EAST BAY CITIES SEWAGE DISPOSAL SURVEY

REPORT UPON

THE COLLECTION, TREATMENT AND DISPOSAL OF SEWAGE

AND INDUSTRIAL WASTES OF THE EAST BAY CITIES,

CALIFORNIA

To

THE MAYOR AND COUNCIL

REPRESENTING THE CITY OF BERKELEY

AS THE SPONSORING AGENT

FOR THE SEVEN COOPERATING CITIES

ALAMEDA
ALBANY
BERKELEY
EMERYVILLE
OAKLAND
PIEDMONT
RICHMOND

By

THE BOARD OF CONSULTING ENGINEERS

CHARLES GILMAN HYDE
HAROLD FARNSWORTH GRAY
A. M. RAWN

JUNE 30, 1941

the opportunity still exists at prices which may not yet have become exorbitant.

14. That the construction and operation of the recommended sewerage, sewage treatment and disposal works be performed by the East Bay Municipal Utility District for the reason that its administrative and engineering organization, with few additions to its technical staff, is exceedingly capable and well equipped to execute these functions.

15. That 40-year serial bonds, preferably general obligation bonds, carrying the lowest obtainable rate of interest, be issued to provide construction funds.

REPORT UPON THE COLLECTION, TREATMENT AND DISPOSAL
OF SEWAGE AND INDUSTRIAL WASTES OF THE EAST BAY CITIES, CALIFORNIA

FINDINGS

The Board of Consulting Engineers reports the following FINDINGS as the result of its own studies and deliberations and a review of the great mass of information developed by the Survey staff:

Capacity of San Francisco Bay Waters to Dispose of Sewage.

1. By virtue of its vast tidal prism, amounting to some 2,900,000 acre-feet (940,000 million gallons) per 24 hours, and because of the enormous weight of dissolved oxygen contained therein, the potential capacity of the San Francisco Bay system to receive and innocuously dispose of sewage, expressed in terms of contributory population, is of the order of from 200 to 300 million persons, according to the criteria employed; provided, of course, that the sewage is intimately mixed with the Bay waters.

2. The total average daily supply of dissolved oxygen naturally contained in the tidal prism referred to in Item 1, supplemented through re-aeration and by other sources, is possibly in the region of 35,000,000 pounds.

3. For that section of San Francisco Bay, proper, which lies between Point San Pablo and Hunters Point or Bay Farm Island, the average daily tidal prism is perhaps 510,000 acre-feet (170,000 million gallons) and its potential capacity to receive and innocuously dispose of sewage, reckoned in terms of contributory population, is of the order of 35 to 50 million persons, under the limitations stated in Item 1.

4. The total average daily supply of dissolved oxygen naturally contained in the tidal prism of San Francisco Bay, as described in Item 3, supplemented through re-aeration and by other sources, is possibly in the neighborhood of 6,000,000 pounds.

5. The computed general average daily oxygen (biochemical, 5-day, 20°C) demand of the estimated general average daily flow of sewage from the East Bay area, as considered herein, is 84,000 pounds for the year 1940 and 145,000 pounds for the year 1965.

Present Condition of East Bay Shores and Shore Waters.

6. The East Bay Cities, by reason of the lack of any program of sewage treatment and proper disposal methods, have rankly abused the extraordinary opportunities available for an economical and effective disposal of sewage or treated effluents by dilution in the waters of San Francisco Bay.

7. Because of this bad practice the shores and shore waters of the East Bay Cities have become obnoxiously and notoriously foul and an affront to civic pride and common decency.

8. The foul conditions above noted have rendered the shores and shore waters hardly utilizable for recreational uses (boating, fishing, and the like); completely unsuitable for bathing; and a handicap to industrial development and shipping.

9. With the construction of the San Francisco-Oakland Bay Bridge and the East Shore Highway running north to Richmond, great numbers of people have been made uncomfortably aware of the foul conditions along the Berkeley-Emeryville-Oakland waterfront and are demanding an abatement of the conditions which are universally regarded as a nuisance.

10. When the new East Shore Highway running south to San Jose is constructed, travellers upon this highway will be similarly affronted and offended by the equally foul conditions on the San Leandro Bay marshes, particularly between the lower ends of Fiftieth and Ninety-second Avenues.

Nature of the Local Sewage Disposal Problem.

11. The problem of sewerage and sewage treatment and disposal facing the East Bay Cities must frankly be admitted to be one of aesthetics, primarily, rather than one definitely concerned with the public health, except perhaps indirectly.

Many-Purpose Value of Bay Shores and Waters.

12. San Francisco Bay along the waterfront of the East Bay Cities, if its shores and shore waters were clean and unpolluted, would afford much better facilities and opportunities than now exist or are apparent for the development of recreation and industry, and in some places, of housing. (South Shore - Submerged)

Required Degree or Extent of Sewage Treatment.

13. The oxidizing capacity of the Bay waters is so great that if properly utilized it can and should supplant all refined processes of sewage treatment.

14. Therefore, partial or so-called primary treatment of the sewage of the East Bay Cities, involving short-period subsidence, grease removal, and sludge digestion and de-watering, represents the maximum degree of treatment which local conditions demand, provided the naturally available opportunities are duly capitalized.

15. Good conditions for the disposal of a partially treated (primary)

effluent, in terms of depth and strong currents, are to be found at distances from the shore line which can be readily reached at a reasonable cost.

16. An elaborate investigation of all of the possibilities which have been made apparent by long and careful study has demonstrated that, if the natural advantages of San Francisco Bay as related to the dilution, diffusion and oxidation of sewage are utilized, the most feasible and economical projects are those involving the disposal by dilution of partially treated (primary) effluent.

Recommended Projects--Projects A and K.

17. Holding these facts and conditions in review, the Survey has found that the most rational and economic solution of the problem of collecting, treating and disposing of the dry weather flow of sewage and industrial wastes (together with a proper allowance for infiltration) of the entire East Bay area is represented by a combination of two projects, designated herein as Projects A and K.

18. Project A, as proposed, will provide for the partial or primary treatment and disposal of the sewage of Richmond, of the San Pabl Sanitary District, of a portion (25 per cent) of the Stege Sanitary District, and of areas which are likely to be developed in the Wildcat Creek and San Pablo Creek drainage areas.

19. Project K, as proposed, will provide for the partial or primary treatment and disposal of the sewage of a portion (75 per cent) of the Stege Sanitary District, and of Albany, Berkeley, Emeryville, Oakland, Piedmont, and Alameda, together with certain are not yet incorporated, in Contra Costa County; e.g., the Kensingt district.

20. Under Project A the partially treated sewage will be discharged into deep water off Castro Point, about 750 feet from the shore line.

21. Under Project K the partially treated sewage will be discharged into deep water off the outer end of the Key System pier, Oakland.

Construction Cost of Recommended Projects.

22. The estimated total cost of construction of Projects A and K, based upon the general price levels of the year 1940, is $8,450,000 (see Table No. 88).

23. Based upon the total estimated population of 525,000 tributary in 1945, the computed per capita cost of construction of Projects A and K is $16.10.

24. Based upon an estimated total assessed valuation of 447.5 millions of dollars in 1944-45, the calculated cost of construction of Projects A and K per $1000 of assessed valuation is $18.88.

Annual Costs of Recommended Projects.

25. The estimated total annual costs of Projects A and K are $719,700 as of 1945 (the assumed date of completion), and $626,400 as of 1965 (see Table No. 89).

26. The weighted (true) average total annual costs of Projects A and K for the 20-year period, 1945-1965, are estimated to be $674,200.

27. The estimated per capita total annual costs of Projects A and K for the year 1945 are $1.37 and those for the year 1965 are $0.92, based upon population estimates of 525,000 in 1945 and 682,000 in 1965.

28. The estimated total annual costs of Projects A and K per $1000 of

assessed valuation are $1.60 for the fiscal year 1944-45 and $1.31 for the fiscal year 1964-65, based upon estimated total assessed valuations of 447.5 and 476.5 millions of dollars, respectively.

Cost Comparisons Between Recommended Projects and Others.

29. Twenty-four projects serving various sewerage districts or combinations of districts have been laid out, investigated, and subjected to careful estimation of the cost of construction, and of annual costs as of the years 1945 (the assumed year of completion), 1950, 1955, 1960, and 1965.

30. Many combinations of these projects, selected to provide for the entire East Bay area under discussion, are possible and 35 of the more logical of such combinations have been studied and analyzed as to total construction and annual costs (see Tables Nos. 88 and 89).

31. Four of these combinations of projects give a lower estimated total cost of construction than does the combination of Projects A and K.

32. But Projects A and K, taken together and serving the entire East Bay area (excluding San Leandro), give the lowest estimated total annual costs, over the 20-year period 1945-1965, of any of the 35 combinations which have been reviewed.

33. The estimated total construction costs of the 35 combinations of projects studied range from a minimum of $8,157,000 for Projects A, Q, and R and A, N, and S (both of which exclude San Leandro) to a maximum of $11,261,000 for Projects C, D, L, V, and X.

34. The weighted average total annual costs for the 20-year period

1945-1965 of the 35 combinations of projects reviewed range from an estimated minimum of $674,200 for Projects A and K to an estimated maximum of $959,900 for Projects C, D, L, V, and X (see Table No. 89).

35. In per capita values the computed total annual costs, as of the years 1945 and 1965, range from $1.37 and $0.92 for the combination of Projects A and K, to $1.88 and $1.26, respectively, for the combination of Projects C, D, L, V, and X; the estimated total populations for Projects A and K being as stated under Item 27; the estimated total populations for Projects C, D, L, V, and X, being as follows: 1945, 543,000; 1965, 707,000 (see Table No. 89).

36. In respect to the calculated total annual costs, as of the fiscal years 1944-45 and 1964-65, per $1000 of estimated total assessed valuation, the range is respectively from $1.60 and $1.31 for Projects A and K, to $2.25 and $1.85 for Projects C, D, L, V, and X; the estimated total assessed valuations for Projects A and K being as stated under Item 28; the estimated total assessed valuations for Projects C, D, L, V, and X, being as follows: 1944-45, 453.0 million dollars; 1964-65, 483.0 million dollars (see Table No. 89).

Historical Note Respecting Early Sewerage.

37. The first sewers in the East Bay area apparently were constructed shortly after the year 1869. In 1889 a report by Rudolph Hering on the sewerage of Oakland calls attention to the objectionable results of disposing of sewage along shores and on marshes, intimating that putrefactive odors were becoming aggravated.

than might be surmised; (3) that a considerable proportion of sewage solids, if they could maintain their identity, would eventually be stranded on some shore; (4) that the distance of such travel would generally be relatively long; (5) that it will be essential to treat any sewage, discharged at any of the outfall locations studied, to that degree, at least, where virtually all floatable material, including grease, is removed therefrom.

Condition of East Bay Shores and Shore Waters--Further Discussion.

75. Shoaling of the East Bay shores due to silting probably occurred at a relatively rapid rate during and shortly succeeding the period of unrestricted hydraulic mining in California, and this action is still continuing, but at a greatly decreased rate, due to fine material which is being brought down the Sacramento-San Joaquin river system by floods, plus some accretions of coarser materials eroded by the numerous creeks traversing the local area.

76. This shoaling constitutes an argument against any minor extensions of the many existing sewer outfalls on the mud flats.

77. Even a cursory inspection of the Bay shores in the vicinity of any of the existing sewer outfalls clearly reveals the presence of much material obviously of sewage origin, as well as the formation of deposits of putrefying sewage sludge with attendant foul odors and discoloration of shore waters.

78. In confined areas, especially near docks, the waters are particularly obnoxious; gases of decomposition break the surface with continuous bubbling; and gas-lifted sludge masses frequently boil up to the water surface.

79. In the vicinity of certain sewer outlets during the canning season,

solid wastes from the canneries are particularly noticeable and great quantities of floating waste materials may be seen in the Tidal Canal and elsewhere, transported by the currents.

80. In general, the biochemical oxygen demand of the Bay waters is small and of no significance, ranging from an average minimum of about 0.6 to an average maximum of 1.9 parts per million.

81. A detailed study of the condition of the waters of Oakland Inner Harbor, the Tidal Canal, and San Leandro Bay showed that the dissolved oxygen content of these waters was so depleted by sewage pollution that at many points oxygen values below the generally assumed minimum requirements for fish life were found, while at three stations where sampling was conducted in San Leandro Bay the dissolved oxygen was found to be practically exhausted.

82. In nearly the whole length of Oakland Inner Harbor, easterly from Webster Street, the dissolved oxygen depletion is greater than 50 per cent of the oxygen saturation value, the sag being greatest in the vicinity of Government Island.

83. The investigation referred to in Items 81 and 82 clearly demonstrates that the waters of Oakland Inner Harbor, the Tidal Canal, and San Leandro Bay are polluted to an intolerable degree; that they are foul and repulsive; that they are a detriment to industry, commerce and shipping; that they are inimical to fish life; and that they are entirely unsuitable for recreational purposes.

84. Special studies conducted by the Survey have shown that, if the daily increments of sewage solids are removed from the existing sewage sludge deposits on the mud flats and in the bottoms of sloughs and channels, strong, offensive odors will cease to be generated in appreciable amounts after two weeks, and that areas

INTRODUCTION

The Sewerage and Sewage Disposal Problem Outlined.

This report analyses and discusses the essential aspects of the problem of collection (by means of intercepting sewers) and of the treatment and disposal of the sewage and industrial wastes of seven cooperating East Bay Cities and their tributary environs. Its manner of statement is for the most part direct and simple. We have tried to present the facts, with our conclusions and recommendations, in such plain, non-technical language that they can be readily understood by any citizen who is sufficiently interested to give them his attention.

