Supplemental memorandum re Grande Ronde-Walla Walla diversion project.

Conflict with other projects. The Grande Ronde-Walla Walla diversion project is competitive with proposed power and irrigation development on the Snake-Columbia Rivers between the mouths of the Grande Ronde and Walla Walla Rivers, more specifically between backwater from the proposed Umatilla dam and backwater from the proposed Dry Gulch Rapids site on the Snake River (See W.S.P. 657, p. 256). Assuming that the Umatilla dam is constructed to an altitude of 350 feet, and the Dry Gulch Rapids dam to an altitude of 730 feet, the loss afxhand to the Snake-Columbia system mmxkdxbax380xfeet from the Grande Ronde diversion would be measured by the minimum flow of the Grande Ronde developed through 380 feet of head. If other sites on the Snake River should be proposed to utilize the full available head below the mouth of the Grande Ronde (Altitude approx. 810 feet), the loss to the Snake-Columbia system would be measured by the minimum flow of the Grande Ronde developed through 460 feet of head.

However, the loss to the Snake-Columbia system would probably involve power only, and since thexexxis only a limited storage capacity id available in the Snake River below the mouth of the Grande Ronde, the loss would be no greater than the power available from natural flow, which is around a minimum of 300 second feet. If 300 second-feet were utilized through the full available head of 460 feet it would develop 11,000 H.P., or 8,300 K.W. of prime power. That amount of power must therefor be subtracted from the 29,000 K.W. credited to the Grande Ronde-Walla Walla diversion project, inasmuch as its development in proposed Snake-Columbia projects would entail no additional cost. Installations at the proposed Snake-Columbia projects will doubtless accomodate more than the extreme low flow.

If 8,300 K.W. are deducted from the total of 29,000 K.W. estimated as the Q100 capacity of the Grande Ronde-Walla Walla project under Plan II, the remaining power, properly credited to the project, is 20,700 K.W.

The Grande Ronde-Walla Walla diversion project should not be considered as

competitive with the Snake-Columbia system for Q50 flow, inasmuch as the development of Q50 flow would entail additional installations of comparable cost whether utilized in the Snake-Columbia system or in the Walla Walla River plants.

The loss to navigation on the Snake-Columbia River from the proposed diversion would be negligible, since the entire stream when fully developed would probably be slackwater.

It follows from the foregoing that 8,300 x $15, or $124,500, must be lopped from the estimated annual revenue of $597,000 from power, leaving an annual return of $472,500, with proportionate increase in cost to irrigation.

Conflict with irrigation projects on the Grande Ronde.

The Grande Ronde diversion project is to a certain degree competitive with proposed irrigation projects in the upper Grande Ronde valley. According to the best of my information, however, these projects are all located upstream from two gaging stations in the basin, one on the Grande Ronde near La Grande, the other on Catherine Creek near Union. The total run-off recorded at these two stations is only about 1/4th of the run-off at Rondowa, as will be noted in the following table.

Comparative run-off in acre feet at stations in the Grande Ronde basin.

Year	R.Grande Ronde at La Grande	Catherine Cr. near Union	Total at upstream stations	Grande Ronde at Rondowa	Balance
1926-27	287,000	102,000	389,000	1,650,000	1,261,000
1927-28	405,000	130,000	535,000	2,050,000	1,515,000
1928-29	223,000	92,000	315,000	1,130,000	815,000
1929-30	157,000	48,700	205,700	977,000	771,000
1930-31	171,000	57,400	228,400	876,000	648,000
1931-32	360,000	101,000	461,000	1,850,000	1,389,000
1932-33	266,900	104,000	370,900	1,640,000	1,469,000
1933-34	138,300	54,400	192,700	1,069,000	876,000
1934-35	165,200	75,700	240,900	1,092,000	851,000
1935-36	236,000	70,770	306,770	1,356,000	1,049,000
1936-37	205,100	59,640	264,740	999,200	734,000
1937-38	210,400	107,100	317,500	1,418,000	1,100,000
1938-39	222,000	80,070	302,070	1,186,000	884,000
1939-40	148,000	69,700	217,700	1,121,000	903,000
1940-41	222,000	84,480	306,480	1,214,000	908,000

Assuming that all run-off at the two upstream stations were stored, which is in itself highly improbable, this would not mean a corresponding depletion at the Rondowa reservoir site. Return seepage would doubtless restore a part of the flow at Rondowa. How much water would find its way back to the river is a major ground water problem, but it can probably be estimated at a considerable percentage.

It is further apparent that even at the present time there is very little discharge in the Grande Ronde at the station near La Grande during the critical months of August and September. The gaging station record shows that the mean run-off for August during the 16-year period from 1925 to 1941 was 1,174 acre feet, and for September, 1453 acre feet. Corresponding values for discharge are a mean of 19 second-feet for August, and a mean of 24 second-feet for September. It seems very doubtful, therefor, that the maximum possible storage of water in the upper Grande Ronde valley in future, will materially reduce the low flow now available at Rondowa. On the other hand, return seepage from additional areas brought under irrigation in the future, may quite possibly increase the low flow now available at Rondowa.

If proposed reservoirs in the upper Grande Ronde basin are to be operated also for flood control, which, I understand to be the plan, storage would probably not begin until late winter or early spring, when the heavy run-off begins. If such is the plan, future storage in the upper basin should not affect adversely the value of the proposed diversion project for prime power.

The extent to which future upstream storage will be in conflict with the Grande Ronde-Walla Walla diversion project is a problem that will require considerable study, but a brief review of available discharge records indicates that the fullest development of upstream storage sites would not seriously conflict with the proposed diversion project if the two plans are properly coordinated.

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Future diversions for irrigation in the Grande Ronde basin above Rondowa may materially reduce the present spring run-off at Rondowa, but will probably not reduce further the late summer run-off. There is a possibility that this low summer run-off may be increased by return seepage if additional future irrigation in the upper valley is supplied from winter and spring storage. Under any conditions of water use in the upper basin it is probable that return seepage will provide a substantial flow in the Grande Ronde at Rondowa, but the amount of such return seepage constitutes a major ground water problem.

Required Storage.

In the following table (Table 2) is shown the mean flow for the period of the record at Rondowa together with the minimum flow that might have been obtained each year with storage of 100,000 and 200,000 acre feet.

Table 2

Natural discharge of the Grande Ronde River at Rondowa, Oregon, and regulated flow obtainable by storage of 100,000 acre feet and 200,000 acre feet

Year	Natural flow in Second Feet		Regulated flow in Second Feet	
	Mean	Minimum	100,000 acre feet of storage	200,000 acre feet of storage
1926-27	2,280	466		
1927-28	2,830	470	800	1,020
1928-29	1,560	353	715	980
1929-30	1,360	310	715	940
1930-31	1,210	254	660	860
1931-32	2,550	301	660	860
1932-33	2,260	424	870	1,100
1933-34	1,477	300	840	1,090
1934-35	1,508	304	670	900
1935-36	1,868	256	580	800
1936-37	1,380	230	580	800
1937-38	1,958	308	810	1,070
1938-39	1,638	335	760	1,030
1939-40	1,544	260	760	1,030
1940-41	1,677	458	950	1,170
1941-42	2,323	439		
1942-43	2,953	442		
Ave.	~~1,839~~			

In Table 3 which follows below, the constant flow that could have been maintained throughout the irrigation season, April to September, inclusive, is shown together with the minimum natural flow that occurred in each year of the record. In all years a minimum flow of 300 second feet could have been maintained for power purposes by regulation. It will be noted from this table that a constant flow of 1,000 second feet for irrigation might have been maintained in all years of the record but two (1931 and 1936), and that only a minor deficiency would have occurred in those years.

Table 3

Grande Ronde River at Rondowa, Oregon

Regulated flow available during irrigation season and minimum flow available for power, assuming storage of 100,000 A.F.

Year	Regulated flow April to Sept.	Regulated flow Minimum during non-irrigation season	Natural flow Minimum	Date of Min. Nat'l flow
	Sec-Ft	Sec-Ft	Sec-Ft	
1927	1,650		1,120	
1928	1,320		381	
1929	1,260		310	
1930	1,080		301	
1931	910		301	
1932	1,030		424	
1933	1,380		462	
1934	1,000		385	
1935	1,160	300	260	Dec. 19
1936	960	300	280	Nov. 28
1937	1,030	300	230	Jan. 8
1938	1,320		397	
1939	1,100		350	
1940	1,030	300	260	Aug. 23
1941	1,600		500	Aug. 18

Although the above tabulation shows that 1,000 second feet would have been available for irrigation in all but two years of the record, delivery would have been limited by the size of the tunnel and could not have been made on an irrigation demand schedule. However some degree of regulation to adapt the rate of delivery to irrigation demand would be possible through reservoir head. In general the period of greatest irrigation demand corresponds to the period of high reservoir stage.

Available Storage

A rough estimate of available storage on the Grande Ronde River can be made from a reconnaissance survey of the Wallowa River which shows a part of the area within the proposed Rondowa reservoir site. It is roughly estimated that a storage capacity of 150,000 acre feet could be developed on the Grande Ronde and Wallowa Rivers by the construction of a dam 250 feet high at the

Sheep Creek dam site two miles below Rondowa, near the section line between sections 11 and 14, T. 3 N., R. 40 E. Of this total capacity, about 100,000 A.F. would be in the reservoir above the 2,400-foot contour. Drilling was at or near this site ' connection with F.P. Project 751 shows "broken lava rock" to a depth of 42 feet. From 42 to 62 feet the drill log shows a "close, hard grained andesite and from 62 to 92 feet "broken lava rock". Drilling stopped at 92 feet, and it was concluded that the site was not suitable to a concrete dam. No geologic examination has been made at the site, but it is the opinion of geologists who have noted the drill log that it may be suited to an earthen or rock-fill dam of broad base, with a cut-off wall.

Backwater from a 250-foot dam at the Sheep Creek site would flood an estimated 2,000 acres of timber and woodland and about 14 miles of the La Grande-Joseph branch line of the Union Pacific Ry. Relocation of this railroad would be the principle item in the acquisition of right-of-way for the reservoir. The relocation of the railroad would be to its own advantage, however, so far as regards grade. The 14-mile stretch is now located on an average grade of about 25 feet per mile. Relocation could eliminate all grade in this reach if suitable road bed is found near the 2,500-foot contour.

General Plan of Development.

A rough, preliminary study of the proposed Grande Ronde-Walla Walla diversion project suggests the following general plan of development: an earthen or rock-fill dam at the Sheep Creek dam site on the Grande Ronde River in sections 11 and 14, T. 3 N., R. 40 E., 250 feet in height above the water surface, an 11-foot, concrete lined tunnel 17 miles long taking out from the reservoir thus created at an elevation of 2,400 feet near the mouth of Lookingglass Creek, in Sec. 29, T. 3 N., R. 40 E., and discharging into the South Fork Walla Walla River

at an elevation of 2,220 feet in Sec. 14, T. 4 N., R. 37 E. Possibly a smaller bore tunnel 6.5 miles in length connecting with the main tunnel near its discharge end to convey water for irrigation to the Umatilla River into which it would empty in Sec. 17, T. 3 N., R. 37 E. This tunnel could be constructed on a light grade and some pondage created by a low dam at the Umatilla end permitting flow to be reversed by hydrostatic pressure so as to carry Umatilla River discharge to the South Fork Walla Walla River in winter for power. About 16 miles of canal or conduit to develop 1,220 feet of head above Freewater, Oregon. Two ~~or three~~ power houses on the South Fork Walla Walla River with a total installation of 50,000 K W., possibly utilizing existing plants. A power house, 3,000 K.W., at tunnel end.

This rough preliminary plan would be subject to possible wide adjustment after further study of the irrigable area below Milton-Freewater which may require the reservation of more head for irrigation canals with a consequent loss of head to power.

On the basis of a 16-year record of discharge for the Grande Ronde River at Rondowa (1926-42) it is estimated that storage of 100,000 acre feet above the 2,400-foot contour in the proposed Rondowa reservoir would provide a minimum annual flow of 580 second feet if used primarily for power. A minimum flow of 910 second feet could have been maintained for irrigation from April to September, inclusive, but this would have resulted in a minimum winter flow from the Grande Ronde of 300 second feet for power. In 14 of the 16 years of the record 1,000 Sec F would have been available for irrigation if the Rondowa reservoir had been operated for irrigation purposes primarily.

On the basis of the foregoing, the general potentialities of the project as here outlined are summarized below under two distinct assumptions: (1) use to be primarily in the interests of power production, and (2) use to be primarily in the interests of irrigation.

Plan I. Operation for power primarily.

If the project were operated primarily in the interests of power production, the 16-year record of discharge for the Grande Ronde at Rondowa indicates that a minimum regulated flow of 580 Sec-Ft could be maintained in the Grande Ronde-Walla Walla tunnel. During the year of lowest flow of the record (1936-37) at Rondowa, a record on the South Fork Walla Walla River near its mouth shows a minimum natural flow of 87 Sec-Ft (Jan. 9, 1937). It is estimated that 80 Sec-Ft came from above the proposed tunnel discharge end. This would make a total minimum flow of 660 Sec-Ft available for power development through 1,220 feet of head above Freewater. With a flow of only 580 Sec-Ft in the tunnel (diameter, 11 ft., slope, .002) it would permit use of 90 feet for power head. The total potential power of the project under conditions of flow as above outlined is summarized as follows:

Potential power from Rondowa Diversion Project

Site	Head (ft)	Min. flow Sec-Ft	H.P.	K.W.
Tunnel	90	580	4,170	3,100
So. Fk., Walla Walla	1,220	660	64,400	48,000
		Total power	68,500	51,000

Under this plan a minimum flow of 660 Sec-Ft would have been available for irrigation below Milton-Freewater at altitudes under 1,000 feet. Assuming that 6 acre feet of water per acre delivered at a uniform rate of flow would meet irrigation demands, the flow below Milton-Freewater would have supplied 40,000 acres.

That part of the flow coming from the Grande Ronde (580 Sec-Ft) would have provided a minimum annual supply of 209,000 A.F., or sufficient to provide 6 A.F. per acre to 34,800 acres during the irrigation season, April to September, inclusive.

Plan II. Operation for Irrigation primarily.

If the project were operated primarily for irrigation the proposed Rondowa reservoir would then be used to deliver water on an irrigation demand schedule, in so far as the capacity of the tunnel would permit. A study of the record at Rondowa shows that a storage capacity of 100,000 A.F. would have made available a minimum flow of 1,000 Sec-Ft for irrigation in all but two years of the 16 years of the record. The exceptions are 1931, when only 910 Sec-Ft would have been available, and 1936, when 960 Sec-Ft would have been available. If efficient use of all available flow could not be made in the Walla Walla valley, a tunnel of smaller bore and 6.5 miles in length leading from the Walla Walla end of the main tunnel to the Umatilla River could be constructed to deliver water to the Umatilla valley for irrigation. It is roughly estimated that a total area of 60,000 acres in the Walla Walla and Umatilla valleys could be irrigated from the Grande Ronde diversion.

Under this plan (and disregarding any possible contribution from the Umatilla River) an estimated minimum flow of 400 Sec-Ft would be available for power development, of which about 100 Sec-Ft would be contributed by the South Fork Walla Walla River. This total flow could be developed through 1,220 feet of head above Freewater, and would generate 29,000 K.W. in this reach.

If all water were diverted to the Walla Walla basin a Q50 flow of 910 Sec-Ft would be available for power. This would represent 66,000 K.W. for 50 percent of the time.

Summary and Conclusions.

The Grande Ronde-Walla Walla diversion project, if designed primarily for power, would require the following structures:

1. An earthen or rockfill dam, 250 feet high, Vol., 6,000,000 Cu. Yds. (earth)
2. A tunnel 17 miles long, 11 ft. diameter, slope, .002.
3. About 16 miles of power canal or conduit.
4. A total installation of 51,000 K.W. on South Fork Walla Walla River.

Based on a 16-year record of discharge for the Grande Ronde River at Rondowa, the project would develop 51,000 K.W., and would supply an annual minimum of 209,000 A. F. for irrigation, or in 14 of 16 years would supply 240,000 A.F.

