 7"black and white glossy photograph is the minimum needed. These are required for publicity and presentation purposes.): **See Attached Report.** Also available is a 30-minute Microsoft PowerPoint Presentation.

9. The following is the recommended citation for CHHACE consideration:

Without the facilities of the Orange County Flood Control District much of the development in Orange County would have been either impossible or subject to catastrophic loss of life and property due to flooding.

10. The following is a statement of the owner's support of the nomination:

See Orange County Board of Supervisors resolution following page iv.

_____
Chairman, Los Angeles Section History & Heritage Committee

_____
Los Angeles Section Secretary

_____
Los Angeles Section President

_____
San Diego Section President

_____
San Francisco Section President

_____
Sacramento Section President

Note: For State Historic Civil Engineering Landmark designation the other Section presidents from the state should sign the nomination form or concur with the nomination in writing

AGENDA ITEM TRANSMITTAL

CONSENT ☒
DISCUSSION ☐
PUBLIC HEARING ☐

AGENCY/DEPT. USE
CEO REVIEW
☐ Concur
☐ Do Not Concur

CLERK USE ONLY

TO: BOARD OF SUPERVISORS COUNTY OF ORANGE

FROM: Public Facilities and Resources Department
FILE:

CONTACT FOR INFORMATION
Ken R. Smith 714-834-2308
Sonia Ytuarte Nasser 949-262-2424

MEETING DATE	SUBJECT	SUPV. DIST.
December 14, 1999	Nomination of the Orange County Flood Control District as a Local/StateHistoric Civil Engineering Landmark	All

SUMMARY OF REQUEST (Description for agenda)
PFRD requests Board approval to nominate the Orange County Flood Control District (OCFD) as a Local/State Historic Civil Engineering Landmark under the American Society of Civil Engineers' recognition program.

ADDITIONAL DATA:
The American Society of Civil Engineers (ASCE) established a national program whereby the contributions of the civil engineering profession can be recognized and appreciated. The History and Heritage Committee of ASCE's Orange County Chapter participates in this program by designating local landmarks in Orange County. The Committee believes that the OCFCD deserves designation as a Local/State Historic Civil Engineering Landmark.

The Committee needs the approval of the Board of Supervisors, as the owner of the OCFCD, prior to submitting the nomination to ASCE's Los Angeles Section for review.

(Continued On Next Page)

PREVIOUS RELEVANT BOARD ACTIONS ON THIS SPECIFIC ITEM:
None

FUNDING SOURCE(S)	CURRENT YEAR COST	ANNUAL COST	BUDGETED? ☐ YES ☒ NO
Flood Fund 400	$1,100	$0	

WILL PROPOSAL REQUIRE ADDITIONAL PERSONNEL?
☒ NO IF YES, STATE NUMBER PERMANENT LIMITED TERM

CONSISTENT WITH BOARD POLICY?
☒ YES ☐ NEW ITEM OR EXCEPTION

RECOMMENDED ACTION
Adopt a resolution supporting nomination of the Orange County Flood Control District as a Local/State Historic Civil

ORANGE COUNTY FLOOD CONTROL DISTRICT

On motion of the Chairman of the Board of Supervisors, Charles Smith, duly seconded and carried, the following resolution was adopted:

WHEREAS, the State Legislature on May 23, 1927 approved the formation of the Orange County Flood Control District (OCFCD) and provided that it should be governed by the Orange County Board of Supervisors; and

WHEREAS, since that time, the OCFCD has distinguished itself in the pursuit of excellence in the planning, design, construction, and operation of the flood control system, and the use of said facilities has also benefited water conservation, parks, riding, hiking and bicycling trail programs in the County of Orange; and

WHEREAS, without the OCFCD's facilities much of the development in Orange County would have been either impossible or eventually subject to catastrophic loss of life and property due to flooding; and

WHEREAS, the History and Heritage Committee of the local chapter of the American Society of Civil Engineers (ASCE) recognizes the contributions of the civil engineering profession by designating local landmarks in Orange County as Local/State Historic Civil Engineering Landmarks; and

WHEREAS, the History and Heritage Committee believes that the OCFCD deserves to be nominated as a Local/State Historic Civil Engineering Landmark as the OCFCD has diligently planned projects for flood protection benefiting the entire County of Orange and has requested that the Board of Supervisors approve of this nomination.

NOW, THEREFORE, BE IT RESOLVED that the Orange County Board of Supervisors hereby commends and congratulates the Orange County Flood Control District for 72 years of outstanding service to the County of Orange, and fully supports the nomination of the Orange County Flood Control District as a Local/State Historic Civil Engineering Landmark.

Introduction

Orange County is located along the Southern California Coastal Plain between Los Angeles and San Diego counties. The total area of the county is about 950 square miles or 608,000 acres. The eastern fringe of the county consists of the Chino Hills and the Santa Ana Mountains, which reach a maximum elevation of 5,680 feet at Santiago Peak. Unlike the plains of the Midwestern United States, Orange County's topography changes quickly from the mountains to the sea. Most of the county's coastal plain lies below an elevation of 500 feet above sea level.

Between the mountains and the sea the alluvial plain was formed by the fluvial commingling of three intermittent streams, the Los Angeles River, the San Gabriel River, and the Santa Ana River. The largest of these, the Santa Ana, runs from the crest of the San Bernardino Mountains, passing through Riverside and San Bernardino Counties before entering Orange County through the "narrows" known as Santa Ana Canyon. Prior to 1825 the flood outwash of the Santa Ana meandered from the canyon across the Coastal Plain and merged with the San Gabriel before entering the ocean at Anaheim Bay (near what is now the City of Seal Beach). As a consequence of the flood of 1825 the river mouth of the Santa Ana was diverted several miles southeasterly and the classical sandpit now known as the Balboa Peninsula was formed by river sedimentation.

The flood of 1862 was Orange County's biggest flood, when the river raged out of control. "The destruction was not great, only because the area was so sparsely populated. In the center of Anaheim, four miles from the Santa Ana River, water stood four feet deep. The flood brought from the mountain and canyons great rafts of driftwood, which were scattered over the plain below the city and furnish fuel for the poor people of the city for several years."[1] See Appendix A, Photograph No. 1.

The County of Orange was established in 1889 when the State Legislature separated it from Los Angeles County. At that time the population of Orange County was approximately 19,000. Flooding was not new to the inhabitants of the area. Mild winters and long hot summers usually bless Southern California. Seldom is there any measurable rainfall from May through September. Also, there are usually periods of several years between flood producing storms, all of which produces a false sense of security about flood hazards. Nonetheless, two great floods had been experienced in the 27 years preceding Orange County's formation. All the floods had a similar pattern. Several days of intense rainfall would saturate the watershed then high flows from the hills and mountains were carried onto the alluvial plain. Since the coastal channels were relatively shallow and not well defined, the substantial meandering of the infrequent floods laid down rich soils on the unoccupied coastal plains [2]

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[1] Guinn, J. M., "A History of California, Los Angeles," 1915 as quoted in the Los Angeles Times, Orange County Edition, January 15, 1995

[2] H.G. Osborne, Progress Report on the Flood Control & Water Conservation Activities of the Orange County Flood Control District, April 9, 1962, p.1

It was not until after the Flood of 1916 that flood protection began to receive detailed attention in the county. Later, in 1925 a report on Water Conservation and Flood Control for Orange County was prepared by Mr. J.B. Lippincott. On April 2, 1927, Mr. Paul Bailey, the State Engineer for California, filed a report with the Governor and the State Legislature on the water problems of San Bernardino, Riverside, and Orange Counties. On May 23, 1927 the formation of the Orange County Flood Control District (OCFCD) was approved by the State Legislature.

Historic Significance of Landmark

History of Flood Control in Orange County Prior to the Formation of the Orange County Flood Control District

Early organized attempts to control floodwaters in Orange County were primarily by agricultural groups who constructed and maintained ditches from diversion dams in the streams to irrigate their farms. These protection groups preceded the Anaheim Union Water Company, the Santa Ana Valley Irrigation Company, the Tustin Water Company, the Irvine Ranch Company, and many others.[3] Other early efforts to control floods in Orange County were largely concentrated on the Santa Ana River, and the works constructed were of a temporary nature and accomplished by individuals or by localized protection districts.

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[3] Harrison & Wooley, Study and Report on Drainage Areas of Orange County, June, 1954, p. ii

"Accurate information about large floods in the past cannot be obtained, although measurements of stream flow in Southern California was commenced in the period 1893-1895, it was not until after 1906 that any large number of streams were regularly measured. Prior to that time only rainfall records were available. Only general deductions as to flood data can be made from rainfall records alone. For still earlier information recourse must be had t old books, records of the Missions, and the writings of early day travelers. Such information is only of slight value except as an indication that floods have occurred and possibly the extent of flooded areas, but are of no assistance in estimating the volume or duration of flood runoff.

Using all of these sources of information it appears that floods great enough to attract attention and under present conditions probably cause inconvenience or damage, occurred in the years listed below:

1786	Heavy rains.
1811	Floods-Southern California
1815	Floods-Southern California
1825	Great flood in Santa Ana River
1841-1842	Wettest winter known.
1849-1850	Wet, floods.
1851-1852	Severe floods, Southern California
1853	Big floods
1859-1860	Floods-Los Angeles River; first bridge across river authorized by the city.
1861-1862	Heavy floods in all parts of California. Santa Ana river at Anaheim ran 4 ft. deep and spread in an unbroken sheet to Coyote Hills. Rain for 30 days in succession beginning Dec. 24, 1861.
1868-1869	Floods in Santa Ana River.
1884	Heavy floods of long duration in Santa Ana. Stream cut a new channel to the sea.
1886	Floods. Area Los Angeles to Wilmington inundated. For 2 or 3 weeks railroad communication with outside world was impossible.
1888-1889	Flood-Lower Santa Ana Canyon

1890-1891	Floods Santa Ana River. Lake Elsinore overflowed
1894-1895	Floods Santa Ana
1906	Wet winter. Some floods.
1914	Floods, particularly in Los Angeles County.
1916	Floods in all Southern California streams. This is highest flood on which there is definite information. Measurements not complete in Santa Ana Canyon but were higher on the stream
1927	Flood in Santa Ana. Measurements made in Santa Ana Canyon.

