ANALYSIS OF PROJECT ECONOMY (INITIAL DEVELOPMENT)

Basis of Analysis. The ratio of the value of total estimated benefits to total estimated costs will be used to measure the economic feasibility of this project. In the analysis, two principal comparisons of benefits to costs will be considered:

a. Direct cash benefits (revenues) to total costs. The benefits considered under this heading will include only revenues from water and power sales. It is not considered mandatory that the total of these cash benefits should exceed the total costs, but if it is shown that the project will pay for itself on a cash basis alone, there should be no doubt regarding its economic desirability.

b. Total tangible benefits to total costs. In addition to the cash benefits mentioned above, other tangible but non-income producing benefits will be considered under this heading. These will include navigation, flood control, and salinity control benefits, and the value of preserving or enhancing existing land and industrial values. The total of all these tangible benefits should be well in excess of the total project costs if the project is to be considered economically feasible.

If the project proves economical when measured by the value of these tangible benefits, the additional value of numerous intangible or uncomputable benefits not directly considered will further increase the value of the project and make it all the more desirable.

Originally Proposed Method of Financing. It was originally proposed that funds for the construction of the project be obtained through grant and loan from the Government. A grant based on 30 percent of the estimated total cost of labor and material, or approximately $36,767,000 was requested as a part of the public works program provided for in the National Industrial Recovery Act. A loan of the remaining $132,885,000 was requested to complete the construction work. It was proposed to secure the loan by the issuance of bonds which were to be a first and direct charge and lien upon all revenues and income derived from operation of the project.

The State contended that the Federal Government would be justified in furnishing financial assistance to the project as follows:

a. A direct contribution without payment of interest and without repayment of principal for navigation improvement to the Sacramento River.	$15,000,000
b. A direct contribution without payment of interest and without repayment of principal to Sacramento Flood Control Project.	3,000,000

c. A direct contribution without payment of interest and without repayment of principal for flood control value to the lands along San Joaquin River. $ 600,000

d. A loan of $65,500,000 of non-interest bearing funds reimbursable in forty equal annual payments to pay the cost of the irrigation features. Assuming an interest rate of 3-1/2 percent per annum, the loan on these terms would be equivalent to an immediate direct contribution of 30,500,000

e. A loan to pay the cost of power features, based on an interest rate of 4 percent per annum and repayment of principal in fifty years.

The sum of the proposed justifiable direct contributions listed above is $49,100,000, or $12,333,000 larger than the proposed grant of $36,767,000 requested on the basis of 30 percent of the cost of labor and material. Therefore, it may be seen that the request to the Federal Government for a grant of 30 percent of the cost of labor and material and a loan at 4 percent interest was reasonable in accordance with well established governmental policies and precedents relative to navigation, flood control, irrigation and power.

However, these requests were not granted, and the Central Valley project now stands as a 100 percent Federal Reclamation undertaking under the supervision of the Bureau of Reclamation.

Costs and Annual Expenses.

Construction Costs. The estimated construction costs of the major features of the initial plan are taken from the original State Engineer's plan as outlined in the Amended Application for Grant and Loan, dated January 25, 1934. Several changes from this plan are being made in the project actually under construction. These changes are described under the previous section on Method of Development--Initial Plan. Estimates of the cost of the structures actually being built are not available. It is assumed in this analysis, however, that the changes in plan were occasioned by equal or greater ultimate economy, and that if the costs are greater than those estimated for the original plan, the benefits will likewise be proportionately greater.

Table 9 shows a summary of the estimated costs of the major features of the initial development.

Annual Expenses. Annual costs on the works of the Central Valley project include interest and amortization on bonds, depreciation, and operation and maintenance.

It is understood that under the actual method of financing the project no interest will be charged on the portion of the cost allocated to

irrigation. However, in investigating the economic feasibility of the project, it is assumed in this study that reasonable interest charges on the full construction cost should be included in the annual expense considered, regardless of whether or not these charges will be paid in their entirety by the people of California. Any portion of this cost not actually paid by the direct beneficiaries of the project merely constitutes a subsidy to the project. Interest charges of 3 percent per annum will therefore be included for the total cost of the project. It is considered that this assumed rate of interest is liberal, since the actual cost to the Government for borrowing money is somewhat less than 3 percent.

In computing the annual interest costs, it is assumed that the capital cost of the project will be amortized over a period of [illegible] years at a rate proportional to that proposed in the State's "Amended Application" of January 25, 1934. This results in an average annual interest charge of 1.65 percent of the capital cost, although the actual interest payments would vary from year to year. It it were assumed that the capital cost would be amortized in (53) years at an increasing annual rate such that the total annual payment of principal plus interest would be constant, the average interest charge would be 1.90 percent per annum.

Interest on expenditures, except for water rights and general expense, during the construction period have been added to the capital cost, and are shown in Table 9.

It is understood that certain direct contributions for flood control and navigation are being made to the project by the Government, and that the remaining cost will be paid back to the Government over a 40-year period. However, it is not considered equitable in this study to take advantage of any direct contributions, and an allowance for amortization of the entire cost is therefore included in the estimated annual charges. However, since interests and amortization charges considered are in excess of those actually being paid, the length of time assumed for amortization of the total project cost was extended from 40 to 53 years. In computing the annual amortization charges, the rate of amortization is taken proportional to that proposed in the State's "Amended Application." This results in an average amortization charge of 1/53 or 1.89 percent of the capital cost per annum.

Certain units of the project will wear out or become obsolete and require replacement. Replacement of some units will be required before the loan for their construction has been fully amortized. To provide a fund for the replacement of each unit at the end of its estimated life, an amount for depreciation, which has been calculated on a 4 percent sinking fund basis, has been included in the semiannual or annual charges. See Table 10. These charges are as included in the State's "Amended Application" of January 25, 1934.

