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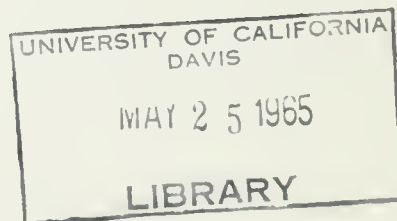
BULLETIN No. 16-64

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WEATHER MODIFICATION OPERATIONS IN CALIFORNIA

OCTOBER 1, 1963-SEPTEMBER 30, 1964

MAY 1965



HUGO FISHER
Administrator
The Resources Agency

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
Department of Water Resources

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DEPARTMENT OF WATER RESOURCES

P. O. BOX 388
SACRAMENTO

March 9, 1965

Honorable Edmund G. Brown, Governor
and Members of the Legislature
of the State of California

Gentlemen:

Bulletin No. 16-64, "Weather Modification Operations in California, October 1, 1963 - September 30, 1964", reports upon project operations conducted during this period by agencies licensed by the State. This is the latest of a series of similar reports which have been published periodically since 1955.

Licensed weather modification operators are required by law to submit to the Department a completion report at the conclusion of operations related to each project. The data presented in Bulletin No. 16-64 has been obtained from these reports.

During the period covered by this bulletin, there were nine projects involving weather modification operations which were undertaken in California. These were accomplished by eight of the eleven operators who were licensed by the Department for such activities.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "William E. Warne", is written over a horizontal line.

Director

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

EDMUND G. BROWN, Governor

HUGO FISHER, Administrator, The Resources Agency

WILLIAM E. WARNE, Director, Department of Water Resources

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DIVISION OF RESOURCES PLANNING

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WEATHER MODIFICATION OPERATIONS IN CALIFORNIA
OCTOBER 1, 1963 - SEPTEMBER 30, 1964

INTRODUCTION

The continuing growth and development of the Nation is accompanied by increasing requirements for water for additional and more intensively irrigated land, for expanding industry, for growing cities, for greater recreational facilities, and for increased hydroelectric power development. The need for additional water supplies has increased significantly during the past 20 years. One of the methods being investigated and employed to satisfy this need is the modification of natural weather patterns by artificial nucleation.

This report presents a summary of all weather modification projects conducted in California during the period October 1, 1963, through September 30, 1964, as reported to the Department of Water Resources. At the conclusion of each weather modification project, the licensee is required by law to submit a completion report to the Department of Water Resources. These reports include such information as the name of the agency sponsoring the project, location of the project, log of all seeding operations, cloud-seeding techniques and type of equipment used, and the names of all persons who assisted in the operation. The data presented in these completion reports are summarized and published by the Department in an annual report on weather

modification operations in California. This is the ninth report published in this series.

A detailed report which presents the theory of weather modification, evaluation of methods and results, and a history of cloud-seeding operations from July 1947 through June 1952 was published by the State Water Resources Board in June 1955 as Bulletin No. 16, "Weather Modification Operations in California".

Appended to this report are the statutes on the regulation and control of natural precipitation by artificial means.

SUMMARY OF 1963-64 OPERATIONS

During the period October 1963 through September 1964, nine weather modification operations were conducted in California from Plumas County in the north to San Diego County in the south. Five of the operations were concentrated along the western slope of the Sierra Nevada Mountains, one operation was in the Central Coast Range, and three project areas were in Southern California. All nine cloud-seeding projects were for the stated purpose of increasing precipitation, and most of the seeded area was above water conservation reservoirs or hydroelectric installations. Approximate areas affected by cloud-seeding operations during 1963-64 are shown on Plate 1.

Water conditions during the period October 1, 1963, through September 30, 1964, were well below normal, with the

State experiencing the driest water year since 1954-55. The dry condition is exemplified by the condition in the central and northern part of the State in which many low-elevation streams that normally flow throughout the year were dry. In Southern California a drought condition has prevailed since about 1944.

Precipitation over the State during the water year averaged about 70 percent of normal. Actually, the water year began with every indication that it would produce a bumper water crop. However, the nearly complete absence of precipitation during February, along with below normal precipitation during January and March, resulted in a reversal of the early-season trend. As a result of the below normal precipitation during the major precipitation season, the maximum snowpack accumulation for the year was some 50 percent below the normal.