In the eighty years from 1850 to 1930 there are recorded here 15 years in which major floods occurred. Of these 1862, 1884, and 1916 are the greatest floods, those most likely to cause large property damage or loss of life. None of these great floods were measured in Orange County and any estimate of height or volume is dependent upon measurements made at points where the streams leave the mountains in San Bernardino County or upon estimates based on rainfall. The probability is that the 1916 flood is the highest water experienced in the Santa Ana River in seventy years. The flood of 1862 probably exceeded that of the 1916 both in height and volume of flow. The flood of 1884 was of great volume and of long duration, though it may not have produced the crest flow of 1862 or 1916."[4]

The flood of 1916 was of great significance in its effect on a growing Orange County. It consisted of two storms, the first starting on January 16 and the second reaching a peak on January 28th. Cross-sections made near the Orange County line by the County Surveyor indicate a maximum flood discharge of 45,000 second-feet. There were 28 lives lost and the estimated damage to Orange, San Diego, Riverside, San Bernardino, and Los Angeles Counties was in the neighborhood of ten million dollars. Damages to Orange County were as follows:[5]

[4] "Control and Conservation of Flood Waters in Orange County California, April 1931," Elliott, G.A, Etcheverry, B.A., Means, Thos. H.

1916 Flood Damage to Orange County	
Lives lost	4
Agricultural lands	$350,000
Municipal	32,000
Water Supply	57,000
Highways and bridges	81,000
Railroads, telephone and telegraph lines	400,000
Total	**$920,500**

In 1918, the Board of Supervisors of San Bernardino, Riverside, and Orange Counties enlisted consulting engineers, Mr. John H. Quinton, Mr. F.H. Olmstead, Mr. A.L. Sonderegger, and Mr. W.K. Barnard, to report on the methods, possibilities, and benefits of conservation and flood control on the Santa Ana River. This report resulted in a preliminary assessment and recommended further detailed studies to determine the best flood control measures. Since 1918, San Bernardino, Riverside, and Orange Counties and other organizations had been spreading the floodwaters in the upper portions of the basin. By 1925 the three counties had spent about ten million dollars on retarding reservoirs and stream control works.

By 1927 Orange County had developed into a highly agricultural area with the subsequent amount of urban development. With the county developed to this extent, it became economically feasible to expend funds for flood protection. On April 2, 1927, Mr. Paul Bailey, a prominent consulting engineer residing in Orange County, and who at

[5] J.B. Lippincott, p. 37-38

that time was also the State Engineer, filed a report with the Governor and the State Legislature on the water problems of the San Bernardino, Riverside, and Orange Counties. The consulting Engineering Committee working with Mr. Bailey at that time was J.B. Lippincott, for Orange County, Mr. A.L. Sonderegger, for Riverside County; and Mr. George S. Hinckley, for San Bernardino County. On May 23, 1927, the formation of the Orange County Flood Control District was approved by the State Legislature.[6]

Unique Features Which Set Landmark Apart from Other Civil Engineering Projects

"The Orange County Flood Control District (OCFCD) is a subdivision of the state government and amounts to a delegation by the legislature of the state's power to deal with flood control and water conservation problems to a local group. The legislature provided that the boundaries of the OCFCD would be the same as those of Orange County. It provided that the OCFCD should be governed by the Board of Supervisors of Orange County. It provided for the levying of taxes and for the issuance of bonds under certain circumstances."[7] The facilities constructed by the OCFCD have prevented a great deal of losses to life and property that would have otherwise have been experienced from

[6] Harrison & Wooley, 1954, p.iii.
[7] H.G. Osborne, p. 3

flooding. By constructing flood control facilities concurrently with new development, the OCFCD has made residential and commercial developments in the county more secure from flooding.

Comparable or Similar Projects

Los Angeles County Flood Control District, California

The phenomenal population growth of the Los Angeles area began about the turn of the twentieth century with the completion of the transcontinental railroads and the expansion of the electric interurban and street railroads. The ill-defined drainage courses of the area were usually dry, except during infrequent winter storms. Often several years would pass without significant stream flow. In 1914 one of the large infrequent winter floods inundated unprotected developments. The City of Los Angeles was a thriving center of business and the population had more than doubled since the prior episode of flooding. The County's Board of Supervisors recognized the need for a funding mechanism for construction of flood retention dams in the mountain areas to reduce the volume and rate of runoff tributary to the county's shallow, erodible streambeds.

Shortly thereafter, the State Legislature created the Los Angeles County Flood Control District and provided authority for the issuance of municipal bonds if approved by the voters of the district. Bond elections were successful and by the mid-1930's much had been accomplished. However, more work was needed and the United States

Congress adopted the 1936 Flood Control Act. This Act authorized planning for a new federal funding program which included not only the Los Angeles Drainage Area project, but also the Santa Ana River Project to benefit the counties of Orange, Riverside and San Bernardino.

The Los Angeles County Total Flood Control System was designated a Local Civil Engineering Landmark in 1975 by the Los Angeles Section of ASCE.

Miami Conservancy District, Dayton, Ohio

"The first regionally coordinated flood control system in the United States embodying retention reservoirs for controlled release of flood waters. The actual project consisted of construction of five dams, levee and channel improvements of nine villages and towns, the relocation of four railroad lines and of many highways and wire lines, the removal of one village, the lowering of water and gas mains and many other civil engineering works. Since 1922 the Miami Valley has not been damaged from flooding. The District was designated 1972 as a National Historic Civil Engineering Landmark."[8]

Contribution this Project made toward Development of Orange County

Orange County was rapidly transformed from an agricultural county to an industrialized area after World War II. Many war veterans settled in the county after the war and the area exploded with residential development. In addition, many of these war

[8] Guide to History & Heritage Programs, American Society of Civil Engineers, 1993

veterans went to work at the numerous aviation and aerospace companies that were also located in Orange County. As the county blossomed with population growth, the OCFCD actively participated in the planning of flood prevention by way of analyzing flood hazards and issuing reports to the California State Real Estate Commissioner and to the local planning commissions. Numerous residential and commercial developments were afforded flood protection because of the planning commissions' requirements for flood channel construction as a condition of development approval.

Recognizing the need for a broader base of financing for regional flood control improvements, the OCFCD in 1955 completed a comprehensive Engineers Report recommending a countywide plan of constructing channel improvements, dams and retarding basins that could be funded with municipal bonds if approved by the district's voters.

In June of 1956, the district's voters by a two-thirds majority approved a $43,620,000 bond issue to initiate the construction recommended in the Engineers Report. The bond issue provided funds for rights-of-way acquisition and construction of the countywide network of flood channels. These channels provided points of discharge for the storm drainage systems that were needed to effectively drain the city streets being developed during the great residential development boom in the late 1950's and 1960's. Without the channel improvements completed under this bond issue and subsequent construction financed by "pay-as-you-go" ad valorem taxes, the county's flood-safe

development would have been stymied by about 1965 when the population had reached more than 500,000.

Key Professionals Associated with Project

Joseph B. Lippincott — Hydraulic engineer.

J.B. Lippincott was retained by the County of Orange in 1925 to prepare a report outlining the deficiencies related to flood control in the county. The report was subsequently used in the appeal to the State Legislature for the formation of the OCFCD in 1927. See Appendix A, Photograph No. 3.

Born October 10, 1864 in Scranton Pennsylvania, son of Joshua Allen and Harriet (Barlow) Lippincott. Joseph's father was an Episcopal clergyman and an educator. Lippincott was a student at Dickinson College during 1880-82. He then transferred to the University of Kansas where he earned a B.S. in engineering in 1887.

Lippincott's first professional civil engineering job was with the Santa Fe Railroad; he worked on the construction of the railroad between Kansas City and Chicago. During 1888-89 he was a division engineer on the construction of the Missouri, Kansas & Texas Railway. Later he was a resident engineer of the Kansas City Belt Line Railroad. From 1889-91 he worked with U.S. Geological Survey as a topographer. He worked with John Wesley Powell's Irrigation Survey, which attempted to launch a federal reclamation program in the West. Lippincott lost his job when Congress did not

fund the Survey project. He moved to California shortly thereafter and began a private practice as a hydraulic engineer on various irrigation projects.

From 1896 to 1902 he was a hydrographer with the U.S. Geological Survey in California. From 1902 to 1904 he was a supervising engineering of the Southwest-Pacific Coast District of the U.S. Reclamation Service and was in charge of the Klamath River project in Oregon and Yuma project. In 1902, the Reclamation Service selected Lippincott as its first commissioner. He still maintained a part-time engineering practice on the side. The Reclamation centerpiece project was to be the Owens Valley Project. Lippincott acted as a double agent on behalf of the City of Los Angeles' effort in their plan to take water from the Owens Valley. [9]

In 1906, Lippincott was made assistant chief engineer on the construction of the Los Angeles Aqueduct. He resumed private practice in 1913 and was a consultant on municipal water works for the cities of San Francisco, Fresno, Santa Barbara, and Los Angeles. He also provided services to other California towns, and El Paso, Texas, Phoenix, Arizona, and the Counties of Los Angeles and Orange. In 1917 he became the chief engineer and manager for the William E. Hampton Co., during this time he was involved in building barrack roads at Fort MacArthur and Fort Rosecrans, and a temporary aviation field at North Island. From 1918-19 he was in charge of housing projects for the U.S. Housing corporation at Neville Island and at Bethlehem,

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[9] Reisner, Marc, Cadillac Desert-The American West and Its Disappearing Water, Viking Penguin, New York, New York, 1986, pp. 65, 70-97.

Pennsylvania. From 1919 until he died he was in private practice and worked on irrigation projects in California, Mexico, Alaska, and Hawaii.

Lippincott was very active in public life and served as civil service commissioner of Los Angeles in 1910. He was the park commissioner of Los Angeles from 1908-1916, state commissioner of the 6th District Agricultural Association of California in 1911, and consulting engineer for the state of California. Lippincott also served on the Tri-County Flood Control Board and Los Angeles County Flood Control District from 1927-1928. He was a member of the Water and Power Commission of the Los Angeles Chamber of Commerce from 1924-1936, and he was the commissioner of the International Water Boundary Commission in 1932.