Throughout extensive areas the waters and shores of the East Bay Cities are grossly polluted by sewage and industrial wastes. The effects are all too manifest to residents and visitors in terms of floating material, discolored water, sludge deposits in shallow waters and on mud flats near shore, and nauseating odors.

The problem under consideration in this report is therefore the collection, treatment and disposal of the sewage and industrial wastes of the East Bay Cities in such manner as to positively do away with these foul conditions. This greatly to be desired end should be accomplished at the minimum cost consistent with effective results. The East Bay Cities should provide safe and clean shores and shore waters as a matter of common decency and reasonably clean municipal housekeeping.

At the outset it should be frankly stated and clearly understood that this problem is primarily one of aesthetics, and not definitely concerned with the public health, except indirectly. The shores and shore waters in question are so forbidding in their present state that they are not being used to any important extent for recreational purposes such a-

picnicking, sun bathing and swimming. If they were so used the danger to public health might become of significance. If the existing conditions are ameliorated, the situation may be altered. In such case hygienic safety for all reasonable recreational uses must be assured. The limited use of these waters for boating does not constitute, or at any rate has not as yet been proved to constitute, a health hazard. Clean shores undoubtedly would encourage their use for recreational purposes and remove the food supply for rats, thereby indirectly benefiting the health of the community. A State Inspector on the night of June 2-3 caught 24 rats with 36 set traps within 100 feet of the Ashby Avenue sewer. Traps set more than 200 feet from the mouth of the sewer were not sprung nor were traps set across the highway from the mouth of the sewer. These rats run long distances up the sewers, as evidenced by rat dirt upon the manhole ledges. Several instances of rats entering homes and industries through traps have been reported but none of these reports have been confirmed.

The studies with which this report deals have been made on behalf of seven contributing cities, namely: Alameda, Albany, Berkeley, Emeryville, Oakland, Piedmont, and Richmond. For reasons which will become apparent it has been necessary to give due and equal consideration to the conditions and needs of the Stege Sanitary District, serving portions of Albany, Berkeley, El Cerrito, and Richmond and of such additional territory as is naturally tributary to the East Bay shores and shore waters from Richmond on the north to Oakland and Alameda on the south. The City of San Leandro, which naturally would be expected to be included in the group of cooperative cities, has undertaken to solve its sewerage and sewage disposal problem independently. To date this has been but partially accomplished, since presumed lack of funds has prevented the construction of an outlet sewer to San Francisco Bay in accordance with the terms of the permit

granted by the State Board of Health dated November 4, 1938.

The territory embraced in the cooperating communities and in the areas tributary thereto, exclusive of San Pablo and Wildcat Creek areas, has a total length northwest-southeast of somewhat over twenty miles. The width of the area varies from about two miles at its narrowest portion to seven miles at the widest part. It embraces an area of 57,000 acres, or 89 square miles, of which 15,400 acres, or 24 square miles, are represented in parks, heavy industrialized districts, and other areas in which population development of consequence is not anticipated. The 1940 population of the 41,600 acres most commonly used for residential purposes is 492,000. It is predicted that the 1965 population, or the population used as a basis for sewage treatment plant design, will be close to 738,000. The design population for intercepting sewers is 830,000, which for practical purposes is considered saturation, and it is anticipated that this population will be approached by the year 1990, or, if exceeded, the increment will be small. The corresponding populations densities would be in 1940, 11.8; in 1965, 17.8; and in 1980, 20 person per acre.

The inclusion of the Wildcat Creek and San Pablo Creek areas would add 19,300 acres or 30 square miles, exclusive of East Bay Municipal Utility District watershed lands, and a proportionate length to the above area. Practically all of the area of these drainages is suitable only for residential purposes and because of topography will have a sparse population. The estimated and predicted populations of these areas and the population densities respectively for the specified years are as follows: for 1940, 16,600 and 0.9; 1965, 38,000 and 2.0; 1980, 114,000 and 6.0.

Such a long narrow strip of land, 20 miles in length and averaging $4\frac{1}{2}$ miles in width, dipping very gradually into the east shore waters of San Francisco Bay, brings about many difficulties, both physical and

economic, in attempting to concentrate the sewage of the area for treatment and disposal, particularly at any single point.

The sewage from existing population and industries is discharged to the Bay and its estuaries through 60 outlets exclusive of sewers serving small individual industries and the Standard Oil Company's refinery at Richmond. Of the 60 sewer outfalls under immediate consideration, 35 are of appreciable size, counting the 9 Alameda outlets as one; the others drain areas of a block or so, or single industries. Of the 35 principal outfalls 27 are so-called sanitary sewer systems and 18 are combined or partially combined* systems or sewers. Fortunately all but approximately 7300 acres or 11.4 square miles of the area served by combined sewers can be more or less easily separated.

The sanitary sewer outfalls range in size from 6" to 48" in diameter and the combined outfalls from 14 inches in diameter to double horseshoe shaped sewers 6' x 6' in dimension. Many of the combined sewers are inadequate in size to meet the requirements for good storm drainage. In some instances storm drains have not been provided, and as a temporary measure the storm waters have been diverted into sanitary sewers. The overtaxed combined systems, and sanitary sewers with temporary storm connections, which frequently become permanent, spout during the winter months, giving rise to many complaints because of fecal matter scattered upon the streets.

The existence of these combined or temporarily combined sewers greatly complicates the sewage collection and disposal problem and increases the scope and cost of an adequate solution. Most of these combined sewers have no other excuse for existence than that their construction was a

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* A "combined" sewer is a conduit or drain which carries both domestic sewage and industrial wastes together with the run-off from rainfall.

matter of momentary convenience. At the time of their construction apparently no thought or heed was given to the unsatisfactory and costly conditions which might follow as a consequence at some future time when sewage treatment would become necessary.

Many of the so-called separate sanitary sewers have been poorly constructed and receive great quantities of ground water during and subsequent to storms. Rain leaders from roofs and paved areas are surreptitiously connected with these sewers. The several municipalities should proceed, without fear or favor, to eliminate such rain water connections to sanitary sewers.

The rational and comprehensive solution of the sewerage and sewage disposal problems of the East Bay Cities and tributary areas involves the concentration of sewage and trade wastes at favorable points, the treatment of these wastes to such extent and in such manner as the conditions dictate, and the final disposal of the treated effluents at places, sufficiently remote from human observation, where adequate dilution will obtain at all times due to sufficient water depth and favorable currents. Thus sanitary and aesthetic requirements will be fulfilled with complete protection of the public health. And finally the economic requirements must be met by constructing and properly operating the project or projects whose performance shall meet the required standards at the lowest possible annual cost.

Purpose and Scope of This Report.

The purpose of this report is to investigate the shortcomings of present sewage disposal methods and provide in their stead an adequate economical system of intercepting sewers and treatment plants consistent with modern engineering principles and the reasonable aesthetic requirements of a modern and prosperous community.

In order to accomplish this purpose the scope of the survey is

of necessity quite broad. The results of many studies made by the engineering staff of the Survey, under the direction of the Board of Consulting Engineers, are presented in tables and diagrams. These studies were essential to the determination of the best and most economical solution of a rather complex problem, which has numerous ramifications and wide implications.

Twenty-four projects have been outlined and investigated, which will serve either the individual communities or various groupings of these communities. Some of the projects, in addition, have certain possible modifications, which actually increases the number of possible projects examined. On the bases of expected performance and of estimated costs, both for construction and for operation expressed on an annual basis, a group of 2 projects has been selected as representing the Board's conception of the most rational solution of the problem of sewage disposal of the cooperating East Bay Cities. However, other projects or groups of projects are feasible. The report is believed to be sufficiently comprehensive for determination of the absolute and relative validity of each and all of these projects investigated.

In addition to the projects described, a large number of other projects have been examined, but have been eliminated from further consideration as being either impractical, unsuitable or unnecessarily costly.

Specifically, the report deals with the following more important matters:

1. The extent of the areas currently served and to be served in the future with sewage treatment and disposal works.
2. The climatology, geography, topography and geology of these areas.
3. The tides, tidal prisms and currents in San Francisco Bay at the

Historical Notes.

It is regrettable that no attempt has ever been made to prepare a consecutive history of sewerage in any of the cooperating cities or in the tributary areas, including Sanitary Districts, considered herein. At best the available information is fragmentary. It is probable that many of the earlier reports and appurtenant maps have been lost or are buried in files long since dead. It is probable, therefore, that the most interesting and valuable feature of this discussion will be that which deals with the activities leading up to the inauguration of the investigations upon which this report is based.

The oldest engineering report on sewerage in this area, available to the Board, is one entitled "Report of the Board of Engineers on the Grades, Streets and Sewerage of the City of Oakland, 1869". The Board consisted of five engineers appointed by the Mayor and Common Council on April 12, 1869. Its personnel was: George F. Allardt, Chairman, George Davidson, George E. Gray, Milo Hoadley and W. F. Boardman, City Engineer. In this report no sewers were reported as having been constructed. The discussion was devoted to the future construction of two main sewers, with laterals and house drains, for all of which certain fundamental principles regarding their design and construction were set forth. At that time the City occupied an area extending about 1.5 miles north and south and 2.5 miles east and west. It was described as "situated on a low, sandy peninsula."

Other reports with respect to Oakland's sewerage problem followed (See Bibliography, Appendix IV) among which may be mentioned one by the distinguished sanitary engineer, Rudolph Hering, in 1889. In this report it was stated that:

"Already a large number of sewers have been built. They are planned to take, besides foul water, also some roof water, and to discharge at the nearest and most convenient points along the shore of the lake (Lake Merritt), estuary and bay.

"The outfalls are generally placed between high and low water, delivering the sewage upon the beach. During the warm and dry weather, this is said to cause considerable foulness.

"The sewers are mostly built of vitrified stone pipes although formerly cement pipes were also largely used. As regards durability, the former are said to have given better satisfaction, which experience has also been gained in the East."

* * *

"The ventilation of the sewers is accomplished through perforated manhole covers in the streets. The escape of foul odors, particularly at the head of sewers, suggested the introduction of charcoal ventilators, which are said to have greatly diminished the trouble.

"The most objectionable feature of the present system and which is becoming more aggravated every year, is the disposal of the sewage along the shores and into the marshes, where its suspended matter deposits and putrefies."

Mr. Hering believed the estuary to be capable of receiving and innocuously disposing of the coarsely screened sewage of Oakland and Alameda when the combined population reached 300,000, if not a very much higher figure. He recommended four intercepting sewers as proposed by the City Engineer, T. W. Morgan. Pumping was planned for one of the interceptors. The cost of the works recommended, as made by the City Engineer, and approved by Mr. Hering, was estimated to be about $430,000.

None of Oakland's sewers have been carried any considerable distance out from shore into the Bay or Estuary, and none extend to deep water except as such a condition exists at or near shore. The same statement can be made with respect to all other sewer outfalls in the entire East Bay region.

The first of the several main trunk combined sewers in Berkeley were constructed in 1913 under a bond issue amounting to about one-half million dollars. Additional trunk lines were constructed and certain existing lines extended in 1928 under a bond issue of $311,750 and local assessments totaling $223,000. Unfortunately these constructions committed the City to a partially combined system of sewers which is most disadvantageous with respect to the best solution of the present problem of treatment and disposal, and one from which it is now difficult to recede. However, there can be not the slightest question but that this should be done at as early a date as possible.

In Albany, as in most annexed territory in the other East Bay communities, the lateral sewers were built by real estate development companies. Speaking in general terms such systems have rarely been correlated with other developments, and have not considered possible territorial extensions or contributions from higher elevations to be developed later. The first sewers in Albany were constructed in 1910-12.

El Cerrito lies wholly within the Stege Sanitary District, which was organized in 1913. In 1930 the two original outfalls were joined and extended along the south edge of Point Isabel to its southwesterly tip, at a cost of $140,000.

In the comprehensive report of Edward A. Hoffman, City Engineer, and John D. Miller, Sanitary Engineer, to the Mayor and Council of Richmond

on "Main Sanitary and Storm Sewers", dated June 12, 1929, the following statements appear:

"The city as a whole has its domestic sewage disposal through ten or twelve outlets at varying points along its southern and western shore lines.

"The sanitary sewers of this city represent the cumulative results of between 80 and 100 separate sewer plans and constructions. But few of the systems were planned for the ultimate development of the district being sewered, and only a very small number in recent years have allowed for accommodation of sewage from topographically tributary areas. Of course, such a large number of different 'jobs' under different engineers, administrations and owners will leave us a wide variation in the intelligence and excellence of plans and quality of construction."

The San Pablo Sanitary District was organized in December, 1921. During the following years lateral sewers, mostly 6 inches in size, and a 10 to 24 inch diameter outfall sewer, were constructed. The outfall discharges into the upper end of San Pablo canal.

On May 16, 1933, T. F. Eastman presented a paper on Oakland's sewer problem to the San Francisco Section, American Society of Civil Engineers, in which a considerable amount of information relative to the then existing conditions was given and certain suggestions offered respecting possible remedies.

Under date of December 29, 1936, in response to a resolution of the Oakland City Council, the City Engineer, Walter N. Frickstad, submitted a valuable report outlining the problem of the correction of conditions on the western waterfront of the city and in the Estuary, suggesting certain possible remedies, and recommending that funds be provided for a comprehensive study of the matter.

In February, 1937, one of the members of the Board of Consulting Engineers prepared a statement in which he had occasion to say:

"The pollution of the Estuary has, until the present moment, been the most obvious, obnoxious situation. The Estuary has perhaps always been and will continue to be a sort of 'side door' to Oakland, although a 'front door' to Alameda.