If developed primarily for irrigation the project would require a total installation of 66,000 K.W. if Q50 power should be developed in full. It would then develop only 29,000 K.W. of prime power, but would provide an annual minimum of 330,000 A.F. for irrigation, and in 14 of 16 years would provide 360,000 A.F.

If there should be a surplus of water for use in the Walla Walla valley for irrigation, a part could be diverted to the Umatilla valley, but this would add the cost of 6.5 miles of tunnel and would lower the yield of Q50 power.

Following is an estimate of the value for power and for irrigation of the project under the alternative plans of operation:

Potential Power and Irrigation from Grande Ronde-Walla Walla Diversion Project

	Kilowatts		Acre-Feet available for irrigation April to September, inclusive	
	Q100	Q50	Minimum	In 14 of 16 Yrs
Plan I	51,000	51,000	209,000	240,000
Plan II	29,000	66,000*	333,000	360,000

*Assumes all flow diverted to Walla Walla basin.

At $15.00 per K.W.Yr. for prime power, and 1 mill per K.W.H. for dump power, the potential returns from power are estimated as follows for the project:

Estimated Returns from Power under Alternative Plans

Plan I		Plan II	
51,000 K.W.Yrs @ $15.00 ---	$765,000.	29,000 K.W.Yrs. @ $15.00 --	$435,000.
~~00,000~~ K.W.Yrs. @ $8.76 --	~~000,000.~~		
18,500	$2.19	~~162,000~~	
		~~570,000~~	
Total yield	$765,000.		~~$750,000.~~
		40,500	$475,500

The estimated value of dump (Q50) power at 1 mill* per K.W.H. is based on its availability during the irrigation season when it could be used for pumping. The estimated yield of Q50 power assumes all flow utilized in the Walla Walla basin and consequently none diverted to the Umatilla basin.

Under Plan II a total installation of 66,000 K.W. would be necessary, but no power house would be constructed at the tunnel end, since the tunnel would be discharging to capacity for about six months of each year, leaving no head in the tunnel available for power.

The larger conduit necessary under Plan II to carry Q50 flow would entail some additional cost.

Construction of a 6½-mile tunnel to carry water to the Umatilla valley would entail a material additional cost, but, if all flow were utilized in the Walla Walla basin, this cost item could be eliminated.

If all flow could be utilized in the Walla Walla basin it is apparent that the more economical development and operation of the project would be for irrigation primarily. Under Plan II the total estimated revenue from power would approximately equal 62 % of the revenue from Plan I, and an estimated 20,000 additional acres could be irrigated.

[redacted] *Estimated value, 1/4 mill only

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Following is an estimate of costs of the project; assuming that it is designed for operation under Plan II, and that all flow is used in the Walla Walla basin:

1. Sheep Creek dam, earthen, 6,000,000 cu yds	$10,000,000.
2. Land acquisition, 2,000 acres @ $50	100,000.
3. Relocation of 15 miles of railroad @ $100,000 per mile	1,500,000.
4. Tunnel excavation 435,000 cu yds @ $8.50	3,697,500.
5. Tunnel lining, 125,000 cu yds @ $12.00	1,500,000.*
6. 16 miles of wood stave pipe (10-ft) @ $20 per lineal ft	1,700,000.
7. Installation of 66,000 K.W. (turbines and generators) @$20	1,320,000.
8. Acquisition of P.P.& L. rights and structures (rough)	500,000.
	$20,317,500.

Some salvage of P. P. & L. structures would be possible. Assuming a total cost of $20,000,000., an overall charge of 5 percent for interest, amortization over a 50-year period, operation, maintenance and replacements, and no taxes, the retirement of the total debt in 50 years would require annual payments of $1,000,000. Deducting from this total annual an estimated ~~$760,000~~ 577,000 received from sale of power, a balance of ~~$240,000~~ 423,000 would be charged to irrigation. If 60,000 acres could be irrigated from the Grande Ronde diversion, irrigation costs would average ~~$4.00~~ 6.72 per acre per year over the 50-year period. This estimate does not include the cost of irrigation ditches.

R. O. Holland

Portland, Ore.
Jan. 6, 1944.

* This rate taken from Boulder Dam diversion tunnel excavation costs, may be low. Boulder Dam rock is of vulcanic origin, hard and strong, and probably offered as much resistance to the drills as would be encountered in the basalt flows of the Grande Ronde region, but no supports were required for Boulder Dam excavation, whereas excavation in basalt flows may run into unconsolidated interflow material requiring supports. Rough, broken bore would also add to lining costs, and the

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long haul increase mucking costs. The rate is used on the assumption that tunneling methods are gaining from experience.

Memorandum for Mr. [redacted]

Herewith is a brief report on the possibility of diverting the Grande Ronde River into Walla Walla and Umatilla River drainage for power and irrigation, submitted in accordance with your memorandum of December 1, 1943.

In the absence of adequate field information it has been necessary to make a large number of assumptions. The estimated capacity of the Sheep Creek (Rondowa) reservoir site is based on the Wallowa River survey and a railroad profile showing the Union Pacific branch line running along the Grande Ronde above Rondowa. I think the estimated capacity is conservative.

The maximum delivery of water by tunnel would permit of very little variation in flow to meet an irrigation demand schedule, but some elasticity would be possible through use of reservoir head. Because of the limitations imposed by tunnel capacity I have dealt in second feet rather than in acre feet in discussing irrigation.

In estimating costs I have borrowed from "Dams and Control Works" by the Bureau of Reclamation, from U.S.E.D engineers, and from various scattered sources. Financing is based roughly on present U.S.E.D. methods, assuming an interest charge of 3 percent, a rough total of 2 percent for operation, maintenance and replacements, and amortization over a 50-year period. I understand that the F.P.C. uses a somewhat higher figure, an overall charge of about 5.5 percent, plus operation costs.

Although costs have in general been estimated on the basis of pre-war prices and wages, and would be much greater on the basis of current values, it seems to me a reasonable assumption that prices after the war will either settle back to former levels, or that power and irrigation values will eventually rise to balance the rise in other commodities and in labor costs.

The principle item of cost, $10,000,000 for the earthen dam, is subject to wide adjustment after complete information is available. The volume is based on a 1:4 upstream and a 1:3 downstream slope, and assumes that suitable earth can be found nearby. Suitable borrow pits could possibly be located on top of the plateau. Spillway cost is lumped in the total. The cost as I have estimated it, is a rough average taken from several of the large earthen dams built by the Bureau of Reclamation. It is apparent that a great deal depends on the haul in computing cost of earth fill. Field examination might reveal something in this regard, but should probably be made by an engineer with experience in this line.

It is apparent that the proposed diversion project could follow one of several plans. I do not consider that this report deals with more than one of these alternatives. It would be of interest to see whether costs could not be materially reduced by some other plan.

I believe that the potentialities of the project justify further study and that all public lands along the line of alternative tunnel locations should be classified as power sites.

R. O. Holland
Jan. 6, 1944.

212 Old Court House (U.S.)
Portland, Ore. Jan. 10, 1944

XXXXXXXXXXXX

MEMORANDUM for Mr. [redacted]

A chart showing tunnel costs on 56 different jobs, which I have just received from Mr. Debler's office, arrived too late to be available for my estimates on the Grande Ronde diversion tunnel, my report having been mailed to you on January 7. This chart contains a wealth of information on tunneling costs, and if you do not already have a copy, you may desire to request one from the Bureau. It is entitled "Drawing X-D-366" and is dated Feb. 2, 1938. According to cost figures shown on this chart some upward revision will be necessary in my estimates for the Grande Ronde-Walla Walla tunnel project. My estimates sum up to about $58.00 per lineal foot of tunnel, 11 feet inside finished diameter. The chart shows 3 short tunnels through basaltic rock, and other material, the cost of which may be compared with the cost of a tunnel in the basaltic areas around Rondowa. Following is taken from the chart:

Project	Tunnel diameter	U.S. cost per lineal foot	Year completed	Remarks
1. Rosa	17.0	$94.81	1938	
2. do	13.75	99.23	1939	
3. Klamath	5.75	35.95	1941	G.P.
4. Kittitas	9.25	147.60	1931	Water up to 2,500/

Nos. 1, and 2, making when compared in cross-section with the proposed 11-foot Grande Ronde tunnel, ($58.00 per lineal foot) make the estimate for the latter look reasonable. No. 3 is a small bore, with consequent high rate of cost. No.4 shows what might result if the proposed Grande Ronde tunnel ran into water. As ground water experts have pointed out to me, much will depend on the position of the ground water table. Tunneling from the discharge end would permit easy drainage of any water that might be encountered, but tunneling from the upper or intake end would involve a serious drainage problem that might make the whole project impracticable. This would result from the great length, 17 miles.

The chart does not describe any tunnel of more than 4 and a fraction miles in length. No topography is available from which to determine the possibility of sinking shafts at intervals for the Grande Ronde tunnel project, and its great length would probably make such shafts necessary. The first need for a thorough study of feasibility would be a topographic map of the entire tunnel location.

If the salaries and other office expenses of government engineers should be included in estimates of cost, a percentage overhead charge must be added to my estimates. Apparently tunneling costs must carry also a charge of about 10 percent for engineering, supervision and general overhead.

Very truly yours,

R. O. Holland

212 Old Court House, (U.S.)
Portland, Ore. Feb. 1, 1944.

MEMORANDUM for Mr. [redacted]

With further reference to my brief report on the possible Grande Ronde-Walla Walla diversion:

Cost estimates submitted with my report are based on an interest charge of 3 percent amortized with principal payments over a 50-year period. It is interesting to note that the Bureau of Reclamation computes its costs on a basis of no interest charge to irrigation. If that part of the Grande Ronde project chargeable to irrigation, roughly 40 percent, were repaid without interest, the annual charge to irrigation (60,000 acres) would be 1/40th of $133, or $3.32 plus an operation and maintenance charge of $1.00, or a total charge of $4.32 per acre. If, as I have suggested, the total cost of the project were revised upward from $20,000,000 to $25,000,000, the entire increase would have to be charged to irrigation, unless higher returns than estimated could be had from power. If power, as estimated, could carry 60 percent of 20,000,000, or $12,000,000, irrigation would have to carry the balance, or $8,000,000, plus the added $5,000,000, or a total of $13,000,000. Using the B. of R. formula, per acre costs would then be $216.66, and annual charge would be 1/40th of $216.66, or $5.42 plus an operation and maintenance charge of $1.00, a total of $6.42 per acre.

As a basis for comparison it is interesting to note that the "North Unit" of the Deschutes Project involves a per acre charge of $5.25 per year as estimated in the 1937 report by Fisher. The Wickiup reservoir, a part of this project, has since been constructed. The lands to be irrigated are in general hay and grain lands. The Walla Walla lands are potentially valuable also for truck farming, a more intensive type of farming, and could therefor carry a somewhat higher cost.

Another factor that could affect the feasibility of the project is the value of power for pumping. Where a relatively low lift, only, is required, irrigation might afford to pay more than 1 mill. I understand from well informed sources that the ground water table in the lower Walla Walla basin is so shallow in certain areas that only a comparatively low lift is necessary so long as the ground water is regularly replaced and not depleted too rapidly by over-pumping. If the Q50 power available could yield more than 1 mill, a materially higher return might be had. It is also interesting to note that the Q50 period of power generation would come largely during the season when low flow is the rule in Pacific Coast streams (April to September). With some additional storage to carry on into October, the Q50 power could conceivably be converted to prime power. If this were practicable, the original estimate of return could be restored, partly or wholly. (Reference to my memorandum of Jan. 25, 1944, re error).

Very truly yours,

R. O. Holland

Grande Ronde

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

P. O. Box 499
Grants Pass, Oregon

March 3, 1945

Mr. Randolph O. Helland, Hydraulic Engineer
Geological Survey
212 Old Court House (U.S.)
Portland, Oregon

Dear Mr. Helland:

Your letter of December 26 to Mr. C. C. Fisher at Salem regarding the Grande Ronde Project was forwarded to this office for reply. In some manner the letter was misplaced before the requested data were worked up. I am very sorry that the reply was delayed for such a long time.

No information is available in this office on the Wallowa River above Wallowa. I am uncertain as to where these data could be secured. Possibly the Boise Office may have some information with regard to the Wallowa River.

With regard to the Grande Ronde River above Elgin, the following data are submitted in response to your request.

(a) The potential Grande Ronde Project development would consist of three units: LaGrande, Union and Cove, for which the principal source of supply would respectively be the Grande Ronde River, Catherine Creek, and Indian Creek. The following storage reservoirs would serve the units:

	Dead Storage	Irrig. Storage	Multiple Use	Flood Cont. Storage	Tot. Cap.
Grande Ronde	2,000	100,000	40,000	35,000	177,000
Catherine Creek	1,000	--	15,500	6,800	23,300
Little Indian Creek	500	11,000	--	--	11,500
Totals.....	3,500	111,000	55,500	41,800	211,800

(b) About 26,400 acres of land are now irrigated to some extent within the project area. The distribution of these lands and an estimate of the stream depletion by them is as follows:

Present Irrigation Development

	Arable Class Lands		Pasture Class Lands	
	Net Area Acres	Est. Stream Depletion ac.ft.	Net Area Acres	Est. Stream Depletion ac.ft.
LaGrande Unit	5,100	3,800	4,500	2,300
Union "	7,900	7,900	5,800	4,400
Cove "	3,100	2,200	--	--
Totals.....	16,100	13,900	10,300	6,700

(c) When fully developed, the project will furnish a full water supply to 63,500 acres of arable class land and surplus and return flow to 32,900 acres of pasture class land. The acreage distribution and estimated stream depletion under ultimate development are as follows:

Ultimate Irrigation Development - with storage

	Arable Class Lands		Pasture Class Lands	
	Net Area Acres	Est. Stream Depletion Ac.Ft.	Net Area Acres	Est. Stream Depletion Ac. Ft.
LaGrande Unit	45,600	55,500	24,900	24,900
Union "	10,300	12,900	8,000	11,500
Cove "	7,600	8,200	--	--
Totals....	63,500	76,600	32,900	36,400

(d) For the ultimate development the stream diversion requirements for the lands are estimated to be as follows:

	Arable Class Lands		Pasture Class Lands	
	Net Area Acres	Diversion Requirement Ac. Ft.	Net Area Acres	Diversion Requirement Ac. Ft.
LaGrande Unit	45,600	136,300	24,900	6,800 ♀
Union "	10,300	36,100	8,000	12,000 ♀
Cove "	7,600	18,200	--	--
Totals.....	63,500	190,600	32,900	18,800

♀ Requirement for pasture class lands with prior rights which must be supplied. Diversion for additional pasture class lands will be dependent upon amount of surplus run-off and return flow available.

Yours very truly,

F. C. Hart,
Engineer

C.C. - C. C. Fisher, Engineer
460 North High Street, Salem, Oregon

A Brief Summary of Facts Relating to the Possibility of Diverting the Grande Ronde River into the Walla Walla River for Power and Irrigation.

As an alternative plan for the development of power in the Grande Ronde River below Rondowa, and as a source of supplementary water for irrigation in the Walla Walla valley, and possibly also in the Umatilla River valley, the possibility of diverting the Grande Ronde near Rondowa appears to have sufficient merit to justify further investigation. By constructing a dam 250 feet high at the Sheep Creek dam site two miles below Rondowa, an estimated storage capacity of about 150,000 acre feet would be created. A concrete lined tunnel, 11 feet in diameter and 17 miles in length, having its intake in the reservoir thus created, would carry the flow of the Grande Ronde to a point on the South Fork of the Walla Walla River in Sec 14, T. 4. N., R. 37 E., below which it could be utilized through about 1,220 feet of head before its diversion to irrigation canals. In the following pages the project is discussed briefly as to available water supply, possibilities for storage, general plan, and value for power and for irrigation.

Water Supply.

A gaging station has been maintained on the Grande Ronde River at Rondowa since 1926 about 300 feet below the mouth of the Wallowa River, and about two miles upstream from the Sheep Creek dam site. Much water is diverted from the Grande Ronde at points upstream from the gaging station. The record indicates in general a heavy run-off from February to June, with a rapid decline during summer after which the river remains low throughout the fall and winter. A summary of this discharge record follows.

9-211 c UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH File No. 1822

UNPUBLISHED DATA

Drainage Area 2,555 Square Miles.