He was awarded the J.J.R. Cross Medal in 1914 from the American Society of Civil Engineers for his paper on "Tufa Cement as Manufactured and Used on the Los Angeles Aqueduct." He was also an honorary member of the American Society of Civil Engineers, Southern California Engineers and Architects Association, Southern California Institute, Beta Theta Pi, Tau Beta Pi, and the California and Los Angeles Country Clubs of Los Angeles. He was an Episcopalian, and was married in Beverly, New Jersey in April 1890 to Josephine Phillips Cook. They lived at 1256 W. Adams St. and his office was located at 714 W. Olympic Blvd. in Los Angeles, California. They

had two children, Rose H. and Joseph Reading Lippincott. Joseph Barlow Lippincott died in Los Angeles on November 4, 1942.[10]

Paul Bailey — First Chief Engineer for the Orange County Flood Control District

Mr. Paul Bailey was a prominent consulting engineer who was residing in Orange County in the 1920's. He was also State Engineer in 1927 and was the engineer who filed the report with the Governor and State Legislature which led to the creation of the Orange County Flood Control District. He was later retained by the County of Orange to be the District's first chief engineer. In 1933 when the State Legislature formed the Orange County Water District, Bailey was hired as the water district's first engineer. He died in 1986 in Santa Ana, California.

M. N. Thompson — Second Chief Engineer, Orange County Flood Control District

Information on the district's second engineer is extremely scarce; newspaper articles refer to him as "Nick" Thompson. It is known that he succeeded Paul Bailey as chief engineer in 1930. Art Beard succeeded Mr. Thompson as the chief engineer in 1941 and served in that capacity until 1949. Jack Bradley served as the chief engineer of the flood control district from 1949 until 1953.

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[10] Who Was Who In America, Vol. 2, 1943-1950, A.N. Marquis Co., Chicago, 1963, p.895.

P.H. Budd — Chief Engineer, Orange County Flood Control District, 1953 – 1955.

P. H. Budd was a native of New York State where he received his early schooling. In 1908 he received his civil engineer degree from Cornell University and subsequently was employed by the Department of the State Engineer and Surveyor of New York for nine years during the construction of the barge canal and terminals, advancing from rodman to an assistant engineer. He resigned from state service in 1917 to enter a private business venture. He resumed engineering work as an assistant engineer for Walter G. Clark, consulting engineer of New York and Los Angeles, for whom he made studies of the Colorado River in connection with the development of the lower river by private capital. This included preliminary designs and estimates for dams at Boulder Canyon, Black Canyon (Hoover Dam) and Bull's Head (Davis Dam).

In 1929 he moved to Orange County where he worked on various local projects. Since 1934 he was with the Orange County Flood Control District working on design and construction projects. In 1949 he was appointed Assistant Flood Control Engineer and succeeded Jack A. Bradley as chief engineer in January of 1953. He was a life member of the American Society of Civil Engineers and the Orange County Engineer's Club.

Herbert George Osborne — (1915-) Chief Engineer, Orange County Flood Control District, 1955-1980

A naturalized American born in Canada in 1915, his father was also a civil engineer who worked on projects such as the Panama Canal and the Canadian Pacific Railway. At the age of five, H.G. Osborne's family moved to Fullerton, California where his father established a private civil engineering firm that specialized in residential subdivision. Osborne graduated from Fullerton High School in 1933 and then attended the California Institute of Technology from 1933 to 1935. He ran out of money for college in 1935, then managed to get a job in Caltech's hydraulic lab as a technician. He saved enough money to resume his studies from 1939 to 1942. In 1942 he earned a Bachelor of Science degree in Civil and Mechanical Engineering.[11] In addition, he later completed courses in public administration, public health, law, disaster operations, biochemistry, and computers.

From 1942 to 1946 he served with the U.S. Navy as a line officer on a destroyer escort, seeing action in both the Atlantic and the Pacific. He is currently a retired commander from the Civil Engineer Corps of the Naval Reserve. From 1946 to 1950 Osborne worked for the Southern California Water Company. In addition, he also worked part-time preparing structural designs in private engineering practice. In 1950 he joined the Orange County Flood control District. He was named assistant chief engineer in 1953, and in 1955 the chief engineer of the Flood Control District.[12] See Appendix A, Photograph No. 4.

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[11] Los Angeles Times, Orange County, Sunday, Part X, November 28, 1976.
[12] County Roundup, January 1971, Volume 4, Number 1.

In 1974, Osborne was selected to head the newly formed County of Orange Environmental Management Agency (EMA). The EMA integrated six formerly independent departments such as the County's Road Department, the Planning Department, the Harbors, Beaches and Parks Department, and the Orange County Flood Control District. This all occurred just weeks after Osborne had been named the acting planning director and air pollution chief. He also served as the Water Pollution Control Engineer and Waterworks Districts Engineer for the County of Orange.

Osborne has been involved in many professional and civic organizations such as: advisory member of the Orange County Planning Commission, former Chairman of the County Supervisors Association's Committee on Flood Control and Water Resources, County Sanitation Review Board, County Regional Parks Committee, committee chairman of the California County Engineers Association, Sierra Club, and consultant to the World Health Organization in Rio de Janeiro, Brazil in 1967 on erosion and water supply problems.

Osborne has served as a past president of the Orange County Branch and vice-president and president of the Los Angeles Section of the American Society of Civil Engineers. Osborne continues to be active in the ASCE, serving on the History and Heritage Committee of the Orange County Branch.

He is a member of the American Waterworks Association, the American Geophysical Union, the California Water Pollution Control Association, the City

Engineers Association of Orange County, and a past president of the Orange County Engineers Club. Osborne also served on the State Water Quality Advisory Committee and the State Water Quality Control Board. Mr. Osborne is currently a Director of the Orange County Water District.

Osborne remained the head of the Environmental Management Agency (EMA) until his retirement in 1980. In 1992, when the County of Orange EMA relocated its headquarters in Santa Ana, California, as a tribute to Osborne, the new building was named after him. Mr. and Mrs. Osborne reside in Fullerton, California.

Chronological Highlights of the Orange County Flood Control District

Significant Events in the 1920s

1. "Report on Water Conservation and Flood Control on the Santa Ana River for Orange County" was prepared in July 1925 by J.B. Lippincott. This report was instrumental in the formation of the formation of the Orange County Flood Control District.

2. The Orange County Flood Control District is formed by the State Legislature on May 23, 1927.

> "To provide for the control of the flood and storm waters of said district, and the flood and storm waters of streams that have their source outside of said district, but which streams and flood waters

thereof, flow into said district and to conserve such waters for beneficial and useful purposes by spreading, storing, retaining, and causing to percolate into the soil within said district, or without said district, such waters, or to save or conserve in any manner all or any of such waters and protect from damage from such flood or storm waters, the harbors, waterways, public highways and the property in said district."-The Orange County Flood Control Act, Chapter 723, Statues of 1927, and as amended.

3. "Upon a Plan for the Control of Floods and Conservation of Water in Orange County California" [also known as the Engineer's Report of 1929] was prepared by Paul Bailey, Chief Engineer Orange County Flood Control District. April 1929.

4. June 1929, first attempt to pass a flood control bond issue was made by the District for the amount of $16,500,000. It was for the construction of dams at Prado, Brea Creek, Fullerton Creek, Carbon Creek, Santiago, San Juan, and Trabuco Creeks. The bond issue failed by 410 votes. It appears that a controversy over the best location for the dam on the Santa Ana River was a deciding factor in the action of the voters.

Significant Events in the 1930s

1. "National Public Works Project for Orange County, California" report prepared by M. N. Thompson. The report proposed a variation from the 1929 plan by Paul

Bailey; it proposed water conservation and reclamation. The Board of the OCFCD made a decision not to proceed with the plan.

2. In 1931 the Irvine Company and associated water agencies constructed a large water conservation project including Santiago Dam and reservoir on Santiago Creek, a distribution aqueduct and reservoirs such as Peters, Rattlesnake, Lambert, Laguna, Sand, and Bonita Canyons in the foothills surrounding the Tustin plain.

3. In May 1935, an application to Federal Emergency Administration of Public Works, by the Orange County Flood Control District Project was made for a grant and loan for construction under provision of Work Relief Bill of 1935. The application included 24 original black and white photographs of the 1916 flood.

4. The Federal Flood Control Act of June 22, 1936 authorized the Santa Ana River Basin (and Orange County), California, Federal Flood Control Project. The project consisted of Prado Dam, Brea Dam, Fullerton Dam, Loftus Diversion Channel, Carbon Canyon Dam, Villa Park Dam, San Juan Dam, Trabuco Dam, and Aliso Creek Dam.

5. The county experienced serious flooding in 1937 and in 1938. The flood of March 2, 1938, with a peak flow of 100,000 cubic feet per second (cfs) in the Santa Ana River, rushed across the Coastal Plain, devastating residential areas of central Anaheim and Santa Ana, wrecking highway and railroad bridges,

inundating farmland from Costa Mesa to Los Alamitos. According to the Los Angeles Times, Orange County Edition, of January 15, 1995 there were 58 deaths and $12 million in damages in the 1938 flood. The article states that "among the dead were 43 residents of a Mexican settlement in Atwood that was swept by and eight-foot wall of water." See Appendix A, Photographs Nos. 5, 6, 7, and 8.

6. In 1938, the OCFCD began construction of protective works on the major streams of the county. Emergency state funds for $200,000 were used to pay part of the cost.

7. In 1939 the Congress of the United States directed the Army Corps of Engineers (ACOE) to proceed with design of Prado Dam which had previously been authorized by the Flood Control Act of 1936. The dam and reservoir lands would overlie the farming community of Rincon, which is located within Riverside County and above the narrows of Santa Ana Canyon. The cost-sharing requirements of the federal program required the local sponsor, the OCFCD, to acquire lands, easements, and rights of way for the project. In addition the OCFCD also had to relocate affected utilities, highways, and the Atkinson, Topeka & Santa Fe Railroad which previously traversed the river bed area at the dam site.

8. Concurrent with Prado Dam, the ACOE also proceeded with the design of Brea Dam and reservoirs on Brea Creek and Fullerton Dam on Fullerton Creek in the city of Fullerton.

Significant Events in the 1940s

1. The War Department entered into a contract to construct Fullerton Dam in June 1940 and construction was completed in May 1941.
2. The War Department entered into a contract to construct Brea Dam in June 1940, and construction was completed in March 1942.
3. Prado Dam was completed in May 1941 by the War Department.
4. From 1943 to 1946 there was very little activity in flood control, except for flood channel maintenance and the construction of drainage systems for the new military bases for the Army, Navy, and Marine Corps.