During the 1963-64 season, nine weather modification projects were conducted by eight of the eleven licensed operators. The total operating time of ground-based generators on these projects was about 10,192 hours. Total flight time for air-borne disbursement was about 242 hours. Six operators used silver iodide as a nucleating agent for ground-based generators, and one used non-toxic metallic haloids in an experimental project. Nucleating agents used in air-borne disbursements were dry ice (solidified carbon dioxide), silver iodide, and assorted non-toxic metallic haloids. During this period an estimated 175,832 grams, or 388 pounds, of silver iodide, 2,427 pounds of haloids, and 1,039 pounds of "dry ice" were released.

The amount of silver iodide released during the 1963-64 season was 45 percent of that released during the 1962-63 season. Total operating time during the 1963-64 season was 43 percent of the previous season's. Of the 366 calendar days during the year covered by this report, seeding operations were conducted on 106 days, as compared with 133 days for the 1962-63 season.

During the period covered by this report, the eleven licensed operators applied for and received renewals of their licenses. Table 1 lists all licenses which were active during the 1963-64 period.

Projects conducted in California during the 1963-64 season are listed in Table 2. Data on generator-hours, rate of use of silver iodide, etc., and target areas presented in this report were obtained from completion reports and maps submitted to the Department by the project operators. Each project in the table is designated by a coding number consisting of three elements. The first element is the license number, the second indicates the water year, and the third is assigned in numerical sequence to projects undertaken by a licensee during the year as shown by published notices of intention filed with the Department.

Each project is identified by the same code number on Plates 1 and 2. Plate 1 shows the approximate target area of each project, and Plate 2 indicates the days each project was operated.

TABLE 1

ACTIVE WEATHER MODIFICATION LICENSES
DURING THE PERIOD OCTOBER 1963 THROUGH SEPTEMBER 1964

License : Number :	Licensee
1	North American Weather Consultants Santa Barbara Municipal Airport Goleta, California
5	Water Resources Development Corporation 460 South Broadway Denver, Colorado 80209
6	Weather Modification Company San Jose Municipal Airport San Jose, California 95110
12	Precipitation Control Company of California 105 Pierce Street Taft, California
14	North American Weather Consultants of California Santa Barbara Municipal Airport Goleta, California
18	Los Angeles County Flood Control District P. O. Box 2418, Terminal Annex Los Angeles, California 90054
21	Atmospherics Incorporated 3435 East Pontiac Way Fresno, California 93703
22	San Bernardino Valley Municipal Water District 355 North "D" Street, P. O. Box 1144 San Bernardino, California
23	Pacific Gas and Electric Company 245 Market Street San Francisco, California 94100
24	International Weather Control, Inc. 40 West First Street, Suite 104 Reno, Nevada
25	K.R.C. Service Corporation 2956 C Street San Diego, California 92102

TABLE 2

WEATHER MODIFICATION OPERATIONS IN CALIFORNIA
 COMPILED FROM LICENSEES COMPLETION REPORTS
 OCTOBER 1, 1963 - SEPTEMBER 30, 1964

Project number	Licensee	Client	Target area	Period of operation	Rate of use of silver iodide:		Total generator-hours:	Purpose
					Ground-based	Air-borne		
6-64-1	Weather Modification Company	Santa Clara Valley Water Conservation District	Santa Clara County	Nov. 1, 1963 Apr. 1, 1964	27.2	30	1,289.5	62.5 Precipitation increase
12-64-1	Precipitation Control Company of California	Kern County Board of Supervisors	Kern River Watershed	Nov. 5, 1963 Apr. 1, 1964	----	43	----	100.0 Precipitation increase
14-64-1	North American Weather Consultants of California	Southern California Edison Company	Upper San Joaquin River Basin	Oct. 1, 1963 Sept. 30, 1964	6.7	--	2,553.5	---- Precipitation increase
18-64-1	Los Angeles County Flood Control District	Los Angeles County Flood Control District	Drainage areas tributary to District's Reservoirs	Nov. 19, 1963 May 6, 1964	6.0	--	585.0	---- Precipitation increase
21-64-1	Atmospherics Incorporated	Kings River Conservation District	Kings River Watershed above Pine Flat Dam	Oct. 1, 1963 May 2, 1964	10.0	(a)	1,597.3	26.5 Precipitation increase
21-64-2	Atmospherics Incorporated	County of Tulare	Tulare County	Nov. 1, 1963 May 27, 1964	----	(b)	----	51.0 Precipitation increase
22-64-1	San Bernardino Valley Municipal Water District	San Bernardino Valley Municipal Water District	Upper Santa Ana River Watershed	Oct. 1, 1963 May 1, 1964	20.6	--	2,331.0	---- Precipitation increase
23-64-1	Pacific Gas and Electric Company	Pacific Gas and Electric Company	Watersheds of Mountain Meadows and Butt Valley Reservoir and Lake Almanor	Nov. 22, 1963 May 31, 1964	26.6	--	1,804.0	---- Precipitation increase
25-64-1	K. R. C. Service Corporation	Vista Irrigation District	Lake Henshaw Watershed San Diego County	Aug. 6, 1963 Dec. 31, 1963	(c)	(c)	31.5	1.6 Precipitation increase