Daily discharge, in second-feet, of **Grande Ronde River at Rondowa, Oreg.** SUBJECT TO REVISION *, for the year ending September 30, 19* **46**

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	460	550	539	460	670	898	2420	5020	6,960	2600	662	443
2	454	546	546	460	694	889	2370	5380	6390	2700	648	442
3	454	553	539	466	835	880	2260	6040	6460	2890	625	436
4	448	655	539	454	871	871	2140	7,110	5880	2730	618	430
5	460	686	539	460	871	767	2020	7,860	6340	2520	586	448
6	460	602	553	480	871	758	2050	7,720	7,170	2380	567	490
7	460	588	546	1,110	1,300	758	2190	7,360	6780	2310	567	473
8	454	581	532	1,200	2,800	792	2860	7,060	6460	2260	581	454
9	448	553	480	972	2650	784	2810	6830	6250	2180	560	442
10	442	574	418	810	2260	853	2650	6830	5720	2110	533	448
11	442	686	389	818	2150	907	2600	6780	5420	2070	595	442
12	454	632	362	1,050	1,980	1,050	2490	060	5270	1,980	588	442
13	460	581	367	1,710	2730	1,340	2340	5530	4780	1,800	610	436
14	518	574	389	1,770	2600	1,540	2220	6040	4290	1,730	595	418
15	499	512	400	1,500	2320	1,560	2180	5680	3850	1,610	588	424
16	486	480	372	1,350	1,930	1,540	2240	5570	3640	1,450	574	499
17	480	473	442	1,190	1,690	1,520	2370	5550	3620	1,360	546	492
18	473	486	442	1,090	1,540	1,460	2550	5210	3870	1,250	518	492
19	466	499	473	1,000	1,360	1,400	2910	4940	4250	1,170	499	473
20	466	480	546	934	1,240	2040	3570	4700	4720	1,120	484	506
21	460	48	553	862	1,150	2680	4230	4480	5350	1,090	492	574
22	460	512	512	702	1,130	2940	4270	4310	5920	1,040	499	602
23	460	532	454	670	1,090	3550	4230	4210	5270	992	480	588
24	448	546	418	678	1,040	3210	4360	4230	4980	925	460	588
25	448	518	412	686	963	2810	4140	4840	4840	898	448	581
26	454	532	372	640	907	2490	3890	5100	4210	844	499	574
27	448	546	400	610	934	2240	3690	5500	3670	801	525	560
28	450	512	448	595	898	2090	3480	5440	3180	767	492	546
29	450	486	454	553		1,980	3570	5740	2910	742	473	539
30	470	532	460	648		1,930	4230	6100	2660	694	456	533
31	500		460	655		2180		6800		670	460	
	14,352*		14,356*		41,474*		89,330*		151,110*		16,842*	
	10,455*		26,583*		50,707*		181,120*		49,083*		14,810*	

MEAN	462	548	463	858	1,481	1,626	2,978	5,843	5,037	1,603	543	494
ACRE-FEET	28,450	32,640	28,470	52,730	88,260	100,000	177,200	359,200	299,700	98,540	33,410	29,380

U. S. GOVERNMENT PRINTING OFFICE 6-7149

YEAR 19~~43~~44 MEAN 1,826

ACRE-FEET 1,322,860

Year 1945

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT

File Number 135

UNPUBLISHED RECORDS
SUBJECT TO REVISION

Daily discharge, in second-feet, of Catherine Creek near Union, Oreg. for the year ending September 30, 19 45

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	23	33				55	108	410	489	200	47	29
2	22	26				55	102	520	460	180	45	28
3	21	31				50	95	661	481	170	43	28
4	21	65				45	87	744	424	160	42	28
5	21	38				39	84	772	440	143	41	30
6	20	30				49	84	727	440	133	42	31
7	21	30				39	87	688	420	128	42	30
8	20	28				34	92	545	409	121	43	29
9	20	26				32	90	610	409	115	41	28
10	20	29				33	87	610	375	112	40	27
11	20	31				35	87	570	357	115	47	26
12	20	26				45	81	506	343	102	43	25
13	22	29				58	80	510	310	95	45	25
14	27	20				61	80	450	275	100	40	25
15	23	14				61	92	400	254	94	38	27
16	22	12				58	105	410	243	89	37	37
17	22	13				56	124	430	251	84	35	30
18	22	13				53	149	400	275	81	34	30
19	21	15				49	200	370	303	77	32	29
20	21	12				57	297	340	326	73	31	34
21	21	17				70	372	316	357	69	31	39
22	21	19				92	357	290	382	67	30	37
23	21	19				117	347	287	343	66	30	37
24	21	22				110	297	300	303	64	32	36
25	20	22				103	257	320	303	60	32	35
26	20	25				97	230	320	280	57	33	33
27	20	24				89	210	360	250	55	35	31
28	20	18				84	210	340	230	53	34	30
29	20	32				78	220	350	220	52	31	30
30	20	25				80	280	400	210	51	30	29
31	30					107		489		49	30	
	663*	750*				1,991*	4,991*	14,545*	10,162*	3,015*	1,156*	910*
Mean	21.4	25.0				64.2	166	469	339	97.3	37.3	30.3
Acre Feet	1,320	1,490				3,950	9,900	28,850	20,160	5,980	2,290	1,800

Max. MEAN —

PERIOD ACRE FEET —

9-211c UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH File No. 1948

Daily discharge, in second-feet, of Grande Ronde River below Wenaha River, at Troy, Oreg. (SUBJECT TO REVISION), for the year ending September 30, 1946

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	633	715	731	633	900	1,160	3660	7,130	8,670	3380	796	622
2	605	771	731	633	940	1,180	3520	7,680	7,860	3280	750	616
3	605	739	691	633	1,100	1,160	3160	8,510	7,680	3420	720	609
4	581	795	647	633	1,190	1,150	3090	9,360	7,300	3280	720	622
5	599	880	731	633	1,120	1,050	2960	10,100	7,480	2920	735	635
6	593	771	731	633	1,180	1,030	2980	9,530	8,350	2850	720	622
7	593	739	731	1,120	1,320	1,030	3220	9,190	8,610	2650	735	622
8	593	739	747	2,180	4,270	1,040	3000	9,000	8,140	2610	735	616
9	593	723	691	2,550	4,410	1,020	4590	8,610	7,480	2650	742	609
10	581	707	605	1,140	3,660	1,070	4160	8,740	6,680	2540	742	616
11	593	853	518	1,160	3,180	1,200	3850	8,800	6,380	2430	750	616
12	599	819	557	1,410	3,010	1,390	3720	7,860	6,190	2300	750	622
13	599	755	557	3,090	3,500	1,880	3640	8,800	5,840	2100	780	609
14	612	739	581	4,090	3,700	2,050	3540	8,140	5,230	1,970	780	616
15	633	661	533	3,090	3,360	2,140	3460	7,450	4,690	1,880	765	628
16	633	619	691	2,650	2,800	2,140	3460	7,360	4,570	1,720	750	653
17	626	619	787	2,280	2,350	2,140	3660	7,330	4,270	1,510	735	677
18	612	619	747	2,000	2,120	2,080	3870	6,140	4,500	1,490	705	684
19	605	691	747	1,740	1,940	2,200	4500	6,380	5,380	1,430	677	677
20	605	633	844	1,560	1,780	2,780	5330	6,300	5,430	1,340	649	735
21	605	626	827	1,420	1,640	4,570	6820	5,900	5,840	1,250	635	758
22	605	653	819	1,330	1,590	4,570	6570	5,870	6,880	1,140	635	780
23	593	723	747	1,000	1,540	5,030	6,270	5,950	6,320	1,130	649	772
24	593	723	661	970	1,410	4,810	6,490	5,560	6,030	1,120	649	780
25	593	675	647	950	1,270	4,360	5,840	6,550	5,640	1,030	635	765
26	593	723	619	836	1,270	3,700	5360	6820	5060	970	649	765
27	593	640	619	828	1,250	3380	5200	7,680	4270	938	635	750
28	593	715	626	878	1,170	3140	5030	6820	3820	890	642	735
29	593	675	668	804		2820	5200	7,510	3700	878	642	735
30	593	675	668	869		2760	6300	8,100	3320	828	642	728
31	661		626	869		2190		8580		795	635	
	18,708*	21,225*		58,970*		73,550*		181,020*		61,784*		
	21,395*	44,022*		73,210*		237,950*		58,750*		20,284*		

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	605	715	685	1,439	2,106	2,362	4,465	7,676	6,054	1,995	703	676
Acre-Feet	37,110	42,440	42,100	88,510	117,000	145,200	266,900	472,000	360,200	116,500	43,210	40,250

YEAR 1945 MEAN 2,447
ACRE-FEET 1,771,400

9-211a—2M—8-38.

Year 1945

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT

File Number 1816

UNPUBLISHED RECORD
SUBJECT TO REVISION

Daily discharge, in second-feet, of Grande Ronde River at La Grande, Oreg. *for the year ending September 30, 19*45

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	29	27	43	29		165	869	1,350	995	141	27	18
2	29	32	39	29		160	695	1,360	862	126	25	17
3	28	35	35	29		160	611	1,480	862	113	24	16
4	26	39	34	31		130	528	1,490	803	108	23	16
5	26	49	40	31		76	512	1,170	810	98	23	19
6	26	42	39	35		149	583	1,370	967	92	22	25
7	25	37	39	618		135	725	1,260	932	87	22	30
8	24	34		237		132	1,020	1,160	862	78	23	25
9	23	33		116		116	911	1,080	810	72	24	23
10	23	33		108		138	758	1,050	790	67	22	21
11	23	46		101		184	713	981	683	63	23	20
12	23	44		119		354	689	925	611	63	26	20
13	26	37		237		539	647	1,040	556	59	27	20
14	36	30		269		517	647	967	417	58	29	20
15	37	22		211	205	435	701	932	465	58	28	20
16	33	18		177		395	848	1,020	415	53	29	20
17	29	21		152		359	939	1,150	372	50	27	25
18	27	20		135		305	1,060	1,090	346	48	24	26
19	26	22	22	129		293	1,350	1,040	318	45	21	25
20	25	27		121		328	1,640	1,010	297	42	20	27
21	24	27		92		594	1,770	967	289	40	20	35
22	24	36		75		925	1,560	939	285	37	18	51
23	24	32		70		1,280	1,380	1,020	253	37	17	44
24	23	45		65		848	1,450	1,260	225	36	16	40
25	23	38		65		713	1,250	1,560	208	33	16	36
26	23	50		65		611	1,060	1,510	200	32	20	33
27	23	36		65		528	981	1,560	177	31	22	31
28	23	29		65		534	925	1,460	168	30	24	30
29	23	34		70		539	981	1,280	161	29	22	28
30	23	37		70		623	1,210	1,190	155	28	20	28
31	25			75		946		1,170		28	19	
	1,012*			3,891*		13,211*		37,241*		1,882*		789*
	802*		797*		5,740*		29,013*		10,294*		705*	
Mean	25.9	33.7	25.7	119	205	426	967	1,201	510	60.7	22.7	26.3
Acre Feet	1,590	2,010	1,580	7,320	11,380	26,200	57,550	73,870	30,310	3,730	1,400	1,560

YEAR

MEAN 302

ACRE-FEET 218,500

9-211 c UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH File No. 2045

UNPUBLISHED RECORD
SUBJECT TO REVISION

Daily discharge, in second-feet, of Grande Ronde River below Wenaha River, at Troy, Oreg. *for the year ending September 30, 19* 45

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	633	715	731	633	900	1,150	3660	7,130	8,670	3380	796	622
2	605	771	731	633	940	1,180	3520	7,680	7,860	3280	750	616
3	605	739	691	633	1,100	1,160	3160	8,610	7,680	3420	720	609
4	581	795	647	633	1,190	1,150	3090	9,360	7,300	3280	720	622
5	599	880	731	633	1,120	1,050	2960	10,100	7,480	2920	735	635
6	593	771	731	633	1,180	1,030	2980	9,530	8,350	2,850	720	622
7	593	739	731	1,120	1,320	1,030	3220	9,190	8,610	2,650	735	622
8	593	739	747	2,180	4270	1,040	5000	9,000	8,140	2,610	735	616
9	593	723	691	2,550	4410	1,020	4690	8,610	7,480	2,650	742	609
10	581	702	605	1,140	3660	1,070	4160	8,740	6,680	2,540	742	616
11	593	653	518	1,160	3180	1,200	3850	8,800	6,380	2,430	750	616
12	599	819	557	1,410	3010	1,390	3720	7,860	6,190	2,300	750	622
13	599	755	557	3,090	3500	1,880	3640	8,800	5840	2,100	780	609
14	612	739	581	4090	3700	2050	3540	8,140	5230	1,970	780	616
15	633	661	633	3090	3360	2140	3460	7,450	4690	1,880	765	628
16	633	619	691	2,660	2,800	2140	3460	7,360	4570	1,720	750	663
17	626	619	787	2,280	2350	2140	3660	7,330	4270	1,510	735	677
18	612	619	747	2000	2120	2080	3870	6,140	4500	1,490	705	584
19	605	691	747	1,740	1,940	2200	4500	6380	5380	1,430	677	677
20	605	633	844	1,560	1,780	2780	5330	6300	5430	1,340	649	735
21	605	626	827	1,420	1,640	4570	6820	5900	5840	1,250	635	758
22	605	653	819	1,330	1,590	4570	6570	5870	6880	1,140	635	780
23	593	723	747	1,000	1,540	5050	6270	5950	6320	1,160	649	772
24	593	723	661	970	1,410	4810	6490	5560	6030	1,120	649	780
25	593	675	647	950	1,270	4360	5840	6650	5640	1,030	635	765
26	593	723	619	836	1,270	3700	5360	6820	5060	970	649	765
27	593	640	619	828	1,250	3380	5200	7,680	4270	932	635	750
28	593	715	626	878	1,170	3140	5030	6820	3830	896	642	735
29	593	675	668	804		2820	5200	7,510	3700	878	642	735
30	593	675	668	869		2760	6300	8,100	3320	828	642	728
31	661		626	869		3180		8580		796	635	
	18,703*		21,225*	58,970*		134,550*		181,620*		21,784*		
	21,395*		44,622*	73,210*		237,950*		58,750*		20,284*		

MEAN	606	713	685	1,439	2,106	2,362	4,485	7,676	6,054	1,496	703	676
ACRE-FEET	37,110	42,440	42,100	88,510	117,000	145,200	266,900	472,000	360,200	116,500	43,210	40,230

YEAR MEAN 2,447

ACRE-FEET 1,771,400

9-211c UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH File No. 1823

Drainage Area 2,555 Square Miles.