Significant Events in the 1950s

Orange County's greatest growth cycle began in 1950, following the recession of 1949. By 1953, the district could look back on only nominal achievements accomplished in the face of the economic stagnation of the thirties, the material shortages of the post-war years and the controls accompanying the Korean War.

1. From 1946 to 1954 Congress made no further appropriations for flood control projects in Orange County. The War Department's proposed projects for Villa Park Dam, Aliso Creek Dam, and Carbon Canyon Dam and Channel were postponed due to lack of appropriations.

2. The winter of 1952 confirmed the need for additional flood protection. Flood flows from the Carbon Canyon Creek flowed unmitigated through downtown Anaheim and westward toward the northwest, merging with Coyote Creek along the Los Angeles County border and flooding roads, residences and farms surrounding the Los Alamitos Naval Air Station.

3. Report prepared by consultants Harrison & Wooley, in March, 1955, "Orange County Flood Control District Engineer's Report to the Board of Supervisors of the Orange County Flood Control District on General Plans, Specifications, and Estimates of Cost for Rights-of-Way for Drainage Facilities for Flood Control in Orange County, California".

4. On June 6, 1956 a bond program for flood control was approved by more than the required two thirds vote. On October 31, 1956, Board of Supervisors adopted an ordinance providing for the issuance of bonds in the amount of $42,620,000.

5. Since 1955, the Orange County Flood Control District has made flood hazard reports to the California Real Estate Commissioner on all subdivisions within the county (including municipalities). These reports have exerted a profound

influence on developers, private engineers, city engineers, and loan institutions in bringing to their attention flood problems and establishing criteria for acceptable levels of probable flood losses. While only advisory, these reports at times have had the effect of flood zoning as far as residential subdivisions of overflow lands is concerned.

6. The unusually wet winter of 1958 did not produce significant flooding in the Orange County area, due to the relatively light intensity of the long periods of rainfall.

Significant Events in the 1960s

1. The Orange County Flood Control District's 1956 bond financed construction was largely completed during the 1960's. The work included the acquisition of flood channel rights-of-way, construction of local flood channel improvements across the coastal plain, and reconstruction of the Santa Ana River levees, from the ocean to the Santa Ana Freeway. The levees were reconstructed based on the reduced flows from Prado Dam and the eventual construction of the authorized dams on Santiago Creek and at Carbon Canyon.

2. In 1961 the ACOE completed Carbon Canyon Dam, enabling the OCFCD to continue with downstream construction of the Carbon Canyon Diversion Channel, changing its point of discharge from central Anaheim, to the Santa Ana River.

Soon thereafter, the residual channel of Carbon Creek was improved running westerly from east Anaheim to the San Gabriel River.

3. In 1962 the Orange County Board of Supervisors requested the U.S. Congress to authorize a restudy of the Corps of Engineers Santa Ana Basins (and Orange County) survey. The Board of Supervisors also authorized a study entitled, "A Study of Flood Control and Water Conservation Deficiencies in Orange County, California". The study when completed in 1964 described approximately $300 million of facilities necessary for protection of impending development in the county.

4. In 1963 the Villa Park Dam on Santiago Creek was completed by the OCFCD alone, utilizing 1956 bond funds, rather than waiting for congressional appropriations.

5. In 1964 Congress authorized the resurvey requested by the Orange County Board of Supervisors in 1962.

6. The Board of Supervisors later directed the Chief Engineer to prepare an Engineers Report for bond election purposes which envisioned the next phase of flood control improvements being funded by a combination of future OCFCD bond elections to supplement possible federal funding if authorized by United States Congress. In addition there was a requirement that private developers

would be responsible for all construction necessary for flood protection of new development.

7. In 1964 Congress responded to a resolution of the Board of Supervisors requesting the ACOE of Engineers to undertake a restudy of the previously authorized Santa Ana River (and Orange County) Project to ascertain the extent to which planned flood control improvements would merit federal appropriations. When the survey report was completed in 1975, activity was commenced to fund what eventually became the most expensive single flood control project in the Western United States, the Santa Ana River Mainstem Project.

8. Following the defeat of two successive flood control bond elections in 1966 and in 1967, the Board of Supervisors adopted a "pay-as-you-go" philosophy for the construction of needed flood protection public works.

9. The county experienced two successive flood producing storms in January and February of 1969. Each of the severe storms was approximately one week in duration and each was rated by the United States Geological Survey as <u>once</u> in a 30-year recurrence. The interim flood channels of OCFCD functioned well, largely preventing flooding of private property, but the unlined earthen channels were badly eroded, requiring millions of dollars for repairs, some of which was eligible for Federal Emergency Management reimbursements. See Appendix A, Photographs Nos. 9 and 10.

The ACOE prudently operated Prado Dam so as to reduce the threat of lower Santa Ana River levee failure. During the peak inflow of up to 77,000 cfs outflow was held to a maximum of 5,500 cfs. In so doing Prado Reservoir accumulated the highest water level in storage (50% of maximum capacity) since completion in 1941. The ACOE minimized releases due to weakened downstream levees which required extensive repairs to avoid flooding between Anaheim and Huntington Beach. The resulting unusually long draw down period for the reservoir caused concerns about flood storage deficiency should another great storm occur in March, similar to the March 1938 Flood.

The combination of the two long-duration storms was even more significant on the Santiago Creek watershed. Private homes along the natural streams of the Santa Ana Mountain canyons (outside the ownership of the OCFCD) overflowed their banks, grievously damaging private homes by erosion and inundation. Canyon roads and bridges were overwhelmed and destroyed. Spillway flow from the Irvine Company's Santiago Dam, (designed only for water conservation, peaked at 12,000 cfs, discharging downstream to OCFCD's Villa Park Dam.

Although the hydrograph of peak inflow to Villa Park was less than the 100-year design rate, the flood volume far exceeded the design volume of the flood control reservoir, which was empty, to debris pool, at the start of the

February storm. The outlet gates of the dam are designed for a maximum rate of 3,500 cfs. As the reservoir approached spillway elevation OCFCD's operators increased the gated discharge to 4,500 cfs, to little avail. Spillway flow peaked at 6,000 cfs before the storm abated.

Lower Santiago Creek flows through the cities of Orange and Santa Ana to its confluence with the Santa Ana River. Probably not since the completion of Santiago Dam in 1931 had the lower Santiago Creek experienced as much flow as in 1969. The creek overflowed its banks only within the rock masonry-lined channel of Hart Park and without serious damages there. However, the fast-moving stream flow caused a great deal of erosion. Unprotected, natural banks of the stream in some areas were severely eroded, destroying several homes and apartment houses, roads, and bridges. Fortunately, there was no loss of life, despite the heroic efforts of hundred of volunteers who fought the bank erosion with sandbagging, and military helicopter personnel dropping junk auto bodies from the air at otherwise inaccessible locations. See Appendix A, Photograph No. 11. A complete history of the event is recounted in John K. Kern's book, "The 1969 Floods in Orange County," Santa Ana, California, December 1972.

Significant Events in the 1970's

1. In 1970 the ACOE restudy of the 1936 Santa Ana Basin Plan had reached a level revealing that Prado Dam Reservoir would not control a project storm without controlled spillway discharge. With updated hydrology, only a seventy-year flood could be controlled without spillway discharge. With new project storm and changed watershed hydrologic conditions, the ACOE projected a 100-year recurrence flood interval would fill Prado Dam to capacity and spillway flow would be approximately 48,000 cfs. Further, the larger Standard Project Flood would result in spillway flow of 150,000 cfs. Either event would overwhelm the existing OCFCD levees and the devastating damage estimates ultimately led to Congressional support for authorization to totally rebuild the Santa Ana River system including additional upstream storage volumes and increased lower channel capacity.

2. In the early 1970's many miles of flood channel construction were funded by the property value increases on OCFCD's ad valorem tax revenue. Notably, the side slope revetments along the Santa Ana River from the Pacific Ocean to Weir Canyon Road were reconstructed. From 17th Street in Santa Ana to the ocean, a reinforced concrete side slope lining replaced the wire-reinforced asphalt lining of the soft-bottom channel, which was badly damaged in 1969. From the Santa Ana

Freeway to Weir Canyon Road, the OCFCD and the Orange County Water District collaborated on a dual channel concept with a primary flood channel revetted with loose rock riprap. This enhanced the diversion of runoff from small storms into off-channel spreading grounds, while confining flood flows to the soft-bottom, revetted channel with hydraulic capacity only for the original design flood from Prado Dam. This interim, but expensive improvement of the river was necessary because of the uncertainty about when, if ever, the ACOE would receive Congressional appropriations for the larger upstream flood storage capacity needed to control the Standard Project Flood.

3. In 1974 the Board of Supervisors adopted a new organizational structure under which the formerly separate departments of Planning, Building & Safety, Roads, Surveyor, Solid Waste, Water Pollution, Harbors, Beaches and Parks, and the Flood Control District were merged under the Environmental Management Agency (EMA). The OCFCD's Chief Engineer, George Osborne was appointed as Director of the new Agency. The former departments were restructured with most of the technical flood control responsibilities assigned to the Assistant Director for Development under Carl Nelson (the former Assistant Chief Engineer of OCFCD). The Development function also included the Office of County Surveyor, and Nelson was appointed the concurrent titles of County Surveyor, as well as Manager of Harbors, Beaches and Parks.

4. The new agency heralded not only the full endorsement of administrative efficiencies inherent in seasonal joint use of equipment and labor available in Roads and Flood, but also for park maintenance and in joint use of facilities. For instance, Irvine Regional Park was expanded into the normally dry reservoir area of Villa Park Dam and enhanced with riparian habitat and nature trails. Likewise, a former wastewater pond obtained from Moulton Niguel Water District was converted into a flood-retarding basin with year-round recreational use to complement the Laguna Niguel Regional Park. Many other examples exist such as the "Mountains to the Sea" concept of bicycle riding trails open to the public along the flood control district's Santa Ana River, San Diego Creek, Aliso Creek, Trabuco and San Juan Creeks.

