United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See instructions in *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by Marking "x" in the appropriate box or by entering the information requested. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900a). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name St. Francis Dam (Site of)

other names/site number California State Landmark No. 919

2. Location

street & number N/A ☐ not for publication

city or town Santa Clarita ☒ vicinity

state California code CA county Los Angeles code 037 zip code 91350

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ☐ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. I recommend that this property be considered significant ☐ nationally ☐ statewide ☐ locally. (☐ See continuation sheet for additional comments.)

Signature of certifying official/Title Date

State of Federal agency and bureau

In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. (☐ See continuation sheet for additional comments).

Signature of commenting or other official/Title Date

State or Federal agency and bureau

4. National Park Service Certification

I hereby certify that this property is: Signature of the Keeper Date of Action

☐ entered in the National Register.
☐ See continuation sheet.

☐ determined to be eligible for the National Register.
☐ See continuation sheet.

☐ determined not eligible for the National Register

☐ removed from the National Register.

☐ other, (explain:)

5. Classification

Ownership of Property
(Check as many boxes as apply)

- ☐ private
- ☐ public-local
- ☐ public-State
- ☒ public-Federal

Category of Property
(Check only one box)

- ☐ building(s)
- ☐ district
- ☒ site
- ☐ structure
- ☐ object

Number of Resources within Property
(Do no include previously listed resources in the count.)

Contributing	Noncontributing	
		buildings
1		sites
		structures
		objects
1		Total

Name of related multiple property listing:
(Enter "N/A" if property is not part of a multiple property listing.)

Number of contributing resources previously listed in the National Register

0

6. Function or Use

Historic Functions
(Enter categories from instructions)

INDUSTRY/Waterworks

Current Functions
(Enter categories from instructions)

VACANT/NOT IN USE

7. Description

Architectural Classification
(Enter categories from instructions)

N/A

Materials
(enter categories from instructions)

foundations N/A
walls
roof
other

Narrative Description
(Describe the historic and current condition of the property on one or more continuation sheets.)

8. Statement of Significance

Applicable National Register Criteria

(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

☒ **A** Property is associated with events that have made a significant contribution to the broad patterns of our history.

☒ **B** Property is associated with the lives of persons significant in our past.

☐ **C** Property embodies the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

☐ **D** Property has yielded, or may be likely to yield, information important in prehistory or history.

Criteria Considerations

(Mark "x" in all the boxes that apply.)

Property is:

☐ **A** owned by a religious institution or used for religious purposes.

☐ **B** removed from its original location.

☐ **C** a birthplace or a grave.

☐ **D** a cemetery.

☐ **E** a reconstructed building, object, or structure.

☐ **F** a commemorative property.

☐ **G** less than 50 years of age or achieved significance with the past 50 years.

Areas of Significance

(Enter categories from instructions.)

community planning & development
engineering
politics/government

Period of Significance

1924-29

Significant Dates

1928

Significant Person

(Complete if Criterion B is marked above)

Mulholland, William

Cultural Affiliation

Architect/Builder

City of Los Angeles BWWS

Narrative Statement of Significance

(Explain the significance of the property on one or more continuation sheets.)

9. Major Bibliographic References

Bibliography

(Cite the books, articles, and other sources used in preparing this form on one or more continuation sheets.)

Previous documentation on file (NPS):

☐ preliminary determination of individual listing (36 CFR 67) has been requested
☐ previously listed in the National Register
☐ previously determined eligible by the National Register
☐ designated a National Historic Landmark
☐ recorded by Historic American Buildings Survey # ____________
☐ recorded by Historic American Engineering Record # ____________

Primary location of additional data:

☐ State historic preservation office
☐ Other State agency
☐ Federal agency
☐ Local government
☐ University
☒ Other

Name of repository:

Various

10. Geographical Data

Acreage of Property 9.88

UTM References
(Place additional UTM references on a continuation sheet.)

	Zone	Easting	Northing
1	11	362860	3823900
2	11	362710	3823550
3	11	362630	3823490
4	11	362930	3823820

☐ See continuation sheet

Verbal Boundary Description
(Describer the boundaries of the property on a continuation sheet.)

Boundary Justification
(Explain why the boundaries were selected on a continuation sheet.)

11. Form Prepared By

name/title Mitch Stone & Judith Triem, Principal Investigators

organization San Buenaventura Research Associates date 6/23/2004

street & number 1328 Woodland Drive telephone 805-525-1909

city or town Santa Paula state CA zip code 93060

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps

A **USGS map** (7.5 or 15 minute series) indicating the property's location.

A **Sketch map** for historic districts and properties having large acreage or numerous resources.

Photographs

Representative **black and white photographs** of the property.

Additional Items
(Check with the SHPO or FPO for any additional items)

Property Owner

(Complete this item at the request of SHPO or FPO.)

name USDA Forest Service/Angeles National Forest

street & number 701 North Santa Anita Avenue telephone 626-574-5274

city or town Arcadia state CA zip code 91006

St. Francis Dam (Site of), Los Angeles County, California — Narrative Description [continued]

The St. Francis Dam site is located within San Francisquito Canyon in northern Los Angeles County, approximately ten miles to the northeast of the nearest urbanized place, the City of Santa Clarita. The dam site consists of a portion of the creek bed and two steep hillsides flanking the creek, as well as a small segment of the post-disaster two-lane blacktop San Francisquito Canyon Road constructed along the canyon floor bisecting the dam site on the northern side of the creek. Powerhouse No. 2, located nearby, is not included in this nomination.

The site of the base of the dam at San Francisquito Creek is located at approximately 1,650 feet Mean Sea Level (MSL) in elevation. The tops of the abutments were located on the flanking hillsides to the northwest and southeast, at approximately 1,850 MSL. Some concrete rubble from the collapsed portions of the dam is included within the nominated site, but is not readily distinguishable from the surrounding natural materials of the canyon floor. The pulverized remains of the concrete structure which formed the dam's western wing dike is somewhat more visible. [Figure 2]

The topography within the setting of the dam site is a combination of rolling and steep hillsides with local peaks to roughly 1,000 feet above the canyon floor. Vegetation is mainly native chaparral, and riparian within the channel of San Francisquito Creek. Surface flows within the creek are seasonal. San Francisquito Powerhouse No. 2 is located approximately 1.2 miles downstream from the dam site.

Summary of Signficance

The St. Francis Dam site is significant at the state level under Criterion A as the site of the second largest disaster in terms of loss of life of any type in California history, and the largest in the state of human origins. Further, the collapse of the dam led directly to changes in the design and construction of dams not only within California, but elsewhere in the United States. The St. Francis Dam disaster was seen as the capstone of an infamous series of events which began with the Lippincott surveys in the Owens Valley in 1905, and as such, became a prominent element not only within the broader fabric of California's history, but also within the lore which grew up around the development of water resources in the West.

The site of the St. Francis Dam disaster is also significant under Criterion B as directly causing the abrupt end of the career of William Mulholland, chief engineer of the City of Los Angeles Bureau of Water Works and Supply, one of the principal enablers of the growth and development of modern Los Angeles.

Period of Signficance

The period of significance for this property is 1924-29, covering the construction of the St. Francis Dam, its failure, the disaster recovery period, and the creation of new dam safety regulations in California.

Water and the City of Los Angeles

During the 1860s, Los Angeles was a small frontier town, more closely resembling the remote Spanish pueblo of its founding than a modern American city. Services provided by the city remained rudimentary, with the city's water supply controlled by a private utility, the Los Angeles City Water Company, under a thirty-year lease granted by the city in 1868.

As the population grew, many residents clamored for the city to switch to a municipally-managed system. With the Los Angeles City Water Company controlling the water infrastructure, and determined to continue its franchise, the changeover from a private to public water provider would prove costly and complicated by litigation. Among the civic leaders involved in the process of forming a municipal water agency were Fred Eaton (who also served as mayor from 1898 to 1900), and engineer J.B. Lippincott, both of whom played major roles in subsequent water development policy for the city. When the city finally gained municipal control of the water supply in 1902, it also inherited the former employees of the Los Angeles City Water Company. Included in this package was superintendent William Mulholland.

Born in Belfast, Ireland in 1855, William Mulholland took on a seafaring life at age 15, arriving in Los Angeles via San Francisco in 1877, in the period following one of the region's most prolonged and devastating droughts. The following year, he began employment with the Los Angeles Water Company. Starting as a ditch-clearer, Mulholland worked his way through the ranks of the company until he became its Chief Engineer in 1886, succeeding Fred Eaton in the post. [Mulholland, 2000: 10-37; Kahrl, 1982: 18-21]

Few had a more comprehensive and first-hand knowledge of the pipes, valves, and other features of the city's water system than William Mulholland, and so he was the city's obvious choice to be appointed superintendent of the city's new Water Department. Later, he would acquire the title of Chief Engineer and General Manager of the Bureau of Water Works and Supply, a position he held for nearly three decades. [Kahrl, 1982: 22-23]

Mulholland became so identified with this post both within and outside the agency, that he became popularly known during his long tenure simply as "The Chief." Although he possessed little formal education of any kind, Mulholland became the architect of the city's vast and ambitious water system, a remarkable engineering accomplishment that enabled the transformation of Los Angeles from a provincial town into a major Western metropolis. [Mulholland, 2000: 87]

This metamorphosis was well underway by the turn of the twentieth century. Between 1900 and 1905, the population of the City of Los Angeles roughly doubled, to 200,000. Even as the rapidly-growing city was attempting to identify new water sources, local supplies dwindled. For a number of years, promoters and others had suggested a variety of solutions to the gathering water crisis. One plan, promoted by Fred Eaton from at least 1892, involved importing water from the Owens Valley on the eastern slope of the Sierra Nevadas, some 240 miles to the north of Los Angeles. This ambitious and unprecedented scheme was not granted serious consideration for another decade. [Kahrl, 1982: 14-16]

The Owens Valley Water Project

In 1902, the same year as the City of Los Angeles established jurisdiction over its water system, Congress created the United States Reclamation Service, a part of the U.S. Geological Survey (USGS), which sought to identify potential water reclamation projects in which water would be used for irrigation in arid but fertile spots across the western United States. The new policy incorporated the American "ideal of the family farm" and connected it to "economic development, resource conservation, and social progress," by using irrigation to open up new farming lands for thousands of families. The federal government's reclamation activities also provided an unanticipated opportunity for the City of Los Angeles to claim the waters of the Owens Valley for its own. [Kahrl, 1982: 17, 39-41]

Frederick Haynes Newell, an experienced engineer from the USGS, was appointed chief engineer for the Reclamation Service, and he in turn appointed Los Angeles resident J.B. Lippincott, whose experience included work for the USGS and private consulting, as supervising engineer for California. The Reclamation Service's first task was to identify potential projects in each state. California's possible projects included the Colorado River near Yuma, Arizona; the Klamath River in Oregon, Kings River in the San Joaquin Valley, the Sacramento Valley, and the Owens River Valley in Inyo County.