(a) Operator used dry ice (CO₂ crystals) and silver iodide for air-borne operation. Dry ice dispersed at 3 pounds per mile, rate for silver iodide not given. Total dry ice used was 1,109 pounds and total silver iodide used was 387 grams.

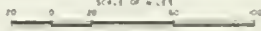
(b) Operator used dry ice (CO₂ crystals) and silver iodide for air-borne operation. Use rates not given. Total dry ice used was 530 pounds, and total silver iodide used was 963 grams.

(c) Amounts dispersed on or after October 1, 1963. This was a research project where assorted non-toxic metallic haloids were used experimentally. Specific agents were not indicated for proprietary reasons. Rate of use of agents was 30 to 50 pounds per hour for ground based generators and 450 to 1,500 pounds per hour for air-borne operations. Total haloids used between October 1, and December 31, 1963, was 2,427 pounds.

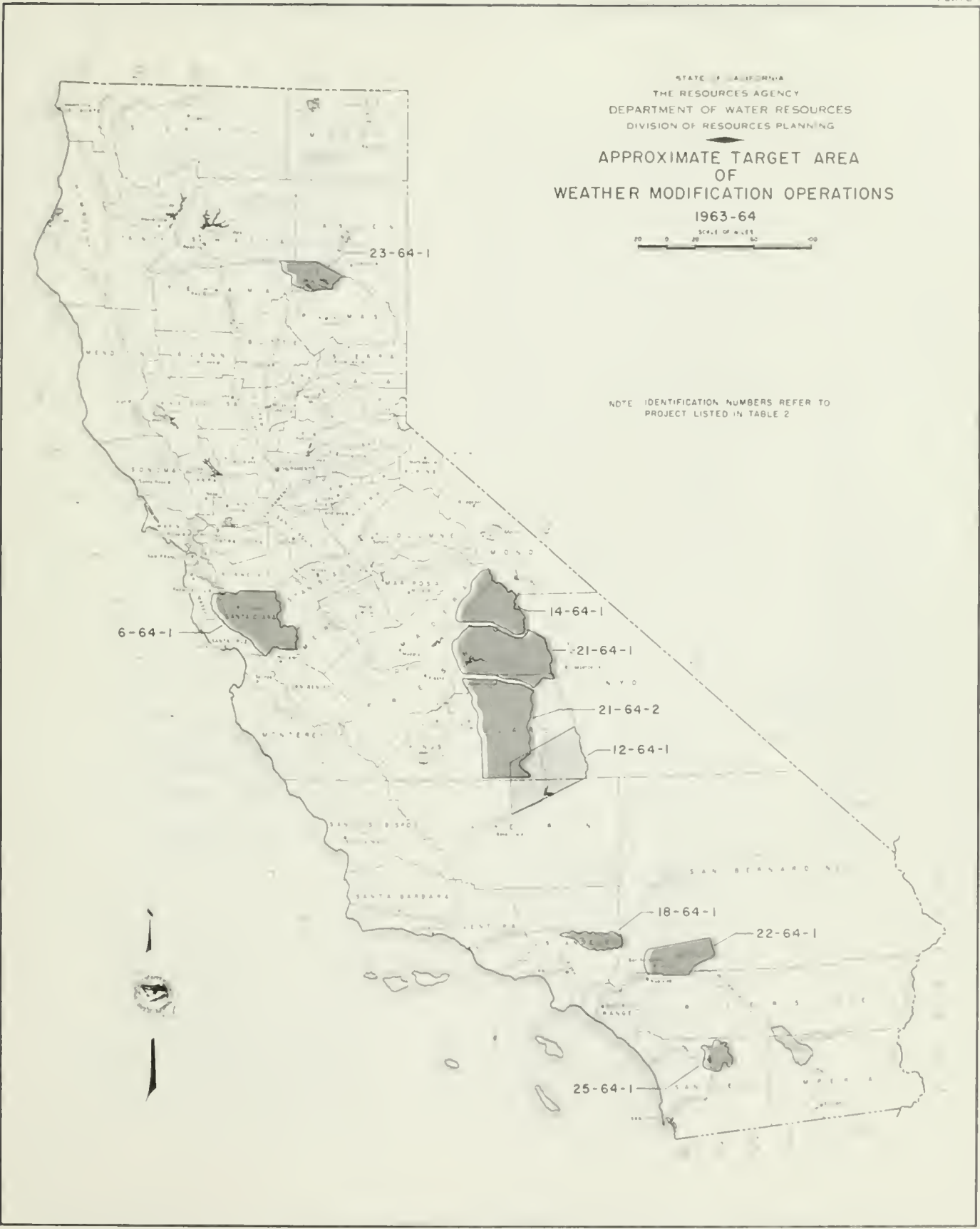
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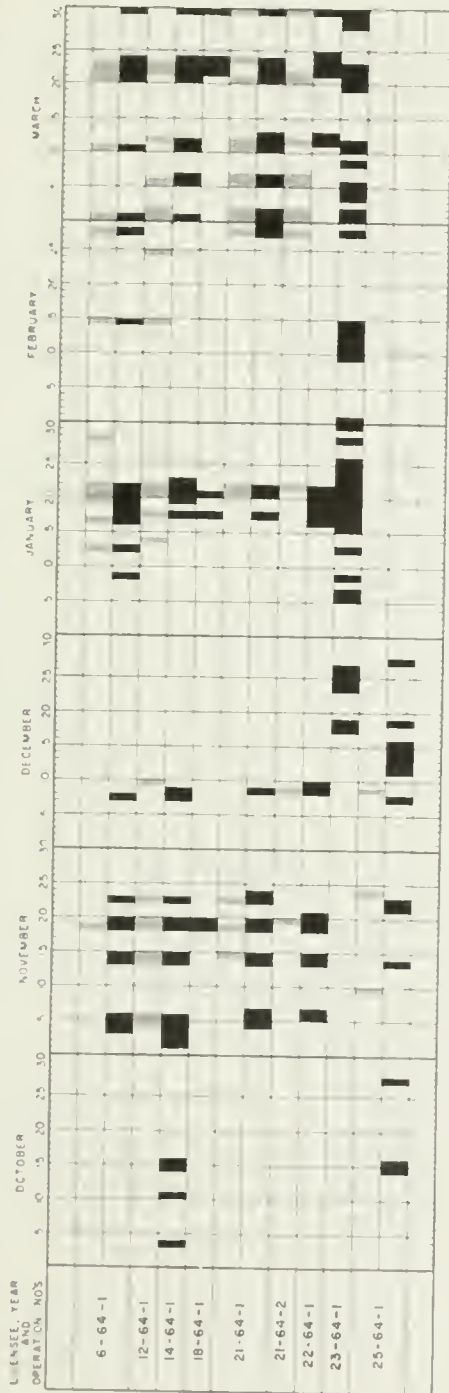
APPROXIMATE TARGET AREA
OF
WEATHER MODIFICATION OPERATIONS
1963-64