"Until recently the western waterfront has in truth been a 'back door' to the city. The area has been given over to industry and transportation. Human contacts with sewage pollution there, until now, were for the most part either fairly remote or more or less momentary, depending upon whether one were a worker in the district or a traveller through it. Recently, however, conditions have changed with reference to the importance of the western waterfront. Due to the development of the Port of Oakland and to the construction of the trans-bay bridge and its approaches, the western front is no longer a 'back door' but a 'front door'.

"Through this newly-become-important door the port and the bridge invite great numbers of people whose contact with the area and its filthy conditions would otherwise be but transitory, at the most. Now, however, that contact has become very intimate. In consequence complaints of the bad conditions are coming from all quarters, including our neighbor San Francisco".

A definite cooperative movement of all the East Bay Cities was inaugurated on November 3, 1937, at a meeting of representatives of Council and others. The procedures leading directly to the undertaking of the present study are well stated in the Preliminary Report upon Sewage Disposal for the East Bay Cities of Alameda, Albany, Berkeley, El Cerrito, Emeryvill Oakland, Piedmont, Richmond, and San Leandro by a Committee of East Bay

Engineers, Oakland, California, June, 1938. The Foreword in this report reads as follows:

"While the need for a more sanitary and less obnoxious method of disposal of sewage of the East Bay communities has received some attention from the Engineers of the respective cities for a number of years and more recently had been considered by them in joint committee, it was not until November 3, 1937, at a meeting of Council Members and other representatives of all the East Bay Cities that a definite cooperative movement was initiated. At this meeting, held in the Oakland Council Chamber in response to the invitation of Mayor W. J. McCracken, it was agreed that each City Council would authorize its City Engineer to represent his city on an Engineers' Committee to prepare a preliminary report on sewage disposal. Mayor McCracken further suggested that a permanent organization be formed to cope with the mutual problems of the several cities. A committee was appointed to prepare a plan for such an organization. This committee reported to a second meeting of the representatives of the several cities January 19, 1938, and outlined the organization of an association to be known as "The East Bay Municipal Executives Association". The assembled body acted favorably on the report and elected Mayor Henry A. Weichhart of Alameda its first president. The assistance of this Association has been invaluable to the Engineers' Committee, which, because of its help and cooperation, has been able to attack the problem of sewage disposal for the whole community much more effectively than would otherwise have been possible

"The Engineers' Committee had little organization work to complete before undertaking its assigned problem. This Committee, augmented by several Planning Engineers and the two County Surveyors, had existed since October 16, 1930, on which date it was organized by authorization of the

Mayors of all the East Bay communities to study the Hoover-Young Bay Bridge Report. The harmonious functioning of the Committee and its usefulness in connection with the first problems presented by the proposed Bay Bridge lead to its continuance as a Technical Committee. As such, it reported on September 7, 1933, upon "Arterial Highways to the Bay Bridge".

"On June 14, 1937, Mr. Walter N. Frickstad, Vice-Chairman, succeeded Harry Goodridge, who had served as Chairman since organization. George Sperbeck, City Engineer of Alameda was elected Vice-Shairman, and R. T. Belcher, City Engineer of Piedmont, Secretary.

"After reorganization, the Committee met monthly and considered a multiplicity of problems including: The East Shore Highway, Gas Tax, Regional Mapping, Curb and Gutter Construction, and preliminaries of Sewage Disposal. Shortly after the first joint meeting of the Cities, the Engineers' Committee met November 12, 1937, and in effect assigned the work of preparing the desired report upon Sewage Disposal to a sub-committee composed of the City Engineers of the 9 cities immediately affected, supplemented by such members of their staffs as might be assigned. The officers of the larger organization served as officers of the sub-committee."

For nearly two years this report and its recommendations lay fallow. The Golden Gate International Exposition came and went with no action being taken to ameliorate the untoward conditions along the western waterfront, assuming, of course, that such amelioration was possible, which is doubtful except at a relatively great expense of time and money.

As of March 10, 1939, Harold Farnsworth Gray, a member of this Board, prepared a "Report on the Sewage Disposal Problem of the East Bay Cities" for the Berkeley Chamber of Commerce, which report was later adopted by the Chamber and transmitted to the Berkeley City Council. This report

summarized the situation, from the Berkeley viewpoint, as follows:

"The present waterfront nuisance in the East Bay Cities adversely affects Berkeley, whether it is on our own waterfront or in our neighboring communities.

"The nuisance is a deterrent to community development, to residential construction, to the influx of new industries, to recreation and perhaps health, and to business. It depreciates property values, and corrodes harbor structures and shipping. It has nothing to commend it, and does nothing to commend us to the visitor in our midst.

"The problem is capable of solution by proven processes of sewage disposal. But careful engineering studies are necessary to determine the best and most economical solution, now and in the future.

"As the problem is regional in character, it should be studied as regional in scope. Whether Berkeley shall solve its own problem alone, or in combination with the other cities of the region, is a decision which should await the results of an adequate engineering study of the whole regional problem made with due regard to the specific problems of each component part of the region.

"Berkeley, as a municipality, should cooperate in such a study, bearing its due share of the expense of the study. And this study should be begun at the earliest practicable moment. We recommend that the City Council and the City Manager of Berkeley give this matter primary consideration."

As the result of public request, and after many conferences, the Councils of the 7 cities, Alameda, Albany, Berkeley, Emeryville, Oakland, Piedmont, and Richmond took appropriate action to create an executive committee and agreed to appropriate funds for a comprehensive survey and

OUTLET OF UNIVERSITY AVENUE SEWER, BERKELEY, ABOUT MID-TIDE
Note the sludge banks to the right of the sewer outlet, buoyed up sludge at the outlet and the nearness of the East Shore Highway. The sewage from a population of 18,500 and a small amount of industrial waste is discharged here.

ASHBY AVENUE SEWER, BERKELEY, DISCHARGED AT THE SHORE LINE
The rock in the foreground is the rip-rap wall of the East Shore Highway. Seagulls may always be seen around the outlet. The sewage from 40,000 persons and a considerable amount of industrial waste is discharged here.
(Photographs taken June 1941)

OUTLETS OF SEWERS 15N AND 15S (PLATE 51) ADJACENT TO THE CENTRAL APPROACH TO THE SAN FRANCISCO-OAKLAND BAY BRIDGE

The sewage from a population of 107,700 and a large amount of industrial wastes discharged from these outlets constantly replenishes the putrefying organic matter upon the mud flats, the odors from which are most unpleasant to the thousands who must travel this way daily. (Photograph taken June 1941)

have been made.

The topography of the area is a gradual slope to the bay, except for a small portion of the extreme upper end, which is quite hilly.

The development of the area has been quite recent and consists of the small but substantial type of home, costing on the average about $4500.

There is no industrial sewage discharged to the system.

The per capita sewage flow and water consumption of the area compares with that of the Seminary Avenue and 37th Avenue and Post Street areas in Oakland.

It is not possible to drain additional areas to this outfall and as the area is well improved, the sewage flow will probably not increase appreciably.

Notes on the University Avenue Sewer, Berkeley.

The sewage flow was measured at University Avenue and 4th Street, Plate 56. There are no records of previous flow measurements.

The area draining to the point of measurement is relatively flat in contour and slopes gently from the Berkeley hills to the bay.

The major portion of the University of California drains to this sewer, the only exception being Hearst Gymnasium, which drains to the Ashby Avenue system.

The character of the district and improvements is much the same as the lower portion of the Ashby Avenue system, old and well established. There has been little new home construction in the area during the past 10 years.

The per capita sewage flow of 91 gallons and per capita water consumption of 96 gallons are higher than for any other area. The small difference between sewage flow and water consumption is probably due to the

fact that much of the University supply is discharged to the sewerage system from showers, etc. No allowance was made for the population of the University of California, although the metered water supply to the University from the East Bay Municipal Utility District was included. If the University water supply is deducted, then the per capita water consumption becomes 76 gallons per day, which is comparable to the water consumption in other similar areas.

There are no industries of any consequence connected to the system above the sampling point.

Notes on the Ashby Avenue Sewer (Potter and Fifth Streets), Berkeley.

The sewage flow of the Ashby Avenue sewer was measured at Potter and Fifth Streets in 1940, Plate 57. The flow from practically the same district was measured at Folger Avenue and the shore line in 1912. Considerable alteration in the sewerage system has taken place since that date. In 1914 the previously separate sewerage system was made into a combined system by the construction of large trunk sewers from the proceeds of the 1913 bond issue.

The interpretation of sewage flow quantities at Potter and Fifth Streets as measured in 1940 is somewhat complicated by seasonal industries. If a deduction is made for the two principal industries, Heinz Cannery and the Durkee Food Products, the per capita sewage flow and per capita water consumption become 68 and 71 gallons per capita per day, respectively. These figures compare in sewage flow and per capita water consumption with other residential areas.

This is the second largest area in which the sewage flow was measured by the Survey.

The topography of the area is relatively flat, rising gradually

public expense upon the private property whereon these nuisances exist, then an enhancement of the value of these properties will have resulted. The Board of Consulting Engineers does not presume to pass upon the points of public policy involved in such a procedure, but it seems reasonable to suggest that all the implications in such a project should be thoroughly understood by the electorate of the several cities, and that they should pass upon its propriety.

There is also reason to doubt the real effectiveness over any great length of time of proposals to fill or dyke off the tide flats. The removal of the points of deposit of sewage sludge somewhat further out into the bay would soon result in the building up of new sludge banks which would produce obnoxious odors again. When it is realized that the stench of the western waterfront sludge flats is frequently, indeed almost daily, very obvious along San Pablo Avenue, especially in the afternoon and evening, and is quite often definitely identified at night in appreciable obnoxiousness even easterly of Telegraph Avenue in Berkeley (a distance of at least three miles) it will be obvious that the removal of the source of the stench but a half mile or so westerly will be of inconsiderable benefit either to the residents of the affected areas, or to the travelers upon the East Shore Highway.

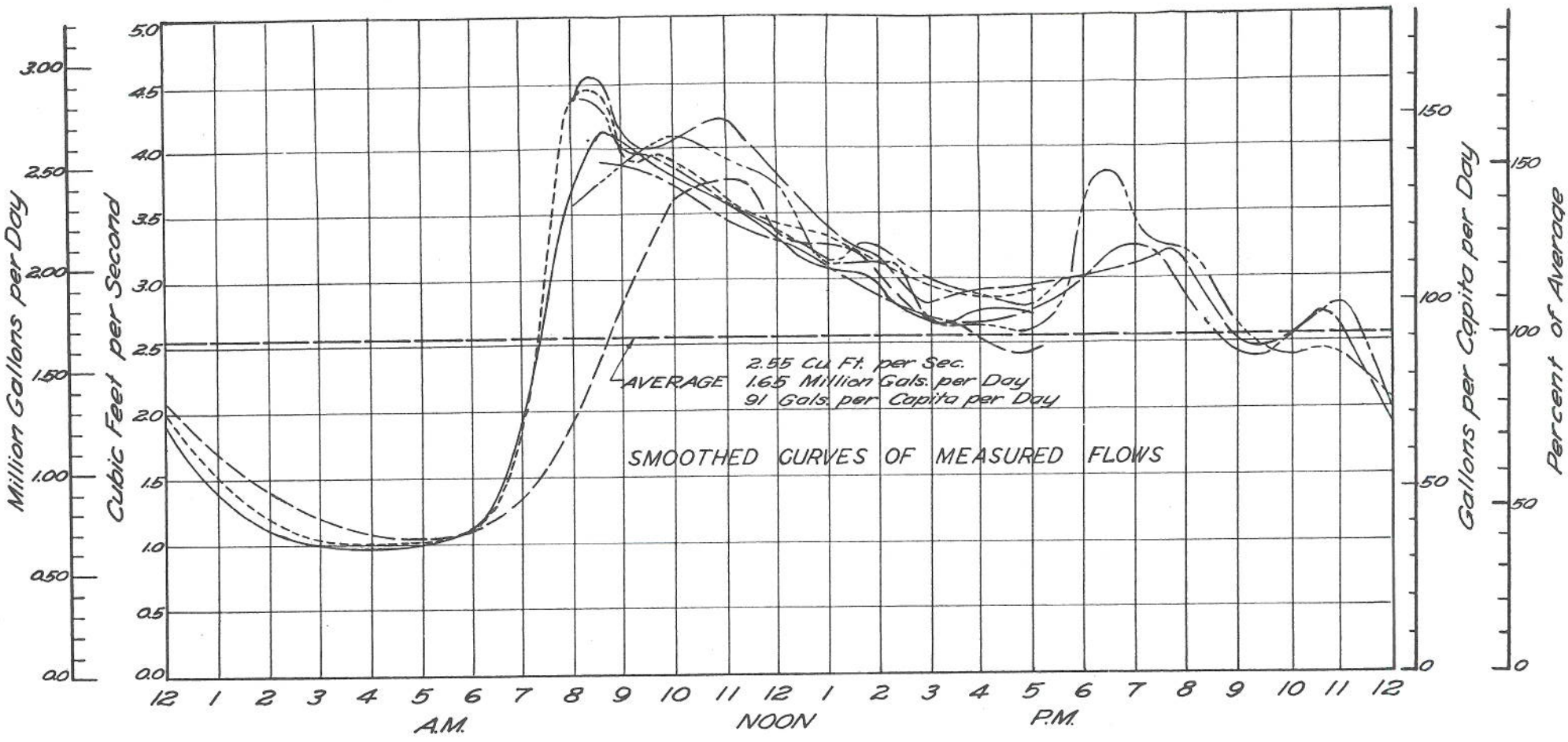
Funds for Temporary Measures.