Newell first suggested the Owens Valley as a project in April 1903, and Lippincott sent engineer J.C. Clausen to look over the area. On the basis of the region's water potential, Lippincott suggested that federal lands be "withdrawn," or temporarily removed from lands available to settlers, in consideration of a possible reclamation project in the valley. By the end of 1903 over a half million acres of the Owens Valley were withdrawn. Valley landowners were enthusiastic about the proposed reclamation project, seeing a way to use water from the nearby Sierra Nevadas to more intensively farm their naturally arid lands. Clausen began a full-scale survey in September 1903, while Lippincott also supervised surveys on other possible sites in the state. [Kahrl, 1982: 41]

Clausen's work continued into summer 1904, although major investigations into a potential reclamation dam site were halted in April when Lippincott requested a drilling rig to continue the investigation. When the rig did not arrive, Lippincott ended federal investigations in the Owens Valley in September. [Kahrl, 1982: 43]

Meanwhile, during the late summer, Lippincott took a private trip to Yosemite, stopping in the Owens Valley along the way, with a group of friends including Fred Eaton. Upon his return to Los Angeles, Eaton decided to bring William Mulholland to the Owens Valley to show him the potential water resources, and suggested that Los Angeles consider using them. In September, Lippincott wrote to his Reclamation Service superior, Newell, to tell him that Los Angeles was looking at the Owens Valley as a solution to its water problems. The residents of Owens Valley remained unaware of the city's interest. [Kahrl, 1982: 53-58]

Under special arrangement, Lippincott continued to operate his consulting business while in the employ of the Reclamation Service. Although Newell was concerned about the possibility of conflict of interest between Lippincott's private work and his government job, he also was concerned about the lack of a budget to complete all possible reclamation projects in California, and in November 1904 warned his engineers of the possibility that funds would be insufficient to complete all of the proposed work. [Kahrl, 1982: 59-61]

In November, Clausen submitted a report on the conditions in the Owens Valley, concluding that it was suitable for reclamation, and that a storage reservoir could be constructed at Long Valley. However, before the report and its important information on stream measurements and water supplies could be released to the general public, in late November it was made available in a meeting between Lippincott, Newell, and Los Angeles's leading "water men," including Mulholland, Eaton, and city attorney William B. Mathews. Information about the city's interest, however, was carefully kept secret, with the complicity of the publishers of the Los Angeles newspapers. By the end of 1904, the Owens Valley reclamation project was being downplayed in Reclamation Service publications, and the City of Los Angeles was poised to drive into the breach.

In March 1905, Lippincott, acting as a private consultant, agreed to provide the Los Angeles Water Commission with a report on potential new water sources for the city. Omitting the Owens Valley and using data he had previously collected for the USGS, Lippincott concluded that there were no nearby water sources sufficient for the city's anticipated growth.

Lippincott also asked Fred Eaton to take on some of his reclamation duties, in particular, to informally investigate some power companies' applications for rights-of-way while Eaton was in the Owens Valley during March of 1905. Eaton used his authority to gain information from the federal land office and was perceived to be working as a federal agent. Eaton was able to buy, for himself, options on land at Long Valley that the Reclamation Service had previously considered as a dam site. In fact, Eaton was acting as an agent for the City of Los Angeles, and once this land was under city control, the Reclamation Service's plans in the Owens Valley effectively ended.

The following month, two Los Angeles water commissioners joined Mayor Owen McAleer, City Attorney William B. Matthews, Fred Eaton and William Mulholland on a field investigation of the valley. Impressed by what they found, the city began paying Eaton for his options two months later, although no specific bond funds would be earmarked for the purpose until September. In late July, the Reclamation Service held a public hearing about the potential for an Owens River project and the question of abandoning the project in favor of the city. The city, recognizing that secrecy could no longer be maintained, finished acquiring Eaton's land options, and on July 29, 1905 the Los Angeles Times announced that Los Angeles planned to build a great aqueduct to bring Owens Valley water south. [Kahrl, 1982: 67-69; Spalding, 1929: 343-4]

Controversy quickly surfaced over the aqueduct project, with accusations of conflicts of interest against Lippincott and Eaton, complaints from Owens Valley ranchers, and public suspicion of the degree to which the project benefited the powerful participants in a land syndicate in the San Fernando Valley. Nevertheless, Los Angeles voters approved the first project bonds in September 1905, and the city filed its first notice of water rights appropriations from the Owens River. Shortly afterwards, the federal government began its first investigation of Lippincott's controversial activities.

Before the second bond campaign, the city appointed a panel of engineering experts to evaluate the aqueduct plan. They altered the original plan, abandoning storage reservoirs and rerouting the aqueduct, which was to cross the high desert through Lancaster and Palmdale and Big Tujunga Canyon, entering the San Fernando Valley north of Los Angeles through San Francisquito Canyon. The new route through San Francisquito Canyon created three elevation drops suitable for power generation, and the panel suggested incorporating hydroelectric stations into the project as a way to generate electrical power and additional revenue for the city. Bonds were approved in 1907, and the department's annual report of that year listed San Francisquito Canyon as one of the new power plant sites. [Kahrl, 1982: 150, 152]

Construction of the aqueduct began in 1907. Three years later, the aqueduct faced a cash shortage and a strike, which became a major political issue during Socialist mayoral candidate Job Harriman's campaign in 1911. Although he lost the election, Harriman's charges that the aqueduct water would disproportionately benefit a handful of rich San Fernando Valley land owners survived the campaign, to become ensconced in the lore surrounding the aqueduct construction, as well as a rallying cry against the project in the Owens Valley. It also spurred a 1912 city investigation into corruption in the building of the aqueduct. In 1913, with the completion of the aqueduct, much of the public protest ebbed as the water began to flow. [Kahrl, 1982: 173-9]

Meanwhile, auxiliary features of the aqueduct and power generation facilities were still under construction. City voters approved the first power plant bonds in 1910. Powerhouse No. 1 was completed in 1917, even though the initial bond referendum had failed that year, and in 1920 Powerhouse No. 2 began to generate power. Both were located along the aqueduct, in the upper and lower reaches of San Francisquito Canyon.

<u>Local Water Storage and the Construction of the St. Francis Dam</u>

Even with the completion of the Owens Valley Aqueduct, the City of Los Angeles's water supplies remained far from assured. The population of the city continued to grow much more rapidly than forecasted, reaching over a million by 1925. Further, the return of drought conditions in the early 1920s caused public anxiety, and seasonal variations in irrigation use in a water system with no effective storage capacity meant that Owens Valley water was being wasted, flushed out to the ocean during the winter.

In addition, Mulholland, who had originally advocated the continuation of limited agriculture in the Owens Valley, changed his mind about supporting the city's land and water rights acquisitions. With the elimination of irrigated agriculture in the upper Owens River Valley, flows through the aqueduct increased, as did the need for seasonal storage.

The years 1924 to 1927 marked the peak of the "water wars" between the Owens Valley and the City of Los Angeles. Growing resentment of the city by valley residents sparked often violent protests, included several dynamitings of the aqueduct. Drought, population growth, and fear of continued insurgency, taken together combined to persuade Los Angeles officials of the need to develop an extensive reservoir system. These proposed storage facilities were intended to fulfill a dual role: to guarantee a constant water supply to the burgeoning metropolis, and locate the water supply a sufficient distance from the Owens Valley to provide some measure of protection from violent acts of insurrection.

Accordingly, William Mulholland set about planning eight new reservoirs and the raising of an existing dam, effectively doubling water storage capacity to 57,600 acre feet. Mulholland's preferred site for the largest of these reservoirs would be Big Tujunga Canyon, located in the San Gabriel Mountains abutting the eastern end of the San Fernando Valley. When land acquisition in the canyon proved problematic and more expensive than anticipated, he focused his attentions elsewhere. Mulholland's decisions from this point forward were to prove particularly fateful to his own career, and even more so, to scores of others who played no part in them.

As an alternative location of his principal reservoir, Mulholland turned to a site with which he'd become familiar during the construction of the southern reaches of the Owens Valley Aqueduct ten years earlier. Thirty-five miles north of downtown Los Angeles, the aqueduct traversed a ridge on the southern flank of San Francisquito Canyon. The canyon was also the site of two city-owned hydroelectric plants, Powerhouse No. 1, completed in 1917, and Powerhouse No. 2, constructed in 1920.

Mulholland became at least generally familiar with the geological conditions present in the canyon during the construction of the aqueduct. Noting the presence of unstable Pelona Schist, a "weak material, badly shattered, very susceptible to seepage of water, and to slippage along the planes of cleavage," in the slopes, he elected to built a 6.5 mile tunnel within the mountain, rather than the originally anticipated hillside viaduct.

Given these conditions, San Francisquito Canyon would seem at the outset to have been a less than ideal choice for the location for a high concrete dam. According to Mulholland's later testimony, however, in 1912 additional geological investigations of the future St. Francis Dam site undertaken by Mulholland and the noted Stanford University Geology professor John Casper Branner, assuaged any reservations he might have had in his own mind about the suitability of the site. [Coroner's Inquest, 1928]

The first formal survey of the dam site was conducted in 1922, and by May 1923 engineering plans for a 175-foot high concrete gravity arch dam designed to retain 30,000 acre feet of Owens Valley water emerged from the Bureau of Waterworks and Supply. Mulholland and his crew at the bureau evinced complete confidence in their abilities as dam designers and builders, justified by their successful construction of some twenty dams by the time they began work in San Francisquito Canyon, including some of the largest earth-fill dams in the world. The St. Francis Dam was the bureau's first mass concrete dam, however, and represented a number of design challenges that the bureau had not encountered in their prior efforts.

The St. Francis Dam was one of two concrete arch dams of similar design to come out of Mulholland's office during this period. An earlier "twin," Weid Canyon Dam, was built in the Hollywood Hills in 1924. Shortly after its completion, this dam was renamed in honor of William Mulholland, in recognition of his singular contributions to the development of water resources for the city. [Mulholland, 2000: 281]

Even during the design stages of the St. Francis Dam, the bureau continued its race against the city's steadily increasing demand for water. In an effort to accommodate these needs, in July of 1923, the design capacity of the San Francisquito reservoir was increased by nearly ten percent, to 32,000 acre feet, which was accomplished by raising the dam ten feet in height. This storage capacity figure represented a one-year water supply for the City of Los Angeles at that time, meeting Mulholland's principal design criterion for the reservoir. By fixing on this goal, it would later become clear, Mulholland's engineers were not only chasing a moving target, they were incorporating serious flaws into the dam's design. [Rogers, 1995: 26-7]

The construction of the St. Francis Dam commenced in April, 1924. Even as the dam began to rise, so did the city's demand for water. The bureau responded in July 1925 by increasing the dam's height a further ten feet, expanding the reservoir's storage capacity to 38,168 acre feet, equal to the city's annual water demands in 1924. To accomodate this second increase in reservoir size, the dam's western wing dike was also extended by 600 feet. [Figures 1, 2]

The St. Francis Dam was completed in May 1926. Two months earlier, the bureau had begun diverting aqueduct water into the reservoir, allowing it to rise nearly two feet per day until it crested one year later, only three feet below the spillway, in time for the dry season. After partial draining during the summer and fall of 1927, the reservoir was again refilled, now to within inches of the spillway, during the winter of 1927-28. It reached capacity on March 7, 1928, allowing water to be directed to the other city reservoirs, which were all filled to capacity five days later. With the satiation of the entire city reservoir system complete, excess water was diverted into San Francisquito Creek, which ran for the first time since construction began on the dam four years earlier. [Rogers, 1995: 32-3] [Figures 3, 4]

The St. Francis Dam Fails

On the morning of March 12, 1928 damkeeper Tony Harnischfeger telephoned William Mulholland with a disturbing report: he had noticed leakage on the dam's western abutment. This leak was different in character from the seepage observed in the dam's downstream face since the reservoir was filled to capacity five days earlier. Harnischfeger described the leak as muddy. To a water engineer, this condition suggested hydraulic piping, the process of soil washing out from under a dam's foundation.