The estimated annual costs of operating and maintaining the works of the project are shown in Table 11. The works for which there will be operation and maintenance charges are the dams and appurtenances, power

TABLE 9

*SUMMARY ESTIMATE OF CAPITAL COST

Unit	(1) Preliminary Expense	(2) Cost of Land and Right of Ways	(3) Construction	(4) Engineering Charges	(5) Legal Administrative & Other Overhead Charges	(6) Interest During Construction	(7) Total Cost
Shasta Dam and reservoir	$225,900	$2,540,400	$ 49,426,900	$1,807,600	$2,485,400	$5,313,100	$ 61,799,300
Shasta power plant	52,700	-	12,114,900	579,400	421,400	1,307,200	14,475,600
Kenswick dam and afterbay	19,200	15,000	1,752,500	61,900	85,100	103,300	2,037,500
Kenswick power plant	19,000	-	4,366,300	208,800	151,900	344,400	5,090,400
Shasta transmission line and terminal substation	51,000	477,200	11,249,600	509,900	458,900	1,011,700	13,758,300
Sacramento-San Joaquin Delta cross channel	15,100	230,000	3,250,100	166,400	121,000	96,700	3,879,300
Contra Costa conduit	9,400	397,000	1,775,000	94,400	85,000	51,100	2,411,900
Friant dam and reservoir	63,900	230,000	11,801,300	418,900	575,900	585,300	13,675,300
Madera canal	12,600	63,200	2,825,400	125,600	113,000	85,100	3,224,900
Friant-Kern canal	99,100	1,611,100	21,170,900	990,500	891,500	1,103,500	25,866,600
San Joanquin pumping system	55,400	558,900	12,172,100	553,500	498,200	305,200	14,143,300
Water rights and general expense	-	-	-	-	-	-	8,000,000
Total	$623,300	$6,122,800	$131,905,000	$5,516,900	$5,887,300	$10,307,100	$168,362,400

*Estimate from "Amended Application" prepared by State of California, dated 1/25/34 (not including Friant power plant).

plants and equipment, transmission tower lines, substation, canals, structures on canals, pumping plants, and the right of ways for canals and transmission lines. The charges are as included in the State's "Amended Application" of January 25, 1934.

The lump sum amounts provided for the dams and appurtenances is almost twice as high as values used by the U. S. Bureau of Reclamation for Boulder Dam, which were set at 0.1545 percent of the capital cost (without interest during construction) per annum.

For power plants and equipment a lump sum of $10,000 plus $0.65 per KVA was used for annual operation and maintenance. This value is comparable to a value of $0.444 per KVA plus $10,000 actual operation and maintenance costs for the Exchequer plant of the Merced Irrigation district and a value of approximately $0.35 per KVA plus $10,000 for Boulder power plants.

Transmission line annual operation and maintenance charges were set at 0.75 percent of the capital invested as compared with 0.50 and 0.82 percent for lines of the Southern California Edison, and 0.24 percent for the Pacific Gas and Electric Company and 0.86 to 0.89 percent for the Boulder-Los Angeles line.

Terminal substations annual operation and maintenance charges were estimated at 2.0 percent of the capital cost as compared with 1.40 and 1.92 percent for Southern California Edison Company substation, 1.71 and 2.77 percent for Pacific Gas and Electric substations, and 2.61 percent estimated for the Boulder Canyon power terminal.

Other items of operation and maintenance charges were determined by an engineering advisory committee for the State's water resources investigations.

TABLE 10

ANNUAL DEPRECIATION CHARGES #

Item	Base cost	Base cost, engineering and overhead	Years to accumulate replacement fund	Factor percent of base cost plus engineering and overhead (1)	Amount to be set aside annually
Shasta Dam and reservoir					
Dam and appurtenances*	$27,049,000	$33,811,200		0.35	$118,300
Shasta power plant					
Equipment	4,978,000	6,222,500	25	2.40	149,300
Building, etc.*	5,556,700	6,945,900		0.35	24,300
Keswick Dam and afterbay					
Dam and appurtenances*	1,524,000	1,905,000		0.35	6,700
Keswick power plant					
Equipment	2,070,000	2,587,500	25	2.40	62,100
Building, etc.*	1,726,800	2,158,500		0.35	7,600
Shasta transmission line and terminal substation					
Tower line	6,187,200	7,734,000	40	1.05	81,200
Substation equipment	3,122,000	3,902,500	25	2.40	93,700
Substation buildings*	448,100	560,100		0.35	1,600
Sacramento-San Joaquin Delta Cross Channel					
Dam lock and headgate*	2,132,000	2,665,000		0.35	9,300
Wicket and gates	207,900	259,900	40	1.05	2,700
Canal	275,000	343,700	50	0.65	2,200
Minor structures*	211,300	264,100		0.35	900
Contra Costa Conduit					
Canal	920,100	1,150,100	50	0.65	7,500
Pumps, motors, etc.	74,100	92,600	25	2.40	2,200
Building, etc.*	44,500	55,600		0.35	200
Minor structures*	504,800	631,000		0.35	2,200
Friant Dam and reservoir					
Dam and appurtenances*	10,221,600	12,777,000		0.35	44,700

TABLE 10 (Continued)

ANNUAL DEPRECIATION CHARGES #

Item	Base cost	Base cost, engineering and overhead	Years to accumulate replacement fund	Factor percent of base cost plus engineering and overhead (1)	Amount to be set aside annually
Madera Canal					
Canal	$ 2,177,900	$ 2,722,400	50	0.65	$ 17,700
Minor structures	279,000	348,800		0.35	1,200
Friant Kern Canal					
Canal	14,879,500	18,599,400	50	0.65	120,900
Tunnels*	392,500	490,600		0.35	1,700
Minor structures*	3,137,400	3,921,800		0.35	13,700
San Joaquin Pumping System					
Complete development					
Canal	5,533,500	6,916,900	50	0.65	45,000
Pumps, motors, etc.	1,186,000	1,482,500	25	2.40	35,600
Buildings, etc.*	1,823,000	2,278,800		0.35	8,000
Steel leaf dams	821,900	1,027,400	40	1.05	10,800
Minor structures*	507,500	634,400		0.35	2,200
Power line	712,500	890,600	40	1.05	9,400

* These units, if properly maintained, should have indefinite lives. The factor .0035 has been applied to accumulate a contingency fund to cover unforseen replacements and repairs not included in the regular maintenance work.