1963-64

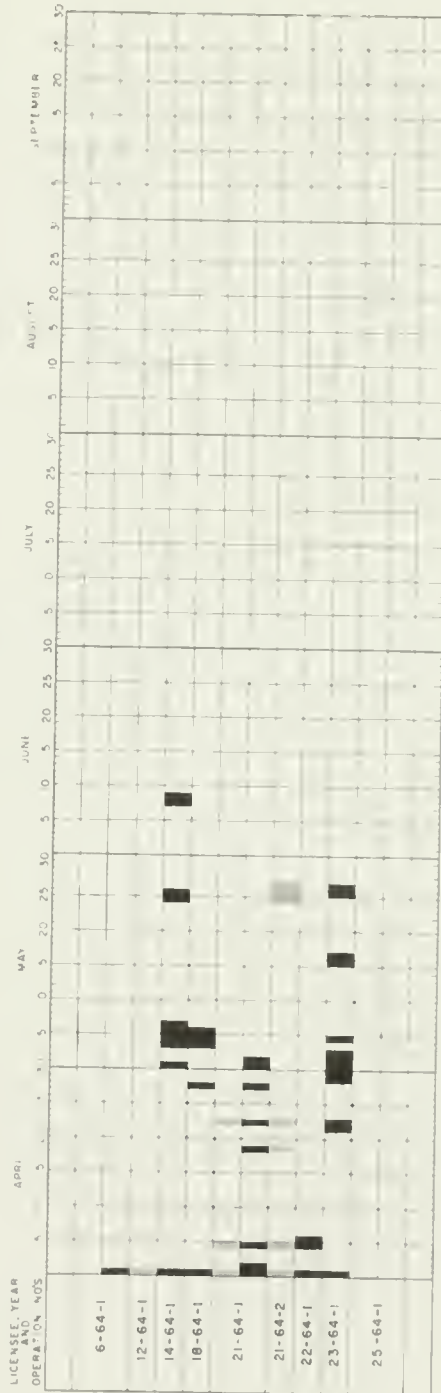


NOTE: IDENTIFICATION NUMBERS REFER TO
PROJECT LISTED IN TABLE 2





1964



1964

 AIRCRAFT
 GROUND BASED GENERATORS

CALENDAR OF WEATHER MODIFICATION OPERATIONS
 OCTOBER 1963 THROUGH SEPTEMBER 1964
 SHOWN DAYS OF CLOUD SEEDING

CHAPTER 4, DIVISION 1 OF THE WATER CODE

CHAPTER 4, DIVISION 1 OF THE WATER CODE, STATE OF CALIFORNIA

REGULATION OF RAIN-MAKING AND RAIN-PREVENTION

(Chapter 4 added by Statutes of 1951, Chapter 149,
as part of codification)

400. The public interest, health, safety, welfare, and necessity require that scientific experimentation in the field of artificial nucleation, and that scientific efforts to develop, increase, and regulate natural precipitation be encouraged, and that means be provided for the regulation and control of interference by artificial means with natural precipitation of rain, snow, moisture, or water in any form contained in the atmosphere, within the State, in order to develop, conserve, and protect the natural water resources of the State and to safeguard life and property.

401. As used in this chapter:

- (a) "Department" means the Department of Water Resources.
- (b) "Person" means any person, firm, association, organization, partnership, company, corporation, private or public, county, city, city and county, district, or other public agency. (Amended by Stats. 1959, Ch. 1269)

402. No person, without first securing a license from the Department, shall cause or attempt to cause condensation or precipitation of rain, snow, moisture, or water in any form contained in the atmosphere, or shall prevent or attempt to prevent by artificial means the natural condensation or precipitation of rain, snow, moisture, or water in any form contained in the atmosphere.

403. Any person desiring to do any of the acts specified in Section 402 may file with the Department an application in writing for a license. Each application shall be accompanied by a filing fee fixed by the Department with the approval of the Department of Finance but not to exceed fifty dollars (\$50) and shall be on a form to be supplied for such purpose by the Department.

404. Every application shall set forth all of the following:

- (a) The name and post-office address of the applicant.
- (b) The previous education, experience, and qualifications of the applicant, or, if the applicant is other than an individual, the previous education, experience, and qualifications of the persons who will be in control of and charged with the operations of the applicant.

(c) A general description of the operations which the applicant intends to conduct and the method and type of equipment that the applicant proposes to use.

(d) Such other pertinent information as the Department may require.

405. Upon the filing of the application upon a form supplied by the Department and containing the information prescribed by this chapter and accompanied by the required filing fee the Department shall issue a license to the applicant entitling the applicant to conduct the operations described in the application for the calendar year for which the license is issued, unless the license is sooner revoked or suspended.

406. A license may be renewed annually upon application to the Department, accompanied by a renewal fee fixed by the Department with the approval of the Department of Finance but not to exceed twenty-five dollars (\$25), on or before the last day of January of the calendar year for which the license is renewed.