It must be further realized that any of the suggested schemes of temporary relief are beyond the current fund resources of any of the affected cities, and it will be necessary to obtain some special authorization for such expenditures, either by an extra tax beyond the normal taxing limits, or by a short term loan of some type. Either procedure involves an election, which in Oakland alone would cost in the region of $40,000, and proportionally

Table No [illegible] Appendix IV

Shee 4 Sheets

Description of Waste	Laboratory Sample No.	Sampling Period "h" Hours	Waste Sampled Cu. Ft.	Unit	No. Units per "h" Hours	Cu. Ft. Waste per Unit	Immediate B.O.D. ppm	5-day B.O.D. ppm	5-day B.O.D. ppm of Settled (2 hr.) waste	Oxygen Consumed ppm	Chlorine Demand ppm	Grease ppm	Total Solids ppm	Suspended Solids ppm	Volatile Solids %	Settleable Solids ml/l	pH	Alkalinity ppm as $CaCO_3$	Acidity ppm as $CaCO_3$	Dissolved Oxygen ppm	Temperature °F	Date
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Laundries:																						
Suds waste (Plant No. 1)	339	Grabs	21.4	100 Cu. Ft. Waste	0.214	100	0	770	725	400	1	714	2700	760	-	20	10.0	800	-	4.1	120	12-17-40
Rinse water (Plant No. 1)[2]	340	Grabs	80.3	100 Cu. Ft. Waste	0.803	100	0	90	-	60	0	70	880	147	-	-	8.3	200	-	3.8	120	12-17-40
Composite for plant	-	-	101.7	100 Cu. Ft. Waste	1.017	100	0	233	-	131	0	206	1260	276	-	-	9.0±	326	-	1.4	120	-
Suds waste (Plant No. 2)	344	Grabs	20.0	100 Cu. Ft. Waste	0.20	100	0	590	-	575	1	468	-	500	-	-	-	-	-	-	-	12-26-40
Rinse water (Plant No. 2)[2]	343	Grabs	16.0	100 Cu. Ft. Waste	0.16	100	0	73	-	56	0	16	-	79	-	-	-	-	-	-	-	12-28-40
Composite for plant[3]	-	-	36.0	100 Cu. Ft. Waste	0.36	100	0	360	-	338	0	267	-	312	-	-	-	-	-	-	-	-
Suds waste (Plant No. 3)	361	Grabs	17.7	100 Cu. Ft. Waste	0.177	100	0	2750	-	700	2	718	2500	809	-	30	-	-	-	-	-	1-3-41
Rinse water (Plant No. 3)	362	Grabs	37.5	100 Cu. Ft. Waste	0.375	100	0	130	-	58	0.3	86	930	118	-	15	-	-	-	-	-	1-3-41
Composite for plant[4]	-	-	55.2	100 Cu. Ft. Waste	0.552	100	0	976	-	264	0.8	276	1436	340	-	20	-	-	-	-	-	-
Pigment and Chemical Manufacture:																						
Pigment wastes:																						
Chrome Yellow[5]	318	Grab	11750	Ton of Pigment	25.0	470	0	1000	-	66	10	-	8150	16	-	0	6.0	2400	70	-	149	12-5-40
Blue Lake[7]	319	Grab	6000	Ton of Pigment	1.75	3420	0	300	-	1350	-	-	34100	28	-	0	5.3	-	850	-	105	12-6-40
Chrome Orange[5,6]	320	Grab	12000	Ton of Pigment	5.0	2400	0	100	-	65	3	-	11900	10	-	0	9.3	525	100	-	149	12-3-40
Prussian Blue[7]	321	Grab	3000	Ton of Pigment	10.0	300	0	4	-	170	8	-	-	10	-	0	4.2	-	950	7.7	70	12-6-40
Lemon Yellow[6]	322	Grab	21400	Ton of Pigment	50.0	428	0	10	-	40	1	-	-	10	-	0	6.0	10	200	8.0	70	12-6-40
Para Red[6]	323	Grab	4500	Ton of Pigment	1.5	3000	0	64	-	320	20	-	-	10	-	0	5.4	-	300	-	70	12-6-40
Chrome Green[5]	324	Grab	4800	Ton of Pigment	15.0	300	0	23	-	140	15	-	-	10	-	0	4.9	-	1700	-	88	12-6-40
Violet Toner[7]	325	Grab	3680	Ton of Pigment	1.75	2100	0	500	-	400	120	-	-	10	-	0	4.2	-	275	-	70	12-6-40
Composite pigment waste (Plant No. 1)	-	-	66830	Ton of Pigment	110	608	0	259	-	218	20	0	-	13	-	0	6.0±	-	363	-	102	-
Iron colors (Plant No. 2)[8]	443	-	-	-	-	-	0	10	-	26	72	0	-	70	-	5	-	-	-	-	-	3-24-41
Chemical Manufacturing wastes:																						
Lead arsenic insecticide	390	Grab	-	-	-	-	0	30	-	-	-	-	-	66	-	-	-	-	-	-	-	3-21-41
Plastics	391	Grab	-	-	-	-	50	830	25	1300	865	640	-	2960	79	-	-	-	-	0	-	3-20-41
Carbon bisulfide	392	Grab	-	-	-	-	0	50	-	400	36	18	-	15	-	-	-	-	-	0	-	3-20-41
Explosives[9]	442	Grab	-	-	-	-	0	25	-	410	0	0	-	24	-	-	3.0±	-	-	-	-	3-24-41
Emulsified asphalt:																						
Primary discharge	444	Grab	100	-	-	-	150	600	30	21500	360	39000	-	36000	-	550	-	-	-	0	-	3-25-41
Secondary discharge	445	Grab	900	-	-	-	5	20	-	370	18	680	-	720	-	25	-	-	-	0	-	3-25-41
Composite for process	-	-	1000	-	-	-	20	78	-	2480	52	4510	-	4250	-	78	-	-	-	0	-	-
Barium sulfide	446	Grab	-	-	-	-	-	340	-	650	-	20	-	17500	-	-	-	-	-	-	-	3-27-41
Lime-sulfur sludge	342	Grab	-	-	-	-	-	8000	-	10400	40000	572	-	79600	-	180	-	-	-	-	-	12-20-40
Silicates	376	Grab	-	-	-	-	0	95	95	100	3	22	15800	820	26	30	11.±	1060	-	-	-	1-1-41
Chlorine solutions[10]	341	Grab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12-20-40
Potato Products:																						
Potato Chip waste	338	8.0	95000	100 Cu. Ft. Waste	950	100	0	1350	990	2100	25	243	4540	2250	74	25	7.8	140	50	1.5	65	12-13-40
Roofing Paper:																						
Plant No. 1 (Continuous discharge):																						
Rag & paper felt wastes	294	Grab	317000	Ton of Paper	100	3170	0	91	-	-	-	20	-	402	-	-	6.8	130	-	-	-	11-26-40
Rag & paper felt wastes	295	Grab	317000	Ton of Paper	100	3170	0	94	-	-	-	8	-	320	-	-	7.0	120	-	-	-	11-27-40
Rag & paper felt wastes	299	Grab	317000	Ton of Paper	100	3170	0	93	-	-	13	6	-	534	80	30	6.9	115	-	-	-	11-30-40
Rag & paper felt wastes	300	Grab	317000	Ton of Paper	100	3170	0	116	64	115	30	6	29300	622	81	30	-	-	-	-	-	11-30-40
	346	Grab	-	-	-	-	0	111	-	650	-	43	-	912	-	-	-	-	-	-	-	12-31-40
Average waste	-	-	317000	Ton of Paper	100	3170	0	98	54	-	22	10	-	470	81	30	6.9	122	-	-	-	-



FLOW DATA*

Legend	Day	Date	Total M.G.	Aver. C.F.S.	Min. Rate MGD.	Min. Rate C.F.S.	Max. Rate MGD.	Max. Rate C.F.S.
——— ——— ———	Monday	Oct. 21, 1940	1.71	2.64	0.66	1.02	2.94	4.56
———————	Tuesday	Oct. 22, 1940	1.63	2.53	0.65	1.00	2.69	4.17
——— - ——— - —	Wednesday	Oct. 16, 1940	1.60	2.47	0.65	1.00	2.55	3.94
- - - - - - - - - - -	Thursday	Oct. 17, 1940	1.67	2.58	0.65	1.00	2.88	4.45
——— - - ——— - -	Friday	Oct. 18, 1940	1.68	2.60	0.65	1.00	2.81	4.35
——— - - - ——— - - -	Saturday	Oct. 19, 1940	1.68	2.60	0.66	1.02	2.69	4.17
——— — ——— — ·	Sunday	Oct. 20, 1940	1.55	2.40	0.67	1.04	2.42	3.75
		Average	1.65	2.55	0.65	1.01	2.71	4.20

M.G.D. = Million gallons per day.
C.F.S. = Cubic feet per second.

Population, 1940 18,100
Per Capita Sewage Flow, Gal. per Day 91
Per Capita Water Consumption, Gal. per Day 96
Area in Acres 1,400
Gal. per Acre per Day, Sewage Flow 1,180
Population Density per Acre 12.9

Note:

Sewage flow in 7'-6" diameter sewer measured by a Palmer-Bowlus Flume installed in the sewer at the intersection of University Avenue and 4th Street. Head measured with a plumb-bob and tape at 15 minute intervals.

This area includes the University of California. No allowance has been made for the population increase resulting therefrom.

*Night flows not measured were assumed to be equal to the average of those measured.

See Table No. 29.

EAST BAY CITIES
ALAMEDA, ALBANY, BERKELEY, EMERYVILLE, OAKLAND, PIEDMONT, RICHMOND

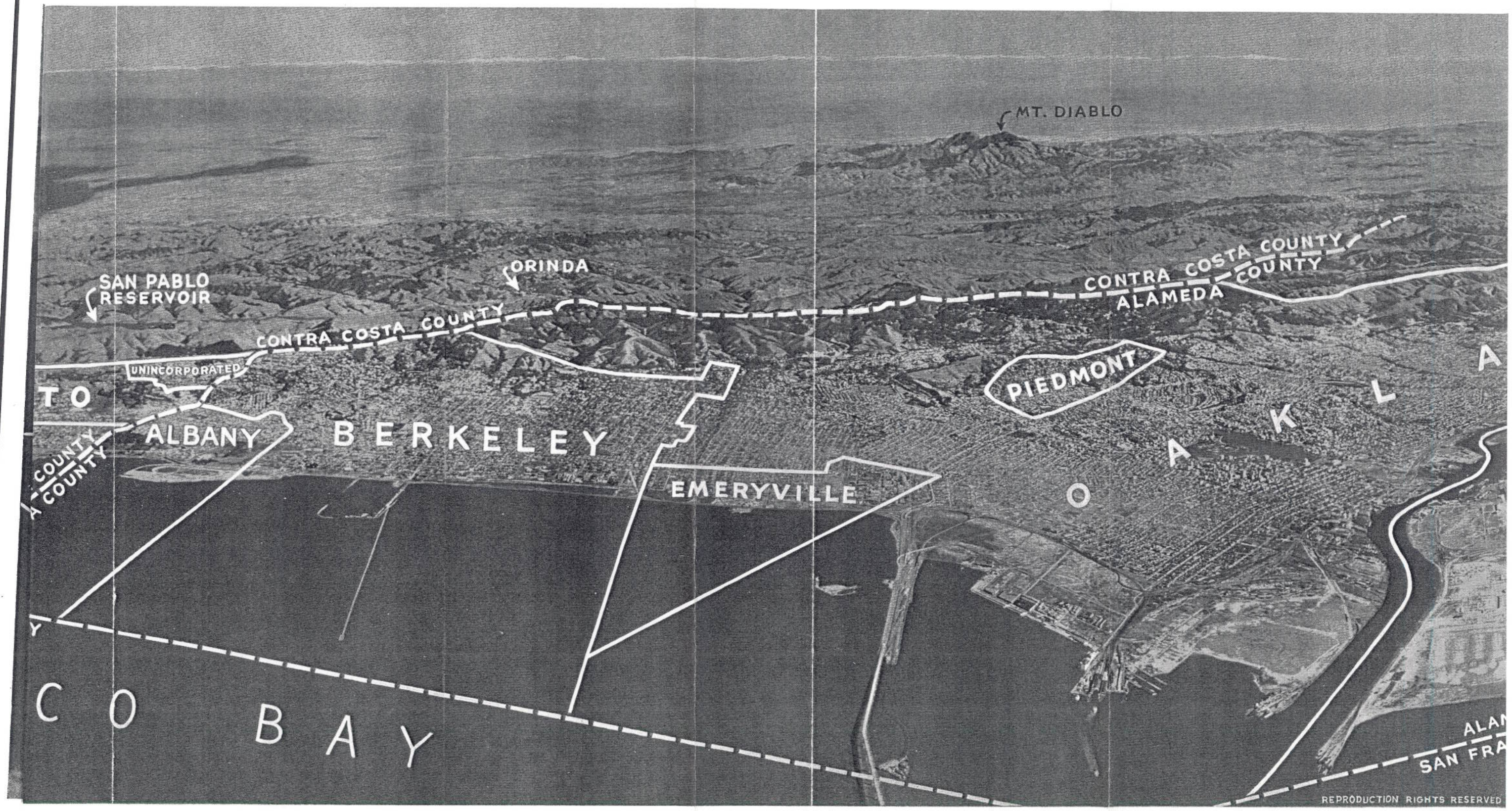
SEWAGE DISPOSAL SURVEY

BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE, A. M. RAWN, HAROLD FARNSWORTH GRAY