5. Around 1975, a capital outlay fund was established to accumulate money for cost sharing for a Santa Ana River project. First appropriation was one million dollars and was added to each year from ad valorum taxes until 1979 and from the Special District Augmentation Fund thereafter. These funds were used for the annual five percent cash contribution to ACOE construction projects and to pay for acquisition of rights of way and relocations. Under the State Water Resources Act of 1945, as amended in recent years, counties are eligible for a seventy-percent reimbursement of funds expended for cost sharing on federal flood

control projects. However, there is a growing backlog of unpaid invoices as the legislature and the Governor cope with prioritization of state appropriations.

6. The end of a five-year period of statewide drought was punctuated by one of Southern California's historically wettest years in 1977-78. Once again, the capacity of Prado Dam was severely tested by several large storms. By winter's end the reservoir had filled to approximately fifty percent of capacity during delayed draw down for repair of Santa Ana riverbed erosion damages to the interim channel's grade-stabilization structures. Generally, flood damage was limited to older roads and bridges, erosion of unprotected private property, and internal damages to interim earthen flood channels.

7. 1978 was a landmark year for several reasons, one of the most remarkable being the completion of the Environmental Impact Study (EIS) and congressional authorization for the ACOE to proceed with the General Design Memorandum for the Santa Ana River Mainstem Project. The name "Mainstem" arising from the previous selection of the "All River" alternative consisting of three parts which would have benefits to all three local (Orange, Riverside and San Bernardino Counties) sponsors. The adopted plan includes three primary features:

    A. A high dam and flood storage reservoir in San Bernardino County. Eventually, after further study of alternative locations, it was named as "Seven Oaks Dam" and located near the historic

Edison/Bear Valley Mutual Water Companies jointly-operated hydroelectric and irrigation plants which is a short distance upstream from the Greenspot Road bridge crossing the Santa Ana River.

B. Raising Prado Dam to provide larger flood storage volume and a new outlet gate system for control of the Standard Project Flood when combined with the operations of Seven Oaks Dam.

C. Reconstruction of the Lower Santa Ana River channel to accommodate larger discharges from Prado Dam than the existing gates affords. The Santa Ana Canyon reach of the river is to remain in its somewhat natural regime (largely within the County's Featherly Regional Park and partly occupied by Green River Golf Course) as a riparian corridor for wildlife preservation as required by the adopted EIS.

8. Also in 1978 the voters of California passed the notorious "Proposition 13" initiative which limits the total tax that can be assessed on real property to a not-to-exceed rate of one percent of the County Assessor's appraisal of value unless approved by a two-thirds majority vote. Since most counties at the time were levying a larger total rate of property taxes, the net result was a reduction of revenue. For the OCFCD, this meant downsizing of operational overhead and a

slowdown in capital outlays. The slowdown in capital outlay had a significant impact to the Santa Ana River Project because of the revised cost-sharing formula adopted by the Congress in 1988.

Significant Events in the 1980's

By the early 1980's the OCFCD owned and operated over 300 miles of flood control channels and storm drains, four retarding dams, 11 water conservation and retarding basins, and four pump stations. Upon retirement of George Osborne in 1980, Murray Storm was selected as Director of the Environmental Management Agency. Within EMA, Carl Nelson continued leadership of the flood control district, under the title – Director of Public Works and County Surveyor, until his retirement in 1989.

1. Major winter storms produced damaging floods in 1980 and again in 1983.
2. Rainfall totals for 1983 rivaled that of 1978, making the five-year period from 1978 to 1983 one of the wettest five-year periods on record. More significantly, a very intense rainstorm occurred along the Orange County coast in the early morning of March 1, 1983. It was extremely damaging because it coincided with extra lunar high tides, extremely low atmospheric pressure, and high on-shore winds. All of which combined to produce the highest backwater conditions experienced in Orange County since the construction of the OCFCD's tidal channels began with the 1956 bond issue. The intensity of precipitation as

reported on automatic rain gages between Huntington Beach and Santa Ana equaled or exceeded the theoretical 100-year intensity for periods of 3-6 hours, the critical time of concentration of the affected flood channels. See Appendix A, Photograph No. 12. Hence the interim earthen channels, the Santa Ana Delhi, Greenville-Banning, Huntington Beach, Talbert, East Garden Grove Wintersburg, Westminster, Anaheim-Barber City, Bolsa Chica, and Los Alamitos, all designed for a 25-year storm, were confronted with a 100-year runoff rate against tidal backwater conditions. The consequence was flooded streets unable to flow freely into underground storm drains hydraulically inhibited by flood channel backwater. A large number of homes and businesses were flooded. Additionally, many ocean-view homes in the Sunset Beach/Surfside and Seal Beach communities were flooded by ocean waves overtopping the natural beach berms and flowing to lower elevation streets already burdened with rain runoff.

3. Subsequent improvement projects for tidal channels have been re-evaluated and as funds become available, the concrete channel linings are now designed as vertical wall channels to fit within existing rights of way and provide 100-year hydraulic capacity. Fortunately, this severe rainstorm of 1983 did not follow the general pattern of other, larger floods moving inland to the San Bernardino Mountains with increasing ferocity from orographic effects. In this event, inflow to Prado Dam and discharges to the lower Santa Ana River were inconsequential.

4. In 1986 the ACOE submitted its restudy of the Santa Ana River Mainstream Project report to the Congress of the United States requesting authorization for what is called a "new construction start". The project was authorized for construction in 1988, the three local sponsors signed a Local Cooperation Agreement, and the first funds for construction were appropriated in 1989. The first unit of construction was Reach 1 of the Santa Ana River channel reconstruction at the ocean mouth between Newport Beach and Huntington Beach.

5. Prior to the ACOE Santa Ana River construction, the OCFCD proceeded with two major "relocation projects", they are:

   A. The replacement of the Coast Highway bridge to accommodate the widening of the Santa Ana River Channel.

   B. The relocation of the Talbert Channel outlet to the ocean. This included an innovative dry weather removal of a levee on one side to accommodate a restoration of tidal continuity to a former wetlands area and regrading the wetlands as a tidal estuary for wildlife/environmental mitigation of the impacts of the river mouth construction that would follow.

6. In 1986, the OCFCD completed a new regionally calibrated Orange County Hydrology Manual for use in determining peak flow rates and hydrographs for

frequencies ranging between 2-year and 100-year. Special districts, municipalities, and District 12 of the California Department of Transportation use the manual extensively throughout Orange County.

7. A Flood Control Fund Report was prepared at the request of the Board of Supervisors of the OCFCD in 1987. The report evaluated the existing condition of OCFCD's facilities and estimated the cost of eliminating the existing flood control deficiencies at $2.4 billion in 1987 dollars that included the Federal Government's share for the Santa Ana River Mainstem Project of $0.8 billion. OCFCD's financing requirement for OCFCD's regional system including the Santa Ana River was estimated at $1.6 billion.

8. A follow up report in 1988 resulted in the Orange County Board of Supervisors' adoption of a financing plan and prioritization of funding for the Santa Ana River Mainstem Project. The report also recognized that major reduction in 100-year flood threat due to the existing deficiencies in the regional flood control system could not be accomplished within the next 25 years without implementing benefit assessments to supplement OCFCD's revenue stream.

9. In 1989 upon the retirement of Carl Nelson, William L. Zaun was appointed as Director of Public Works, including responsibility for continuation of the OCFCD's activities.

Significant Events of the 1990's

The Orange County Flood Control District currently maintains over 310 miles of flood control channels and storm drains, 9 pump stations, 7 retarding basins or dams, and 17 water conservation basins. While much of OCFCD's growth is due to facilities constructed as conditions to land development, OCFCD has made significant progress in improving the flood protection of the older deficient regions of Orange County. Since 1988, the OCFCD has completed approximately $140 million in capital improvement projects on the regional county flood control system on a pay-as-you-go basis.

The Santa Ana-Delhi, Talbert Valley, and East Garden Grove-Wintersburg watersheds having been targeted for fast-track improvement by the Orange County Board of Supervisors in 1988 received a higher share of the funding.

From 1991 through calendar year 1994, most of the district's efforts were focused on keeping pace with the ACOE Santa Ana River Project. As of 1998, the cost of the Santa Ana River Project is estimated by the ACOE to be $1.333 billion. The river marsh restoration along the southerly side of the river mouth was completed entirely at federal expense as required under the Endangered Species Act to enhance habitat for the protection of the California Least Tern, the Beldings Savannah Sparrow and the Light-footed Clapper Rail. The completed marsh has been an instant success.

1. Annually the ACOE has been provided congressional appropriations for upstream extensions of the lower Santa Ana River reconstruction. In 1997 Reach 7 was completed in 1997. Reaches 8 and 9 are scheduled for FY 98-99. Santa Ana

River will have capacity for the future increased discharges from Prado Dam while controlling the Standard Project Flood.

2. In 1993 ground was broken for the Seven Oaks Dam, as of November 1998, the dam is 85-90% complete. When completed circa 1999, the dam along with the strengthened lower river levee improvements will provide Orange County with 100-year flood protection and residents will be freed from mandatory flood insurance requirements of the Federal Flood Insurance Act due to the Santa Ana River.

3. The OCFCD has mapped the lands needed for expansion of the flood storage at Prado Dam, the third feature of the Mainstem Project. However, in 1994, the OCFCD was ensnared in the declaration of bankruptcy by the County of Orange. Although the ACOE is continuing its design work on the raising of Prado Dam, the reduced annual revenues restrained the OCFCD. In addition, the State of California is in arrears on reimbursements for invoiced amounts which now total millions of dollars for prior rights of way acquisitions and completed relocation work. Until resolution of OCFCD's cash flow difficulties, it appears that completion of the Prado Dam feature cannot be definitely scheduled. Currently no schedule has been established for raising Prado Dam. The OCFCD is working with the ACOE to develop a new schedule that will allow it to overcome unanticipated revenue short falls. However, in expression of its support for the

project, the OCFCD arranged for the $12 million realignment of State Route 71 removing it from the projected inundation area for future Prado Dam.

In 1998, the State of California included $20 million in the FY98-99 budget for reimbursement to the OCFCD authorized under the State Subvention Program.