(1) Factor is based on annual contribution to replacement fund with interest at 4 percent per annum.

From "Amended Application," prepared by the State of California, dated January 25, 1934.

TABLE 11

ANNUAL OPERATION AND MAINTENANCE CHARGES*

Item	Base cost	Base cost engineering and overhead	Annual Operation and Maintenance Factor	Annual Operation and Maintenance Amount
Shasta Dam and reservoir				
Dam and appurtenances	$27,049,000	$33,811,200		$100,000
Shasta power plant				
Equipment	4,978,000	6,222,500	$10,000 + $0.65 per kva	188,800
Building, etc.	5,556,700	6,945,900		
Keswick dam and afterbay				
Dam and appurtenances	1,524,000	1,905,000		5,000
Keswick power plant				
Equipment	2,070,000	2,587,500	$10,000 + $0.65 per kva	
Building, etc.	1,726,800	2,158,500		42,500
Shasta transmission line and terminal substation				
Transmission line				
Land and right of way	400,000	500,000	.0045	2,300
Power line	6,187,200	7,734,000	.0075	58,000
Terminal substation				
Land	15,000	18,700	.0045	100
All equipment	3,122,000	3,902,500		
Buildings, etc.	448,100	560,100	.02	89,300
Sacramento-San Joaquin Delta cross channel				
Right of way	200,000	250,000	.0045	1,100
Dam, lock and headgate	2,132,000	2,665,000	.016	42,600
Wickets and gates	207,900	259,900	.039	10,100
Canal	275,000	343,700	.023	7,900
Minor structures	211,300	264,100	.016	4,200
Contra Costa conduit				
Right of way	345,000	431,200	.0045	1,900
Canal	920,100	1,150,100	.023	26,500
Pumps, equipment, etc.	74,100	92,600	.055	5,100
Buildings	44,500	55,600	.016	900
Minor structures	504,800	631,000	.016	10,100

TABLE 11 (Continued)

ANNUAL OPERATION AND MAINTENANCE CHARGES*

Item	Base cost	Base cost engineering and overhead	Annual Operation and Maintenance Factor	Annual Operation and Maintenance Amount
Friant Dam and reservoir				
Dam	$10,221,600	$12,777,000	lump sum	$ 21,000
Madera Canal				
Right of way	55,000	68,800	.0045	300
Canal	2,177,900	2,722,400	.023	62,600
Minor structures	279,000	348,800	.016	5,600
Friant-Kern canal				
Right of way	1,401,000	1,751,200	.0045	7,900
Canal	14,879,500	18,599,400	.023	427,800
Tunnels	392,500	490,600	.016	7,800
Minor structures	3,137,400	3,921,800	.016	62,700
San Joaquin pumping system complete development				
Right of way	486,000	607,500	.0045	2,700
Canal	5,533,500	6,916,900	.023	159,100
Pumps, motors, etc.	1,186,000	1,482,500	.0555	82,300
Buildings, etc.	1,823,000	2,278,800	.016	36,500
Steel leaf dams	821,900	1,027,400	.039	40,100
Minor structures	507,500	634,400	.016	10,200
Power line	712,500	890,600	.0075	6,700
Electric energy for pumping			207,000,000 kw hrs at .004	828,000

* From "Amended Application," prepared by the State of California, dated January 25, 1934.

Revenues and Benefits. Power benefits are ordinarily defined as (1) annual net revenue from the sale of electric energy and (2) the annual public savings effected by low power rates. No knowledge is had regarding the effect of this power development on power rates of private utilities; therefore, only (1) will be considered here.

Water benefits are defined as (1) annual net revenue from the sale of water for irrigation of land, (2) dependable supply of water to industries now suffering from periodic water shortage and assuring water to those industries faced with a potential deficit, (3) release of water for navigation and (4) release of water to control the encroachment of salt water on agricultural lands and into sources used by industry.

Power Output. The estimated output capacity of the Shasta power plant, determined by a detailed study of reservoir operations for the critical period 1919-1935, inclusive, is based on the following assumptions:

(1) Overall plant efficiency of 75%
(2) Reservoir evaporations of 3.5' depth annually
(3) Reservoir releases for navigation, irrigation, industrial and municipal water supply, salinity control and other uses

In other words, the meeting of mandatory releases for (3) above is the primary factor governing reservoir operations. However, in addition to the mandatory releases, water passes the dam, comprising spill and flood control releases used in whole or in part for power production, and releases made primarily for power.

The revenues which will be obtained from the sale of electric energy to be developed are based upon, first, the amounts and characteristics of the power; second, its unit value; and third, a consideration of the demand for power and the rate at which it can be absorbed in the tributary market.

The average annual output of the Shasta and Keswick Plants for the 13-year period (1919-1931) would have been 1,361,200,000 kwhr. On the basis of the period 1890-1931 the average annual output would have been 1,560,300,000 kwhr, with a minimum of 1,106,700,000 kwhr in 1924.

Unit Value of Power. The unit value of the power to be produced by the project has been based upon a determination of the present day cost of developing an equivalent amount of steam-electric energy of similar characteristics by a privately owned utility. This basis is believed to be the most reasonable one offered because of the present low cost of producing electric energy by steam plants which can be located near the load center of the area of consumption. Values so obtained are lower than the cost of hydroelectric energy delivered to the load centers of areas served by present hydroelectric plants and are also lower than the prices now being paid for hydroelectric energy under existing contracts. They are therefore believed to be conservatively low. The results of extensive detailed studies are presented briefly herewith.