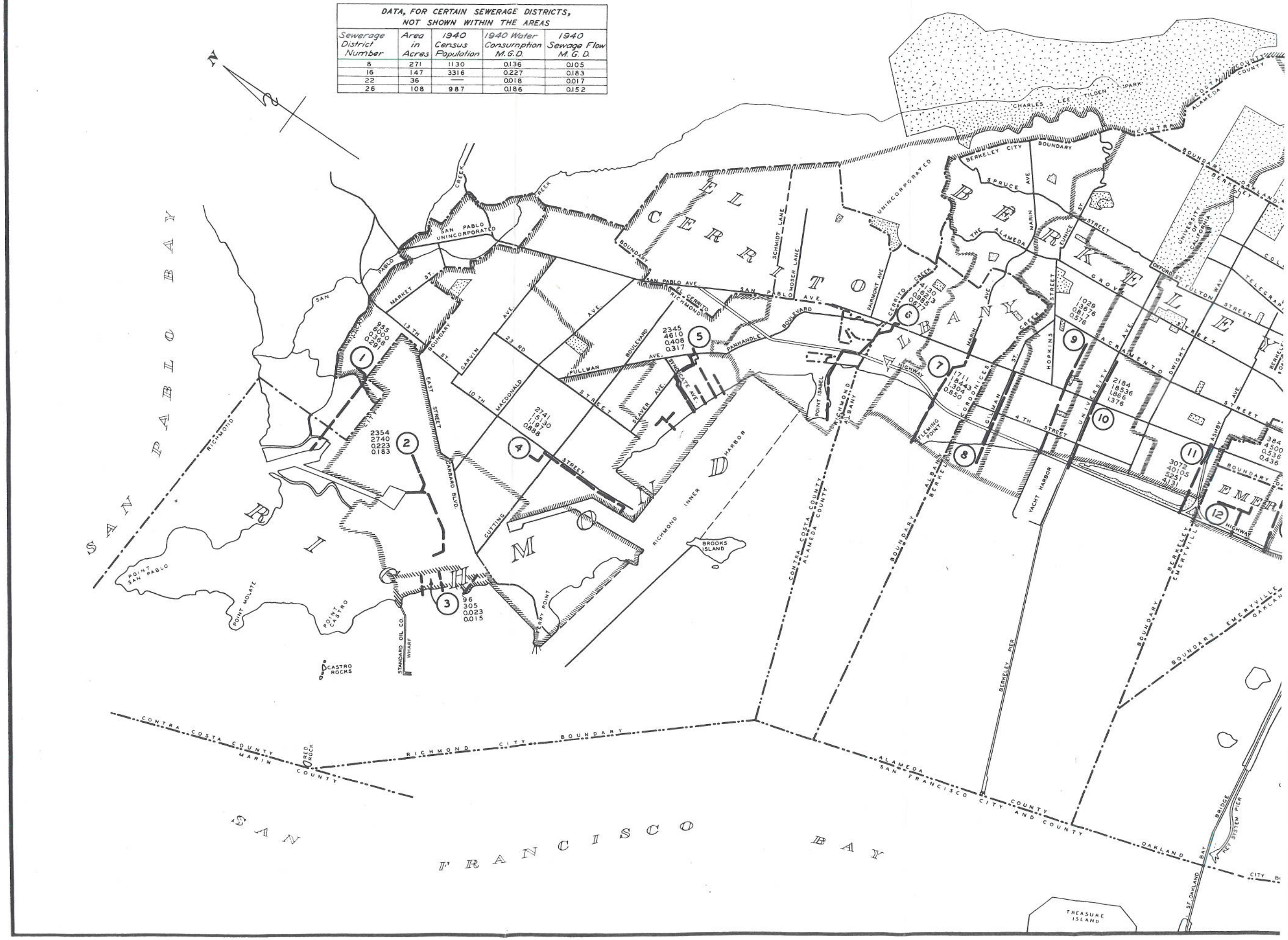
FLOW CHART

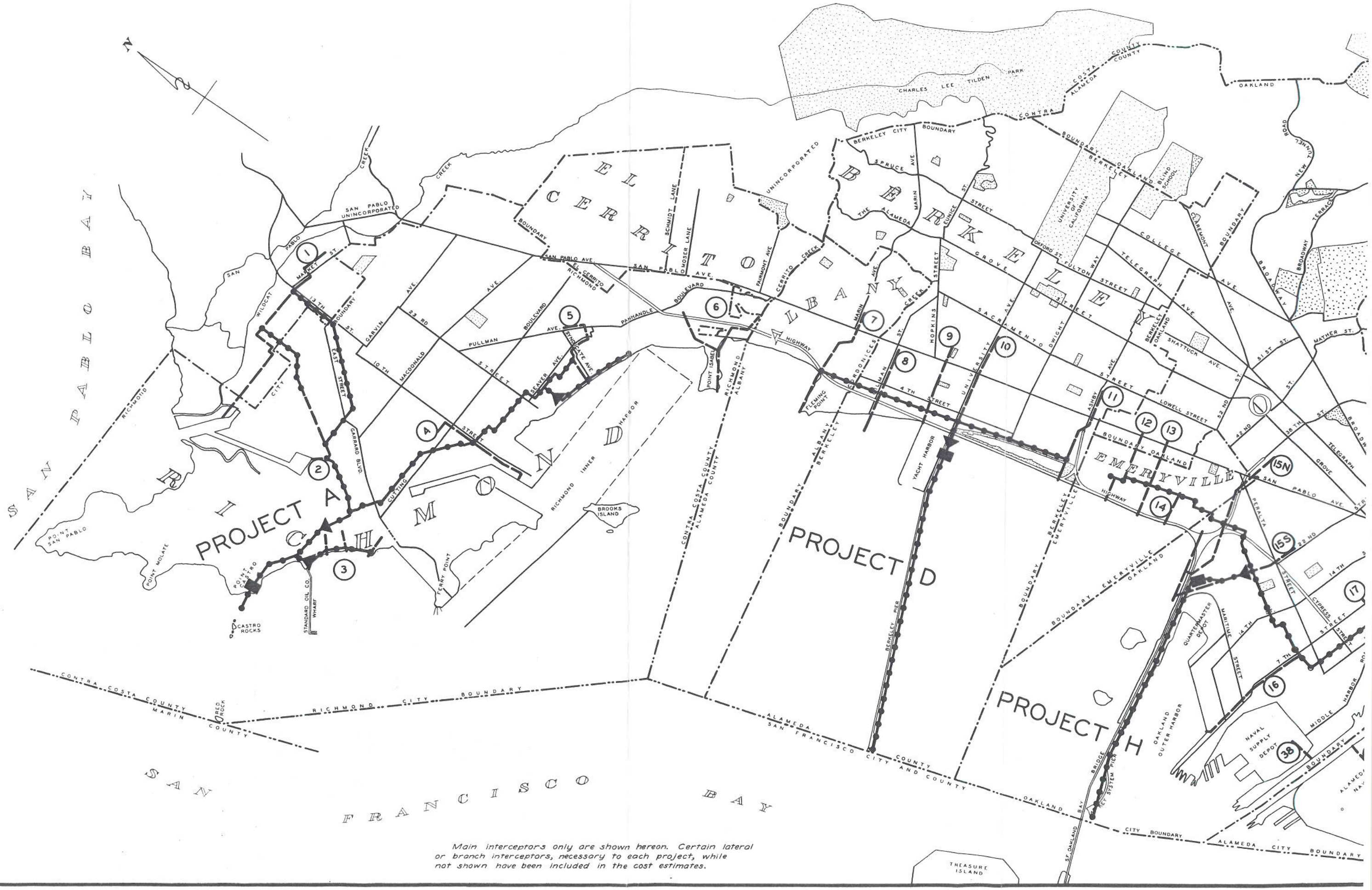
UNIVERSITY AVE. & 4TH. ST.
BERKELEY 1940

DRAWN BY A.I.R. - J.D.
CHECKED BY N.D.B.
APPROVED P.P.P. C.F.H.
DATE 6/30/41
PLATE NUMBER 56

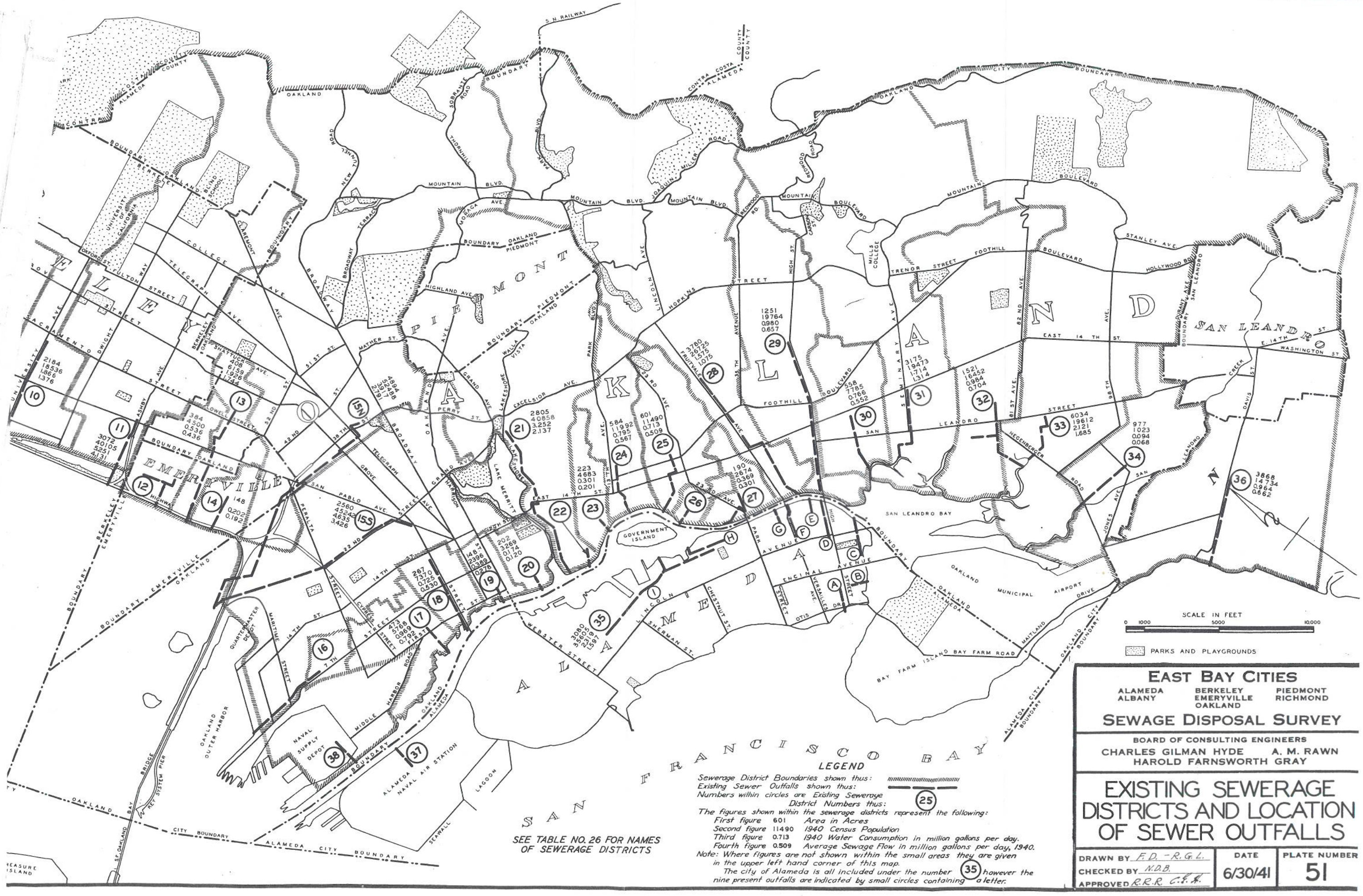


DATA, FOR CERTAIN SEWERAGE DISTRICTS, NOT SHOWN WITHIN THE AREAS				
Sewerage District Number	Area in Acres	1940 Census Population	1940 Water Consumption M.G.D.	1940 Sewage Flow M.G.D.
8	271	1130	0.136	0.105
16	147	3316	0.227	0.183
22	36	—	0.018	0.017
26	108	987	0.186	0.152





Main interceptors only are shown hereon. Certain lateral or branch interceptors, necessary to each project, while not shown have been included in the cost estimates.



LEGEND

Sewerage District Boundaries shown thus: ////////////////////

Existing Sewer Outfalls shown thus: ——

Numbers within circles are Existing Sewerage District Numbers thus: (25)

The figures shown within the sewerage districts represent the following:

First figure	601	*Area in Acres*
Second figure	11490	*1940 Census Population*
Third figure	0.713	*1940 Water Consumption in million gallons per day.*
Fourth figure	0.509	*Average Sewage Flow in million gallons per day, 1940.*

Note: Where figures are not shown within the small areas they are given in the upper left hand corner of this map.