Mulholland and his assistant chief engineer Harvey Van Norman hurriedly departed Los Angeles for San Francisquito Canyon, arriving at the dam by late morning. After inspecting the dam for about an hour and a half, Mulholland, Van Norman and Harnischfeger concluded that the water leaking from under the abutment was clear, and was only becoming turbid as it cascaded down the hillside. Satisfied that the leak presented no immediate concerns, Mulholland and Van Norman returned to Los Angeles shortly after noon. [Figures 5, 6]

The first indication of an impending catastrophe at the St. Francis Dam was seen at between 8:30 and 9:00 PM that evening by Ray Silvey, night-shift operator at Powerhouse No. 1. As he was driving to work on the road beside the reservoir on the way to his 11:00 PM shift, Silvey noted a foot-high crack on the road "just upstream of the dam." Although he could not have have recognized its significance, this was most likely the initiation of a landslide on the dam's eastern abutment. Then, shortly before midnight, Ace Hopewell, the last Powerhouse No. 1 employee to drive past the dam that evening, stopped his motorcycle when he heard what to him sounded like a landslide in the distance. In doing so, Hopewell became one of only a handful of surviving witnesses to the sight or sound of the St. Francis Dam failure. [Outland, 1963: 76]

The first notice of the dam's collapse came at 11:57:30 PM, when the operators at Powerhouse No. 1 detected an abrupt voltage drop on their instruments. They were seeing the destruction of the Southern California Edison Company's electric transmission lines strung across San Francisquito Canyon, a few hundred feet downstream from the dam. At the same instant, lights dimmed momentarily in Los Angeles, as the Edison Company's substation at Saugus 9.5 miles to the southwest of the dam shorted out from the overload. [Outland, 1963: 77]

Within minutes after midnight, Powerhouse No. 2 and the downstream DWP employee's village in San Francisquito Canyon were engulfed by a wall of water, silt and debris over 100 feet in height moving down the canyon at 18 miles per hour. The powerhouse, a massive poured-in-place concrete building constructed only eight years earlier, was completely erased, and 25 of the department's 28 employees and their family members living in city-owned homes immediately below the dam perished. They would be only the first of hundreds of casualties to follow, as the inundation ran its course to the Pacific Ocean, 54 miles away.

As the deluge worked its way southwards through the farmsteads of lower San Francisquito Canyon, it suspended within its bulk a massive and destructive conglomeration of silt and debris, including rocks, trees, buildings and barbed wire. Less than an hour after the dam's failure, the wave reached Castaic Junction, a hamlet adjacent to the Ridge Route over the Tehachapi Mountains. Several more lives were claimed at that location, and the main highway connecting Los Angeles and Bakersfield was buried under water, silt and debris. From Castaic, the main wave turned westwards, into the upper reaches of the Santa Clara River Valley. [Outland, 1963: 87-88] [Figure 7]

The cascade of electrical power failures that began shortly before midnight, minutes after the dam's collapse, continued as the flood waters roiled downstream. The utilities initially compensated, even as the high-tension lines operated by the Los Angeles Bureau of Power and Light and the Southern California Edison Company were being cut in rapid succession by the waters.

Finally, when the Edison Company substation at Saugus was inundated at 12:45 AM, residents of Ventura, Santa Barbara and much of Los Angeles counties found themselves in darkness. Still, the likely cause of such an unusual set of system failures remained unappreciated by the utility dispatchers who were witnessing it. A general alarm had not been sounded. [Outland, 1963: 91-93]

The magnitude of the calamity came into sharp focus at 1:09 AM, over an hour after the dam's collapse, when Powerhouse No. 1 reported an empty St. Francis Reservoir to the Department of Water and Power offices in Los Angeles. Efforts on the part of the DWP to alert residents of the Santa Clara Valley now began in earnest, but would be hampered by the widespread power outages.

Word of the desperate situation finally reached the Ventura County Sheriff's office in Ventura at 1:20 AM, instantly igniting a frantic effort to warn communities in the Santa Clara Valley of the impending flood. Dauntless efforts by numerous individuals, both official and private, to raise the alarm began, and continued well into the early morning hours of March 13. Impromptu evacuations throughout the darkened valley saved thousands of lives, but hundreds of others would not be alerted in time. [Outland, 1963: 101]

The warnings came too late for the Southern California Edison employees stationed at the work camp at Kemp, a Southern Pacific Railroad siding located on a low bench above the Santa Clara River, 17 miles downstream from the dam, near the Los Angeles-Ventura county line. Most of the workers were asleep in their tents when the flood waters inundated the camp, at nearly the same moment word of the dam break reached the Ventura County Sheriff. Of the approximately 150 Edison workers encamped at Kemp, 84 were listed as casualties of the flood. [Outland, 1963: 107]

Roughly an hour after washing over the Edison camp at Kemp, the flood waters reached the town of Fillmore and the sparsely-populated settlement of Bardsdale, 30 miles downstream from the dam. The bridge connecting the twinned communities located on opposite banks of the Santa Clara River was instantly destroyed. Located well above the riverbed, Fillmore was spared the direct impact of the flood waters, and with a half-hour's prior notice, many area residents had already begun moving towards higher ground. [Figures 8, 9]

At shortly after 3:00 AM, the rising waters of the Santa Clara River breached the Willard Bridge east of Santa Paula. Word of the impending flood had reached Santa Paula around an hour beforehand, leading to a frantic effort to evacuate the city's exposed lower elevations. The audible destruction of the bridge provided one final, and highly compelling, alarm to an already alerted community. The largest populated place to be attacked directly by the flood waters, the destruction at Santa Paula would be the most dramatic, costly and well documented. [Outland, 1963: 122-7] [Figures 10-12]

The broadening and slowing flood waters reached Saticoy at the western end of the Santa Clara Valley at 4:05 AM. With nearly three hours of warning, the evacuation of these low-lying areas, as well as the Oxnard plain, were essentially complete. At 5:25 AM, nearly five and half hours after the collapse of the St. Francis Dam, and 54 miles downstream, the flood's tide, now composed of roughly equal parts water, and mud and debris, exhausted itself at the Santa Clara River's Pacific Ocean mouth. [Outland, 1963: 128]

When the sun rose a half hour later, the process of tabulating the toll in life and property along the flood's path of destruction began in earnest. So also begin efforts to explain the dam's failure in engineering, geological and political terms. It was a debate which attracted experts from around the nation, and would carry on for decades.

<u>Disaster Response, Accounting for the Damage, and Recovery Efforts</u>

The morning of March 13, 1928 saw the immediate mobilization of the Los Angeles Police Department, Los Angeles County Sheriff and all available Department of Water and Power personnel, as well as charitable and service organizations, such as the American Red Cross, American Legion and the Fillmore Service Club. The rescue and recovery efforts did not suffer from a lack of manpower or a commitment of resources, but was hampered by the immense area of devastation, and particularly the erasure of most of the valley's transportation network from Castaic to the Pacific Ocean. For the better part of the first day, the residents of the Santa Clara Valley fended for themselves.

When outside relief organizations began arriving in the valley, they were surprised to find many immediate life-saving efforts already taking place at makeshift rescue camps, including one at Rancho Camulos near Piru, where some of the Edison Camp survivors were initially sheltered. An ad-hoc tent city was quickly created in Santa Paula, which provided temporary housing for 600 displaced residents, some remaining for as long as three months after the flood, even while scores of others were taken in by friends and relatives. Aid provided to the injured and homeless proved to be a less pressing concern to the residents of the valley than dealing with the vast numbers of corpses, however. The overwhelmed local mortuaries were forced to stockpile the victims of the flood in provisional open-air morgues. [Outland, 1963: 140-3; Travis, 1929] [Figure 13]

The day following the dam break, a citizen's committee was founded to coordinate relief efforts throughout the Santa Clara Valley. It would be chaired by prominent Santa Paula resident Charles Collins Teague. Three days later, the Ventura County Board of Supervisors authorized the creation of a blue ribbon committee to investigate the dam disaster and take up the issues of losses and compensation. Again, Teague would be its leader.

A counterpart committee from Los Angeles was also formed, headed by Los Angeles Chamber of Commerce president George Eastman. Together, these two groups became known collectively as the Committee of Fourteen. Their duties were divided formally into claims and reconstruction tasks. Working in concert, the Committee of Fourteen prevailed upon the Los Angeles City Council to immediately authorize $1.0 million for claims settlement and recovery efforts. [Teague, 1944: 185; Travis, 1929]

The Committee of Fourteen also actively mediated between aggrieved residents of the disaster area and the City of Los Angeles in the settlement of claims. The Los Angeles City Attorney set up a field office in Santa Paula to screen and process damage claims, with the objective of providing expedited settlements, in exchange for agreements on the part of the claimants to relieve the city of further exposure to liability or lawsuits.

As a matter of policy, the City of Los Angeles agreed to restore or replace damaged or destroyed housing, but refused to make lump sum payments for such losses. The city also declined to negotiate with claimants who hired a contingency fee attorney.

This scheme was enforced on a local basis by Teague and Ventura County District Attorney James Hollingsworth through novel, if heavily-handed means. Out-of-town attorneys were expelled from the disaster area, escorted to the county line by the Ventura County Sheriff, and sternly cautioned against returning. Teague also threatened to publish the names of these attorneys, whom he regarded as "parasites," in the local newspaper. Evidently, few did return, and consequently only 44 lawsuits would be filed against the City of Los Angeles for wrongful death and property damage claims. By comparison, 228 death and injury claims, and a great number more for property loss, were settled amicably within a year and a half of the disaster. [Travis, 1929]

Teague also proved instrumental in persuading local and Los Angeles authorities to engage the services of the University of California Farm Extension Service as an unbiased and expert third-party to survey damage to agricultural lands. Losses were calculated on the basis of the survey and field investigations. [Outland, 1963: 151-4; Teague, 1944: 186-7, 190-4; Travis, 1929]

Investigations, Interpretations and Recriminations

The St. Francis Dam disaster proved to be a blow not just to the residents of Los Angeles and Ventura counties, but to the reputation of the City of Los Angeles, and those who had acted on its behalf. The city was still reeling from the prolonged, sometimes violent, and still quite recent history of the Owens Valley water wars, which had been put to rest less than a year before the dam collapse. The fact that the water unleashed on the Santa Clara Valley was extracted from the Owens Valley, by what many regarded as unsavory means, colored the public's perceptions of the disaster. Feeding on the lore which had influenced the public's interpretation of the water wars, conspiracy theories abounded.