4. In June of 1996, the courts approved a bankruptcy recovery plan. During the interlude, the OCFCD has continued to provide operational services. These include restoration of flood control facilities damaged during another localized, but record-breaking intensity rainstorm in 1995. This rainstorm produced runoff in excess of the 25-year capacity of concrete-lined channels in the west Orange County cities of Buena Park, Stanton, Garden Grove, La Palma, Cypress, Los Alamitos and Seal Beach in January of 1995. Repair costs reimbursable by the Federal Emergency Management Agency have been very helpful in light of the bankruptcy described above. Despite structural damages, the OCFCD's system prevented widespread flooding as occurred in the 1952 flood in the same areas of the county.

5. December 6, 1997 Storm. The first significant El Niño storm arrived in Orange County in the early morning hours of December 6, 1997. By the time the storm ended 24 hours later, it had delivered significant amounts of rainfall throughout the county, and produced periods of high rainfall intensity along the coastal areas of southern Orange County. Laguna Beach was particularly hard hit by this

storm. It delivered over 7.6 inches of rain in a 24-hour period, and had rainfall intensities during certain hours reaching in excess of 1,000-year rainfall frequencies. This storm was also responsible for producing the high ocean waves that heavily damaged the Laguna Beach boardwalk. It produced numerous mudslides; roads closures, channel erosion and deposited storm debris throughout the county. The impact of the storm was severe enough that the Board of Supervisors declared a local emergency and prompted the state to declare a state of emergency.

6. February 6 and February 23, 1998 Storms. After the initial rainstorm in December, there were many other storms that contributed to the tremendous amount of rainfall in the county. However, two other storms likely to be remembered when speaking of El Niño, occurred in February. Though covering a smaller area and of shorter duration than those in December, the first of these storms on February 6, 1998 produced record breaking rainfall in the vicinity of the University of California at Irvine. The second significant storm of the month began in the late afternoon of February 23, 1998. The storm was significant enough that it delivered over three inches of rainfall in Santa Ana and over four inches in Laguna Beach, which again suffered severe damage. The storm caused significant mudslides and hillside erosion, undermining homes and inundating creeks with muds. Parts of the county particularly hard hit by the storm included

Santiago, Modjeska and Silverado Canyons, and Trabuco and Serrano Creeks, where hillside erosion and mudslides were again responsible for many road closures. The heavy rainfall also caused erosion in the county's flood control channels, clogged drainage facilities and damaged county parks and harbors.

7. 1997/98 El Niño Storm Damages. It is estimated that Orange County sustained approximately $54.8 million in damages. Storm conditions either caused or contributed to numerous mudslides, road closures, and channel erosion countywide. The severe flooding that occurred in the Laguna Canyon area cause one canyon resident to be swept under water for a quarter of a mile. The resident survived he ordeal with many injuries. In the February 23, 1998 storm, two canyon residents were killed and many others injured by a catastrophic mudflow in a small side canyon tributary to Laguna Canyon. Also major landslides in Laguna Niguel caused millions of dollars in damages when homes slipped into the canyon."[13]

8. In 1997, as part of a massive administrative restructuring by the County of Orange, the Environmental Management Agency was again reorganized. The Orange County Flood Control District is now under the umbrella of the Public Facilities and Resources Department (PF&RD) with William. L. Zaun as the Chief Engineer. After William L. Zaun retired from County service on April 2,

[13] El Nino Update Report 1997/98 for the Orange County Board of Supervisors, Public Facilities & Resources Department, July, 1998

1998, Kenneth R. Smith was named Deputy Director. John Sibley remains Director of the County's Public Facilities and Resources Department.

Why the Project should be considered for a Historic Civil Engineering Landmark Designation

First and foremost, from its creation the Orange County Flood Control District has been operated as an engineering organization pursuant to the requirements of State Law. Its Chief Engineers have been legendary in their pursuit of excellence and professionalism in the planning, design, construction, and operation of the flood control system. In addition, to their engineering excellence, the district's engineers have been leaders of the Orange County Branch and the Los Angeles Section of the American Society of Civil Engineers. They have been honored by their peers with such designations as "Engineer of the Year", Western Region "Government Engineer of the Year", national "Top Ten Leaders of the American Public Works Association", and numerous other awards for their contributions to professional organizations, and in the development of the OCFCD's system of flood protection facilities.

In the early years when funds were not available for construction of channels, dams and pump stations to protect prospective developments, ingenuity was required to educate planning commissioners and city councils of the need to resist unwise developments in flood prone locations. The Chief Engineer and his engineering staff

gave personal attention to the flood hazard reports prepared for all subdivisions within the county (including the municipalities, which are not under the guidance of the County's Planning Commission). These reports by their submission to the Real Estate Commissioner of the State of California exerted a profound influence on developers private engineers, city engineers and lending institutions because they brought attention to flood problems and criteria for acceptable solutions which could be required of the developers. While only advisory, these reports sometimes had the effect of flood zoning as to impact on residential subdivisions on flood overflow lands.

The Orange County Flood Control District since its creation in 1927 and up until today has diligently planned projects for flood protection benefiting the entire community of Orange County. Because of the district's efforts and involvement with state, federal and local government agencies, life and property have been preserved during the many floods experienced during the district's existence. Without the Orange County Flood Control District's facilities, much of the development we see today would have been either impossible or met with catastrophic loss of life and property due to flooding. The satisfactory drainage of the large areas of the formerly undefined coastal plain have been made possible by the Orange County Flood Control District's civil engineers, their devotion to duty and the facilities they have constructed.

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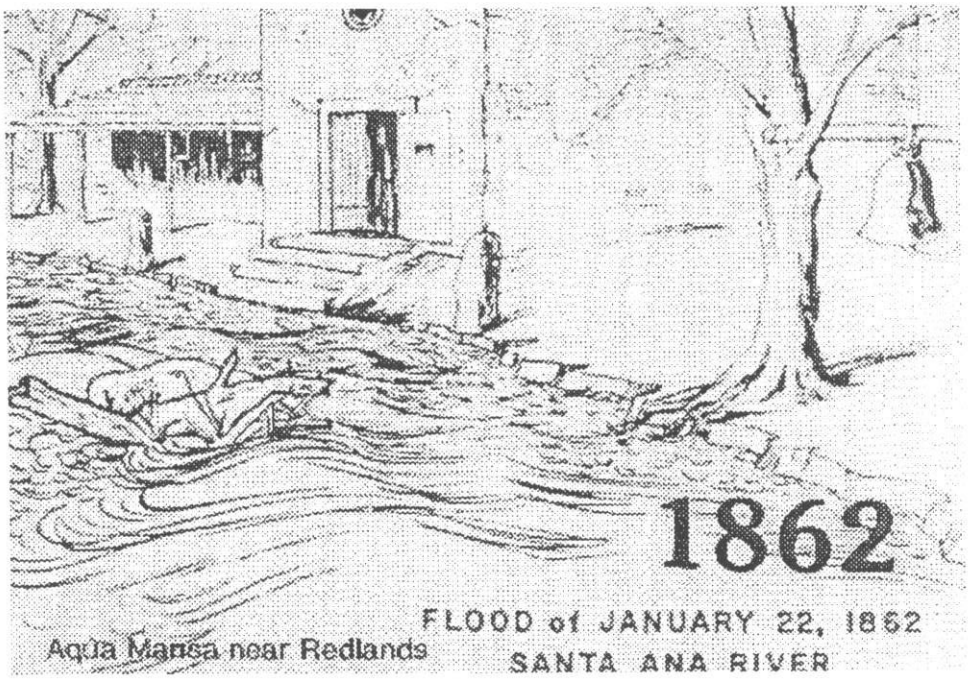
Appendix A