Daily discharge, in second-feet, of **Grande Ronde River at Rondowa, Oreg.** UNPUBLISHED RECORDS *for the year ending September 30, 19* 46

SUBJECT TO REVISION

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	460	550	539	460	570	898	2420	5020	6960	2600	662	442
2	454	546	546	460	694	889	2370	5380	6390	2700	648	442
3	454	553	539	466	835	880	2260	6040	6460	2890	625	436
4	448	555	539	454	871	871	2140	7110	5820	2730	618	430
5	460	621	539	460	871	767	2020	7800	6340	2520	588	442
6	460	602	553	480	871	758	2050	7720	7170	2380	567	490
7	460	588	546	1110	1,300	758	2190	7,360	6780	2310	557	478
8	454	581	532	1200	2800	792	2860	7,060	6400	2270	531	454
9	448	553	480	972	2650	784	2810	6830	6250	2180	550	442
10	442	574	418	810	2460	853	2650	6830	5720	2110	533	448
11	442	686	389	618	2150	907	2600	6780	5420	2070	595	442
12	454	632	362	1050	1980	1,050	2490	6060	5270	1980	588	442
13	460	581	367	1710	2730	1340	2340	6530	4750	1800	610	436
14	518	574	389	1770	2600	1540	2420	6040	4290	1730	595	418
15	499	512	400	1500	2320	1550	2180	5680	3830	1610	588	424
16	486	480	372	1350	1930	1540	2240	5570	3040	1450	574	499
17	480	473	442	1190	1690	1520	2370	5550	3620	1360	546	492
18	473	486	442	1090	1540	1460	2550	5210	3870	1250	518	492
19	466	499	473	1000	1360	1400	2910	4940	4250	1170	499	473
20	466	480	546	934	1240	2040	3570	4700	4720	1120	488	506
21	460	448	553	862	1150	2680	4230	4480	5350	1090	492	574
22	460	512	512	702	1130	2940	4270	4310	5920	1040	499	602
23	460	532	454	670	1090	3550	4230	4210	5270	992	480	588
24	448	546	418	678	1040	3210	4360	4230	4980	925	460	588
25	448	518	412	686	963	3810	4140	4940	4840	898	448	581
26	454	532	372	640	907	2490	3890	5100	4210	844	499	574
27	448	546	400	610	934	2240	3690	5500	3670	801	525	550
28	450	512	448	595	898	2090	3480	5440	3180	767	492	546
29	450	486	454	553		1980	3570	5740	2910	742	473	539
30	470	532	460	648		1930	4230	610	2650	694	454	532
31	500		460	655		2180		6800		670	460	
	14,352*		14,356*		41,474*		89,550*		151,110*		16,842*	
	10,455*		26,583*		50,707*		161,120*		49,083*		14,810*	

MEAN	462	546	463	858	1,481	1,626	2,978	5,845	5,037	1,603	543	494
ACRE-FEET	28,430	32,640	28,470	52,730	88,260	100,000	177,200	359,200	299,700	98,540	33,410	29,380

U. S. GOVERNMENT PRINTING OFFICE 6—7139

YEAR MEAN 1,826

1944 ACRE-FEET 1,322,660

9-211c UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH File No. 1843

Daily discharge, in second-feet, of Grande Ronde River below Wenaha River, at Troy, Oreg. UNPUBLISHED RECORDS SUBJECT TO REVISION *for the year ending September 30, 1944*

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1												528
2												523
3												523
4												551
5												528
6												534
7												512
8												501
9												501
10												496
11												470
12												485
13												501
14												512
15												534
16												563
17											609	612
18											581	619
19											569	581
20											565	572
21											569	563
22											552	581
23											557	640
24											557	587
25											552	593
26											557	575
27											557	563
28											557	557
29											551	593
30											534	661
31											523	
											1,400	1,562

MEAN											17-31 560	552
ACRE-FEET											16,670	32,850

U. S. GOVERNMENT PRINTING OFFICE 0—7149

YEAR OR PERIOD MEAN _____ ACRE-FEET _____

9-211 c

UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH

File No. 1853

Drainage area 2,555 square miles.

Daily discharge, in second-feet, of **Grande Ronde River at Rondowa, Oreg.** *, for the year ending September 30, 19* **44**

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	518	678	686	553	539	539	2160	3230	4040	2300	506	389
2	518	655	678	546	539	539	2360	2960	3480	2040	506	406
3	518	670	710	512	553	539	2630	2810	3620	1810	492	424
4	512	871	734	412	618	546	2920	2810	3280	1670	473	424
5	506	1,110	742	448	712	553	2990	3040	3080	1540	473	412
6	506	934	662	466	1490	560	2910	3570	2990	1430	460	400
7	506	853	640	430	1030	560	2680	3930	2960	1340	442	384
8	506	801	758	394	862	560	2600	3850	2980	1290	436	367
9	506	776	662	406	718	1280	2440	3600	3230	1220	448	362
10	506	758	595	454	655	3030	2260	3300	4040	1180	436	356
11	546	742	532	442	648	2160	2180	3210	3850	1160	424	367
12	618	726	567	499	632	1860	2370	3230	3670	1110	424	362
13	588	718	506	512	588	1580	2400	3420	3480	1060	418	362
14	567	710	512	512	574	1230	2430	3930	3180	1000	448	372
15	560	686	512	525	595	1030	2460	4620	2980	954	454	406
16	567	678	525	512	581	1310	2370	4420	3110	907	442	448
17	588	670	512	506	581	2180	2240	4160	3040	826	430	486
18	625	678	588	486	574	1860	2070	3660	2790	818	418	480
19	625	678	574	480	560	1590	1970	3280	2630	784	418	460
20	625	678	581	466	559	1760	1970	3030	2870	784	406	454
21	655	686	567	466	585	1550	2050	3010	2870	742	406	448
22	694	678	553	466	532	1400	2240	2660	3950	694	406	473
23	686	662	560	486	539	1640	2480	2400	4020	655	400	473
24	710	648	595	499	539	1740	2990	2160	3760	632	394	454
25	718	640	610	486	539	1660	3130	1980	3620	610	400	448
26	718	625	595	448	539	1500	2960	1910	3370	581	412	430
27	694	618	518	412	539	1520	2870	2120	2940	567	412	430
28	686	625	448	406	539	1330	2890	2570	2650	546	412	430
29	686	640	539	442	539	1510	3130	3010	2460	539	389	466
30	726	648	553	512		1740	3320	4180	2310	525	384	480
31	702		525	454		1980		4270		506	384	
	18,686*		18,339*		18,418*		76,470*		97,250*		13,353*	
	21,540*		14,638*		42,936*		100,330*		31,820*		12,653*	
Mean	603	718	592	472	635	1,385	2,549	3,236	3,242	1,026	431	422
Acre-Feet	37,060	42,720	36,370	29,030	39,550	85,180	151,700	199,000	192,900	63,110	26,490	25,100

U.S. GOVERNMENT PRINTING OFFICE 9—1446

YEAR 1944

MEAN 1,274

ACRE-FEET 925,170

9-211 c—2M—3-41

UNPUBLISHED RECORDS
SUBJECT TO REVISION

Year 1944

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT File Number 223

Daily discharge, in second-feet, of Umatilla River at Pendleton, Oreg. *for the year ending September 30, 19*44

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	39	96	78	109	102	297	1,130	1,130	271	62	26	24
2	40	91	88	111	106	281	1,220	934	275	61	26	30
3	39	88	143	107	122	313	1,560	806	291	58	26	31
4	41	107	200	106	179	356	1,850	758	288	60	27	31
5	42	170	228	102	222	390	1,700	758	254	60	27	30
6	44	163	228	102	550	385	1,330	822	231	55	25	28
7	44	142	216	99	876	410	1,050	798	207	51	24	27
8	40	132	213	94	743	558	938	736	202	50	28	27
9	41	120	225	92	580	2,390	820	687	204	50	29	27
10	42	113	219	91	450	4,470	719	617	192	47	27	26
11	49	107	205	89	385	2,040	683	562	169	44	26	25
12	56	104	189	86	348	1,280	827	508	154	42	24	26
13	57	97	175	85	317	890	986	490	145	41	22	25
14	53	94	161	85	313	647	1,140	508	137	41	26	26
15	54	91	153	85	281	536	1,180	526	126	40	30	27
16	56	89	142	83	285	460	1,180	502	124	37	29	34
17	59	88	134	83	309	647	1,050	470	139	37	27	39
18	67	85	126	85	297	1,260	990	425	135	36	26	42
19	65	83	122	83	289	1,260	807	386	126	35	27	44
20	63	81	122	82	273	1,080	855	350	115	37	28	40
21	76	81	115	82	269	827	1,090	313	106	37	27	48
22	88	80	111	82	265	695	1,790	291	113	34	27	44
23	83	80	109	86	249	695	2,160	284	104	31	27	46
24	81	80	107	102	265	876	2,300	267	93	31	25	44
25	81	78	111	104	293	848	2,130	249	87	31	25	41
26	80	77	113	106	309	719	1,690	234	84	30	27	40
27	77	76	113	102	309	596	1,440	219	80	28	27	39
28	73	76	111	97	289	520	1,350	212	77	27	25	38
29	74	76	111	102	305	536	1,350	223	72	24	24	41
30	89	77	109	102		701	1,300	239	65	22	24	46
31	100		107	102		978		254		24	24	
		2922*		2926*		27,941*		10,558*		1,263*		1,036*
	1,893*		4584*		9,580*		58,519*		4,666*		812*	

Mean	61.1	97.4	148	94.4	330	901	1,284	502	156	40.7	26.2	34.5
Acre Feet	3750	5800	9090	5800	19,000	55,420	76,390	30,860	9250	2510	1610	2050

Year Mean 305

~~Period~~ Acre-Feet 221,500

UNPUBLISHED RECORDS
SUBJECT TO REVISION Year 1944

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT File Number 2236

Daily discharge, in second-feet, of Umatilla River above Meacham Creek, near Gibbon, Oreg., for the year ending September 30, 1944

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	44	66	55	62	63	103	456	482	201	56	41	45
2	44	61	73	62	70	100	523	402	181	56	40	45
3	45	60	136	61	98	104	680	370	216	56	40	43
4	45	110	138	60	122	112	745	379	184	55	40	41
5	46	120	134	60	163	112	660	424	167	55	39	39
6	46	96	116	58	460	110	536	460	154	52	39	38
7	46	82	106	56	415	134	456	438	144	52	40	38
8	47	74	116	55	280	274	428	406	144	52	41	39
9	46	69	112	54	210	1,260	370	379	142	50	40	37
10	49	64	103	54	166	1,110	338	334	129	50	40	37
11	60	61	95	53	148	564	362	306	120	50	40	38
12	56	60	86	53	134	438	492	290	114	50	40	37
13	53	60	80	53	128	338	546	294	106	49	41	37
14	51	58	75	53	122	255	572	318	100	49	46	40
15	50	57	69	53	110	219	559	330	95	49	44	41
16	51	55	65	53	116	207	518	310	97	48	43	48
17	57	54	64	54	108	394	442	286	100	47	43	46
18	54	54	62	53	108	550	374	262	98	47	43	50
19	53	53	60	53	106	518	346	240	88	48	42	47
20	53	53	61	53	108	438	366	219	82	50	43	44
21	68	53	60	53	112	338	428	207	80	47	42	44
22	64	53	60	53	106	290	625	195	83	46	43	52
23	61	53	60	59	108	330	775	184	77	44	43	46
24	63	52	61	63	124	379	799	170	72	44	42	45
25	61	52	66	61	122	334	645	157	70	44	43	43
26	60	51	65	60	120	272	536	152	69	44	43	43
27	56	51	64	59	110	255	518	154	68	43	43	43
28	55	51	63	59	108	201	546	164	64	42	43	42
29	56	51	62	60	110	225	572	175	62	41	41	48
30	60	52	62	61	* * * *	310	55[illegible]	187	59	41	41	48
31	68	* * * *	61	62	* * * *	420	* * * *	181	* * * *	41	41	* * * *
	1,668*	1,886*	2,490*	1,763*	4,255*	10,694*	15,772*	8,855*	3,366*	1,498*	1,290*	1,284*
Mean	53.8	62.9	80.3	56.9	147	345	526	286	112	48.3	41.6	42.8
Acre Feet	3310	3740	4940	3500	8440	21,210	31,280	17,560	6680	2970	2560	2550

Year
Period

Mean 150
Acre-Feet 108,700

9-211 c—22M—9-41

UNPUBLISHED RECORDS SUBJECT TO REVISION Year 1944

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT File Number 216

Daily discharge, in second-feet, of North Fork Walla Walla River near Milton, Oreg. *for the year ending September 30, 19* 44

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	5.5	23	17	15.0	15	29	81	133	54.0	5.2	3.1	2.0
2	5.5	21	23	15.0	17	29	86	108	48.0	5.7	3.1	2.0
3	5.5	19	59	14.0	27	32	130	93	44.0	6.2	2.0	2.5
4	5.5	39	58	14.0	34	38	173	88	39.0	6.2	2.0	3.6
5	5.8	38	53	14.0	40	36	161	93	34.0	6.2	2.5	3.1
6	6.0	28	47	12.0	98	35	130	106	32.0	6.2	2.5	2.5
7	6.0	23	41	11.0	93	40	108	106	29.0	6.2	2.5	2.5
8	6.0	20	39	11.0	71	74	98	103	27.0	6.2	2.0	2.5
9	6.0	19	36	11.0	59	402	88	98	28.0	5.7	2.0	2.5
10	6.4	17	32	10.0	50	465	77	84	27.0	5.2	2.0	2.5
11	9.4	16	28	9.8	44	194	64	73	23.0	4.6	2.0	2.5
12	13.0	15	26	9.4	41	127	75	68	21.0	4.6	2.0	2.0
13	10.0	15	24	9.4	39	81	88	66	19.0	4.6	2.0	1.8
14	9.4	14	22	10.0	34	58	98	77	18.0	4.6	2.0	1.8
15	9.8	14	19	9.4	33	48	106	88	17.0	5.7	2.5	2.0
16	10.0	14	17	10.0	33	42	106	93	17.0	5.7	3.1	2.0
17	10.0	13	17	11.0	32	81	86	86	23.0	5.2	2.5	2.5
18	11.0	13	16	12.0	31	135	70	73	21.0	4.1	2.5	3.6
19	10.0	13	15	12.0	29	119	64	66	18.0	3.6	2.5	4.1
20	9.8	12	15	13.0	29	93	66	59	18.0	3.6	2.5	4.6
21	13.0	12	14	12.0	29	68	88	54	17.0	3.6	2.0	4.1
22	15.0	12	14	12.0	29	56	206	51	17.0	4.6	2.0	5.2
23	14.0	12	14	14.0	29	73	282	46	17.0	4.6	2.0	4.6
24	14.0	12	14	18.0	33	98	286	44	14.0	4.6	2.0	4.1
25	15.0	11	15	16.0	34	79	232	42	13.0	4.1	2.0	3.6
26	15.0	11	15	15.0	35	59	185	40	11.0	3.6	2.0	4.1
27	14.0	11	14	14.0	34	46	158	41	9.8	3.6	2.0	4.1
28	13.0	11	14	14.0	33	42	150	46	8.9	3.6	2.0	3.6
29	13.0	11	14	14.0	32	42	156	52	7.3	3.6	2.0	4.1
30	36.0	12	14	15.0		52	153	56	5.7	3.6	2.0	5.2
31	27.0		14	15.0		70		51		3.6	2.0	
	349.6*	501*	760*	392.0*	1,137*	2,843*	3,851*	2,284*	677.7*	148.4*	69.3*	95.3*

Mean	11.3	16.7	24.5	12.6	39.2	91.7	128	73.7	22.6	4.79	2.24	3.18
Acre Feet	693	994	1,510	778	2260	5640	7640	4530	1340	294	137	189

Year Mean 35.8

~~Period~~ Acre-Feet 26,000

S-211 c—2M—9-41

UNPUBLISHED RECORDS
SUBJECT TO REVISION

Year 1944

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT

File Number 215

Daily discharge, in second-feet, of South Fork Walla Walla River below P.P.&L. Co's. plant near Milton, Oreg. *, for the year ending September 30, 19* 44.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	91	111	116	112	102	126	254	292	204	102	87	89
2	91	109	122	111	105	124	279	263	191	102	87	89
3	89	108	148	108	120	127	337	257	194	102	89	87
4	91	160	154	107	132	133	367	269	178	102	91	86
5	92	140	144	107	140	135	330	295	171	102	93	86
6	93	120	133	104	235	136	289	311	164	100	93	85
7	91	111	132	101	244	144	263	298	156	100	91	84
8	91	108	130	101	200	179	254	282	156	100	89	84
9	89	107	124	101	170	526	232	273	154	100	87	84
10	93	105	121	100	151	477	221	254	147	97	87	82
11	112	104	116	100	146	308	226	241	142	97	89	82
12	102	102	115	98	138	260	269	244	138	97	89	84
13	98	102	112	98	135	221	276	254	133	99	89	86
14	94	101	111	100	133	191	279	279	131	97	95	86
15	96	102	108	100	126	178	276	282	131	95	91	86
16	96	101	107	100	132	173	269	273	133	93	89	97
17	100	101	105	102	130	212	251	257	136	93	89	99
18	100	101	104	101	128	260	232	241	133	93	89	99
19	97	101	104	100	127	257	226	226	127	97	89	95
20	98	102	104	100	127	238	238	212	123	100	89	91
21	108	102	104	100	127	210	257	207	120	97	87	91
22	105	102	102	100	126	196	305	201	120	97	87	97
23	104	102	100	107	124	221	364	194	118	97	87	93
24	109	101	104	107	128	241	381	186	116	95	87	91
25	111	98	102	114	130	224	330	178	114	93	87	91
26	105	98	102	108	135	201	292	178	110	91	87	89
27	102	98	104	105	130	183	289	181	112	91	86	89
28	101	100	104	105	128	176	305	183	106	89	86	89
29	102	100	105	104	130	183	324	186	102	91	86	93
30	135	108	105	104		210	324	194	102	91	86	93
31	115		104	102		241		188		89	87	
	3101*	3,205*	3,546*	3,207*	4,079*	6,691*	8,539*	7,379*	4,162*	2,989*	2,745*	2,678*
Mean	100	107	114	103	141	216	285	238	139	96.4	88.5	89.3
Acre Feet	6,150	6,360	7,030	6,360	8,090	13,270	16,940	14,640	8,260	5,930	5,440	5,310