The most prominent and persistent popular explanation for the dam's catastrophic failure was sabotage. The speculation that the dam was destroyed by Owens Valley insurgents was a natural outgrowth of the notorious incidents which punctuated the water wars. Further setting the stage for these suspicions was an anonymous phone call received by the Los Angeles County Sheriff nearly a year before the dam's collapse, suggesting that a contingent of men from Inyo County were headed down to San Francisquito Canyon to blow up the dam. Officers were dispatched immediately. Although no saboteurs were apprehended, a residual feeling of unease remained. [Outland, 1963: 48]

For his own part, William Mulholland initially made no effort to dispel the theories that the dam had been dynamited. He even encouraged these notions by testifying at the Coroner's Inquest convened ten days after the collapse that he had "a suspicion" why the dam failed, but added evasively, "I don't want to divulge it." Later in his testimony, when the questioning turned to whether, if given a second chance, he would "build this dam in the same way it was erected," Mulholland responded, "not in the same place."

Asked how he'd come to that conclusion, Mulholland replied that, to his mind, the site now had "a hoodoo on it." Pressed by the District Attorney to explain this characterization, Mulholland retreated from the implication that the dam site was somehow cursed, and alluded once again to sabotage. The site "is vulnerable to human aggression," he responded, "and I would not build it there." [Coroner's Inquest, 1928: 23, 25]

Also contributing to this line of thinking, a zoologist from Stanford University, finding no live fish below the dam, concluded that they must have been killed by a concussion from an explosion. The dam's construction superintendent also publicly claimed that no other force could have destroyed the structure. Further fueling this view, one week after the dam collapse, the Los Angeles Water Commission renewed memories of the insurgency by placing the entire Owens Valley aqueduct system under armed guard. [Kahrl, 1983: 313; Jones, 1928: 26]

Suspicions of incompetence, or possibly worse, also characterized the post-disaster environment, the investigations which followed, and the public's perceptions of who or what was responsible for the death and destruction wrought by the dam's failure. In particular, questions focused on William Mulholland and Harvey Van Norman's visit to the dam on the morning of March 12, and the conditions they noted during that critical timeframe. Suggestions that the city could have, or should have, evacuated downstream residents on the basis of the leaks in the dam face they'd observed were sharply refuted by both men in their testimony at the Coroner's Inquest. Still, this was a difficult question to put entirely to rest, especially when it was considered within the setting of the contentious Owens Valley water project itself, and the popular feeling that the words and deeds of the determined and single-minded Los Angeles "water men" could not be entirely trusted.

The St. Francis Dam disaster was the subject of no less than a dozen investigations, some driven by the desire to learn lessons in engineering and geology which might prevent future similar occurrences. However, the first and most prominent investigation, the Governor's Commission, served the more immediate need of settling quickly on technical causes that would satisfy the public's desire for answers.

The governor's six-member investigatory commission was chaired by A.J. Wiley, and included two geologists, F. Leslie Ransome of the California Institute of Technology, and George D. Louderback of the University of California, Berkeley, as well as F.E. Bonner, H.T. Corey and F.H. Fowler. They met for the first time in Los Angeles, one week after the dam's collapse, and issued their report on March 24th, after just five days of study.

The commission identified several potential flaws in the design and construction of the dam. In particular, the two geologists criticized the placement of the dam across the San Francisquito fault, as well as the unstable conditions in the Palona Schist on the dam's eastern abutment.

Rejecting the sabotage theories, the Governor's Commission concluded that the dam's failure began on the western abutment, where it crossed the San Franciquito fault, pointing to the possible hydraulic piping Mulholland and Van Norman were asked by damkeeper Tony Harnischfeger to examine the day before the failure, as well as their interpretation of the downstream distribution of the dam's concrete blocks. The landslide on the eastern abutment, they concluded, was caused by it being undermined by eddying flows pouring through the failed western side of the dam. [Figure 18]

As later, more thorough, investigators into the St. Francis Dam failure were to point out, the Governor's Commission committed numerous analytical errors born of the political necessity of drawing rapid conclusions from the tragedy and ending the rumors of sabotage. As the first report issued on the collapse, however, the Governor's Commission report would overshadow the engineering and geology literature for decades thereafter.

In the final accounting, William Mulholland accepted complete responsibility for the failure of the St. Francis Dam, and was widely praised for his humility in the face of the tragedy. Taking immediate action where he was still able, he ordered the water level in the similarly-designed Mulholland Dam above Hollywood to be lowered. During the 1930s, this dam would be substantially retrofitted.

Although Mulholland acknowledged that his office must have overlooked some important consideration in the design of the St. Francis Dam, he expressed dissatisfaction with the official verdict on the causes of its failure. Mulholland also remained defiant in the face of accusations that any issues of competence, let alone malicious intent, played a role in its design and construction. [Mulholland, 2000: 325-6]

Three and a half decades passed before the conventional wisdom regarding the causes of the St. Francis Dam failure were challenged. Examining the available forensic evidence, historian Charles Outland concluded in his 1963 book "Man-Made Disaster" that the Governor's Commission investigation overlooked important evidence, seriously compromising their conclusions. Contrary to the official report, Outland pointed to evidence that a massive landslide had occurred in the unstable Palona Schist on the dam's eastern abutment, essentially reversing the failure sequence described in the report of record. In 1995 Outland's conclusions were scientifically verified and extensively expanded by engineering geologist J. David Rogers. [Outland, 1963; Rogers, 1995]

The passage of time has tended to bolster Mulholland's defense of his own character, as well as his instincts as an engineer. When measured against later building methods the dam was structurally deficient in a number of important respects, any one of which might have led to its eventual failure. However, recent investigators have largely vindicated Mulholland's approach to the design and construction of the dam. Rogers in particular concludes that it was designed within the standards and practices of the era in which it was constructed. [Rogers, 1995: 81-82]

With the benefit of hindsight, a number of engineering decisions made by the bureau could be faulted. These include the planned foundation excavations of 30 to 35 feet into the canyon floor, as well as the number of uplift relief wells intended to prevent the dam from becoming buoyant with the saturation of the concrete by the retained reservoir water. Raising the height of the dam twice during its design and construction, as political necessity dictated, but without increasing the size and depth of its foundation, also contributed to the dam's instability. [Rogers, 1995: 28-32]

The implications of geological conditions on the site were also not fully understood by the bureau. Despite Mulholland's encounter with the unstable Palona Schist in the canyon ten years earlier, apparently little if any further investigation into the underlying materials at the dam site took place prior to the dam's design and construction.

Excavations into the hillsides for the dam's abutments were not extensive, but once again, were typical by the standards of the mid-1920s. Measures to control seepage that became accepted practice after the St. Francis Dam failure, including cutoff walls, internal inspection galleries, grout curtains, and uplift relief wells beneath the dam abutments, were not included in the dam's design.

Perhaps the single most significant deficiency of the design, however, was the lack of contraction joints to accommodate the thermal stresses and shrinkage resulting from the curing of Portand cement. A poorly understood phenomena at the time, thermal stresses in the completed dam resulted in the need to fill a number of expansion cracks in the face of the dam within a year after its completion. A more complete understanding of these and other geological and engineering issues related to the design of concrete gravity arch dams emerged in the years following the St. Francis Dam disaster. [Rogers, 1995: 33-4]

All of this engineering and geological knowledge came too late for Mulholland, and accordingly, the St. Francis Dam disaster would prove to be an immediate and fatal blow to his reputation as one of the nation's leading water engineers. In Mulholland's final annual report to Board of Water and Power Commissioners in July 1928, he referred to the St. Francis Dam disaster only in terms of its impact on the city's water supply, which he considered to be negligible in the immediate term. Shortly afterwards, he took leave of his position at the city. The following March, he was replaced as chief of the newly reorganized Department of Water and Power. His successor was his old protege, Harvey Van Norman. [Annual Report, 1928; Mulholland, 2000: 327]

The last standing section of the dam, as well as the largely intact western wing dike, were destroyed by the City of Los Angeles within 18 months of the disaster, and the more prominent blocks of concrete hammered and dynamited into unrecognizable masses on the canyon floor. A new road to Powerhouse No. 1 breached what remained of the western dam abutment. Powerhouse No. 2 was rebuilt in 1928 on the foundations of the original swept away by the flood, as was a nearby employee's village. Otherwise, little was permitted to remain on the site of the St. Francis Dam to remind a visitor of the events of March 12-13, 1928. [Rogers, 1995: 80-81]

The need for local water storage would be served by a replacement reservoir constructed in 1932-4 in nearby Bouquet Canyon. This new reservoir was retained by an earthen dam. [Hoffman, 1981: 260]

Property Damage and Loss of Life

The official death count for the St. Francis Dam Disaster was 420 individuals, although this figure would of necessity be an estimate. Numerous victims were likely never found, and some amount of double-counting may also have occurred. In any event, conservative estimates of fatalities in the range of 400 to 450 persons safely establishes the St. Francis Dam Disaster as one of the most costly in terms of life in California history, second only to the San Francisco Earthquake and Fire, and easily the largest of human origin.

The best available estimates of property losses included eight miles of Southern Pacific Railroad right-of-way and four railroad bridges damaged or destroyed, nine-hundred nine buildings were destroyed and 331 were damaged. Over 23,000 acres of land, including nearly 8,000 in agriculture, were considered lost. [Figure 14]

Ironically, the single largest landholder in the path of the flood was rescued from nearly certain insolvency by the disaster. The Newhall Land and Farming Company received a $737,030.59 property damage claim settlement from the City of Los Angeles in 1930. This check came at a moment when the company was struggling to recover from the twin effects of a crushing debt and the onset of the Great Depression. The timely income returned the company to solvency, and in the decades thereafter, it went on to become one of the largest real estate developers in California, with a market capitalization in January 2004 of $986 million. [Newhall, 1958: 87]

In the aftermath of the flood, a group of enterprising Santa Clara Valley aviation enthusiasts pooled their resources to acquire flooded, formerly agricultural acres adjacent to the riverbed, where they founded the Santa Paula Airport in 1930. Today, it is the only private-public use airport in Ventura County, as well as the county's oldest airport. [Hayes, 1980]

The full dollar value of the disaster's damages were never completely or officially tallied. According to Outland, the total cost to the City of Los Angeles was probably in the neighborhood of $13.5 million, including roughly $8.0 million toward the settlement of property and wrongful death claims, unknown cleanup and restoration expenses, lost water and power generating revenue, the cost of replacing Power House No. 2, as well as the lost investment in the dam itself. A total of 336 death and 62 disability claims were filed against the City of Los Angeles. Most of the claims were settled with remarkable alacrity, mainly within a year, and without court intervention. [Outland, 1963: 223-27; Jones, 1928: 21]

The method by which the rapid settlement of claims was accomplished succeeded in contributing to the controversy surrounding the disaster, as well as public suspicions of collusion and conspiracy which became a persistent feature of the popular view of the St. Francis Dam story. Each of these themes played out in no small part against the backdrop of the controversial history of the Owens Valley water project itself.