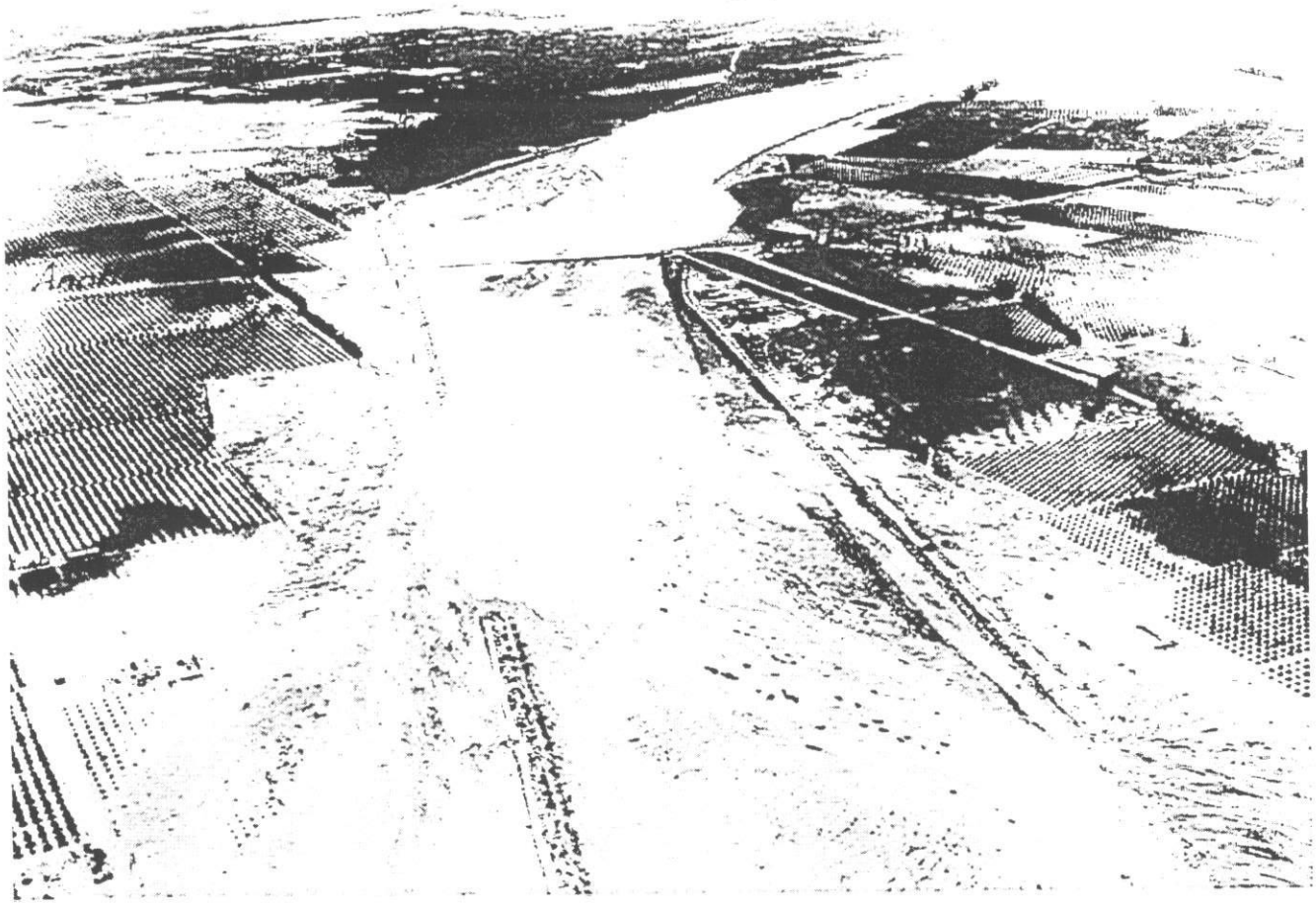


Photograph No. 1 — Flood of January 22, 1862

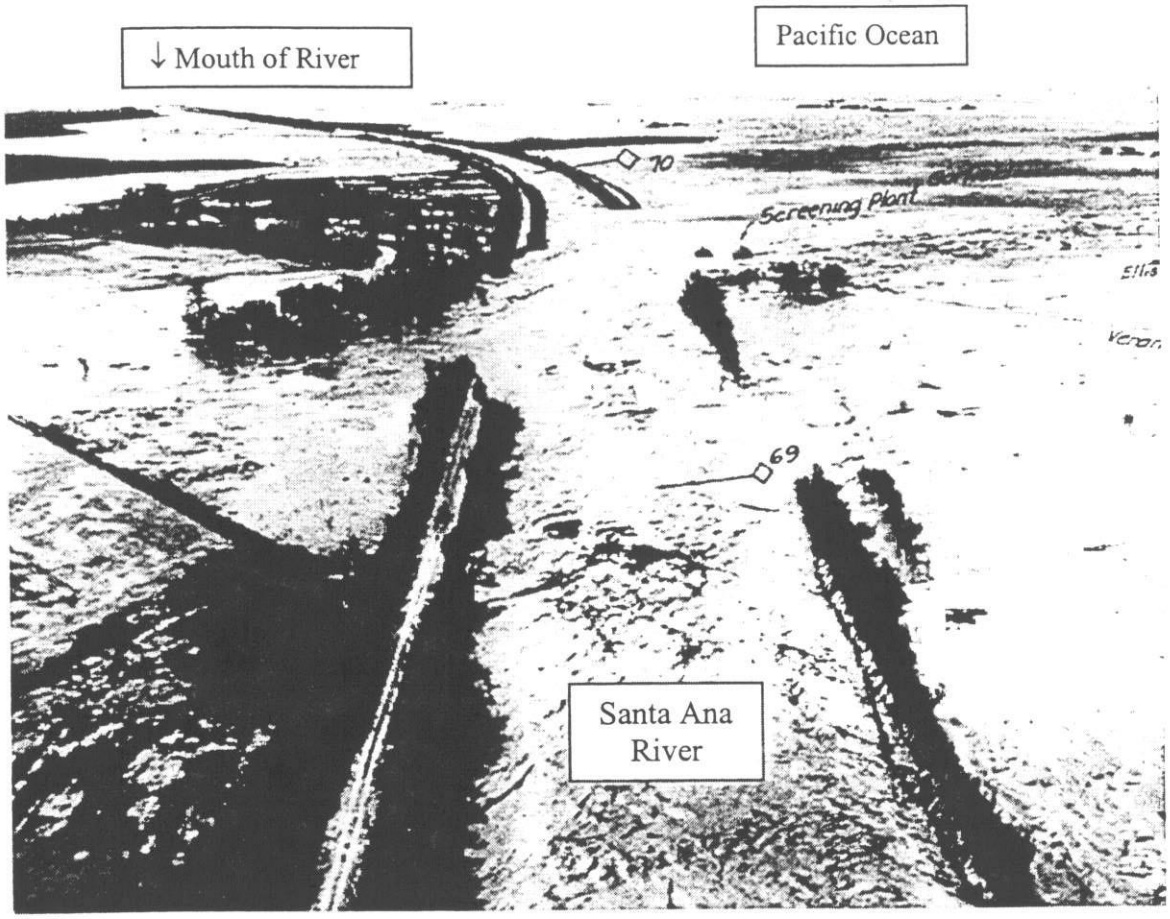
Photograph No. 2 — 1916 Flood, Main Street Santa Ana

Photograph No. 3 — Joseph B. Lippincott

Photograph No. 4 — H. G. Osborne

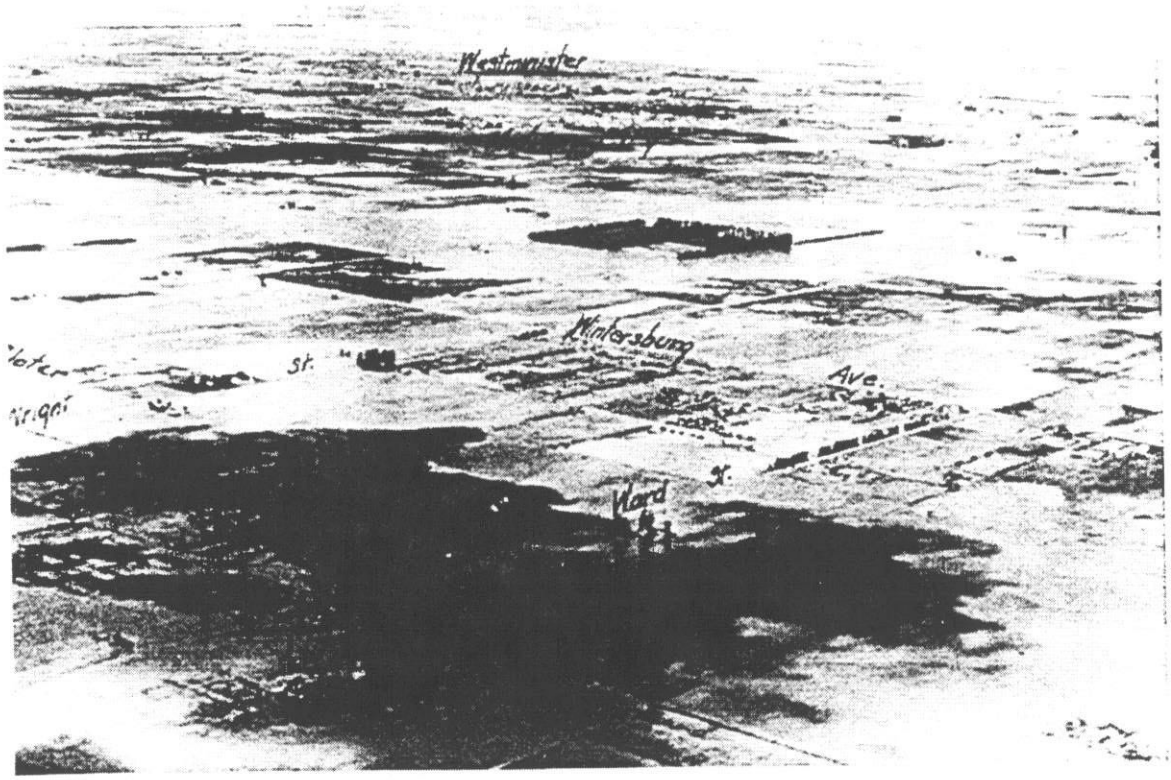


Photograph No. 5 — 1938 Flood, Santa Ana River at Lincoln Ave.

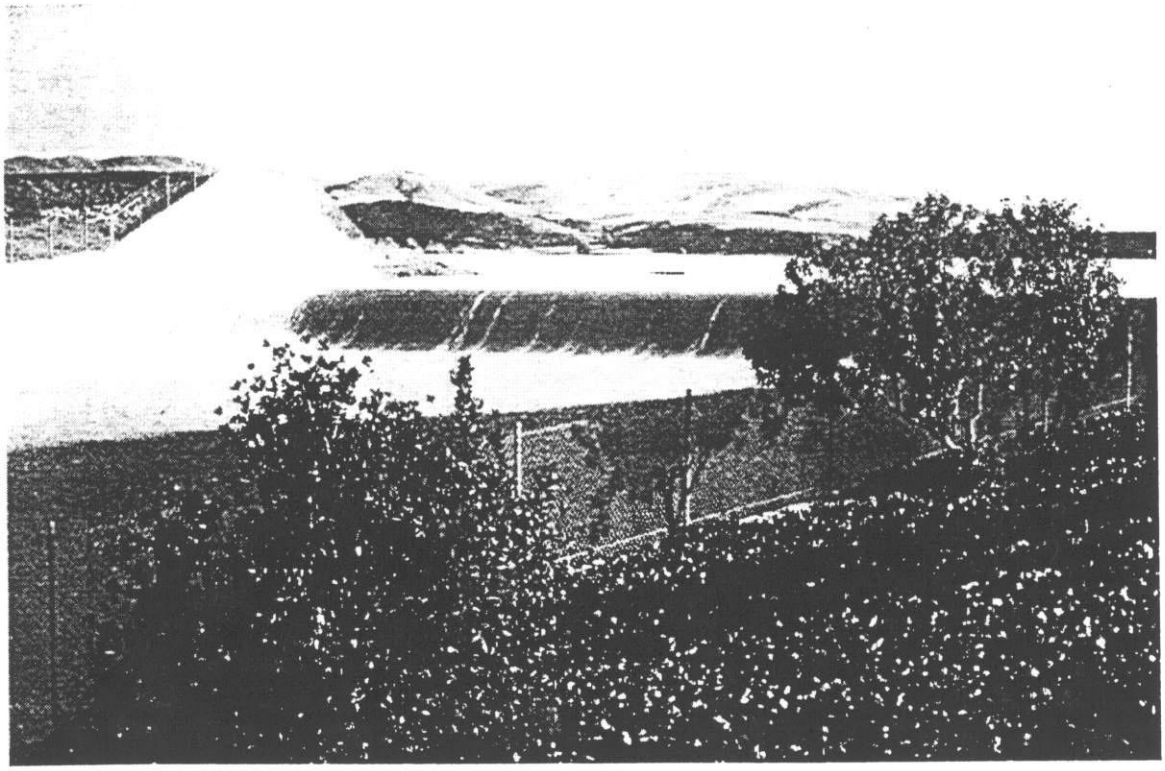


Photograph No. 6 — 1938 Flood, Santa Ana River, Anaheim to River Mouth

Photograph No. 7 — 1938 Flood, Huntington Beach



Photograph No. 8 — 1938 Flood, Westminster and Fountain Valley Area



Photograph No. 9 — 1969 Flood, Villa Park Dam Spillway

Photograph No. 10 — February 1969 Flood,
Laguna Canyon Channel

Photograph No. 11 — 1969 Flood, Emergency Measures Being used to Stabilize Banks of Santiago Creek

Photograph No. 12 — 1983 Flood, Huntington Beach

Appendix B

Importance of Orange County to the Economy of the State of California

Orange County has been and continues to be an integral part in the State of California's economy. What once was a landscape covered by acres of orange groves is now an area where people want to live and businesses want to locate.