Year Mean 143

~~Period~~ Acre-Feet 103,800

8-211 c—225—8-41

UNPUBLISHED RECORDS
SUBJECT TO REVISION

Year 1944

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT

File Number 214

Daily discharge, in second-feet, of South Fork Walla Walla River near Milton, Oreg. *, for the year ending September 30, 19* 44

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	96	110	118	110	108	108	225	278	210	110	94	91
2	97	108	128	108	110	108	262	240	197	110	94	92
3	100	110	157	106	126	106	339	233	197	110	94	91
4	100	178	162	104	135	110	381	257	178	110	94	90
5	102	142	144	106	147	108	329	292	170	106	94	90
6	102	124	133	106	244	104	275	310	165	106	94	90
7	102	116	133	106	229	104	240	292	162	106	94	89
8	100	114	133	104	184	122	229	287	162	104	94	89
9	100	112	124	106	159	348	203	270	157	104	92	89
10	102	110	122	106	144	392	187	236	152	104	91	89
11	131	110	120	106	138	233	200	233	147	104	91	89
12	108	108	118	104	131	184	253	229	140	104	91	87
13	106	108	114	103	128	157	253	253	138	100	91	87
14	104	110	112	103	128	142	240	287	138	102	94	89
15	103	108	110	103	122	133	236	296	135	102	92	89
16	106	108	110	103	126	133	229	283	140	100	91	100
17	110	108	108	104	122	172	210	262	144	98	91	94
18	106	108	108	103	120	214	190	244	138	98	91	96
19	104	108	108	103	118	217	187	225	133	100	91	91
20	103	106	108	103	118	190	197	206	131	100	91	91
21	114	106	108	103	118	167	197	197	128	96	91	91
22	110	106	108	102	118	159	240	194	128	96	91	96
23	108	106	108	106	118	194	329	187	124	96	91	92
24	116	106	110	110	122	214	370	181	120	96	91	92
25	120	104	112	108	120	190	306	172	120	96	91	94
26	114	104	108	106	120	167	275	172	118	94	91	94
27	112	104	106	104	116	149	275	178	118	94	90	94
28	110	104	104	104	114	147	296	187	114	94	90	94
29	118	103	106	106	112	157	320	194	112	94	90	98
30	138	112	106	106	* * *	184	320	203	112	94	90	98
31	116	* * *	104	106	* * *	221	* * *	197	* * *	94	90	* * *
		3,361*		3,258*		5,334*		7,275*		3,122*		2,756*
	3,358*		3,650*		3,895*		7,793*		4,330*		2,845*	
Mean	108	112	118	105	134	172	260	235	144	101	918	91.9
Acre Feet	6660	6670	7240	6460	7730	10580	15460	14430	8590	6190	5640	5470

Year

Mean 139

Acre-Feet 101,100

9-211 c—2M—3-41

Year 1944

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT

File Number 185

UNPUBLISHED RECORDS
SUBJECT TO REVISION

Daily discharge, in second-feet, of Catherine Creek near Union, Oreg. *for the year ending September 30, 1944*

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	27	29	31	27	27	27	149	294	290	130	40	24
2	27	33	31	27	26	27	181	263	260	121	39	26
3	27	33	32	28	26	25	210	257	269	114	39	30
4	27	72	32	23	26	26	243	275	232	107	38	25
5	27	66	29	23	30	25	223	326	213	100	37	24
6	27	43	27	24	80	25	208	386	208	97	36	24
7	27	38	25	24	60	26	190	405	205	90	35	22
8	27	38	30	23	42	30	186	382	203	87	35	22
9	26	37	25	23	34	60	157	343	205	83	40	22
10	27	37	20	24	36	77	143	316	208	83	37	21
11	46	36	21	24	32	65	168	306	195	77	35	21
12	35	35	21	24	29	60	213	310	186	73	33	21
13	31	35	21	25	30	55	203	333	176	69	32	21
14	29	33	21	26	28	38	190	364	166	66	34	23
15	29	33	22	26	29	40	176	394	159	62	33	25
16	29	32	22	26	31	45	161	375	195	60	32	31
17	30	33	25	25	30	58	145	343	200	58	30	30
18	30	32	27	25	31	66	133	300	181	56	30	29
19	30	33	27	26	29	73	126	263	170	56	29	26
20	29	35	27	26	32	69	124	246	181	55	28	25
21	33	33	30	24	28	62	121	234	188	52	27	24
22	32	32	29	23	27	60	131	218	246	49	26	30
23	32	31	37	23	29	64	170	200	226	49	25	25
24	38	30	32	24	28	65	263	183	200	47	25	24
25	44	28	30	24	28	62	257	170	185	46	25	23
26	40	27	28	22	28	58	246	168	180	44	25	22
27	38	28	25	20	28	56	254	178	170	43	25	22
28	37	32	23	19	28	55	278	200	155	45	25	22
29	37	29	22	20	27	62	323	229	143	43	24	24
30	41	30	26	23		89	330	340	133	41	24	24
31	33		25	30		114		297		41	23	
	992*	1,063*	823*	751*	939*	1,664*	5,902*	8,398*	5,928*	2,144*	966*	732*
Mean	32.0	35.4	26.5	24.2	32.4	53.7	197	287	198	69.2	31.2	24.4
Acre Feet	1,970	2,110	1,630	1,490	1,860	3,300	11,710	17,650	11,760	4,250	1,920	1,450

Year

Mean 84.2

Acre-Feet 61,100

Year 1944

OFFICE OF STATE ENGINEER—STATE OF OREGON—WATER RESOURCES DEPARTMENT

File Number 1816

UNPUBLISHED RECORDS

Daily discharge, in second-feet, of Grande Ronde River at La Grande, Oreg. SUBJECT TO REVISION, for the year ending September 30, 1944.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	26	41	40	43	37	55	949	742	257	124	28	14
2	25	39	47	44	36	58	998	640	241	118	27	16
3	24	43	56	46	36	57	1,120	570	330	110	26	17
4	24	61	58	37	36	57	1,130	550	285	105	25	19
5	24	89	56	33	55	56	1,080	592	241	101	24	17
6	25	70	45	31	185	58	921	576	213	92	23	15
7	26	47	38	32	125	65	774	706	198	85	23	14
8	26	44	69	32	90	116	724	676	194	81	23	14
9	26	55	45	32	80	731	652	640	237	77	23	13
10	27	48	30	32	88	834	580	570	273	73	23	13
11	28	48	30	32	75	485	570	525	233	73	23	12
12	30	45	30	32	64	405	628	490	202	73	20	12
13	31	44	30	33	65	303	646	490	180	67	20	12
14	30	41	30	35	60	198	640	515	170	62	20	14
15	28	37	32	34	60	221	628	545	157	57	21	15
16	29	33	33	34	64	298	604	510	205	53	21	17
17	29	51	38	35	62	540	550	470	277	49	19	20
18	30	45	42	36	62	730	505	425	285	46	18	25
19	30	44	42	39	58	688	490	395	253	44	17	24
20	33	44	42	39	64	535	545	355	249	50	17	23
21	35	44	48	36	56	425	522	335	245	46	17	23
22	40	43	47	35	56	385	858	308	308	40	16	28
23	43	41	65	34	54	520	949	281	277	37	16	32
24	43	40	60	34	55	560	1040	253	237	35	16	27
25	43	40	56	35	55	455	984	233	213	35	15	24
26	50	38	54	32	55	370	851	225	202	37	15	22
27	45	31	50	28	55	290	788	221	188	34	16	21
28	43	35	42	28	55	303	774	221	170	32	16	21
29	47	45	39	31	55	430	802	233	150	32	15	25
30	48	41	40	35	* * * *	628	802	245	134	36	15	26
31	50	* * * *	40	40	* * * *	937	* * * *	257	* * * *	32	14	* * * *
	1,038*	1,367*	1,574	1,079*	1,698*	11,595*	23,204*	15,894*	6,804*	1,938*	612*	575*
Mean	33.5	45.6	44.3	34.8	55.4	377	773	513	227	62.5	19.7	19.2
Acre Feet	2,060	2,710	2,730	2,140	3,380	23,190	46,020	31,520	13,500	3,840	1,210	1,140

Year Mean 159

Period Acre-Feet 115,900

9-211 c

UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH

File No. 1933

Drainage area 2,555 square miles.

Daily discharge, in second-feet, of Grande Ronde River at Rondowa, Oreg., *for the year ending September 30, 19* 44

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	518	678	686	553	539	539	2,160	3,230	4,040	2,300	506	389
2	518	655	678	546	539	539	2,360	2,960	3,480	2,040	506	406
3	518	670	710	512	553	539	2,630	2,810	3,620	1,810	492	424
4	512	871	734	412	618	546	2,920	2,810	3,280	1,670	473	424
5	506	1,110	742	448	712	553	2,990	3,040	3,080	1,540	473	412
6	506	934	662	456	1,490	560	2,910	3,570	2,990	1,430	460	400
7	506	853	640	430	1,030	560	2,680	3,930	2,960	1,340	442	384
8	506	801	758	394	862	560	2,600	3,850	2,980	1,290	436	367
9	506	776	662	406	718	1,280	2,440	3,600	3,230	1,220	448	362
10	506	758	595	454	635	3,030	2,260	3,300	4,040	1,180	436	356
11	546	742	532	442	648	2,160	2,180	3,210	3,850	1,160	424	367
12	618	726	567	499	632	1,860	2,370	3,230	3,670	1,110	424	362
13	588	718	506	512	588	1,580	2,400	3,420	3,480	1,060	418	362
14	567	710	512	512	574	1,230	2,430	3,930	3,180	1,000	448	372
15	560	686	512	525	595	1,030	2,460	4,620	2,980	954	454	406
16	567	678	525	512	581	1,310	2,370	4,420	3,110	907	442	448
17	588	670	512	506	581	2,180	2,240	4,160	3,040	826	430	486
18	625	678	588	486	574	1,860	2,070	3,660	2,790	818	418	480
19	625	678	574	480	560	1,890	1,970	3,280	2,630	784	418	460
20	625	678	581	466	539	1,760	1,970	3,030	2,870	784	406	454
21	655	686	567	466	525	1,550	2,050	3,010	2,870	742	406	448
22	694	678	553	466	532	1,400	2,240	2,660	3,950	694	406	473
23	686	662	560	486	539	1,640	2,480	2,400	4,020	655	400	473
24	710	648	595	499	539	1,740	2,990	2,150	3,760	632	394	454
25	718	640	610	486	539	1,660	3,130	1,980	3,620	610	400	448
26	718	625	595	448	539	1,500	2,960	1,910	3,370	581	412	430
27	694	618	518	412	539	1,320	2,870	2,120	2,940	567	412	430
28	686	625	448	406	539	1,330	2,890	2,570	2,650	546	412	430
29	686	640	539	442	539	1,510	3,130	3,010	2,460	539	389	466
30	726	648	553	512		1,740	3,320	4,180	2,310	525	384	480
31	702		525	454		1,980		4,270		506	384	
	18,686*		18,339*		18,418*		76,470*		97,250*		13,353*	
	21,540*		14,638*		42,936*		100,330*		31,820*		12,053*	
MEAN	603	718	592	472	635	1,385	2,549	3,236	3,242	1,026	431	422
ACRE-FEET	37,060	42,720	36,370	29,030	36,530	85,180	151,700	199,000	192,900	63,110	26,490	25,100

U. S. GOVERNMENT PRINTING OFFICE 0—7149

YEAR MEAN 1,274

ACRE-FEET 925,170

9-211 c UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH File No. 1833

Drainage area 2,655 square miles.

Daily discharge, in second-feet, of Grande Ronde River at Rondowa, Oreg. *, for the year ending September 30, 19* 43

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	454	862	1,640	4,180	1,200	2,730	10,000	6,410	7,330	6,200	1,450	889
2	466	767	1,690	3,480	1,200	2,580	9,280	6,610	6,730	5,970	1,410	880
3	466	750	1,450	2,890	1,150	2,420	8,880	6,630	5,990	6,530	1,440	880
4	460	750	1,230	2,310	1,150	2,320	8,310	6,680	5,480	6,830	1,370	862
5	460	710	1,100	2,110	1,150	2,220	7,690	6,460	5,040	6,270	1,360	835
6	466	678	1,050	1,950	1,100	2,000	7,750	6,150	4,800	6,080	1,320	810
7	466	655	1,000	1,780	1,070	1,940	7,890	5,790	4,720	6,530	1,250	784
8	460	726	1,030	1,600	1,050	2,050	8,530	5,350	4,820	6,700	1,220	767
9	454	718	1,100	1,440	1,030	2,140	8,070	5,080	5,120	6,530	1,190	734
10	448	670	1,400	1,380	1,150	2,080	7,090	4,880	5,570	5,380	1,110	710
11	473	632	1,600	1,310	1,320	2,040	6,580	4,640	5,480	4,760	1,050	686
12	518	602	1,570	1,240	1,800	2,080	6,830	4,360	5,770	4,160	1,000	670
13	525	610	1,680	1,220	2,460	3,010	7,580	4,100	5,500	3,570	972	662
14	512	655	2,050	1,420	2,960	3,230	8,690	3,850	5,970	3,370	944	640
15	525	818	2,430	2,180	3,180	2,910	9,960	3,600	5,850	3,300	907	625
16	525	784	2,370	2,040	3,180	2,850	10,900	3,400	5,630	3,100	880	610
17	525	734	2,150	1,410	3,110	2,580	10,500	3,280	5,880	2,870	853	610
18	518	726	1,950	1,200	3,150	2,190	10,000	3,130	7,010	2,860	810	602
19	512	702	1,760	1,300	3,400	2,080	10,700	3,160	8,070	2,910	784	588
20	506	648	1,600	1,500	3,530	1,970	9,890	3,370	7,090	3,010	784	581
21	499	574	1,480	1,600	3,710	1,900	9,460	3,570	6,290	3,030	801	574
22	506	632	1,560	1,570	4,140	1,930	8,400	4,020	5,920	3,100	826	567
23	506	810	1,680	1,500	3,890	2,120	7,660	5,590	5,550	2,790	818	567
24	499	1,620	1,640	1,400	3,570	2,270	7,010	6,830	5,270	2,580	810	567
25	492	1,370	1,910	1,450	3,200	2,290	6,560	7,220	5,440	2,540	784	560
26	492	1,180	1,550	1,400	2,920	2,350	6,010	7,720	5,500	2,420	767	553
27	539	1,170	1,430	1,350	2,790	7,250	5,590	7,630	5,630	2,320	742	532
28	532	1,170	1,510	1,300	2,760	7,860	5,480	7,780	5,920	2,080	718	525
29	512	1,210	1,550	1,250		8,310	5,680	7,490	6,250	1,810	718	525
30	525	1,660	1,580	1,200		8,780	5,700	7,010	6,270	1,620	784	525
31	610		2,490	1,100		9,460		7,250		1,520	888	
	15,451*		50,230*		66,320*		242,670*		175,890*		30,770*	
	25,593*		53,060*		106,240*		169,040*		122,740*		19,920*	

MEAN	498	863	1,620	1,712	2,369	5,427	8,089	5,453	5,863	3,959	992	664
ACRE-FEET	30,650	50,760	99,630	105,200	131,500	210,700	481,300	335,300	348,900	243,500	61,050	39,510

U. S. GOVERNMENT PRINTING OFFICE 6—7169

YEAR 1943 MEAN 2,955

ACRE-FEET 2,137,980

9-211c UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY—WATER RESOURCES BRANCH File No. 2112

Daily discharge, in second-feet, of Walla Walla River below Freewater, Oreg. UNPUBLISHED RECORDS SUBJECT TO REVISION *, for the year ending September 30, 19* 43