EXHIBIT 8

CE TRAL VALLEY PROJECT
OF
CALIFORNIA

ANNUAL ELECTRIC POWER PRODUCTION

IN NORTHERN CALIFORNIA

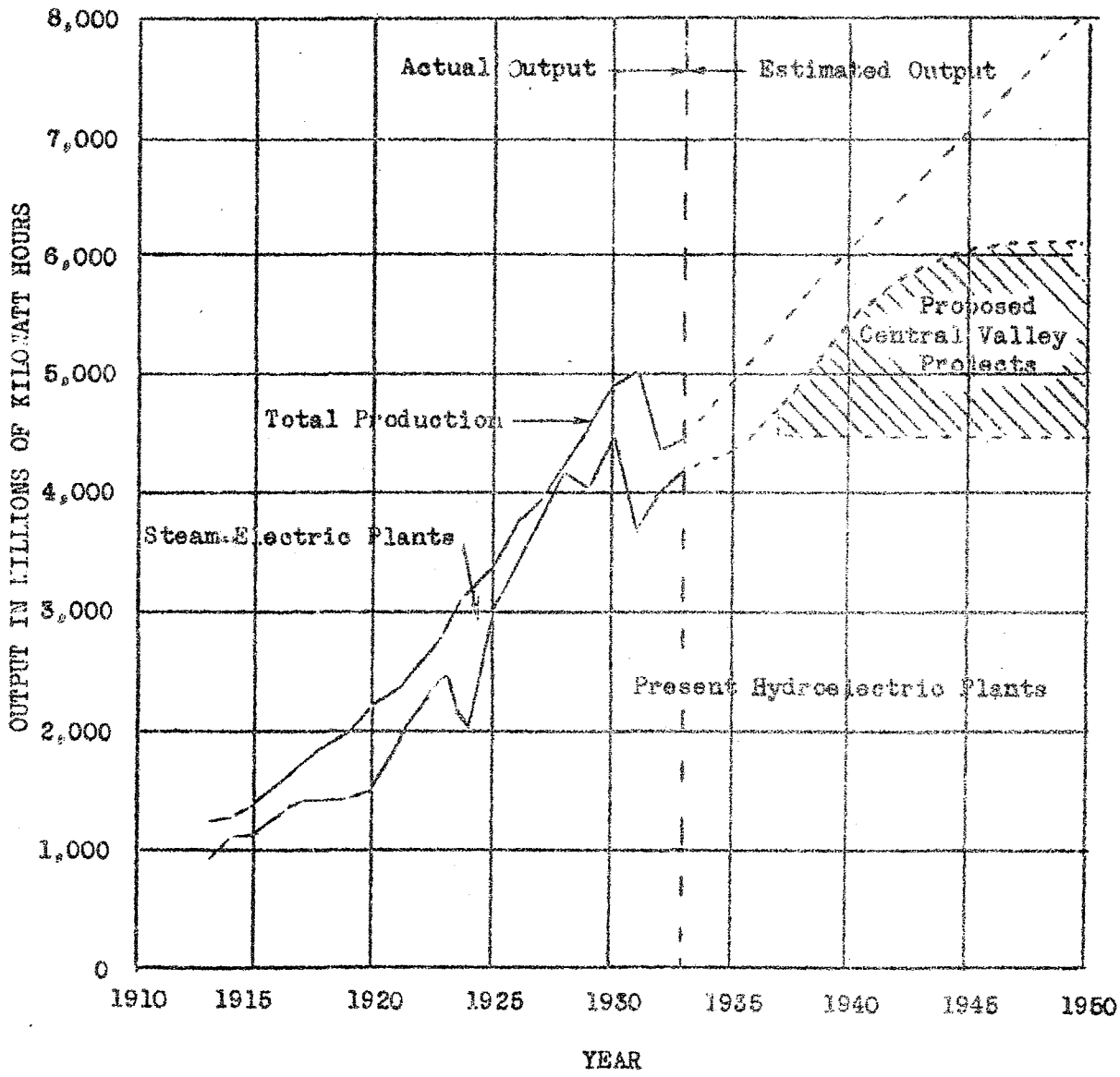


TABLE 12

COST OF STEAM-ELECTRIC ENERGY DELIVERED FROM TERMINAL SUBSTATION*

	Excluding State Tax	Including State Tax
Investment per kilowatt of capacity:		
Steam-electric plant	$ 85.00	$ 85.00
Transmission line and substation	20.00	20.00
Total	$105.00	$105.00
Estimated efficiency:		
Standby oil in barrels per kilowatt per year	0.55	0.55
Output in kilowatt hours per additional barrel of oil	500	500
Price assumed per barrel for fuel oil	0.80	0.80
Cost of energy:		
Fixed costs per kilowatt per year:		
Steam plant -		
Return or interest at 7.5 percent	6.375	6.375
Depreciation at 2.0 percent	1.700	1.700
Operating expenses at $2.65 per kw	2.650	2.650
Standby oil	.440	.440
Federal taxes at 0.4 percent	.340	.340
State tax at 1.35 percent	.00	1.150
	$ 11.505	$ 12.655
Transmission:		
Return or interest at 7.5 percent	1.500	1.500
Depreciation at 1.25 percent	.250	.250
Operating expenses at $0.25 per kw	.250	.250
Federal taxes at 0.4 percent	.080	.080
State tax at 1.35 percent	.00	.270
Subtotal	$ 2.080	$ 2.350
Total fixed costs of steam plant and transmission, per kilowatt per year	$ 13.585	$ 15.005
Output cost per kilowatt hour of plant delivery	0.00160	0.00160
Total costs of substation delivery on basis of 2.5 percent loss in transmission		
Fixed costs per kw per year	13.933	15.389
Output cost per kilowatt hour	.00164	.00164
Recommended unit costs of substation delivery		
Fixed costs per kilowatt per year	13.95	15.40
Output cost per kilowatt hour	.00165	.00165
Average cost per kilowatt hour at 60 percent load factor	.00430	.00458

*From "Amended Application," prepared by the State of California, dated 1/25/34.