<u>Impact on the Regulation of Dam Construction</u>

Until 1915, dam construction in California remained largely unregulated. The first state controls on dam construction in the state were adopted that year, when the Legislature required plans for reservoirs and dams to be submitted to the State Engineer. Still, compliance with this law was essentially voluntary.

Heavy rainstorms in San Diego County in January 1916 caused the failure of one dam and the partial failure of another, resulting in a loss of life and a renewed focus on the issue of dam safety in California. The State Reclamation Board, which had expressed concern that the 1915 legislation did not go far enough, released the recommendations of a two-year study of dam safety in August 1916. The Board recommended State supervision and oversight of the planning, construction, maintenance, and operation storage reservoirs. [*Engineering News,* 1916: 259]

The legislature acted on the Board's report by passing the Dam Safety Act of 1917. The new law granted the State Engineer authority over all dams greater than ten feet in height, or which impounded at least three million gallons of water, built by irrigation districts, individuals and private companies. Exceptions included dams used to retain mining debris constructed by California Debris Commission, dams constructed by municipal corporations and designed by local engineering staff, and dams which were part of a water system regulated by the State Public Utilities Act. [Ch. 377, Stats. 1917, p. 516; California Blue Book, Department of Public Works, 1928: 156]

The State Railroad Commission had been granted authority over all dams owned by public utilities by the State Public Utilities Act of 1915, but the Commission did not begin "effective supervision" until after the passage of the Dam Safety Act of 1917. Between 1917 and 1929, the Railroad Commission oversaw the construction of 46 of the 140 public utility dams built in California to that date. Nevertheless, dams constructed by municipalities, or otherwise regulated, were exempted from the Railroad Commission's pervue. Further, the Commission complained of a lack of clear authority and adequate funding to oversee the maintenance of dams within their regulatory domain. Of particular concern were dams constructed prior to 1917. In 1920 the Federal Power Commission was granted authority to supervise the design and construction of public hydroelectric dams. [California State Railroad Commission, 1928-29: 1-2]

The dam safety regulations in place on March 12, 1928 were a patchwork created as the perceived need for oversight arose. The catastrophic failure of the St. Francis Dam, just two years after it was completed and with great loss of life and property, almost immediately called into question the existing system of regulating dam construction in California.

The magnitude of the St. Francis Dam disaster brought engineers and geologists together from all over the country to theorize about why the disaster occurred, and what measures should be implemented to prevent future occurrences of its kind. Thirteen different panels were convened to investigate the St. Francis failure. The principal investigative body, the Governor's Commission, may have fixed the specific geological conditions and engineering causes of the failure incorrectly, but the panel did identify the weakness in a system that provided for little oversight of design and construction. The consensus of opinion which emerged among engineers and others was that, "state regulation of the construction of all dams — municipal as well as private — was imperative." [*Western Construction News,* 1929: 203]

In the wake of the disaster, new dam safety legislation was adopted by the California Legislature on August 14, 1929, strengthening the existing laws and centralizing authority. Where previously the control of dam construction had been spread out among several agencies, each with varying degrees of supervision, the State Engineer was now provided with authority to review, supervise and maintain all non-federal dams greater than 25 feet high or which impounded at least 50 acre feet of water. In addition, funding was provided for a comprehensive three-year survey and inspection of all existing dams. The new and far more aggressive California dam safety legislation would become a model for other states to follow. [*Western Construction News,* 4-25-1929; Rogers, 1995: 82-4]

The legislature created a new division of State Engineering Department under the supervision of the State Engineer. Trained personnel were selected to carry out the task of reviewing the safety of dams through extensive testing, including field examination, stress analysis and computation. A total of some 830 dams were inspected. The results showed that only one-third of the dams could be viewed as satisfactory in terms of safety; one-third required further investigation and one-third were in need of repair. Those dams identified as unsafe were rehabilitated. [Hawley, 1936]

This more conservative approach to dam building and design led to immediate changes in the planning and construction of new dams. The first project to be effected was the ambitious San Gabriel Forks Dam, planned by the Los Angeles County Flood Control District on a site immediately below the confluence of the east and west forks of the San Gabriel River in the Angeles National Forest. This concrete arch dam, at 425 feet high and 1,700 feet across, was to be the largest concrete structure in the world. It was designed to impound a reservoir of 240,000 acre feet, a quantity over six times greater than the St. Francis Reservoir.

Construction on the San Gabriel Forks Dam began in the Spring of 1929, but was halted in September when a massive landslide occurred during the excavation of the dam's western abutment. Construction was halted, and the State Engineer called in to investigate the feasibility of continuing. The State Engineer's Office report, issued only three months after the creation of the department's duties by the Legislature, called for the abandonment of the concrete arch dam due to the geological instability of the site, and the construction of three, smaller rock-fill dams on the river in its stead.

As a result, the County of Los Angeles would lose nearly its entire investment of $4.5 million on the project, and one Los Angeles County supervisor would be jailed on a related bribery conviction. The new state oversight law had its first test, and in dramatic fashion, potentially averted a catastrophe of a magnitude that would have dwarfed the St. Francis Dam disaster.

Ultimately, two of the three proposed alternative dams were built on the San Gabriel River, but not without the the hand of the State Engineer being felt once again. Further exercising its new powers, the State Engineer in 1935 rejected one of the District's proposed designs for San Gabriel No. 1, the first of two rock-fill dams to be constructed on the river. [Baumann, 1941: 1595, 1635-7]

The impact of the St. Francis Dam disaster was felt keenly outside of California as well. Most notably, the construction of Boulder (Hoover) Dam, then under consideration by Congress, was called into question by those who had been opposing its construction since it was first proposed in 1922. Seizing upon the tragedy, Arizona Governor George Hunt, one of the leading opponents of the entire Colorado River project, commissioned a state investigation of the failure of the St. Francis Dam, which concluded, "the utmost care must be exercised in ascertaining the safety of a damsite before selecting it for water storage. This Congress has thus far failed to do [sic] in the case of the Boulder Dam." [Jones, 1928: 31]

Congressional approval of the authorizing legislation, the Swing-Johnson bill, stalled. Editorials citing the St. Francis Dam disaster as cause for abandoning the Boulder Dam and the Colorado River Aqueduct project were published in newspapers as distant from the region as the Wall Street Journal. The project ultimately overcame this opposition and was approved by Congress in December 1928. The St. Francis Dam failure would once again slow the development of the Colorado River Aqueduct, however, when in 1929 Los Angeles voters, the disaster still fresh in their minds, failed to approve a bond measure to fund its construction. The bond authorization passed overwhelmingly two years later. [Mulholland, 2000: 325; Karl, 1982: 313-4, 341; Hoffman, 1981: 260]

<u>Impact on the Career of William Mulholland</u>

It is unlikely that any other individual can be credited for having made a greater contribution to the transformation of Los Angeles from dusty pueblo to modern metropolis than William Mulholland. It was through his offices, and his personal determination, that the Owens Valley Aqueduct, as well as numerous ancillary water facilities which made this growth possible, were envisioned, designed and constructed. More notably, no individual within this context can be seen to have fallen so abruptly from the great heights of widespread admiration, respect and influence, to virtual ignominy. It was a fall precipitated by a single event, the collapse of the St. Francis Dam.

William Mulholland's final years, until his death in 1935, were spent uncharacteristically out of public view, and he would enjoy little recognition of his life in service to the City of Los Angeles. He also forfeited the opportunity to participate in the design and construction of the next major feat of Southern California water engineering, the Colorado River aqueduct, a project for which he'd lobbied actively for many years. Instead, his name and vast accomplishments would be forever linked to, and overshadowed by, the St. Francis Dam disaster. In a very real sense, William Mulholland became the tragedy's final victim. [Mulholland, 2000: 328-31]

St. Francis Dam (Site of), Los Angeles County, California — Major Bibliographic References [continued]

American Society of Civil Engineers, "Proceedings of the Fall Meeting: Essential Facts Concerning the Failure of the St. Francis Dam." Boston, Mass. October 9-11, 1929, Part I/New York, 1929.

Baumann. M. *Design and Construction of San Gabriel Dam No. 1. Proceedings of the American Society of Civil Engineers*: September, 1941, pp. 1595-1651.

Brown, J.B. & Fairbanks, J.P. "Some aspects of St. Francis Flood Damage of Interest to Agricultural Interests." Ventura, CA, 1928.

California Board Urges State Control of Dams. *Engineering News*, 8/10/1916.

California Blue Book, Department of Public Works, 1928.

California State Railroad Commission. Information Supervision of Dams, 1928-29.

Davis, Margaret Leslie. *Rivers in the Desert: William Mulholland and the Inventing of Los Angeles*. New York: Harper-Collins, 1993.

Engineering News. "California Board Urges State Control of Dams," April 10, 1916.

Gaylord, G.E., Supt., L.A. Division Southern Pacific Lines. *History of the Collapse of the St. Francis Dam in San Francisquito Canyon,* March 12, 1928.

Grunsky, C.E. and Grunsky E.L. "St. Francis Dam Failure: accompanied by Report on Geology of St. Francis Dam Site, by Bailey Willis, 1928" *Western Construction News*, May 25, June 25, 1928

Hayes, Brian (ed.) et. al. *From the Ground Up: The Golden Anniversary Book of the Santa Paula Airport*. Santa Paula, 1980.

Hawley, George W. "Nine Hundred Dams Inspected." *Engineering News-Record,* July 16, 1936.

Hoffman, Abraham. *Vision or Villainy: Origins of the Owens Valley-Los Angeles Water Controversy*. College Station: Texas A&M University Press, 1981.

Joint Architectural Committee. Report on Building Restoration, Nov. 1, 1928.

Joint Committee on Personal Property Damage Report, Jan. 31, 1929.

Jones, Guy L. Member of Arizona Legislature. "San Francisquito Canyon Dam Disaster (California)," Report to His Excellency Gov. George W. P. Hunt, 1928.

Jones, Tad. *When the Santa Clara Ran Red. Immortal Rhymes of the St. Francis Flood*. Los Angeles: self-published, 1928.

Kahrl, William L. *Water and Power*. Berkeley & Los Angeles: University of California Press, 1982.

Lee, Charles H. "Theories of the Cause and Sequence of Failure of St. Francis Dam." *Western Construction News*, June 25, 1928.

Los Angeles County Coroner, *Transcripts of testimony in inquest over victims of St. Francis Dam Disaster,* 1928.

St. Francis Dam (Site of), Los Angeles County, California — Major Bibliographic References [continued]

Los Angeles County Coroner, *Verdict of the Coroner's Jury in the Matter of Julia Rising, et al*. 1928.

Los Angeles Department of Water and Power. *Board of Water and Power Commissioners Annual Reports,* 1925 to present.