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0	85	155	733	70	157	690	630	314	5	0	0
2		26	135	580	75	136	585	695	268	4		
3		24	113	428	68	122	635	590	191	4		
4		10	96	324	88	115	528	505	151	4		
5		3	92	247	83	104	415	399	132	3		
6		0	73	181	88	92	347	383	128	3		
7		4	65	138	104	93	347	359	99	3		
8		3	91	118	102	90	407	324	84	3		
9		10	125	104	96	84	375	321	86	3		
10		6	409	93	90	80	293	290	90	3		
11		3	446	87	203	78	238	314	83	3		
12		.5	339	82	680	77	272	332	98	2		
13		.5	494	82	695	99	399	387	83	2		
14		.5	555	134	670	113	528	371	152	2		
15		61	442	324	570	105	630	332	164	2		
16		60	379	300	482	102	625	290	142	2		
17		42	318	202	411	96	518	232	132	2		
18		27	256	181	351	93	464	202	144	2		
19		19	202	167	328	93	505	181	149	2		
20		12	164	171	347	87	456	169	144	2		
21		7	130	142	451	90	482	151	129	2		
22		5	194	123	487	102	375	171	116	2		
23		8	272	108	415	134	310	276	102	2		
24		221	294	90	332	176	285	300	86	1		
25		155	395	78	256	276	191	290	93	.5		
26		119	290	80	207	456	149	282	92	.5		
27		118	247	93	186	600	116	241	69	0		
28		97	335	90	169	595	174	199	50	0		
29		112	318	90		570	339	164	20	0		
30		174	446	84		585	347	146	18	0		0
31	0		555	78		590		269		0	0	
	0	1,412.5 *	8,432 *	5,752 *	8,104 *	6,190 *	12,075 *	9,795 *	3,809 *	64.0 *	0	0
Mean	0	47.1	272	185	289	200	402	316	120	2.06	0	0
Acre-Feet	0	2,800	16,720	11,370	16,070	12,280	23,950	19,430	7,160	127	0	0

U. S. GOVERNMENT PRINTING OFFICE 16—7119

YEAR 1911-43 MEAN 152
ACRE-FEET 109,907

(1946)

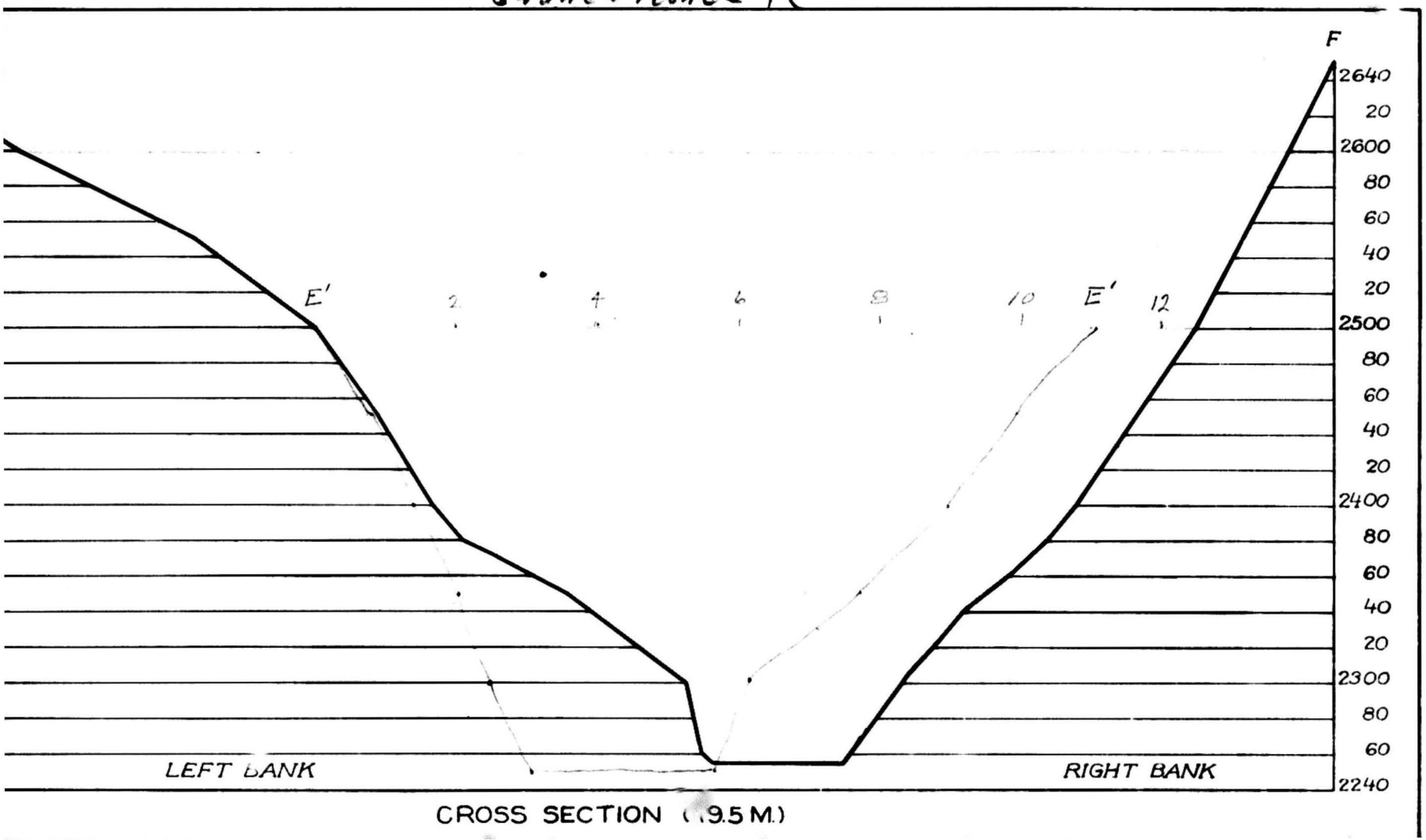
Run-Off in Acre Feet (thousands)

	Winam +Elgin	Zindel	Winam +Elgin	Zindel	Winam +Elgin	Zindel
	1904		1905		1906	
Jan.			38.8	62.1	30.6	51.3
Feb.			35.9	63.9	41.5	82.2
Mar.			85.2	167.0	122.3	212.0
Apr.			114.7	198.0	285.0	472.0	
May			177.6	240.0	-	275.0
June			181.0	227.0	314.0	358.0
July	151.7	204.0	53.3	76.2	92.2	109.0
Aug.	43.3	64.6	19.0	36.7	26.5	43.3
Sept.	29.3	45.6	18.3	34.8	26.1	40.3
Oct.	34.0	53.6	37.2	51.0	29.5	46.5
Nov.	29.5	46.5	30.2	46.8	98.5	177.0
Dec.	30.9	49.3	29.6	46.4	108.6	226.0

	1907		1908		1909	
Jan.	-	168.0		70.7	70.1	91.0
Feb.	-	505.0		67.3	52.8	100.0
Mar.	214.8	410.0		93.1	105.7	212.0
Apr.	358.0	708.0		447.0	151.7	284.0
May	336.0	528.0		287.0	225.1	321.0
June	259.6	346.0		314.0	315.1	400.0
July	126.2	209.0		142.0	125.1	145.0
Aug.	47.4	71.3		39.2	48.1	56.2
Sept.	32.1	55.3		51.1	38.2	39.7
Oct.		45.8		72.6	33.6	44.4
Nov.		52.1		59.4	73.7	136.0
Dec.		101.0		49.3	59.8	75.6

	1910		1911		1912	
Jan.	38.2	56.9	28.0	81.8	85.2	165.0
Feb.	53.2	68.9	21.0	78.9	140.9	315.0
Mar.	530.0	1140.0	131.2	289.0	107.0	276.0
Apr.	411.0	660.0	137.5	230.0	389.0	708.0
May	294.0	446.0	219.0	360.0	573.0	978.0
June	125.8	184.0	275.7	345.0	503.0	744.0
July	41.3	64.0	81.0	127.0	155.9	220.0
Aug.	20.8	34.9	25.2	46.7		98.4
Sept.	22.6	37.2	22.9	36.9		85.1
Oct.	29.1	50.7	30.3	44.7		
Nov.	46.2	111.0	31.3	59.4		
Dec.	54.8	125.0	26.9	43.5		

Sheep Cr dam site
Crooked Rond 12



CROSS SECTION (19.5 M.)

DAM CHARGES

Federal Power Commission fixed charges.

	percent
Interest	3.00
Amortization	1.33
Replacements	0.17
Payments in lieu of taxes	1.00
Total	5.50 percent

In comparison with the above, the following charges are used by the USED in its computations:

	percent
Interest	3.00
Amortization	0.886
Replacements	2.1 (annually on small concrete items)*
Maintenance	0.25

*Assume 30-year life on small concrete items. A good earthen dam is assumed to have no depreciation. (No data on concrete dam depreciation)

Add to costs above shown an estimate of operation costs. In the case of one project of 58,000 k.w., an estimate of $1.50 per k.w. per year was made. In another case (Capacity not stated) operation was charged at $10,000 plus $0,50 per k.w. per year.

One project figured on basis of above totalled 5.04 percent annual charge to overall operation, maintenance, and replacements.

CONDUIT COSTS (Illustrative cases)

Wood stave pipe (Includes cost, erection, freight for 400 miles)

10-foot pipe, low pressure, $20 per lineal foot.
7-foot pipe, 20-foot head, $10 per lineal foot.
7-foot pipe, 200-foot head, $32 per lineal foot.

The above costs are as of 1940(?). They do not include costs of excavation for footing or the costs of trestles.

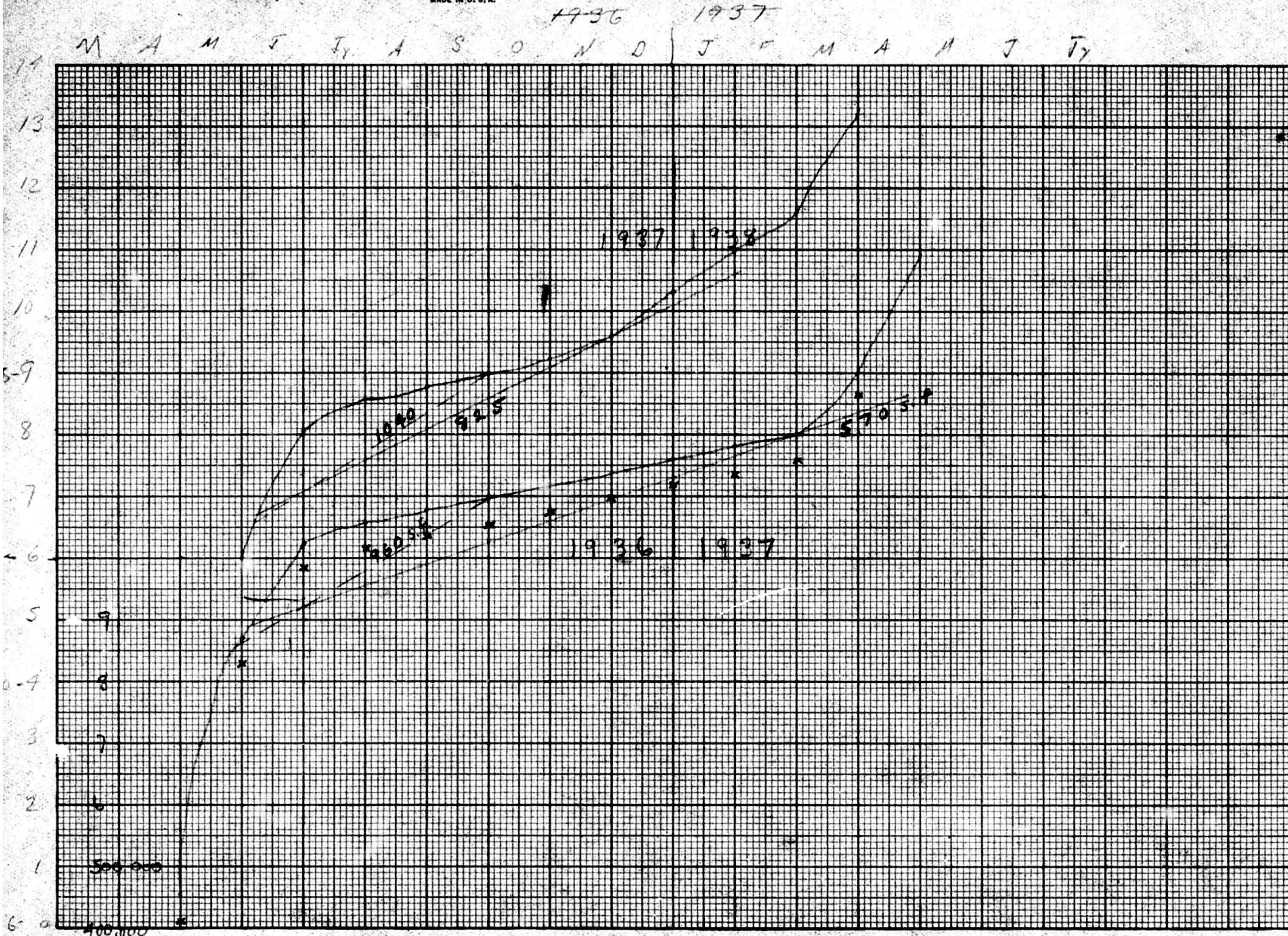
GENERATOR AND TURBINE COSTS (as of 1942) (Deduct 10% for normal times)

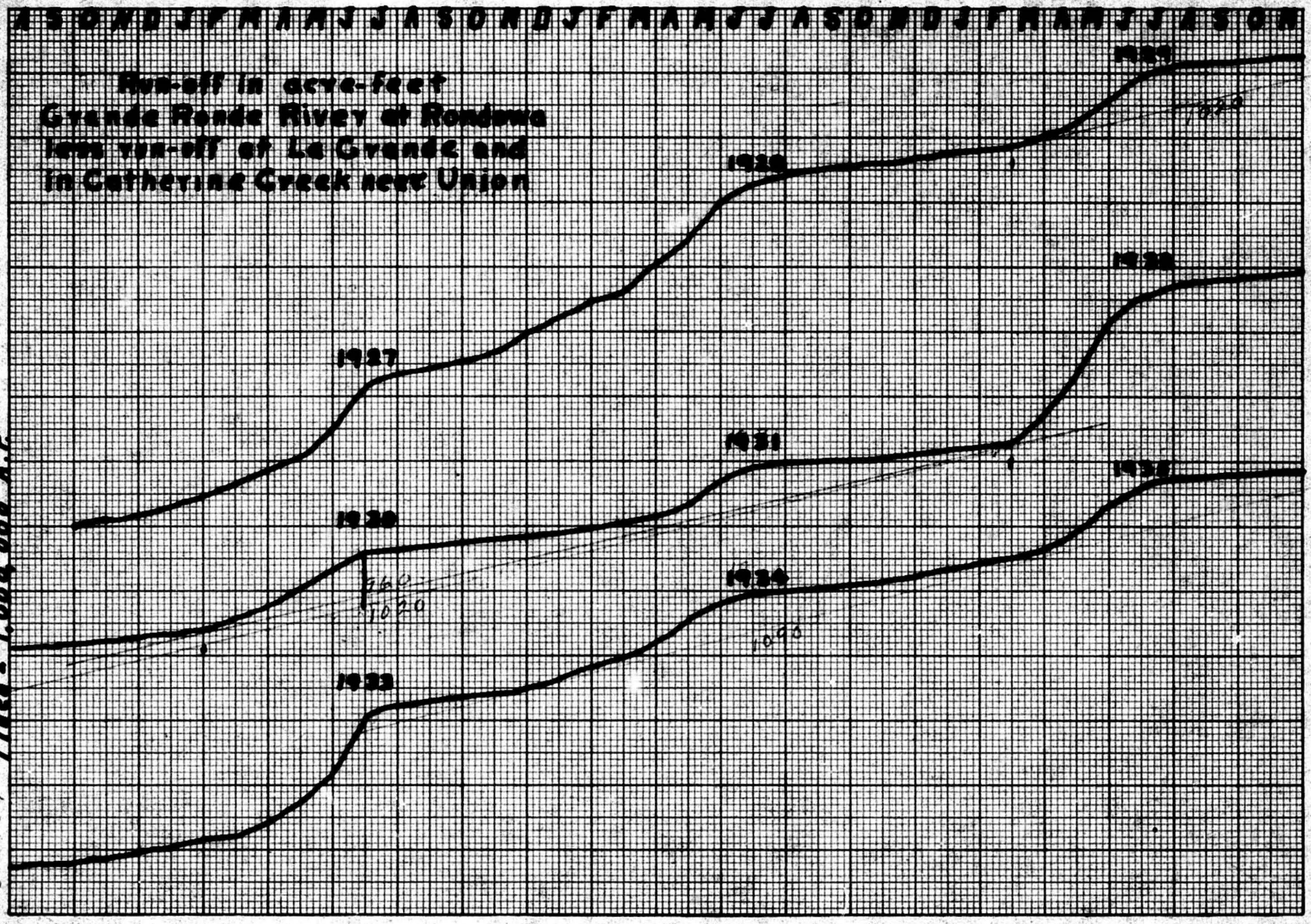
	Head of 400 feet	Head of 800 feet	
Turbines	$8.00 per k.w.	$6.00 per k.w.	
Generators	10.00 " "	10.00 " "	(ADD 27 percent for overhead items)
Total	$18.00	$16.00	