The city of Alameda is all included under the number (35) *however the nine present outfalls are indicated by small circles containing a letter.*

EAST BAY CITIES

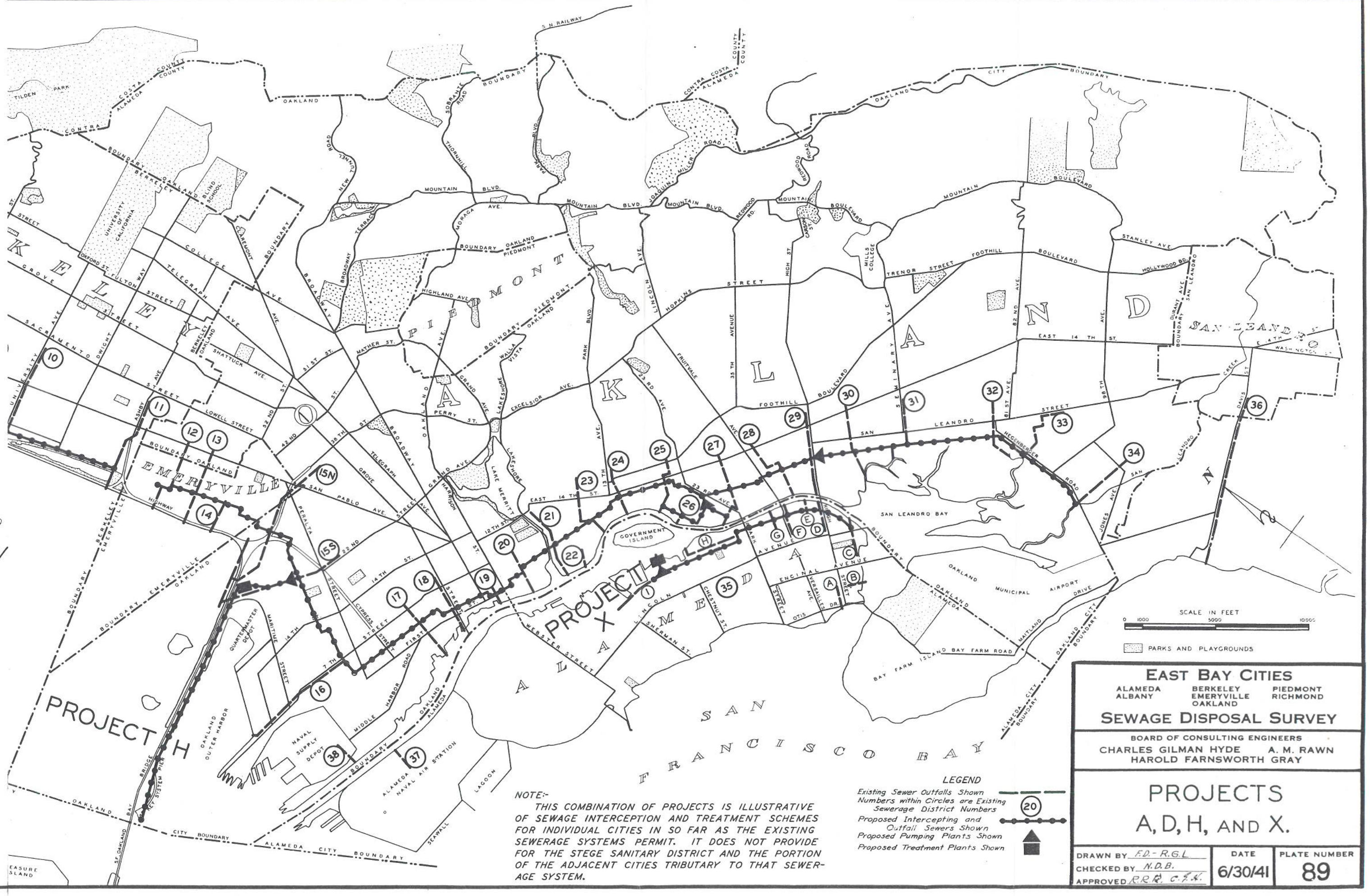
ALAMEDA
ALBANY
BERKELEY
EMERYVILLE
OAKLAND
PIEDMONT
RICHMOND

SEWAGE DISPOSAL SURVEY

BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE
A. M. RAWN
HAROLD FARNSWORTH GRAY

EXISTING SEWERAGE DISTRICTS AND LOCATION OF SEWER OUTFALLS

DRAWN BY F.D. - R.G.L.	DATE	PLATE NUMBER
CHECKED BY N.D.B.	6/30/41	51
APPROVED R.R.R. C.E.H.		



NOTE:-

THIS COMBINATION OF PROJECTS IS ILLUSTRATIVE OF SEWAGE INTERCEPTION AND TREATMENT SCHEMES FOR INDIVIDUAL CITIES IN SO FAR AS THE EXISTING SEWERAGE SYSTEMS PERMIT. IT DOES NOT PROVIDE FOR THE STEGE SANITARY DISTRICT AND THE PORTION OF THE ADJACENT CITIES TRIBUTARY TO THAT SEWERAGE SYSTEM.

LEGEND

Existing Sewer Outfalls Shown
Numbers within Circles are Existing Sewerage District Numbers — 20
Proposed Intercepting and Outfall Sewers Shown
Proposed Pumping Plants Shown
Proposed Treatment Plants Shown

EAST BAY CITIES

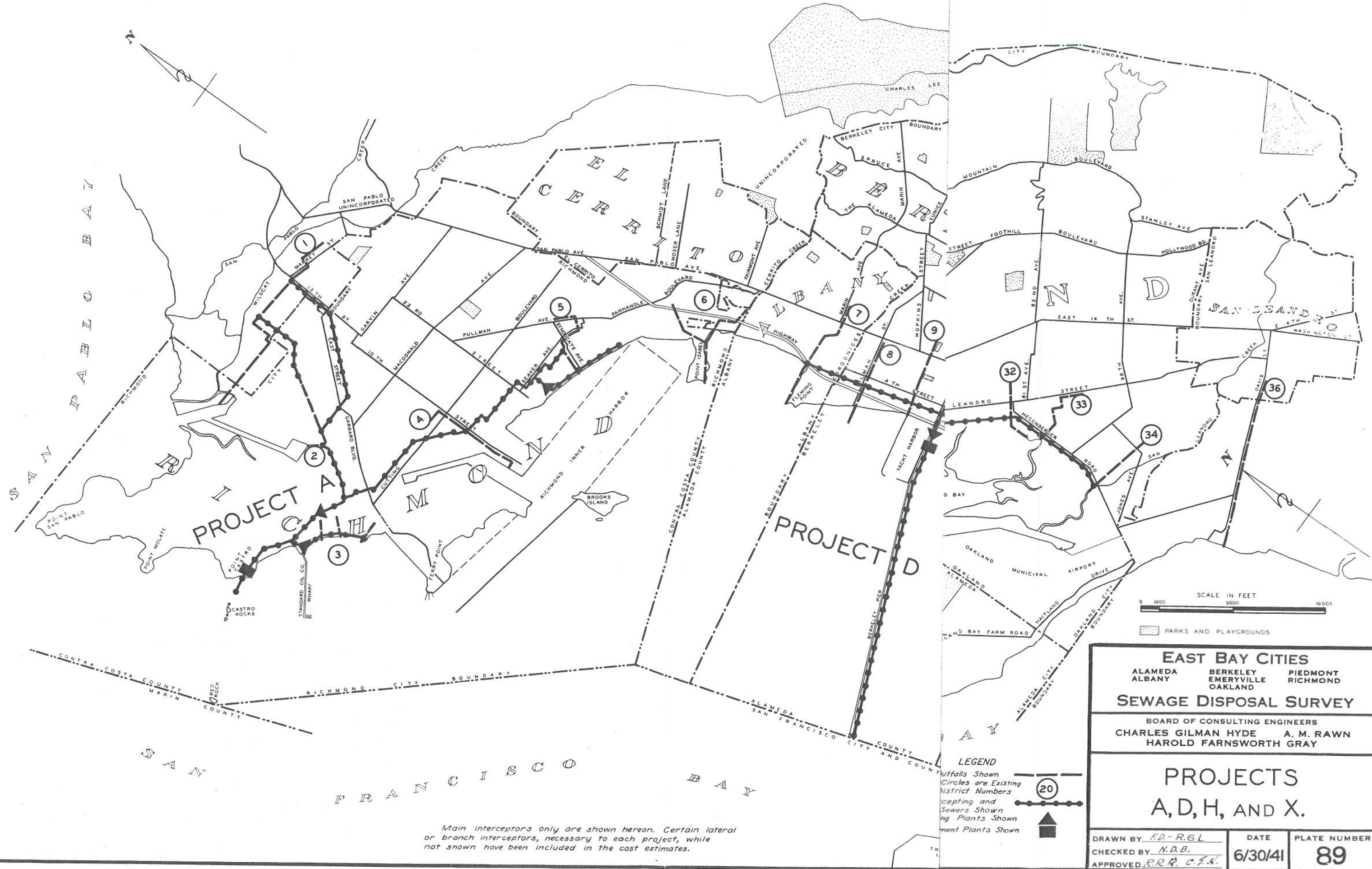
ALAMEDA
ALBANY
BERKELEY
EMERYVILLE
OAKLAND
PIEDMONT
RICHMOND

SEWAGE DISPOSAL SURVEY

BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE
A. M. RAWN
HAROLD FARNSWORTH GRAY

PROJECTS A, D, H, AND X.

DRAWN BY F.D.-R.G.L.	DATE	PLATE NUMBER
CHECKED BY N.D.B.	6/30/41	89
APPROVED R.R.R. C.F.K.		



Main interceptors only are shown hereon. Certain lateral or branch interceptors, necessary to each project, while not shown have been included in the cost estimates.

EAST BAY CITIES

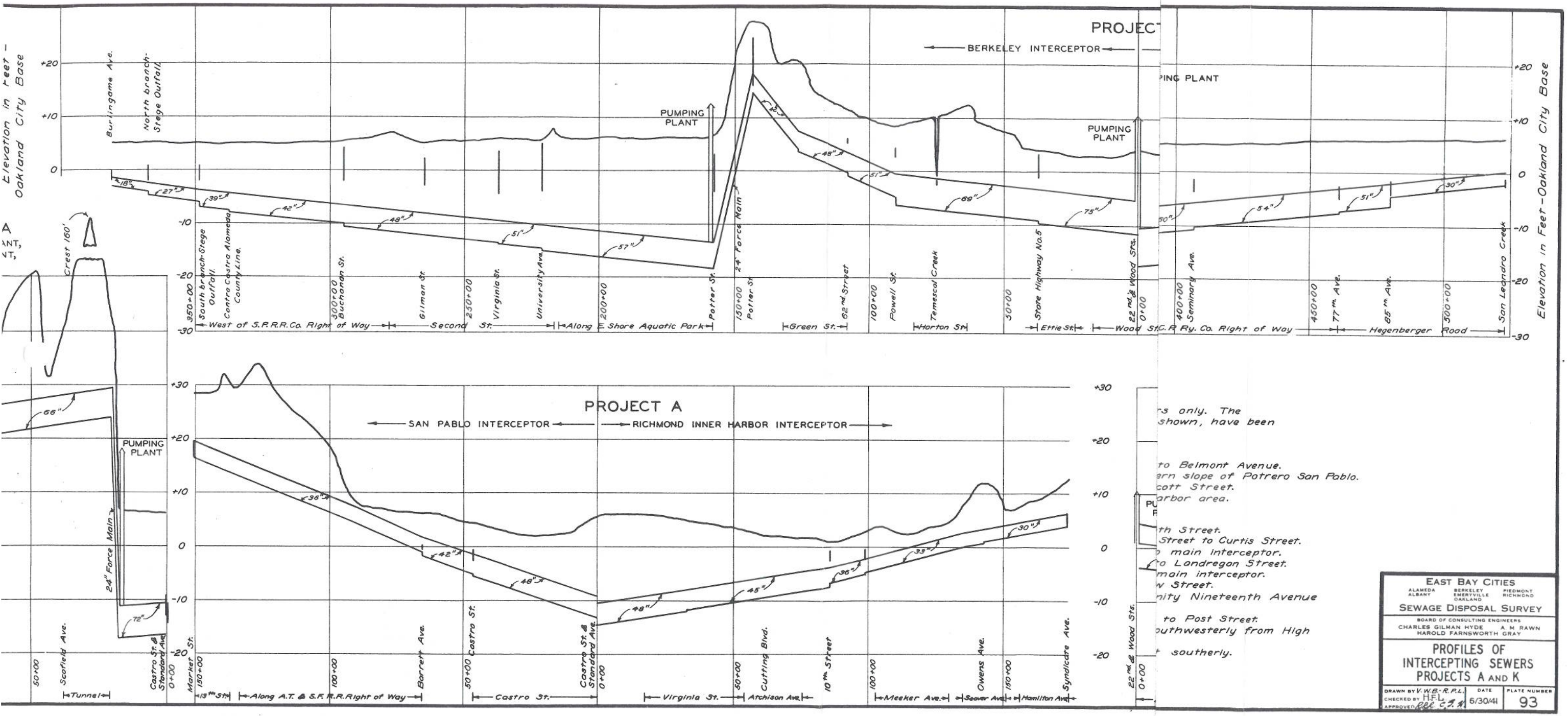
ALAMEDA
ALBANY
BERKELEY
EMERYVILLE
OAKLAND
PIEDMONT
RICHMOND

SEWAGE DISPOSAL SURVEY

BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE
A. M. RAWN
HAROLD FARNSWORTH GRAY

PROJECTS A, D, H, AND X.

DRAWN BY	DATE	PLATE NUMBER
F.D. - R.G.L.	6/30/41	89
CHECKED BY N.D.B.		
APPROVED R.R.R. C.F.K.		



...s only. The
...shown, have been

...to Belmont Avenue.
...ern slope of Potrero San Pablo.
...cott Street.
...arbor area.

...th Street.
... Street to Curtis Street.
... main interceptor.
...to Landregon Street.
... main interceptor.
...w Street.
...nity Nineteenth Avenue

... to Post Street.
...outhwesterly from High

... southerly.