Orange County Population and California Population

Although a significant amount of the California population does not reside in Orange County, the economy generated by the population of Orange County is tremendous for the State of California.

Population of Orange County and California from 1900 through 1999[1]

Decade	Orange County	California	Percent of Orange County Population vs. California Population
1900	19,380	1,485,053	1.3
1910	34,436	2,377,549	1.4
1920	61,375	3,426,861	1.8
1930	118,674	5,677,251	2.1
1940	130,760	6,907,387	1.9
1950	216,224	10,586,223	2.0
1960	703,925	15,717,204	4.5
1970	1,420,386	19,953,134	7.1
1980	1,932,709	23,667,902	8.2
1990	2,410,556	29,760,021	8.1
April 1999 estimate[2]	2,789,000		

[1] U.S. Bureau of Census (www.census.gov/population/cencounts/ca190090.txt)
[2] County of Orange Center for Demographic Research

Orange County Highlights

The County of Orange comprises 947.9 square miles and an estimated 2,789,000 people as of April, 1999. The County has 42 miles of beaches, over 125 miles of bikeways and over 200 miles of hiking trails. The median family income was $61,812 and the median housing costs were $253,969. Taxable sales for Orange County for 1998 were forecasted at $37.0 billion dollars. Tourist Attractions include: Disneyland, Knott's Berry Farm, Arrowhead Pond of Anaheim, Edison Field, Crystal Cathedral and the O.C. Performing Arts Center. The Top 5 Shopping Malls are: South Coast Plaza, Brea Mall, Fashion Island, Main Place and Westminster Mall.

Orange County Government Highlights

- Number of workers as a percentage of population in Orange County is the LOWEST of the 5 largest Southern California counties.
- Sixty four percent of property tax dollars go directly to schools.
- Orange County receives the lowest share of property tax dollars in the entire State.

Attractive for Business

According to business executives, Orange County is an attractive place to conduct business for various reasons [3]: 1) an established customer base; 2) desirable place to live; 3) central location in Southern California, and 4) continuing growth of the area. With the emergence of the high tech industry as a key player in the economy, coupled with the traditionally strong tourism/hospitality industry and core of small businesses, Orange County's contributions will assist in shaping California's economy. Highlighted below are facts regarding Orange County's economy.

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[3] 1999 Orange County Executive Survey

Orange County Economy

High Tech Jobs

- Orange County is one of the most diverse high-tech economies in the U.S., trailing only Boston[4].
- Job growth is in high-value industry clusters such as telecommunications and computer software. High-tech jobs account for 25% of Orange County total jobs[5]. In '98-'99, 48,100 new jobs were added, compared to 3,000 in Santa Clara County, 33,200 in San Diego.
- Jobs created by high-technology companies offer significantly higher average wage levels than other segments of the economy.

Tourism

- Tourism has led to significant job growth in the tourism/hospitality industry, with Disneyland Resort employing 8,500 of the 146,000 jobs[6].
- Orange County tourism attractions (Disneyland, beaches) bring visitors to California where they spend money throughout the state. In 1998, visitor annual expenditures reached its highest level, 5.7 million, even though the number of visitors remained fairly constant[7].

Cluster Diversity

- Small businesses flourish in Orange County's entrepreneurial climate, with only 20% working in companies employing more than 500 people.
- The number of small businesses allows for more stability in times of recession.
- No single sector accounts for more than one third of the economic output.
- Over the last 20 years, Orange County's service sector has grown rapidly, while manufacturing has declined.

Gross County Product/Economic Activity[8]

- If Orange County were a country, it would rank 32nd in the world in GCP.
- Strong export sales to the Pacific Rim.
- Orange County ranks 1st nationally in retail sales per household.

Well Educated workforce[9]

- Number of UC/CSU eligible graduates increasing.
- 30% of the adult population in Orange County has bachelor's degrees.
- High SAT scores compared to peer counties and the United States.

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[4] Milken Institute
[5] Orange County Business Council
[6] ibid.
[7] Anaheim/Orange County Visitor & Convention Bureau; Division of Tourism, California Trade and Commerce
[8] California Department of Trade & Commerce; U.S. Department of Commerce; Cal State Fullerton "Orange County: The Fate of A Post Suburban Paradise", La Jolla Institute 1998, and" Orange County by the Numbers", Orange County Business Council
[9] California Department of Education and ICF/IdeA Metropolitan Strategy

The facilities of the OCFCD are a vital part of the Orange County landscape, it has been estimated that without the current infrastructure and if the Santa Ana River were to breech its banks the following catastrophes would occur:

Levees would be breeched flooding 110,000 acres from Anaheim to the ocean and killing as many as 3,000 people and causing more the $15 billion in property damage. Major transportation corridors would be interrupted such as the San Diego, Garden Grove, Santa Ana, Costa Mesa and Orange Freeways including railroad stations and railroad tracks. Major public facilities would be inundated, hospitals, shopping centers, colleges, sanitation plants, stadiums, Disneyland, Knotts Berry Farm, and hotels.

All of the aforementioned highlights of the Orange County economy would have been either impossible or met with catastrophic loss of life and property due to flooding. The drainage infrastructure that now satisfactorily drains the vast areas of the formerly undefined coastal plain have been made possible by the Orange County Flood Control District's civil engineers and their devotion to duty.

Theodore von Karman stated that "Scientists study the world as it is, engineers create the world that never has been." The engineers of the Orange County Flood Control district have created an Orange County that never was before.

APPENDIX C

SANTA ANA RIVER WATERSHED

ORIENTATION MAP

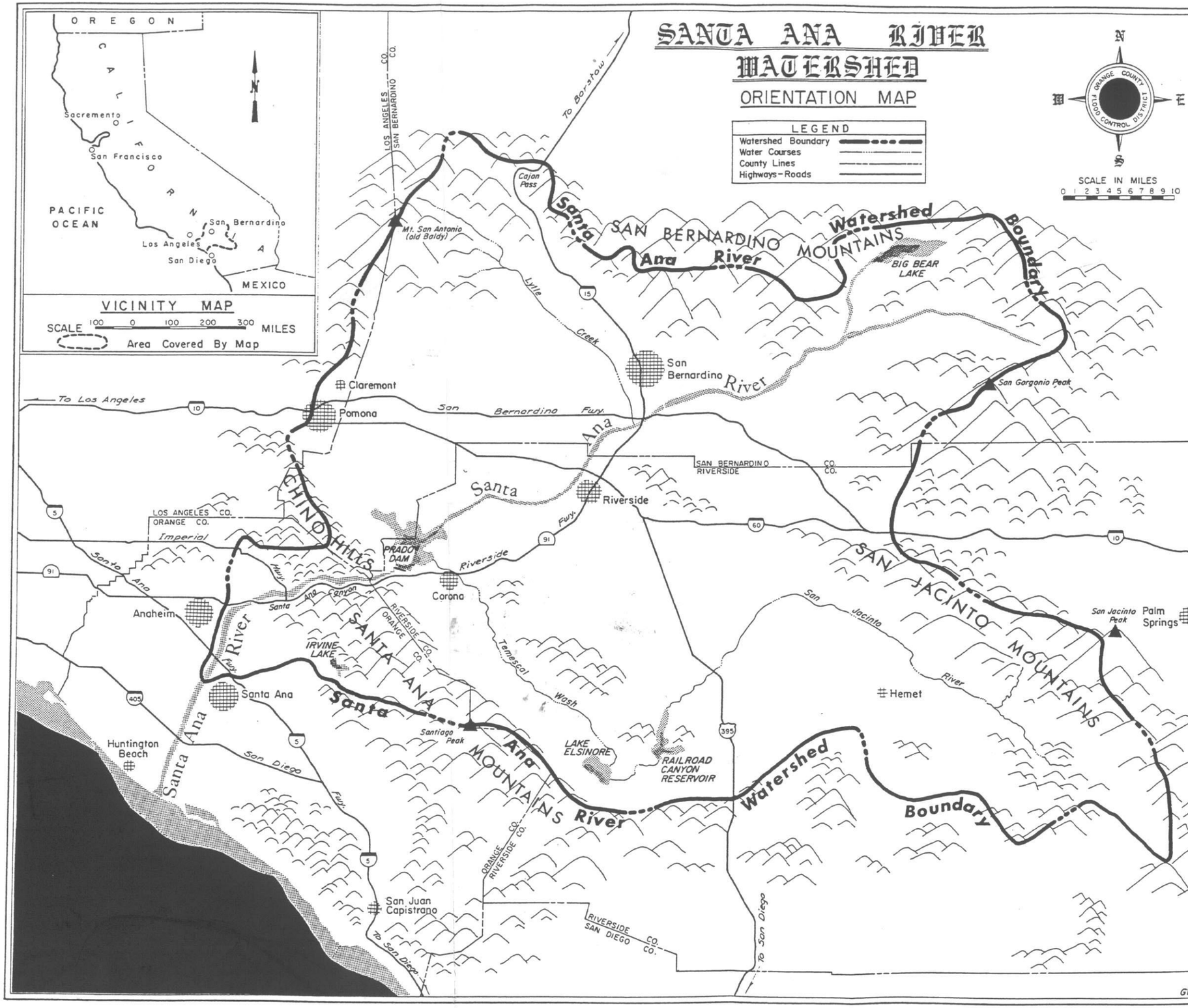

PLATE I