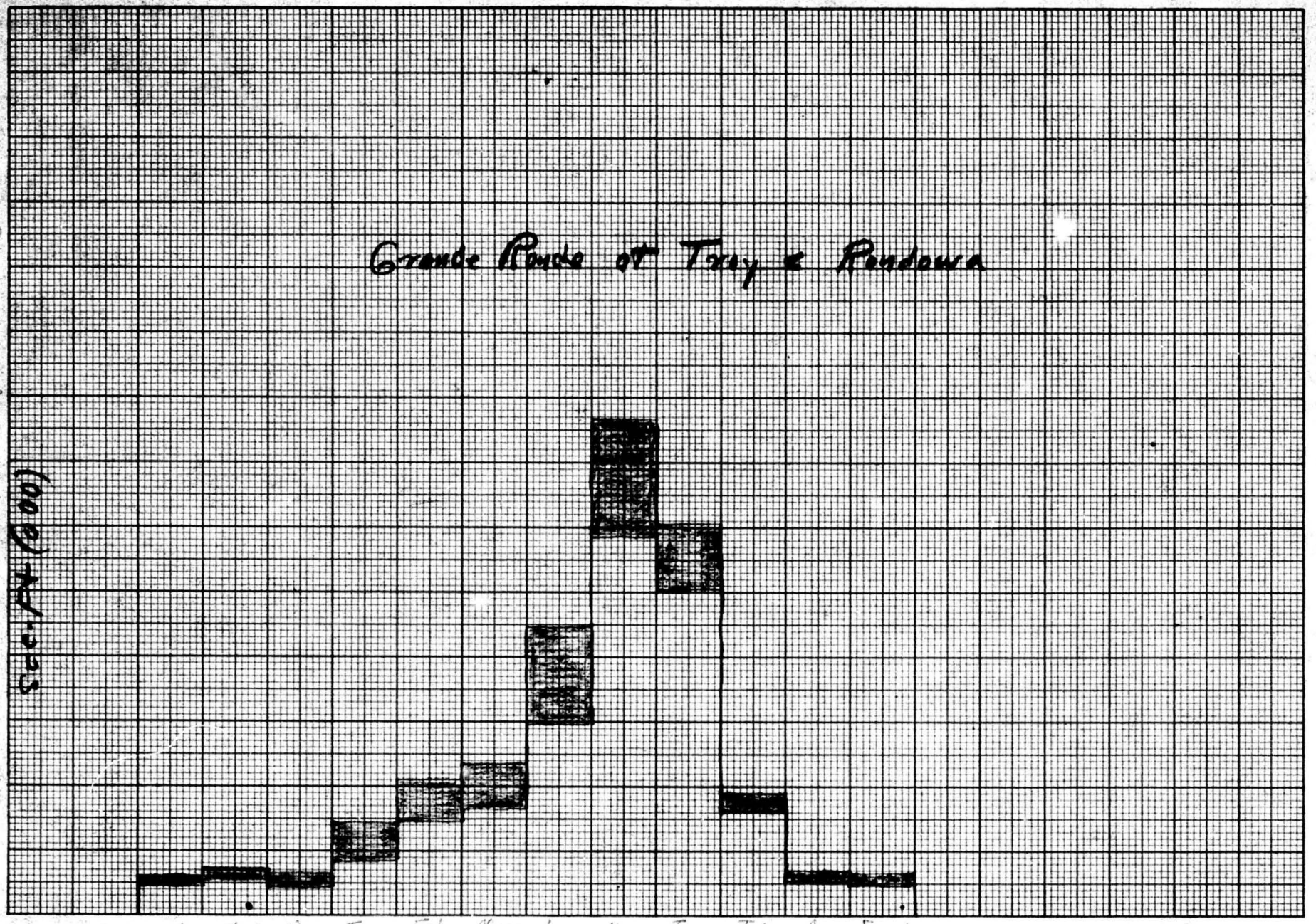
The above costs include installation. Note that cost of turbines decreases with head. The cost of generators may decrease slightly with head. Negligible

TOTAL INCLUDING OVERHEAD: $23 per k.w. at 400-ft head, and $20 per k.w. at 800-ft hd.

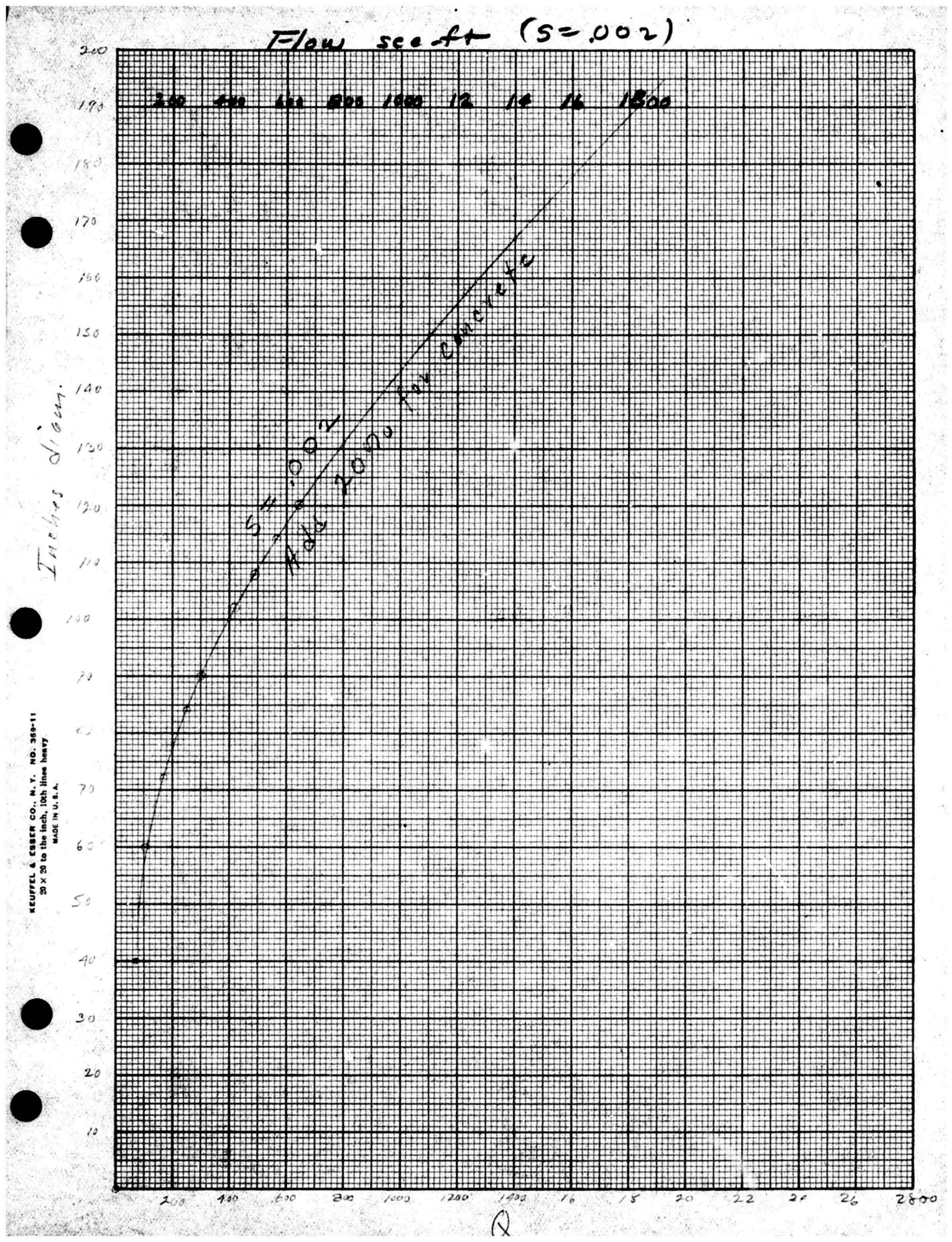
Grande Ronde
at Rondowa

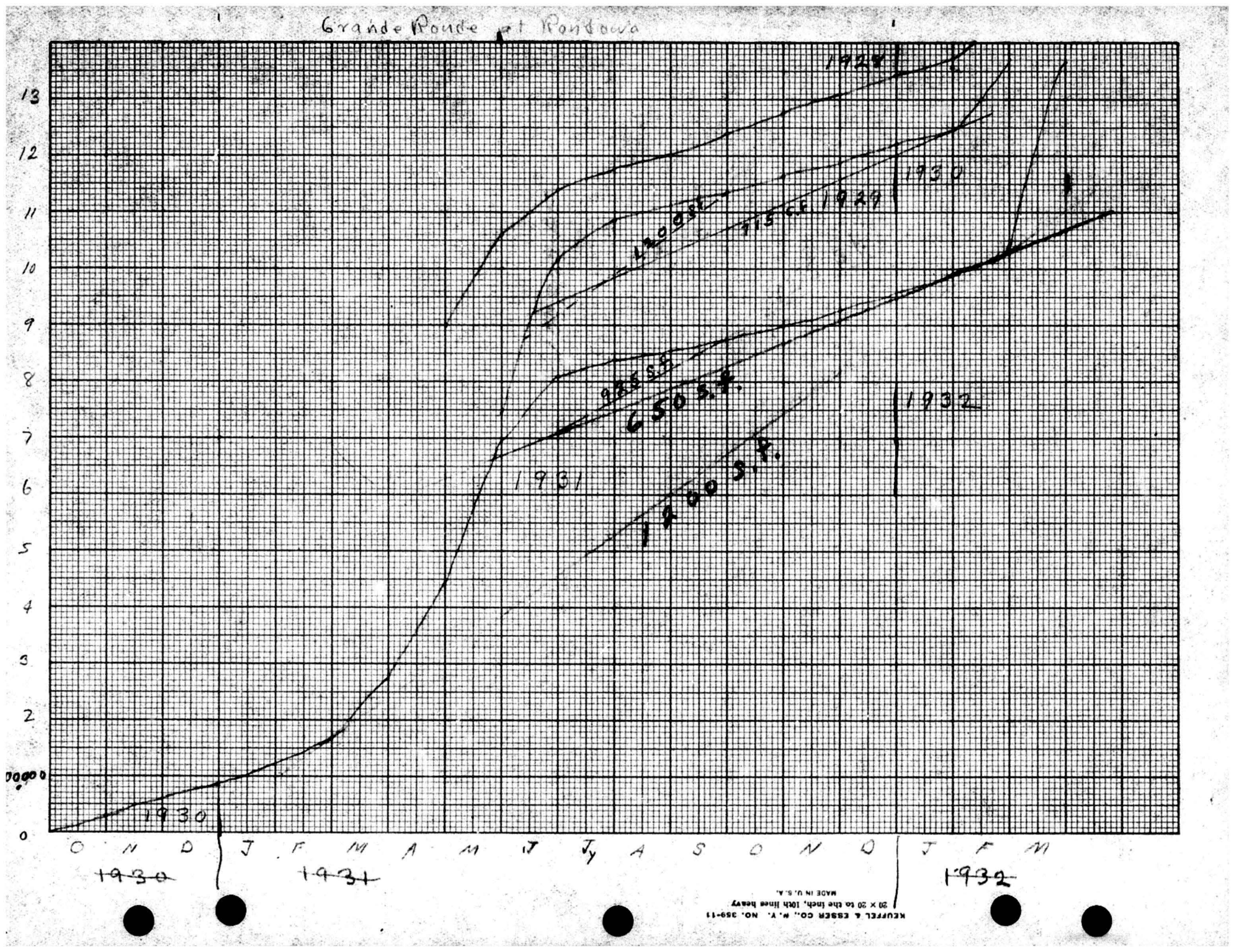






1744-45


Flow sec ft (S=.002)
Inches d/dia.
Q
KEUFFEL & ESSER CO., N.Y. NO. 359-11
20 X 20 to the inch, 10th lines heavy
MADE IN U.S.A.


Grande Ronde at Rondowa
1928
1930
1929
1931
1932
13
12
11
10
9
8
7
6
5
4
3
2
1
0
O N D J F M A M J J A S O N D J F M
1930
1931
1932
KEUFFEL & ESSER CO., N. Y. No. 359-11
20 × 20 to the inch, 10th line heavy
MADE IN U.S.A.