Mead, Elwood. *The St. Francis Dam Failure: From Report of Committee appointed by City Council of Los Angeles to Investigate and Report the Cause of Failure of St. Francis Dam*. New Reclamation Era, May 1928.

Memorandum to Mr. E.F. Scattergood, March 27, 1928. Memorandum concerning destruction at San Francisquito Power Plant No. 2 and St. Francis Dam, March 13, 1928. "Notes taken from Dispatchers Log Book."

Mulholland, Catherine. *William Mulholland and the Rise of Los Angeles*. Berkeley: UC Press, 2000.

Nadeau, Remi. *The Water Seekers*. Garden City, New York: Doubleday and Company, 1950.

Nichols, John. *Images of America: St. Francis Dam Disaster*. Chicago: Arcadia Publishing, 2002.

Newhall, Ruth Waldo. *The Newhall Ranch: The Story of the Newhall Land and Farming Company*. San Marino: Huntington Library, 1958.

Outland, Charles. *Man-Made Disaster: The Story of St. Francis Dam*. Glendale, Ca.: Arthur H. Clark, 1963 and revised edition, 1977.

Rock, Frank. "The 1928 St. Francis Dam Disaster." *California Historian*, Winter, 1994.

Rogers, J. David. "A Man A Dam A Disaster: Mulholland and the St. Francis Dam." *The St. Francis Dam Disaster Revisited*, pp. 1-109. Historical Society of Southern California/Ventura County Museum of History and Art, 1995.

Report of the Commission appointed by Governor C.C. Young to Investigate the Causes Leading to Failure of St. Francis Dam near Saugus, Ca. Sacramento, CA: State Printing Office, 1928.

Spalding, Wiliam A. *Los Angeles City and County Vol. I*. Los Angeles: JL Finnell & Sons, 1929.

Teague, Charles C. *Fifty Years a Rancher*. Santa Paula: self-published, 1944 (second edition).

Travis, George B. Unpublished manuscript. August, 1929. (Collection of the Huntington Library)

Engineering News-Record, "Western Engineers Giving Increased Study to Safety of Dams." November 6, 1930.

Western Construction News. Volume IV, Number 7, April 10, 1929.

Western Construction News. "Supervision of Dams in California." April 25, 1929.

Wiley, AJ, et. al. "Report of the Commission Appointed by Governor C.C. Young to Investigate the Causes Leading to the Failure of the St. Francis Dam near Saugus, California." April 20, 1928.

St. Francis Dam (Site of), Los Angeles County, California — Verbal Boundary Description [continued]

The nominated site is a rectangle measuring approximately 400 meters in length and 100 meters in depth, encompassing the site of the dam and enclosing approximately 9.88 acres.

St. Francis Dam (Site of), Los Angeles County, California — Boundary Justification [continued]

The nominated site is a rectangle measuring approximately 400 meters in length and 100 meters in depth enclosing the footprint of the dam as it was completed in 1928.

St. Francis Dam (Site of), Los Angeles County, California — Photograph and Figure Log [continued]

Figure 1. Sign advertising the construction of the St. Francis Reservoir, probably taken from the dam road on the south side of San Francisquito Canyon in late 1925, after the dam's storage capacity was raised to 38,168 acre feet. (United Water Conservation District/John Nichols Collection)

Figure 2. Site of St. Francis Dam. (Department of Geology, California State Polytechnic University, Pomona, 1980)

Figure 3. Downstream view of the face of the St. Francis Dam after its completion. The only day water was known to have been released from the reservoir into San Francisquito Creek after the construction of the dam began in 1924 was on the day it failed, but this photo was probably not taken on March 12, 1928. (Los Angeles Department of Water and Power)

Figure 4. Portion of a panorama photo of the completed St. Francis Reservoir facing southeast, with the dam's western wing dike visable in the right middle ground. This photo was probably taken in early March 1928. (Los Angeles Department of Water and Power)

Figure 5. Upstream view of the dam, midday on March 12, 1928, roughly 12 hours before the St. Francis Dam failed, during the inspection by William Mullholland, Harvey Van Norman and damkeeper Tony Harnischfeger, all three of whom can be seen walking together above the spillway. (Los Angeles Department of Water and Power/John Nichols Collection)

Figure 6. Downstream view of the dam, midday on March 12, 1928, during the inspection. Water blowing over the spillway onto the dam face complicated the observation of any leaks in the structure, but the leak Mullholland was called to investigate is represented by the darkened area on the western wing dike, seen at the far left side of the photo. (Los Angeles Department of Water and Power/John Nichols Collection)

Figure 7. The remains of a highway bridge crossing the Santa Clara River near Castaic, probably photographed with a week after the dam's collapse. (John Nichols Collection)

Figure 8. Santa Clara Valley residents inspecting a road washout on the northern approach to the Bardsdale Bridge, near Fillmore, probably on March 13, 1928. (John Nichols Collection)

Figure 9. The remains of the Bardsdale Bridge, probably as photographed within a week of the dam's collapse. (John Nichols Collection)

Figure 10. The Willard Bridge, east of Santa Paula, destroyed at 3:00 AM on March 13. Photograph probably taken within a week of the dam's collapse. (John Nichols Collection)

Figure 11. The Isbell Middle School in Santa Paula, and the foundations of the homes previously located on nearby streets, one of which is seen dislocated into the school yard. Photograph probably taken on March 13, 1928. (John Nichols Collection)

Figure 12. A destroyed residential area in Santa Paula. Photograph probably taken on March 13, 1928. (John Nichols Collection)

Figure 13. The tent city in Santa Paula set up to provide temporary housing for as many as 600 residents dislocated by the flooding. Date of photograph unknown, but probably March, April or May, 1928. (John Nichols Collection)

Figure 14. A destroyed citrus orchard, probably located near Bardsdale. Photograph probably taken within a week of the dam's collapse. (John Nichols Collection)

St. Francis Dam (Site of), Los Angeles County, California — Photograph and Figure Log [continued]

Figure 15. Aerial oblique upstream view toward the north/northeast at the dam site on March 13, 1928. Standing block No. 1 is visible in the center right middle ground, and the remaining sections of the wing dike on the dam's western abutment on the hillside to its left, as well as the massive landslide on the dam's eastern abutment. (Spence Collection, UCLA Dept. of Geography)

Figure 16. Downstream view after dam failure, showing standing block No. 1, a portion of the western wing dike, and scour line of the flood waters. Date unknown. (Ventura County Museum of History and Art, with notations by Rogers)

Figure 17. Distribution of Dam Fragments, as illustrated in Governor's Report. (Wiley, et. al., 1928)

Figure 18. Area impacted by the failure of the St. Francis Dam. Composite of USGS Quadrangle Maps with overlay of estimated flood inundation area St. Francis Reservoir by J. David Rogers.

Figure 1. Sign advertising the construction of the St. Francis Reservoir, probably taken from the dam road on the south side of San Francisquito Canyon in late 1925, after the dam's storage capacity was raised to 38,168 acre feet. (United Water Conservation District/John Nichols Collection)

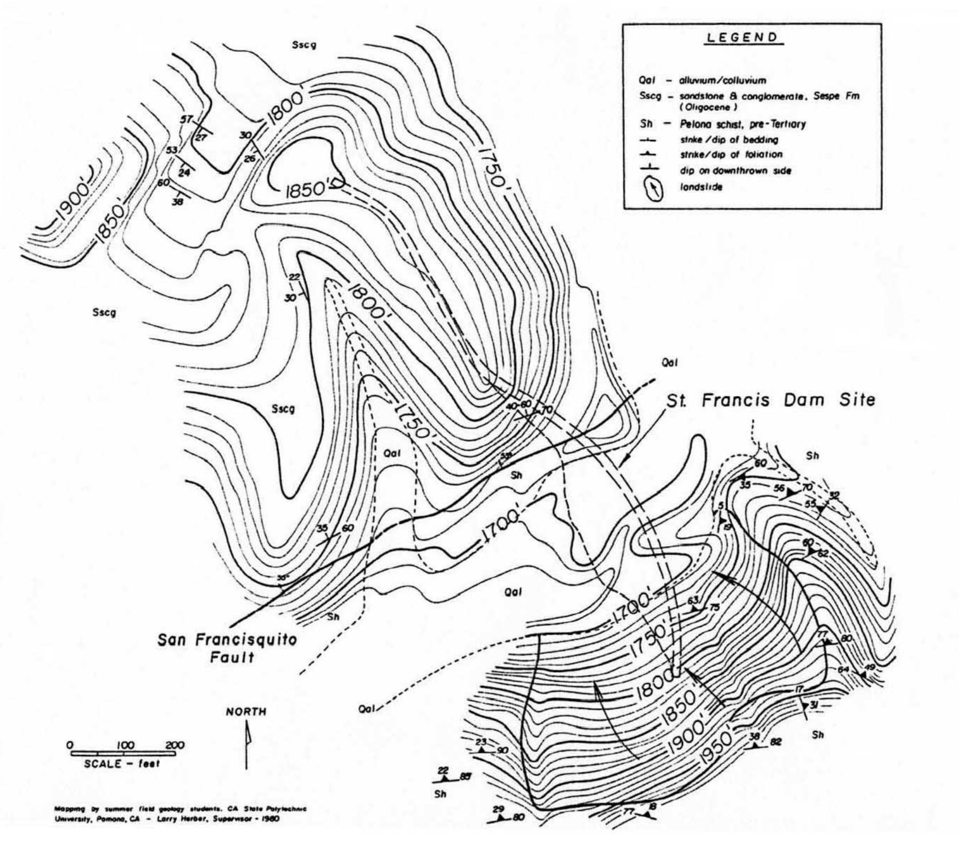


Figure 2. Site of St. Francis Dam. (Department of Geology, California State Polytechnic University, Pomona, 1980)

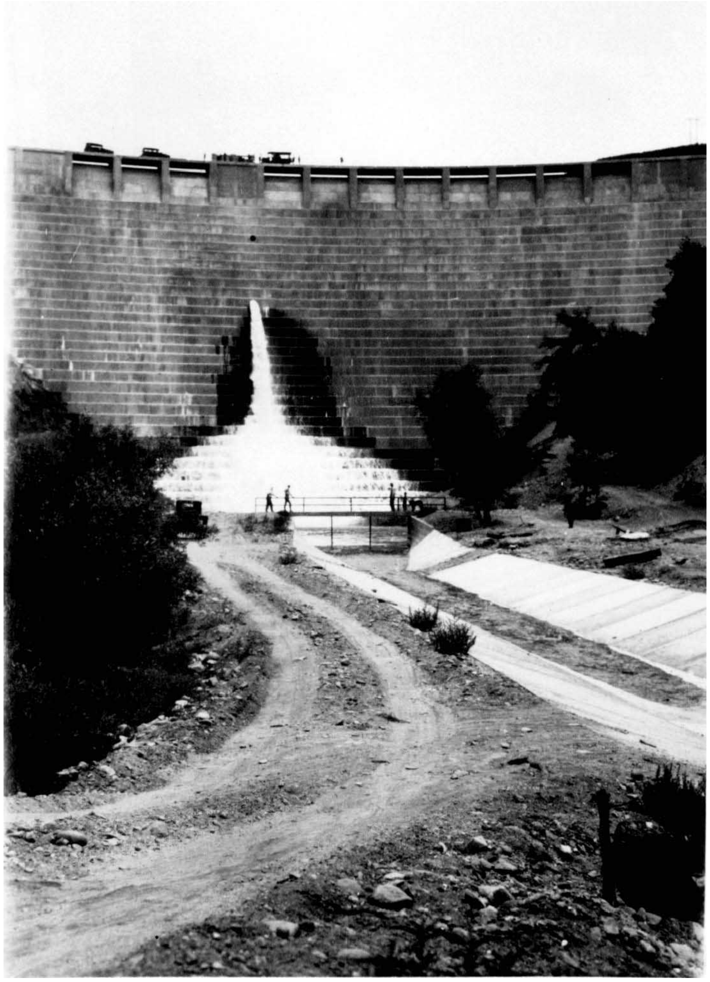


Figure 3. Downstream view of the face of the St. Francis Dam after its completion. The only day water was known to have been released from the reservoir into San Francisquito Creek after the construction of the dam began in 1924 was on the day it failed, but this photo was probably not taken on March 12, 1928. (Los Angeles Department of Water and Power)