TABLE 13

VALUE OF HYDROELECTRIC ENERGY FROM SHASTA AND KESWICK POWER PLANTS BASED ON PRODUCTION BY EQUIVALENT STEAM-ELECTRIC PLANT*

(Shasta Reservoir Operated Under Complete Development of Central Valley Project)

Plant capacities - Shasta - 220,000 kw Keswick - 40,000 kw		total 260,000 kw
Transmission distance		200 miles
Energy output measured at hydroelectric plants:		
Total load to utilize hydroelectric plant output in maximum year	(1)	3,213,500,000 kwh
Hydroelectric plant output - average year		1,560,300,000 kwh
Steam-electric plant output required - average		1,653,200,000 kwh
Energy output - terminal substation measurement (12% loss)		
Total		2,827,900,000 kwh
Hydroelectric plant output - average year		1,373,100,000 kwh
Steam-electric plant output required - average		1,454,800,000 kwh
All-steam-electric plant peak to serve load at 60.3 percent load factor	(1)	535,400 kw
Auxiliary steam-electric plant peak required	(2)	399,500 kw
Auxiliary steam-electric plant capacity required (25% overload)	(2)	320,000 kw

Value of Hydroelectric Energy
(Excluding State Taxes)

All-steam-electric plant cost	
Fixed cost, 535,400 kw, at $13.95 per kw	$7,469,000
Output cost, 2,827,900,000 kwh at $0.00165 per kwh	4,666,000
Total	12,135,000
Auxiliary steam-electric plant cost	
Fixed cost, 320,000 kw (2) at $13.95 per kw	4,464,000
Output cost, 1,454,800,000 kwh at $0.00165 per kwh	2,400,000
Total	6,864,000
Resultant value of hydroelectric energy from terminal substation	
Total	5,271,000
Per kilowatt hour (excluding State Taxes)	0.00384

Value of Hydroelectric Energy
(Including State Taxes)

All-steam-electric plant cost	
Fixed cost, 535,400 kw at $15.40 per kw	8,245,000
Output cost, 2,827,900,000 kwh at $0.00165 per kwh	4,666,000
Total	12,911,000
Auxiliary steam-electric plant cost	
Fixed cost 320,000 kw (2) $15.40 per kwh	4,928,000
Output cost, 1,454,000,000 kwh at $0.00165 per kwh	2,400,000
Total	7,328,000
Resultant value of hydroelectric energy from terminal substation	
Total	5,583,000
Per kilowatt hour (Including State Taxes)	0.00407

Notes: (1) and (2) on following page.

TABLE 13 (Continued)

VALUE OF HYDROELECTRIC ENERGY FROM SHASTA AND KESWICK POWER PLANTS BASED ON PRODUCTION BY EQUIVALENT STEAM-ELECTRIC PLANT*

(1) For the energy output measured at the hydroelectric plants, the total load to fully utilize the hydroelectric plant outputs is calculated as follows: In July of some years, the hydroelectric plants would have operated on a load factor of 1.00 and produced an energy output of 193,200,000 kwh. Under the load characteristics of northern California, these plants would have supplied 62.3 percent of the total load in that month. The total load then would have been 310,100,000 kwh in July. The July load is equal to 9.65 percent of the total annual load which, therefore, would have been 3,213,500,000 kwh. The system load factor is 60.3 percent. The required installation of the substitutional steam-electric plant, therefore, would have been 608,400 kw which reduced to terminal substation equivalent is 535,400 kw. (12 percent transmission loss).

(2) The installation of the auxiliary steam-electric plant was estimated as follows: The most critical period occurred in the autumn of 1931, when the head on the Shasta plant would have been sufficient to maintain full peaking capacity. In November of that year, the capacity would have been reduced to 124,000 kw which reduced to terminal substation equivalent is 109,100 kw. The peak demand in northern California in November is 95 percent of the annual maximum peak demand. The required peaking capacity, therefore, would have been .95 of 535,400 kw or 508,600 kw. The auxiliary steam-electric plant capacity would have been 508,600 minus 109,100 or 399,500. An auxiliary steam-electric plant of this capacity would have been sufficient to meet the other condition which would have occurred. It is estimated that the plant requirements would have exceeded 320,000 kw in only 14 months in the 13-year period 1919-1931 inclusive. The excess capacity requirement would have reached 25 percent in one month only, 19 percent in one month, 18 percent in one month, 11 percent in one month, 7 percent in one month, and 1 percent in one month. The excess capacities of 25, 19, 18, and 11 percent would have been needed for peaking and therefore would have been required for relatively short periods. Therefore, a capacity of 320,000 kw has been adopted for the auxiliary steam plant since such a plant could be overloaded to make up the additional required capacity at the infrequent intervals when such capacity would be needed.

*From "Amended Application," prepared by the State of California, dated 1/25/34.

The value per kilowatt hour resulting from the analysis shown in Table 12 is 3.84 mills if State taxes are not included as a part of the operating costs and 4.07 mills if State taxes are included. In estimating the revenue from the sale of power the price for power is taken as 3.9 mills per kilowatt hour during the period beginning in 1949 and continuing thereafter during the period of the loan. During the early periods of the development of the project the price is somewhat higher. During these periods less water is released primarily for summer irrigation use and therefore the power characteristics are better and more nearly coincide with the power demand. From 1937 to 1944, the price used per kilowatt hour is 4.15 mills and from 1944 to 1949, 4.00 mills per kilowatt hour at Antioch substation.

Power Absorption. The ability of the northern California power market to absorb the electric energy to be produced by the power plants of the Central Valley project is demonstrated by a consideration of the past and estimated future growth of power production and consumption in northern California. The data with respect to past growth and the estimates of future growth are depicted on Exhibit 8.

Water Revenues. The revenues which will be obtained from the sale of water made available by the project are calculated from a consideration of, first, the amounts of water which would be made available from Friant and Shasta reservoirs; second, the unit price which may reasonably be charged for water; and third, the demand for water in the various areas to be served by the project in accord with present and anticipated requirements.

Unit Price of Water. The unit prices of water which have been used in estimating the revenues from water sales are based upon detailed studies of the present cost of water for both irrigation and industrial uses, the cost of development of the supplies made available by the project and the charges for water which can be reasonably paid.

Upper San Joaquin Valley. Since the bulk of revenue to be obtained from water sales under the project is in the upper San Joaquin Valley, the unit price to be charged for water made available for this area has been given most careful consideration. A study was first made of the permissible charges which could be paid for irrigation water on various crops at the land. Total permissible charges were then computed, based upon the actual area of crops irrigated at present which are deficient in water supply and will be served with water made available by Friant reservoir. After taking into consideration the cost of distribution from the main canals of the project to the lands, and with further consideration of the characteristics of the supply furnished both from Friant reservoir and from local sources, the permissible average charge at the main canal side was determined as $3.00 per acre-foot.