EAST BAY CITIES
ALAMEDA, ALBANY, BERKELEY, EMERYVILLE, PIEDMONT, RICHMOND, OAKLAND

SEWAGE DISPOSAL SURVEY

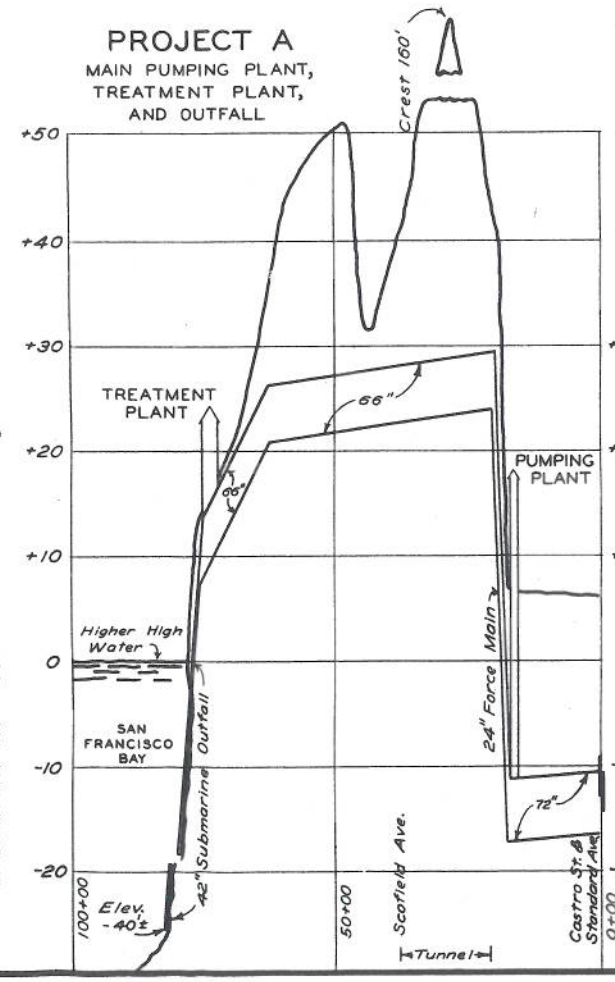
BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE, A. M. RAWN, HAROLD FARNSWORTH GRAY

PROFILES OF INTERCEPTING SEWERS PROJECTS A AND K

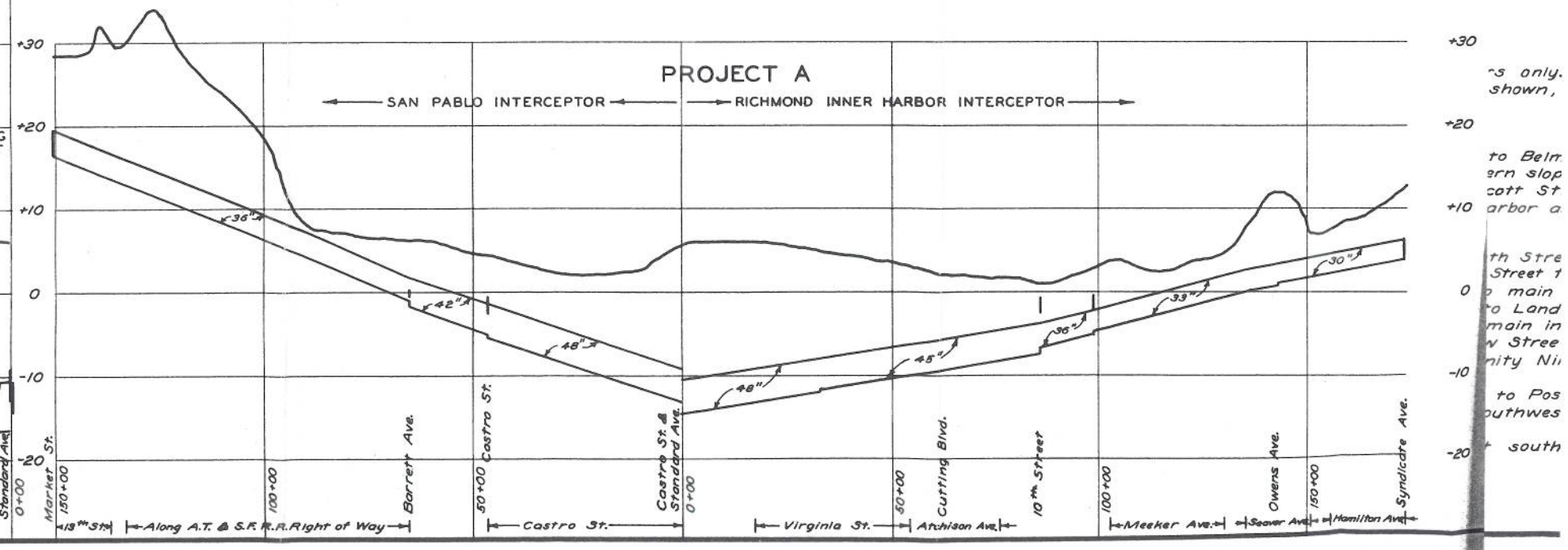
DRAWN BY V.W.B.-R.P.L.	DATE 6/30/41	PLATE NUMBER 93
CHECKED BY H.F.L.		
APPROVED CGH 6.9.41		

PROJECT A

MAIN PUMPING PLANT, TREATMENT PLANT, AND OUTFALL



PROJECT A



SAN PABLO BAY

SUISUN BAY

SAN PABLO

EL CERRITO

RICHMOND

CONTRA COSTA COUNTY

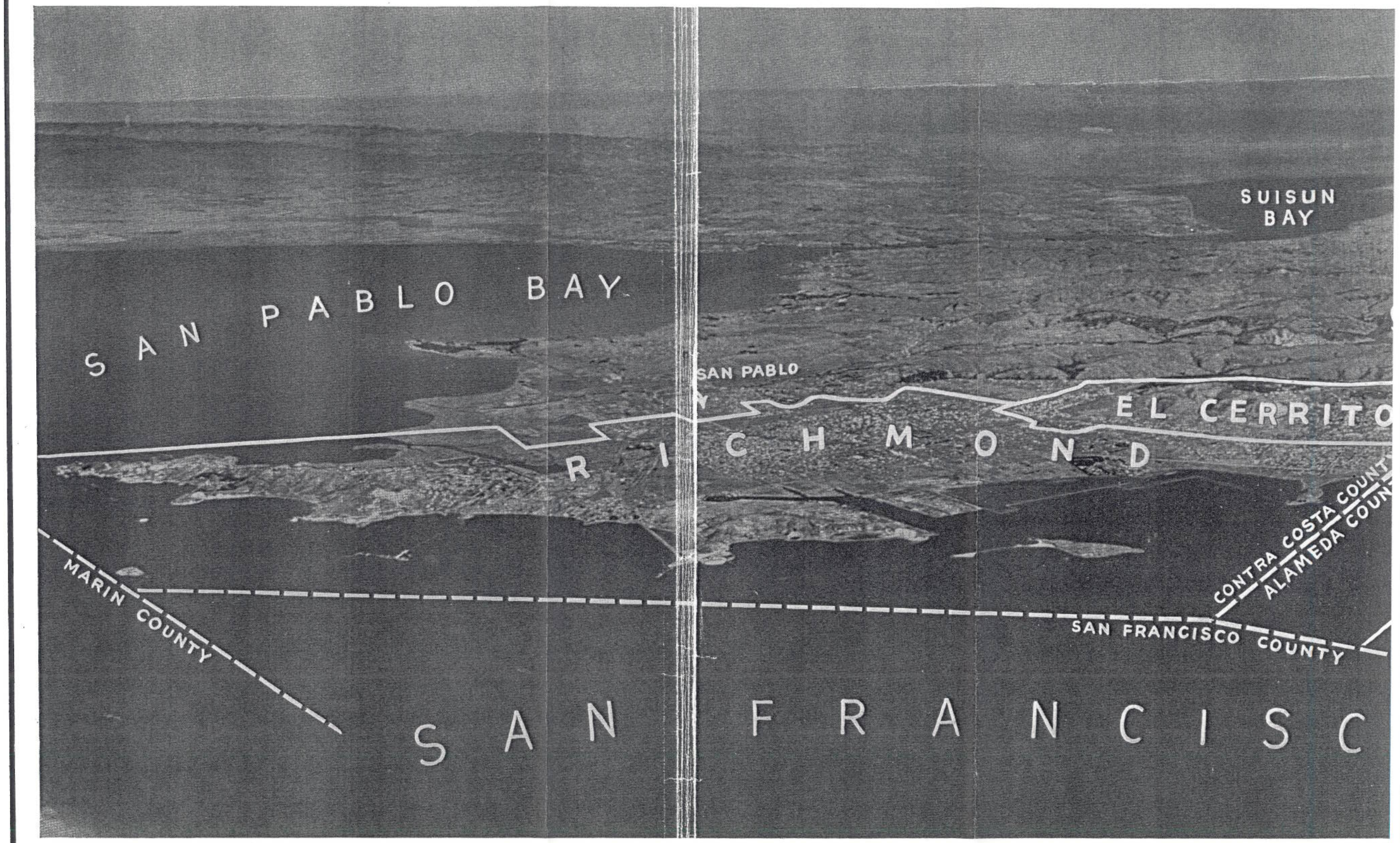
ALAMEDA COUNTY

MARIN COUNTY

SAN FRANCISCO COUNTY

SAN

FRANCISC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CONTRA COSTA COUNTY
ALAMEDA COUNTY
MARIN COUNTY
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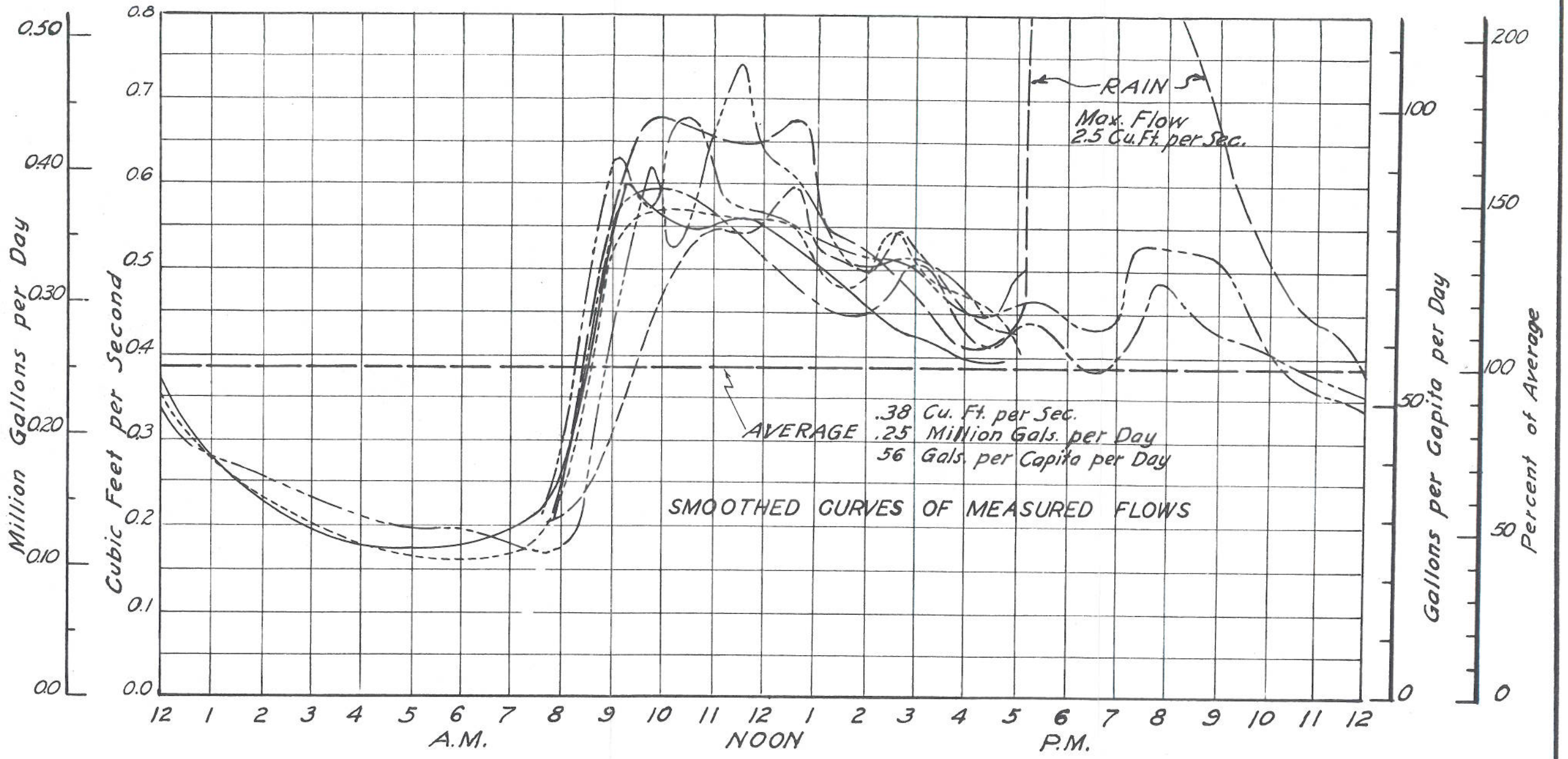


FLOW DATA *

Legend	Day	Date	Total M.G.	Aver. C.F.S.	Min. Rate M.G.D.	Min. Rate C.F.S.	Max. Rate M.G.D.	Max. Rate C.F.S.
—— — ——	Monday	Oct. 7, 1940	.257	.397	0.11	0.17	0.44	0.68
————	Tuesday	Oct. 8, 1940	.242	.375	0.11	0.17	0.39	0.60
—— · ——	Wednesday	Oct. 9, 1940	.240	.372	0.11	0.17	0.39	0.60
- - - - - - - - -	Thursday	Oct. 10, 1940	.246	.380	0.11	0.17	0.37	0.57
—— - - ——	Friday	Oct. 11, 1940	.259	.401	0.11	0.17	0.44	0.68
—— - - —— · · ·	Saturday	Oct. 12, 1940	.257	.397	0.11	0.17	0.48	0.74
—— —— ——	Sunday	Oct. 13, 1940	.241	.373	0.11	0.17	0.39	0.60
		Average	.249	.385	0.11	0.17	0.41	0.64

M.G.D. = Million Gallons per Day
C.F.S. = Cubic Feet per Second

Population, 1940	4,400
Per Capita Sewage Flow, Gal. per Day	56
Per Capita Water Consumption, Gal. per Day	55
Area in Acres	1,580
Gal. per Acre per Day, Sewage Flow	157
Population Density per Acre	2.8

Notes: Sewage flow in 24" diameter sewer measured by a Palmer-Bowlus flume installed in the manhole in the intersection of Seaver Ave. and 42nd Street. Head measured with plumb-bob and tape at 15 minute intervals.