Figure 4. Portion of a panorama photo of the completed St. Francis Reservoir facing southeast, with the dam's western wing dike visable in the right middle ground. This photo was probably taken in early March 1928. (Los Angeles Department of Water and Power)

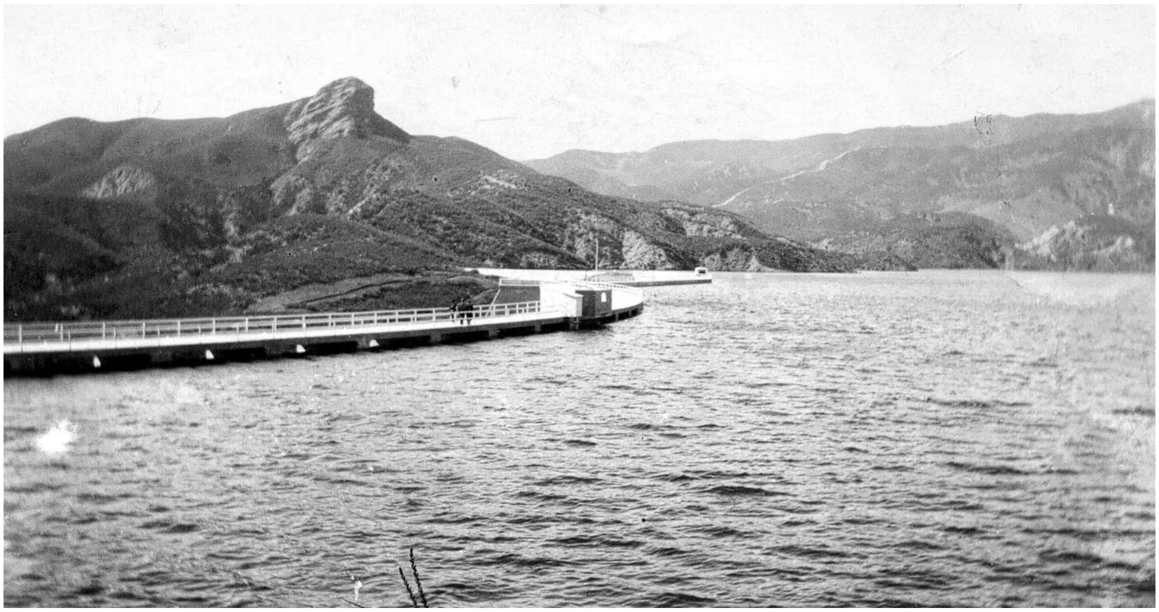


Figure 5. Upstream view of the dam, midday on March 12, 1928, roughly 12 hours before the St. Francis Dam failed, during the inspection by William Mullholland, Harvey Van Norman and damkeeper Tony Harnischfeger, all three of whom can be seen walking together above the spillway. (Los Angeles Department of Water and Power/John Nichols Collection)

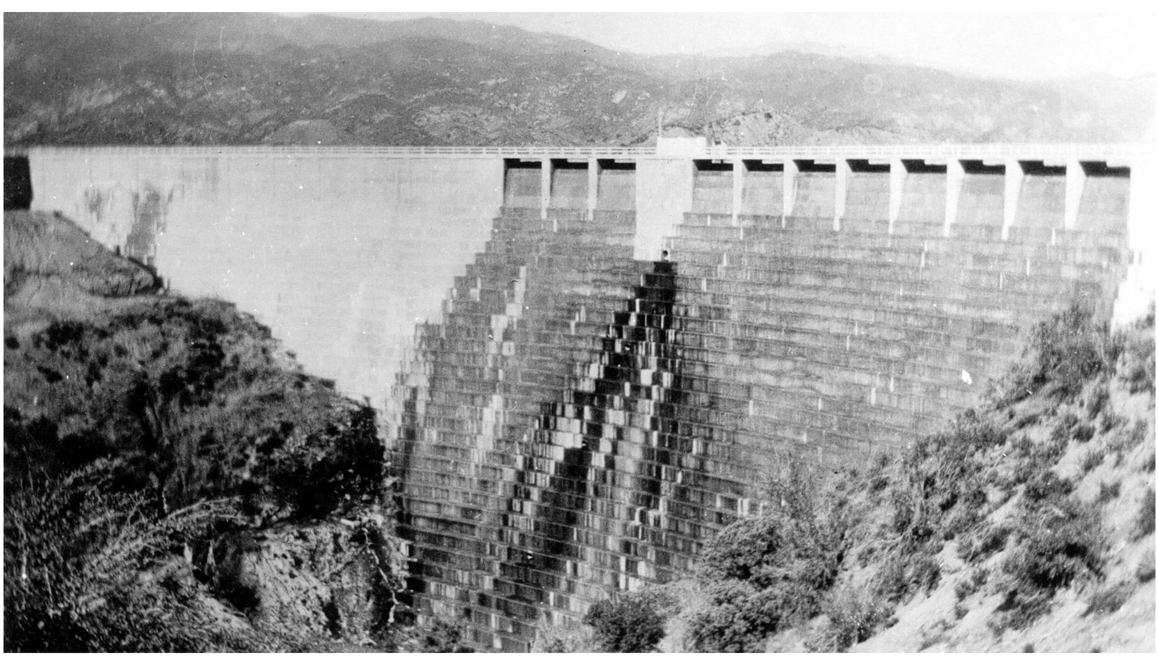


Figure 6. Downstream view of the dam, midday on March 12, 1928, during the inspection. Water blowing over the spillway onto the dam face complicated the observation of any leaks in the structure, but the leak Mullholland was called to investigate is represented by the darkened area on the western wing dike, seen at the far left side of the photo. (Los Angeles Department of Water and Power/John Nichols Collection)

Figure 7. The remains of a highway bridge crossing the Santa Clara River near Castaic, probably photographed with a week after the dam's collapse. (John Nichols Collection)

Figure 8. Santa Clara Valley residents inspecting a road washout on the northern approach to the Bardsdale Bridge, near Fillmore, probably on March 13, 1928. (John Nichols Collection)

Figure 9. The remains of the Bardsdale Bridge, probably as photographed within a week of the dam's collapse. (John Nichols Collection)

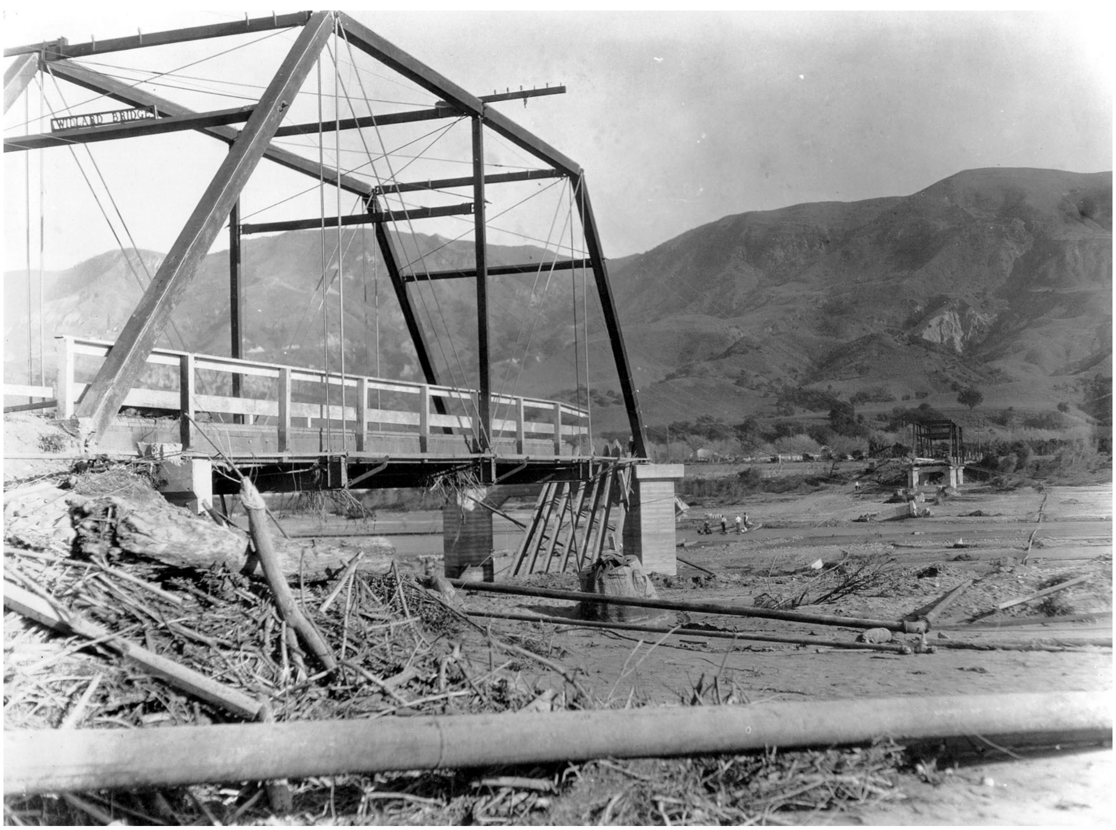


Figure 10. The Willard Bridge, east of Santa Paula, destroyed at 3:00 AM on March 13. Photograph probably taken within a week of the dam's collapse. (John Nichols Collection)

Figure 11. The Isbell Middle School in Santa Paula, and the foundations of the homes previously located on nearby streets, one of which is seen dislocated into the school yard. Photograph probably taken on March 13, 1928. (John Nichols Collection)

Figure 12. A destroyed residential area in Santa Paula. Photograph probably taken on March 13, 1928. (John Nichols Collection)

Figure 13. The tent city in Santa Paula set up to provide temporary housing for as many as 600 residents dislocated by the flooding. Date of photograph unknown, but probably March, April or May, 1928. (John Nichols Collection)