The actual unit prices which will be charged for water delivered from Friant reservoir have not been finally determined, pending the negotiation of contracts with the water users. However, it is tentatively assumed that charges will be based upon character of service and not upon the kind of crop grown.

Water furnished every season as a direct surface irrigation supply would carry the highest charge, while water furnished during the irrigation season for surface irrigation, but varying in amount from season to season, would carry a lesser rate. Finally the water delivered out of season for ground-water storage and subsequent utilization by pumping would carry the lowest rate.

The reasonableness of an average charge of $3.00 per acre-foot for water delivered at the main canal side by the project can be further judged by a consideration of the present cost of water for irrigation in various irrigation districts and for lands served by pumping from wells.

Although some of the irrigation districts served by cheaply constructed gravity diversion systems have costs which are rather low (some less than $3.00 per acre-foot), the costs of water in other existing irrigation districts in the upper San Joaquin Valley are considerably greater. Costs of $5.00 to $7.00 an acre-foot are common. In the Lindsay-Strathmore and Terra Bella irrigation districts, costs range from $27.00 to $46.00 per acre-foot.

Costs of pumping from underground vary in different areas in the San Joaquin Valley, depending on the depth to ground water. In the Madera unit they range from $2.25 to $4.00 per acre-foot; in the Kaweah area from an average of $3.00 to a maximum of $5.50 per acre-foot; in the Lindsay-Strathmore district an average of $7.50 per acre-foot; in the Earlimart-Delano area from $4.00 to $12.00 per acre-foot; in the McFarland-Shafter area from $3.50 to $6.25 per acre-foot and in the Edison area from $10.00 to $12.00 per acre-foot. In some areas, irrigation district assessments must be paid in addition to pumping costs.

Taking the areas as a whole which will purchase the water to be furnished by the project, the average unit price of $3.00 per acre-foot at the main canal side, even after allowing for cost of distribution to the lands, will result in cheaper water than the present costs. This is true also for the tentative charges for water based on character of service. For example, for primary supplies sold at $8.00 per acre-foot at the main canal side, the cost of water delivered at the land in the areas where such supplies would be used, such as the Terra Bella and Lindsay-Strathmore irrigation districts, would be $10.16 per acre-foot. This would compare to present costs for water in these districts of $20.00 to $50.00 per acre-foot. In-season secondary water sold at $2.00 per acre-foot at main canal side would cost about $3.60 per acre-foot delivered at the land, which would be generally less than cost of present supplies in the absorptive areas in which these supplies would be sold and utilized. Water delivered out of season to replenish the underground reservoirs and sold at main canal side for $1.00 per acre-foot would reduce pumping lifts and pumping costs, effecting a saving which if capitalized would more than justify the purchase of water at this price.

The comparison of the unit charges for water delivered by the project with present costs of water, demonstrates that these unit prices are reasonable and will be acceptable to the prospective purchasers of water in the

upper San Joaquin Valley. The only feasible opportunity for these areas in the upper San Joaquin Valley obtaining an additional water supply is through the construction and operation of this project. Any possible further development of local water supplies by agencies in the upper San Joaquin Valley would result not only in insufficient supplies, but also in costs in excess of the proposed unit price of water to be furnished by the project.

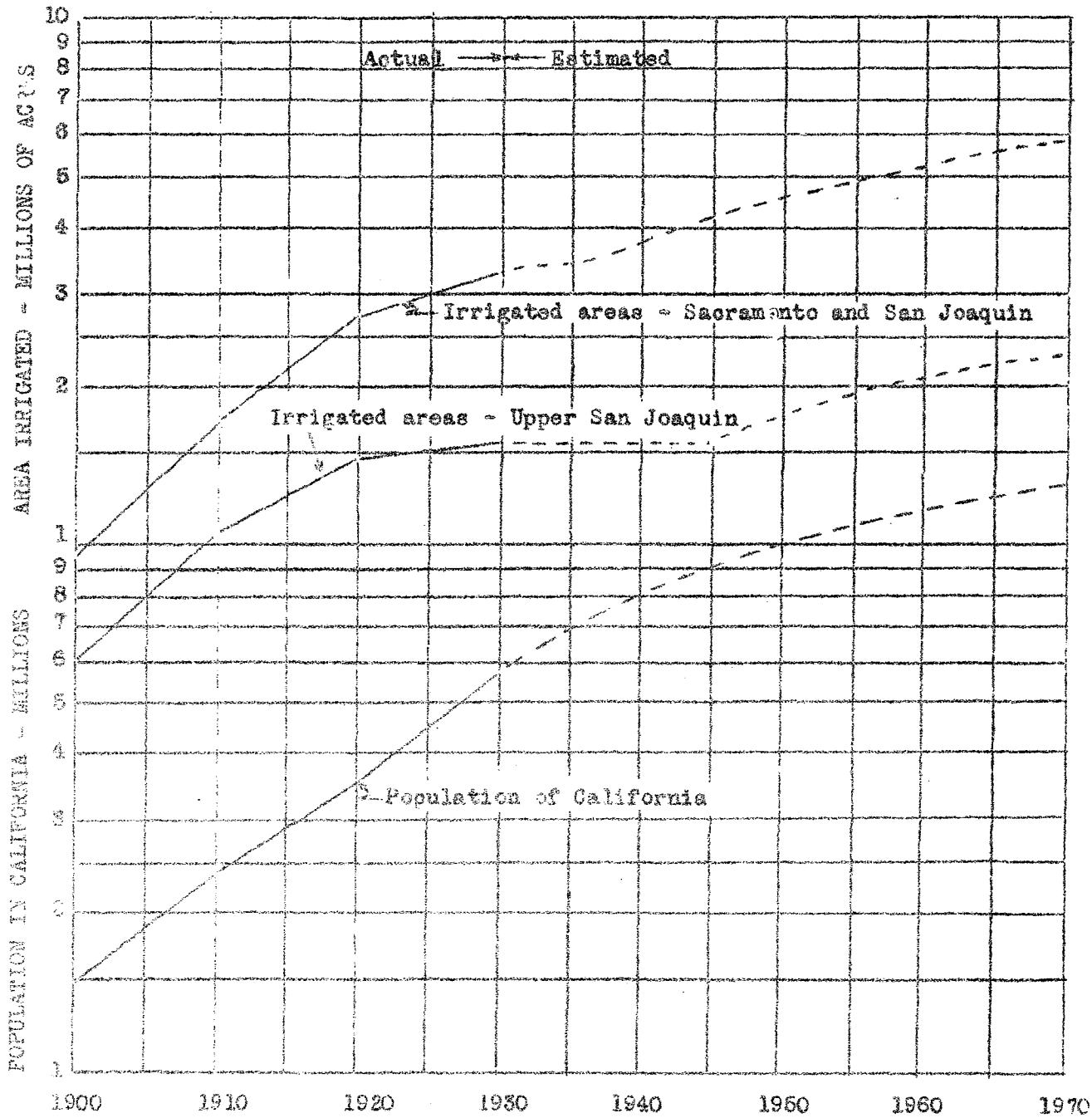
The present developed areas in the upper San Joaquin Valley will utilize the entire supply developed by the initial storage and conveyance units. Initial revenues from the sale of water in this area are based upon the delivery and sale of an average seasonal supply of 700,000 acre-feet. The San Joaquin pumping system will provide an additional supply for the upper San Joaquin Valley which will be absorbed at the rate of 112,000 acre-feet per year for the first four years and at the rate of 92,000 acre-feet per year during the succeeding six years, totalling 1,000,000 acre-feet.