* Night flows not measured were assumed to be equal to the average of those measured.

Rainfall excluded from flow data.

Double peak flow is due to difference in concentration time of the two branches of the system.

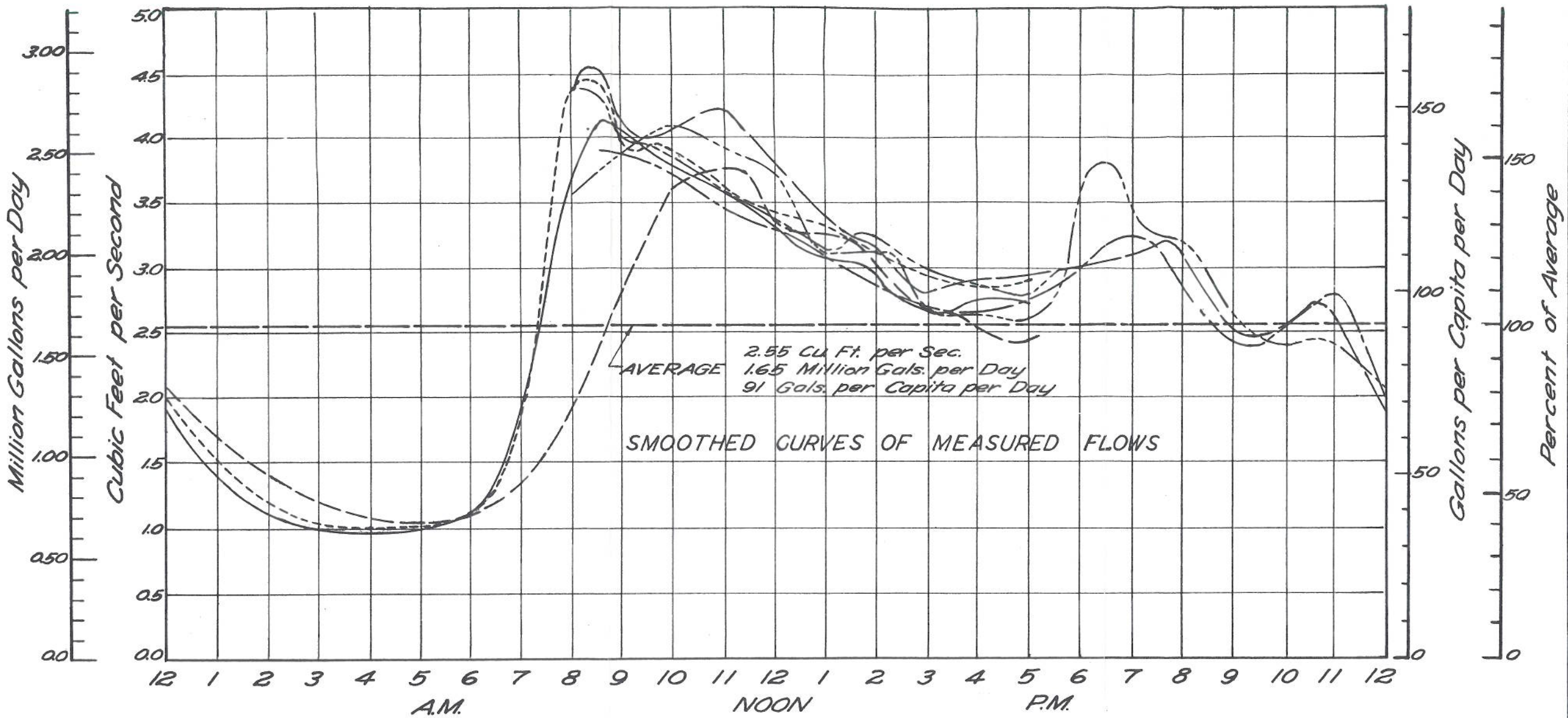
See Table No. 29.

EAST BAY CITIES
ALAMEDA, ALBANY, BERKELEY, EMERYVILLE, OAKLAND, PIEDMONT, RICHMOND
SEWAGE DISPOSAL SURVEY

BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE, A. M. RAWN, HAROLD FARNSWORTH GRAY

FLOW CHART
SEAVER AVE. & 42ND. ST.
RICHMOND 1940

DRAWN BY	CHECKED BY	APPROVED	DATE	PLATE NUMBER
N.T.R.-F.D.	N.D.B.	P.R.R. C.G.H.	6/30/41	54



FLOW DATA*

Legend	Day	Date	Total M.G.	Aver. C.F.S.	Min. Rate MGD	Min. Rate CFS	Max. Rate MGD	Max. Rate CFS
— — —	Monday	Oct. 21, 1940	1.71	2.64	0.66	1.02	2.94	4.56
———	Tuesday	Oct. 22, 1940	1.63	2.53	0.65	1.00	2.69	4.17
— — — — —	Wednesday	Oct. 16, 1940	1.60	2.47	0.65	1.00	2.55	3.94
----------	Thursday	Oct. 17, 1940	1.67	2.58	0.65	1.00	2.88	4.45
— — · — —	Friday	Oct. 18, 1940	1.68	2.60	0.65	1.00	2.81	4.35
— — — · — —	Saturday	Oct. 19, 1940	1.68	2.60	0.66	1.02	2.69	4.17
— — — — ·	Sunday	Oct. 20, 1940	1.55	2.40	0.67	1.04	2.42	3.75
		Average	1.65	2.55	0.65	1.01	2.71	4.20

M.G.D. = Million gallons per day.
C.F.S. = Cubic feet per second.

Population, 1940 18,100
Per Capita Sewage Flow, Gal. per Day 91
Per Capita Water Consumption, Gal. per Day 96
Area in Acres 1,400
Gal. per Acre per Day, Sewage Flow 1,180
Population Density per Acre 12.9

Note:

Sewage flow in 7'-6" diameter sewer measured by a Palmer-Bowlus flume installed in the sewer at the intersection of University Avenue and 4th Street. Head measured with a plumb-bob and tape at 15 minute intervals.

This area includes the University of California. No allowance has been made for the population increase resulting therefrom.

*Night flows not measured were assumed to be equal to the average of those measured.

See Table No. 29.

EAST BAY CITIES
ALAMEDA, ALBANY, BERKELEY, EMERYVILLE, OAKLAND, PIEDMONT, RICHMOND

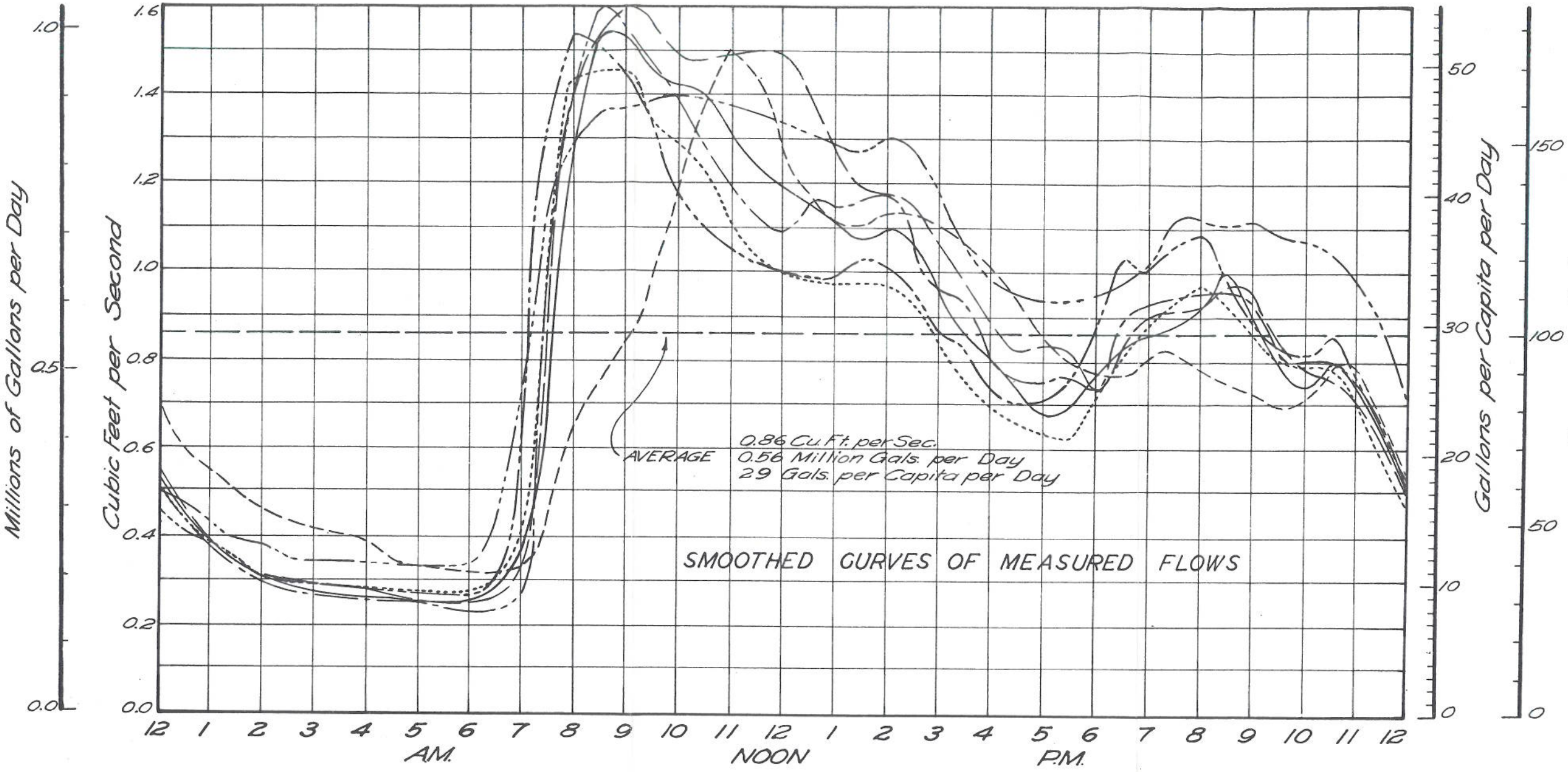
SEWAGE DISPOSAL SURVEY

BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE, A. M. RAWN, HAROLD FARNSWORTH GRAY

FLOW CHART

UNIVERSITY AVE. & 4TH. ST.
BERKELEY 1940

DRAWN BY N.I.R. - J.D.
CHECKED BY N.D.B.
APPROVED P.P.R. C.F.H.
DATE 6/30/41
PLATE NUMBER 56



FLOW DATA

Legend	Day	Date	Total MG.	Aver. Rate C.F.S.	Aver. Rate M.G.D.	Min. Rate C.F.S.	Min. Rate M.G.D.	Max. Rate C.F.S.	Max. Rate M.G.D.
——— ———	Monday	Oct. 14, 1912	0.56	0.87	0.16	0.25	1.03	1.60	
———	Tuesday	Oct. 15, 1912	0.56	0.86	0.16	0.24	1.00	1.55	
— · — · —	Wednesday	Oct. 16, 1912	0.57	0.88	0.15	0.23	1.03	1.60	
.....	Thursday	Oct. 17, 1912	0.52	0.80	0.18	0.28	0.94	1.45	
— — — — —	Friday	Oct. 18, 1912	0.56	0.86	0.17	0.26	1.00	1.55	
——— — — ———	Saturday	Oct. 12, 1912	0.62	0.96	0.21	0.33	0.90	1.40	
— — — — — ·	Sunday	Oct. 13, 1912	0.53	0.82	0.21	0.32	0.97	1.50	
		Average	0.56	0.86	0.18	0.27	0.98	1.52	

M.G.D. = Million gallons per day.
C.F.S. = Cubic feet per second.

Population Estimated, 1912	19,000
Per Capita Sewage Flow, Gal. per Day	29
Per Capita Water Consumption, Gal. per Day	50
Area in Acres	1,420
Gal. per Acre per Day, Sewage Flow	394
Population Density per Acre	13.4

Note:

Sewage flow of 16" diameter sewer measured by a 24" rectangular weir at the end of the sewer, foot of Folger Ave. Head measured continuously by an automatic recorder.

All data from Bachelor of Science thesis of Tom A. Bither, May 1913, in Civil Engineering at the University of California, Berkeley.

See Table No. 29.

EAST BAY CITIES

ALAMEDA, ALBANY, BERKELEY, EMERYVILLE, OAKLAND, PIEDMONT, RICHMOND

SEWAGE DISPOSAL SURVEY

BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE — A. M. RAWN
HAROLD FARNSWORTH GRAY

FLOW CHART
FOLGER AVE. SEWER
BERKELEY, 1912

DRAWN BY	DATE	PLATE NUMBER
CHECKED BY N.D.B.	6/30/41	58
APPROVED R.R.R. C.E.N.		