407. Prior to undertaking any operation authorized by the license the licensee shall file with the Department and cause to be published a notice of intention. The licensee shall then confine his activities for that operation substantially within the time and area limits set forth in the notice of intention.

408. The notice of intention shall set forth all of the following:

- (a) The name and address of the licensee.
- (b) The nature and object of the intended operation and the person or persons on whose behalf it is to be conducted.
- (c) The area in which and the approximate time during which the operation will be conducted.
- (d) The area which will be affected by the operation as near as the same may be determined in advance.

409. The licensee shall cause the notice of intention to be published pursuant to Section 6063* of the Government Code in a newspaper having a general circulation and published within any county wherein the operation is to be conducted and in which the affected area is located, or, if the operation is to be conducted in more than one county or if the affected area is located in more than one county or is located in a county other than the one in which the operation is to be conducted, then such notice shall be published in like manner in a newspaper having a general circulation and published within each of such counties. In case there is no newspaper published within the appropriate county, publication shall be made in a newspaper having a general circulation within the county. (Amended by Stats. 1955, Ch. 482, and by Stats. 1957, Ch. 448)

*A copy of Government Code Section 6063 is appended to this excerpt from the Water Code.

410. Proof of publication shall be filed by the licensee with the Department within 15 days from the date of the last publication of the notice. Proof of publication shall be by copy of the notice as published attached to and made a part of the affidavit of the publisher or foreman of the newspaper publishing the notice.

411. Every licensee shall keep and maintain a record of all operations conducted by him pursuant to his license showing the method employed, the type of equipment used, the times and places of operation of the equipment, the name and post-office address of each person participating or assisting in the operation other than the licensee, and such other information as may be required by the Department, and shall report the same to the Department immediately upon the completion of each operation.

412. Each licensee shall further prepare and maintain an evaluation statement for each operation which shall include a report as to estimated precipitation, defining the gain or loss occurring from nucleation activities, together with supporting data therefor. This statement, together with such other pertinent information as the Department may require, shall be sent to the Department upon request by the Department.

413. Notwithstanding any provision of this chapter to the contrary, the Department may grant a licensee permission to undertake an emergency nucleation project, without compliance by the licensee with the provisions of Sections 407 to 410, inclusive, if the same appears to the Department to be necessary or desirable in aid of extinguishment of fires.

413.5. Notwithstanding any provision of this chapter to the contrary, upon request of the board of supervisors of a county or of the governing body of a city or a public district of the State, and upon the submission of such supporting evidence as the Department may require, the Department may grant a licensee permission to undertake a nucleation project for the purpose of alleviating a drought emergency, without prior compliance by the licensee with the provisions of Section 407 requiring publication of notice of intention, if such project appears to the Department to be necessary or desirable. Nothing contained in this section shall be construed as to relieve the licensee in such case from compliance with the provisions of Sections 407 to 410, inclusive, requiring publication of notice of intention and filing of proof of such publication, as soon after the granting of permission by the Department as is practicable. (Added by Stats. 1955, Ch. 1399)

414. Any license may be revoked or suspended if the Department finds, after due notice to the licensee and a hearing thereon, that the licensee has failed or refused to comply with any provisions of this chapter. The proceedings herein

referred to shall be conducted in accordance with the provisions of the Administrative Procedure Act, Chapter 5, Part 1, Division 3, Title 2 of the Government Code and the Department shall have all the powers granted therein.

415. Any person who violates any provision of this chapter is guilty of a misdemeanor.

NOTE

The foregoing is a true copy of Chapter 4, Division 1 of the Water Code as of 1/1/65. Persons directly concerned with any activities coming under the provisions of this chapter are urged to check with the Department from time-to-time for any revisions that may be made by the Legislature.

For convenience of those persons interested in publication requirements for notices of intention, the following is a copy of Section 6063 of the Government Code.

6063. Publication of notice pursuant to this section shall be once a week for three successive weeks. Three publications in a newspaper regularly published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. The period of notice commences upon the first day of publication and terminates at the end of the twenty-first day, including therein the first day. (Added by Stats. 1949, Ch. 1587; amended by Stats. 1957, Ch. 1670, and by Stats. 1959, Ch. 954)

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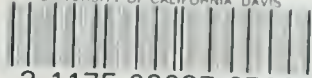
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