Industries and Agricultural Lands in Contra Costa County. The water supply delivered through the Contra Costa Conduit will be used by industries and developed agricultural lands in Contra Costa County lying south of and adjacent to Suisun Bay. The industries in this area require large quantities of fresh water for boiler and processing purposes. It is anticipated that there will be a demand of approximately 34 second feet of fresh water as soon as the conduit is put into operation. This is considerably in excess of the 20 second feet consumed in 1929. The present cost of fresh water ranges from a minimum of 1.2 cents to a maximum of 93 cents, with an average of about 7 cents per 1,000 gallons. The present cheapest fresh water supply is that obtained from the lower river and upper bay channels when it is available, but this source of fresh water has been eliminated to a large extent for several years because of salt water invasion from the bay. Supplies purchased by the industries from established public water supply systems cost on an average about 35 cents per 1,000 gallons.

For the developed agricultural lands in this area, practically the only source of irrigation supply is obtained by pumping from wells. The underground supply available is very limited and entirely insufficient for meeting the requirements of the lands requiring irrigation. Ground-water levels have receded so that present costs for irrigation supplies from wells range from 10 to 20 dollars per acre-foot. The developed agricultural lands in this area aggregate 18,000 acres, of which only about 3,500 acres are now under irrigation from the limited ground water supplies available. It is anticipated that a gross area of about 13,000 acres of these developed producing lands will use an irrigation supply of two acre-feet per acre each season at a maximum rate of 86 second feet.

The total amount of water sold to the industries and agricultural lands combined will amount to 43,500 acre-feet annually. It is anticipated that all of this water will be used and sold at an average unit price of $6.90 per acre-foot immediately after the conduit is constructed and put

EXHIBIT 9



PAST AND ANTICIPATED GROWTH
IN IRRIGATED AREA
UPPER SAN JOAQUIN VALLEY
AND
COMBINED SACRAMENTO AND SAN JOAQUIN VALLEYS

into operation, and the annual revenues set forth for sale of water to this area are calculated on this basis. An association representing the various interests in Contra Costa County has stated in writing that the entire supply (43,500 acre-feet annually) would be contracted for at $6.90 per acre-foot canal side upon completion of the conduit.

Delta Lands and Lands Adjoining Sacramento River. The unit price for water used in calculating the revenues for sale of water to the lands in the Sacramento-San Joaquin delta and those adjoining the Sacramento River is based on the cost of stored water in Shasta reservoir minus the revenue from sale of hydroelectric energy. The net cost of $1.00 per acre-foot computed on this basis has, therefore, been adopted as the unit price for water to be sold to the lands in the delta and those adjoining the Sacramento River.

It is believed that an average annual supply of 230,000 acre-feet of stored water from Shasta reservoir will be used and sold in the delta at a unit price of $1.00 an acre-foot as soon as Shasta reservoir is constructed and put into operation. The estimate of revenues based upon the use and sale of 200,000 acre-feet absorbed during the period 1944 to 1954 is believed to be most conservative.

Navigation. Benefits to navigation on the Sacramento River can only be evaluated on the basis of potential river traffic above Sacramento, since navigation below the city of Sacramento is now well maintained. The Division Engineer, U. S. War Department, estimates that with a dependable six-foot channel from Sacramento to Chico Landing (52.4 miles downstream from Red Bluff, the proposed head of navigation) that commerce on the river would be as follows:

1930	-	280,000 tons
1940	-	420,000 tons
1950	-	630,000 tons
1960	-	945,000 tons
30-Yr.Avg.	-	570,000 tons

Based on present transportation costs and freight rates on those which should exist after improvement of the channel above Sacramento, the Army Engineers estimated that the average saving in transportation costs on river freight would be at least 50 cents per ton which applied to the 570,000 tons average estimated annual tonnage would show an average annual saving of $285,000. It was estimated by the Army Engineers that channel dredging and a series of movable dams with locks would cost $7,400,000 for the section of river between Sacramento and Chico Landing.

It is to be noted that the above value is based on potential traffic from Colusa, Sutter, Butte, and Glenn Counties and does not include Yolo County immediately above Sacramento nor Tehama County in which Red Bluff is located.

A maximum value of navigation (including potential traffic from Yolo and Tehama Counties) would be twice the amount set up by the Army Engineers or $570,000 annually, based on proportionate river miles, together with increased navigation below Sacramento.