Figure 14. A destroyed citrus orchard, probably located near Bardsdale. Photograph probably taken within a week of the dam's collapse. (John Nichols Collection)

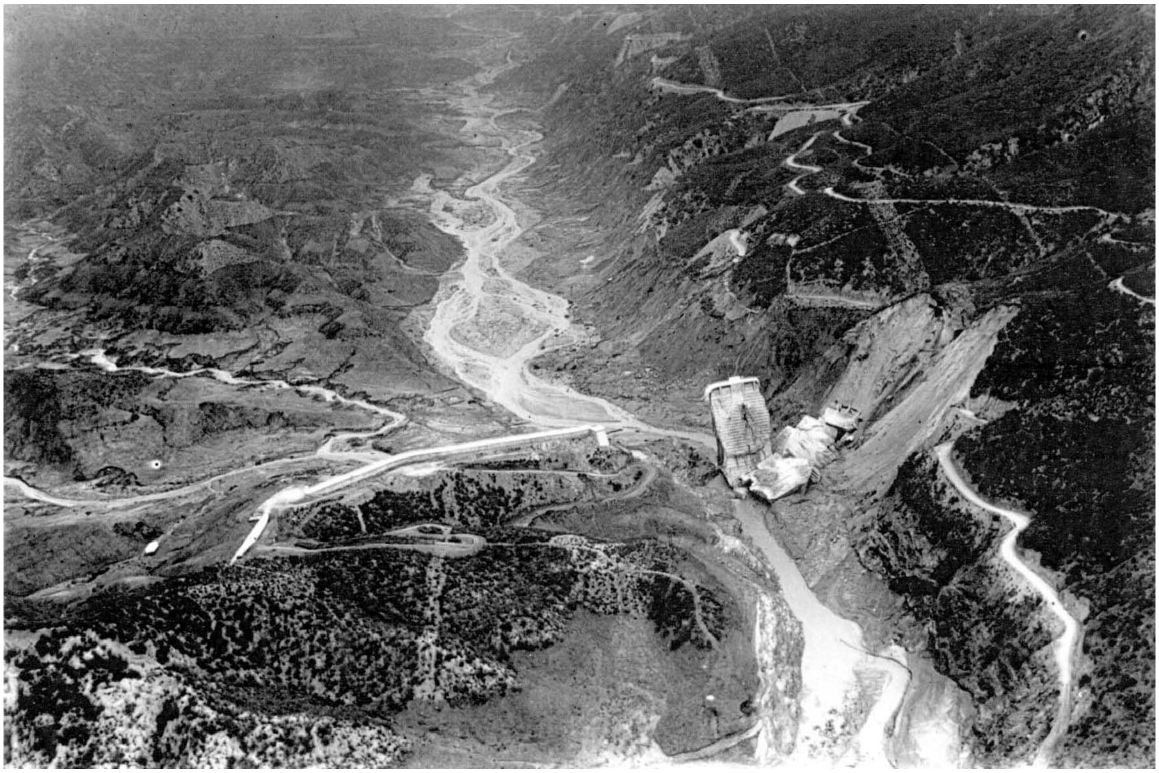


Figure 15. Aerial oblique upstream view toward the north/northeast at the dam site on March 13, 1928. Standing block No. 1 is visible in the center right middle ground, and the remaining sections of the wing dike on the dam's western abutment on the hillside to its left, as well as the massive landslide on the dam's eastern abutment. (Spence Collection, UCLA Dept. of Geography)

Figure 16. Downstream view after dam failure, showing standing block No. 1, a portion of the western wing dike, and scour line of the flood waters. Date unknown. (Ventura County Museum of History and Art, with notations by Rogers)

PLATE 8

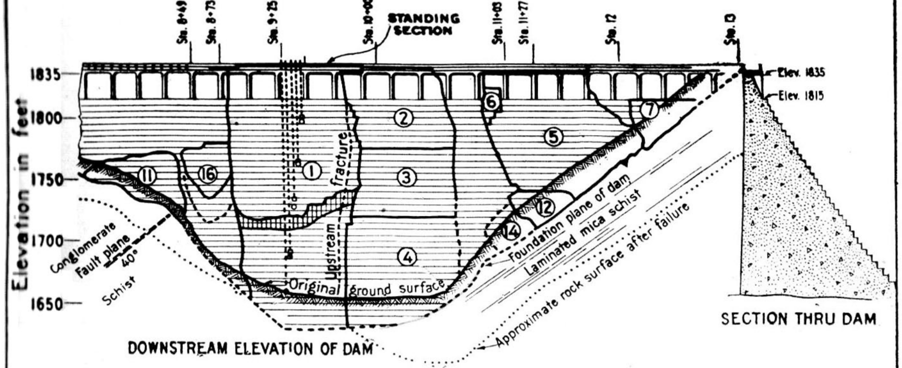
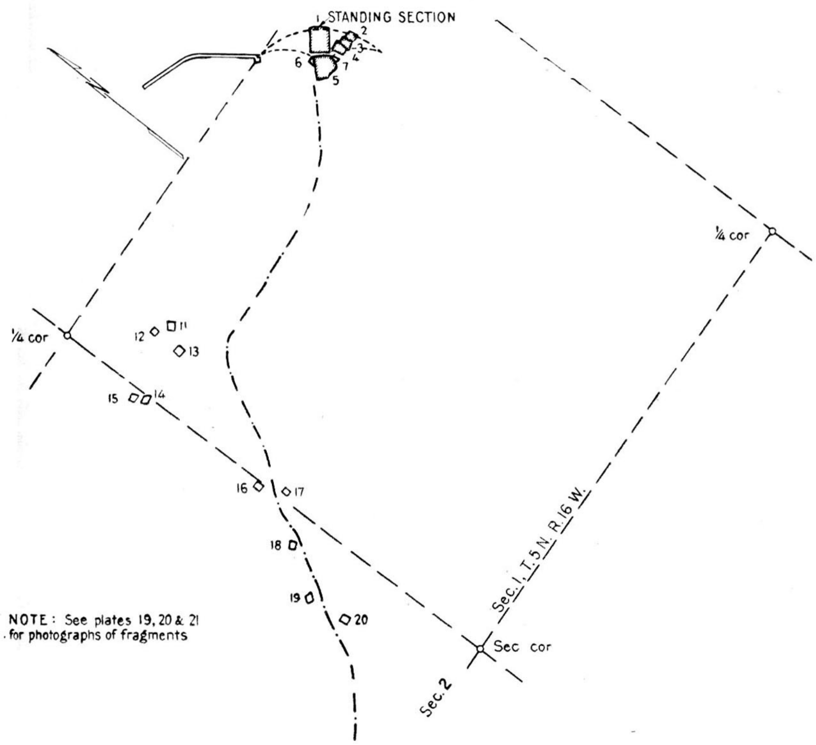


DIAGRAM SHOWING EROSION AND ORIGINAL POSITION OF IDENTIFIED FRAGMENTS



ST. FRANCIS DAM
DISTRIBUTION OF FRAGMENTS
Survey by H. Wildy
SCALE OF FEET
0 500 1000

Figure 17. Distribution of Dam Fragments, as illustrated in Governor's Report. (Wiley, et. al., 1928)

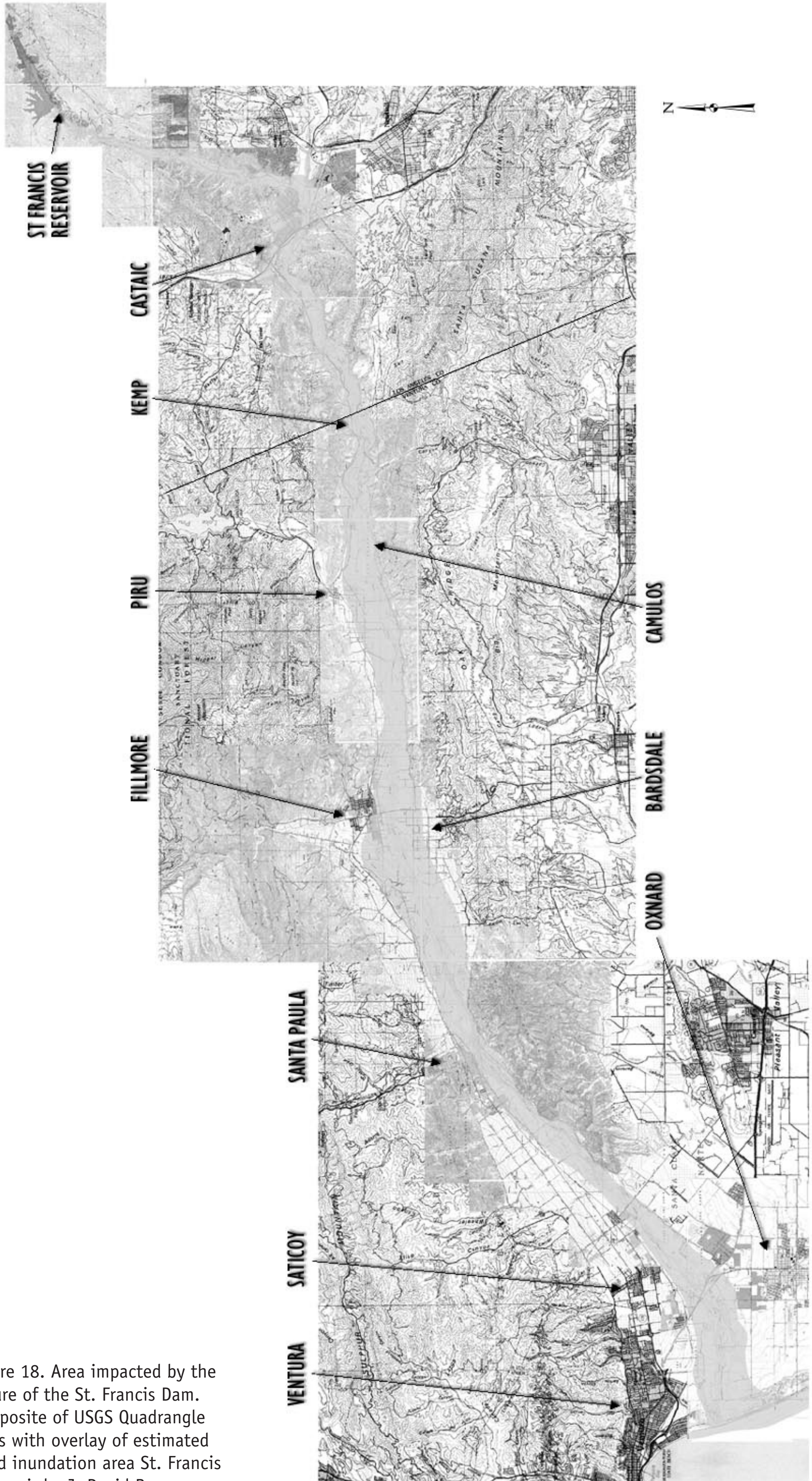


Figure 18. Area impacted by the failure of the St. Francis Dam. Composite of USGS Quadrangle Maps with overlay of estimated flood inundation area St. Francis Reservoir by J. David Rogers.