Although there is some value to navigation on the San Joaquin River due to controlled flows from Friant reservoir, no value for this item is included in this report.

Flood Control. For the purpose of evaluating the flood control value of Shasta Dam and reservoir it was assumed by the U. S. Army Engineers that the flood flow at Red Bluff would be controlled to 125,000 second-feet and that this flow would be exceeded only once in 100 years on the average. It was also assumed that the Sacramento flood control project was 100 percent complete and that the Butte Basin immediately above Colusa remained unprotected. Estimates were made for the average annual damages with and without Shasta, the difference being the annual saving due to reduction in average annual flood damage. This amounts to $164,000 annually.

On the basis that there is 135,000 acres of land above Colusa which would be flooded without control from Shasta reservoir, and the fact that some 830,000 acres have been protected in the valley at a cost of $98,000,000, it seems justifiable that by direct proportion a value of $16,000,000 would be allowable as the maximum capital value of Shasta flood control. At 3 percent, this would give a maximum value of $480,000 annually.

On the basis of studies of the San Joaquin River, the estimated flood resulting from a runoff similar to that of 1911 (exceeded about once in 100 years), with releases controlled by Friant reservoir, would have been 16,000 second-feet in the San Joaquin River from Mendota Dam to the mouth of the Merced River. Without control, the flow which would have to be provided for would amount to 25,000 second-feet. Flood control works including channel construction, dikes, etc., to control this amount of flow would cost approximately $4,000,000, and this value is used as the capital value of Friant Dam and reservoir for flood control. At 3 percent, this would be a value of $120,000 annually.

Salinity Control. Salinity control in the Suisun Bay region is provided for by the release of approximately 384,000 acre-feet of water annually from Shasta reservoir. The value of this release at $1.00 per acre-foot amounts to $384,000 annually.

The maximum value of salinity control set by the U. S. Army Engineers for the construction of conduits extending from controlled fresh-water channels of the lower delta, together with additional works for the reclamation of marshlands of Suisun and San Pablo Bays and channel enlargements in the delta, amounts to a capital expenditure of $18,000,000. The value of a proposed salt water barrier located at Chippo Island, was estimated by the Army Engineers at $52,000,000 for an equally favorable service.

The value of the resultant controlled flow of the San Joaquin River for salinity control is an intangible item although there is no doubt but that there will be a considerable benefit to the lower reaches of the river in this respect.

Other Benefits. Present income of agricultural lands (in San Joaquin Valley) will be preserved by supplying the necessary water at a favorable cost. There are 2,000,000 acres under cultivation in San Joaquin Valley. In the upper portion of the valley 1,250,000 acres are irrigated, some 400,000 acres of which are now overdrawing on the water supplies naturally available to them. These lands are worth more than $250 per acre and yield annually $100 of agricultural products per acre and have only one-half enough water for their use. Therefore, at least 200,000 acres must revert of desert condition if a supplemental water supply is not obtained. The project will therefore continue in production 200,000 acres yielding annually a gross income of $20,000,000, or an estimated net income of $10,000,000 annually.

If the project were not consummated, and the abandonment of 200,000 acres of highly developed lands occurred, the resulting calamity would be reflected not only in local business but also in the business of the State and the Nation. In such event, it is estimated by Professor Geo. D. Dowrie, Graduate School of Business, Stanford University, that the loss of profits to the industrial areas of Los Angeles and San Francisco from wholesale and manufacturing trade with the valleys would amount to nearly $22,000,000 annually. However, this does not represent the entire money value of the valleys to the centers. In addition, persons and firms in these metropolitan areas performing a variety of personal and professional services for the valley population, and transportation companies, financial institutions, both State and Federal, insurance companies, and public utilities doing business directly or indirectly with the affected areas would suffer substandial losses.

In addition to all of the above, there are a number of uncomputable or intangible benefits which are nevertheless very real, including:

(1) Rebuilding depleted underground water storage
(2) Rebuilding water traffic
(3) Saving life (floods)
(4) Providing employment
(5) Expanding industry
(6) Expanding agricultural lands (ultimately)
(7) Increased revenue to State through taxes
(8) General development of wealth: Transportation systems, business and banking institutions, new communities, private and professional services, etc.

Summary of Analysis. Using the figures heretofore developed for annual costs and annual benefits, the following Tables 14, 15, and 16 summarize and compare these costs and benefits to measure the economic feasibility of the project.

TABLE 14

SUMMARY OF ANNUAL EXPENSES AND CASH REVENUES

	Total for 53-Year Amortization Period	Average Annual for Amortization Period	Annual after Amortization Period
Expenses			
Interest	$147,173,000	$2,777,000	None
Amortization	168,362,000	3,176,000	None
Depreciation	39,471,000	746,000	$ 883,000
Operation and Maintenance	109,056,000	2,057,000	2,358,000
Total	$464,062,000	$8,756,000	$ 3,241,000
Revenues			
Water Revenues (2,073,500 ac.-ft.)	$251,680,000	$4,749,000	$ 5,530,000
Power Revenues (1,373,100,000 kwh)	265,192,000	5,004,000	5,355,000
Total	$516,872,000	$9,753,000	$10,885,000
Ratio of Revenues to Expenses	--	1.1	3.4

TABLE 15

SUMMARY OF OTHER ANNUAL TANGIBLE BENEFITS (IN ADDITION TO REVENUES)

	Normal	Maximum
Navigation	$285,000	$ 570,000
Flood Control	284,000	600,000
Salinity Control	384,000	720,000
Preserving present income value of lands and industries	Not included	10,000,000
Total	$953,000	$11,890,000

TABLE 16

COMPARISON OF ANNUAL EXPENSES, REVENUES, AND BENEFITS

	Minimum	Normal	Maximum
Total Revenues	$9,753,000	$10,885,000	$10,885,000
Total Other Benefits	Not included	953,000	11,890,000
Total Benefits	$9,753,000	$11,838,000	$22,775,000
Total Expenses	8,756,000	8,756,000	8,756,000
Annual Net Benefit	$ 997,000	$ 3,082,000	$14,019,000
Ratio of Benefits to Revenue	1.1	1.4	2.6

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