Residual

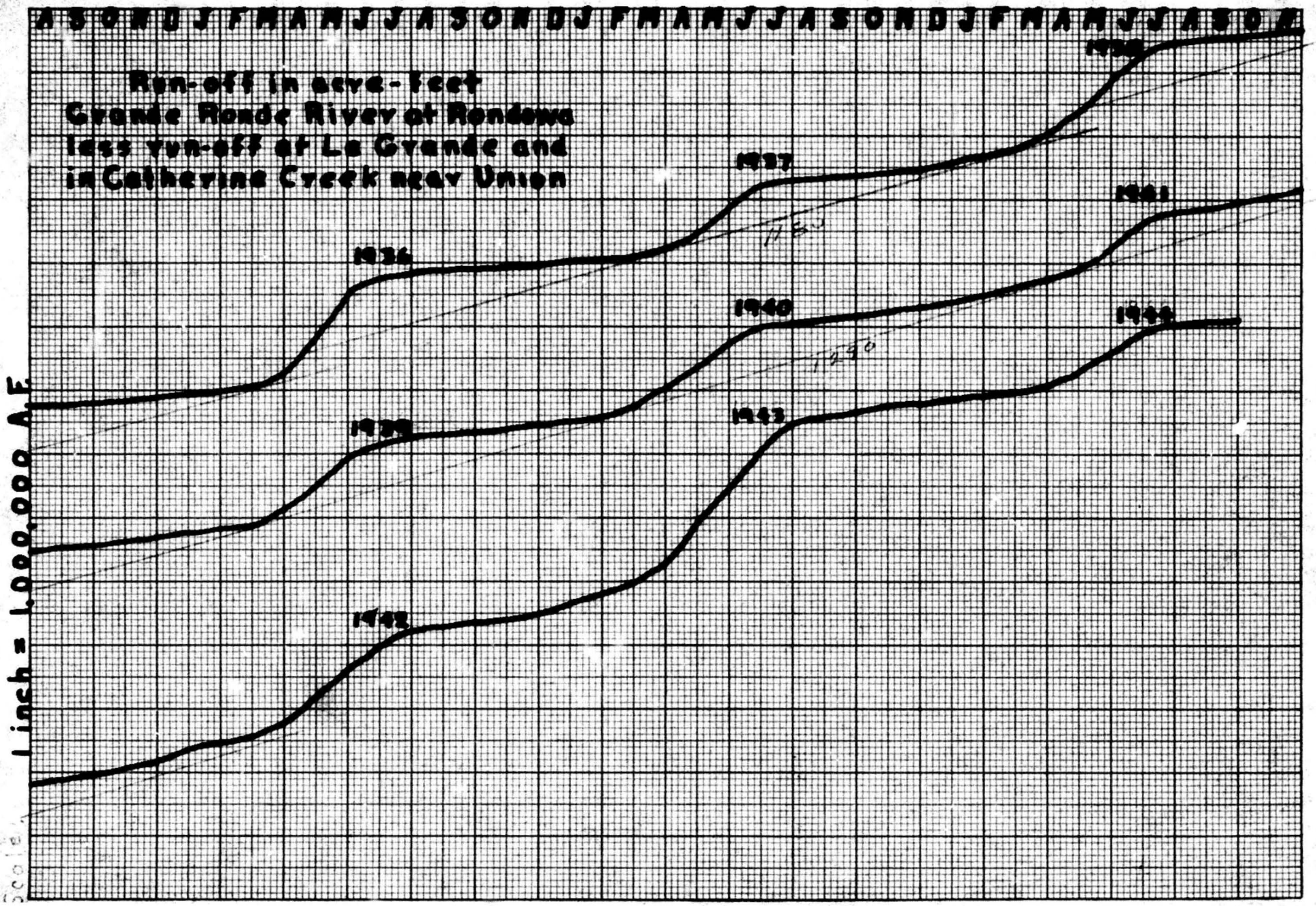
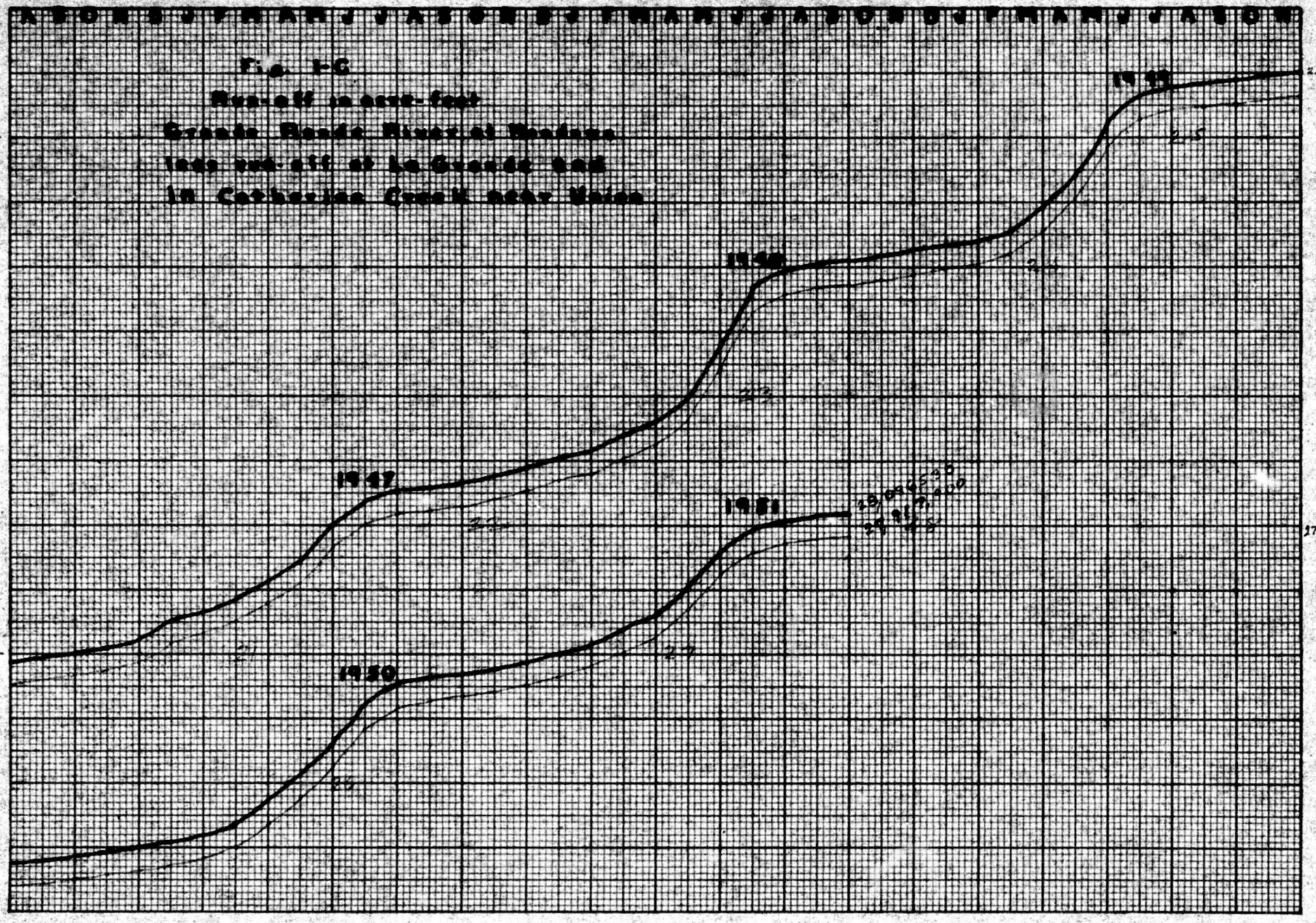
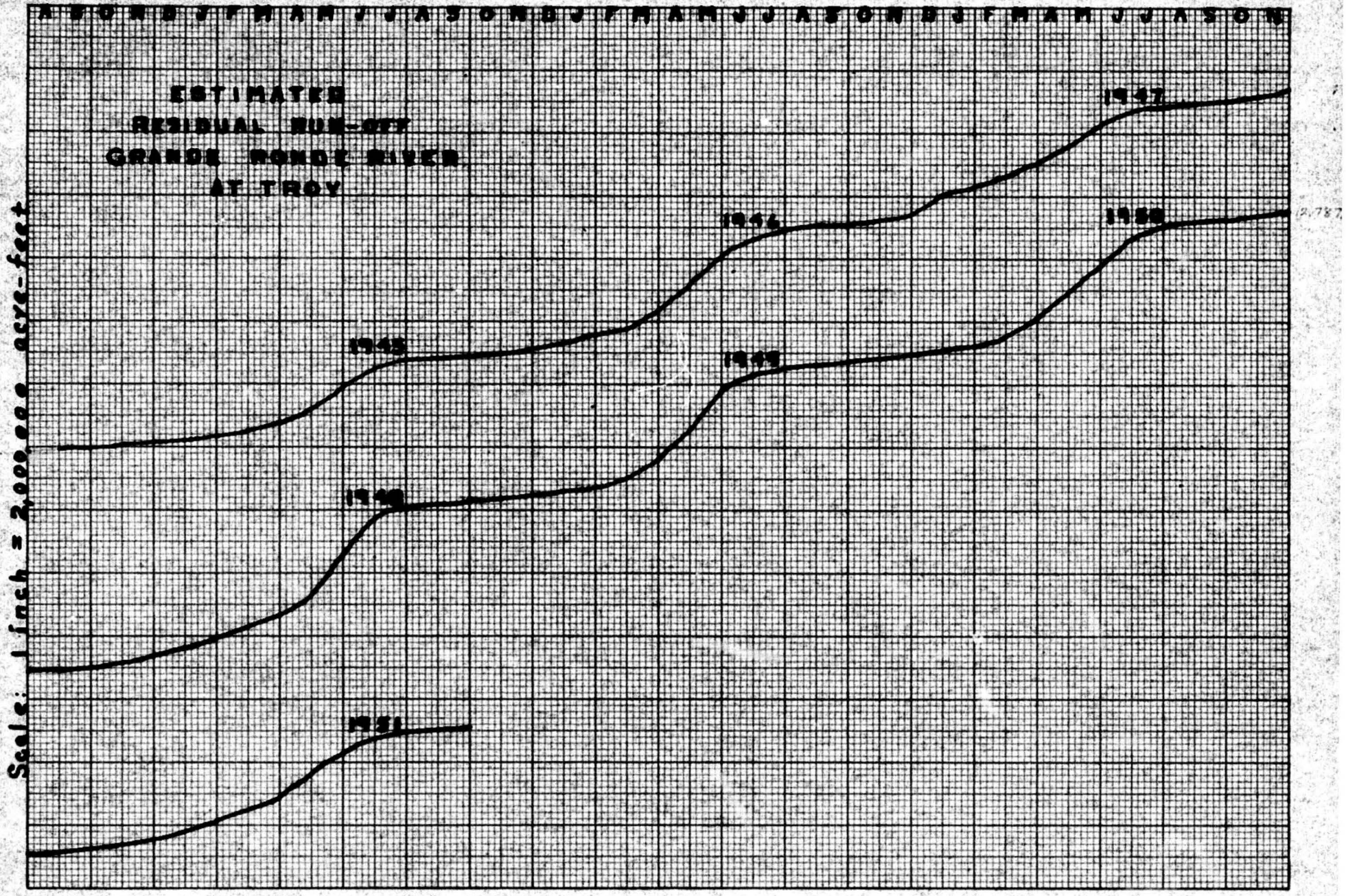
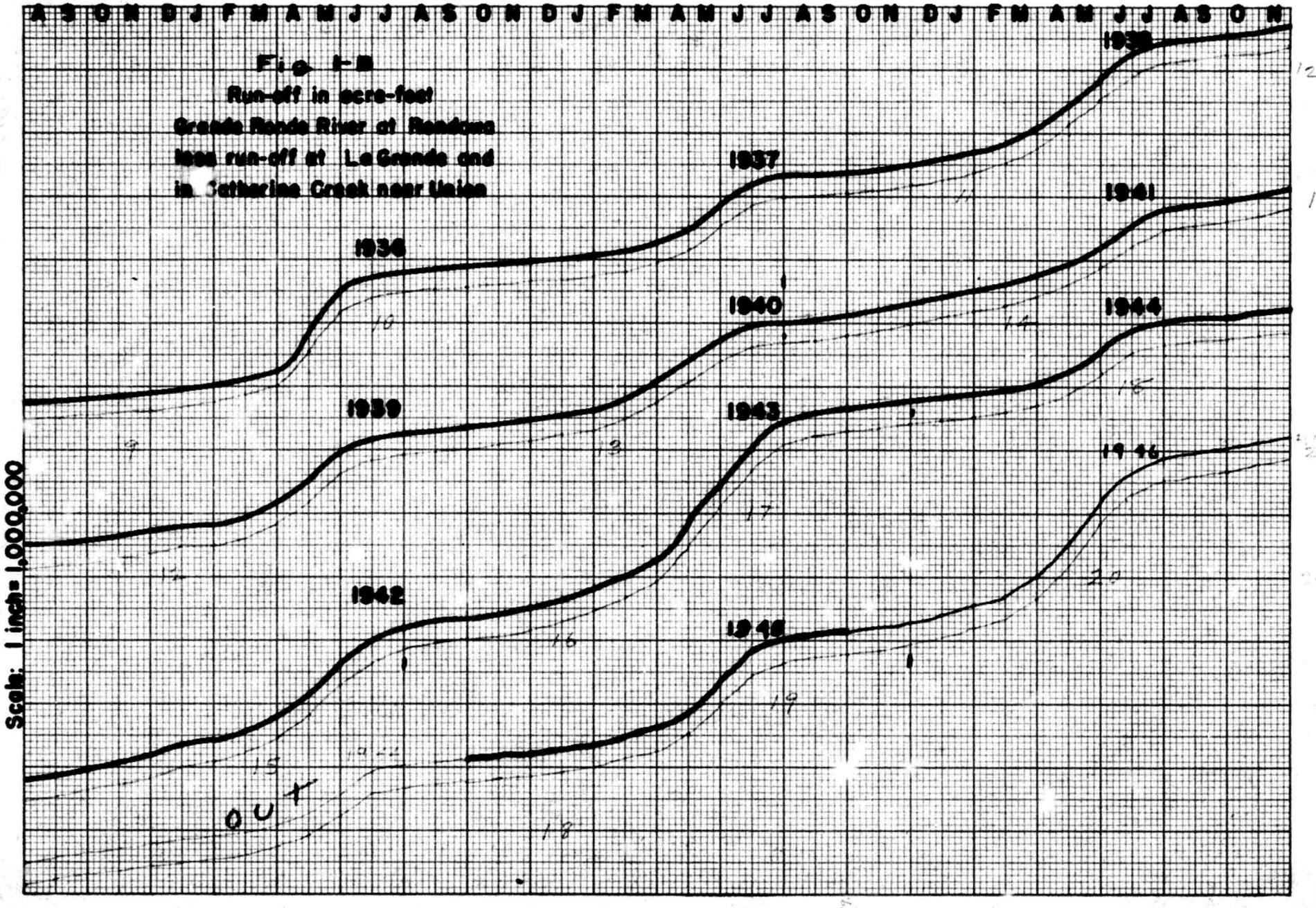
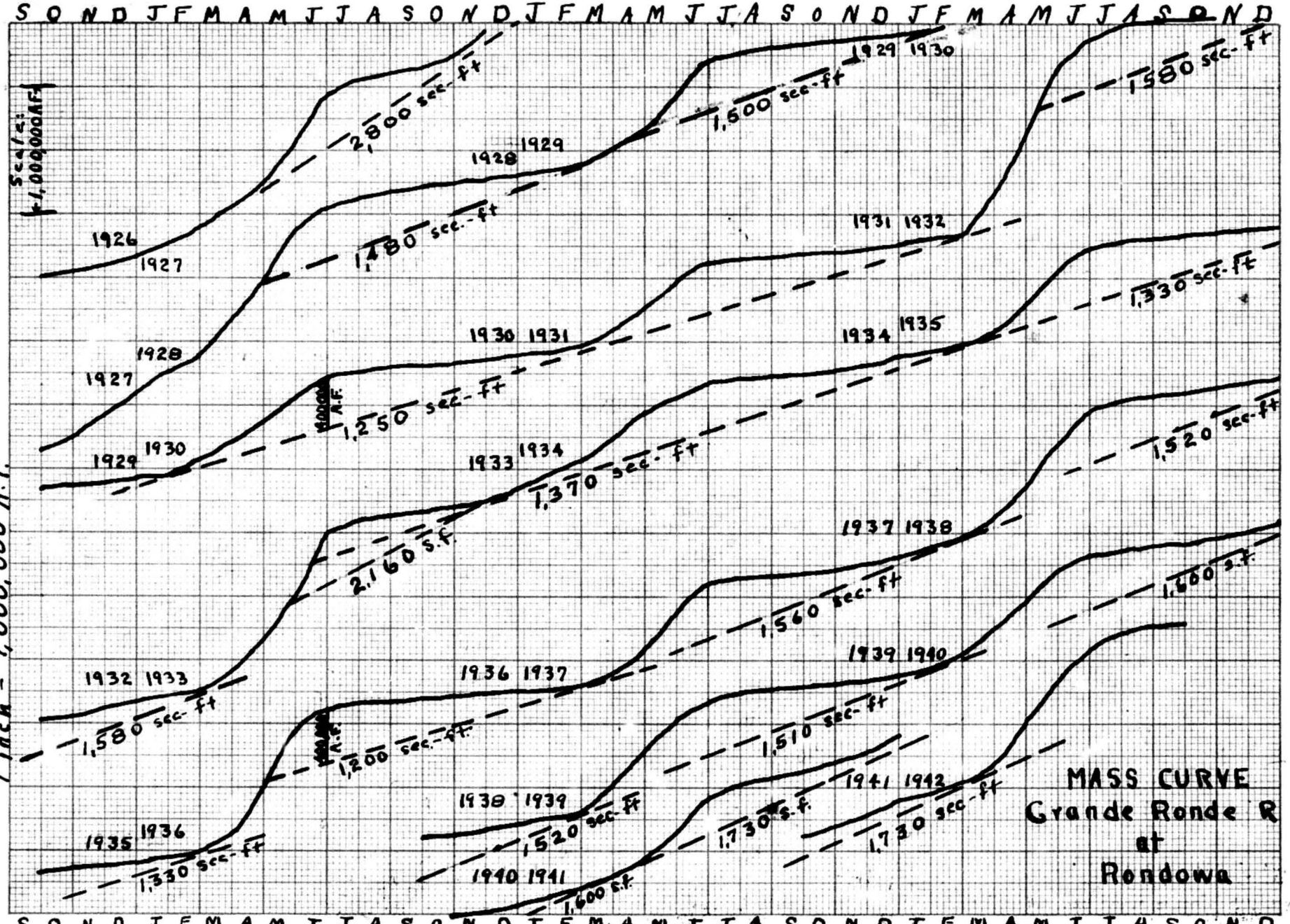


Fig 1-C



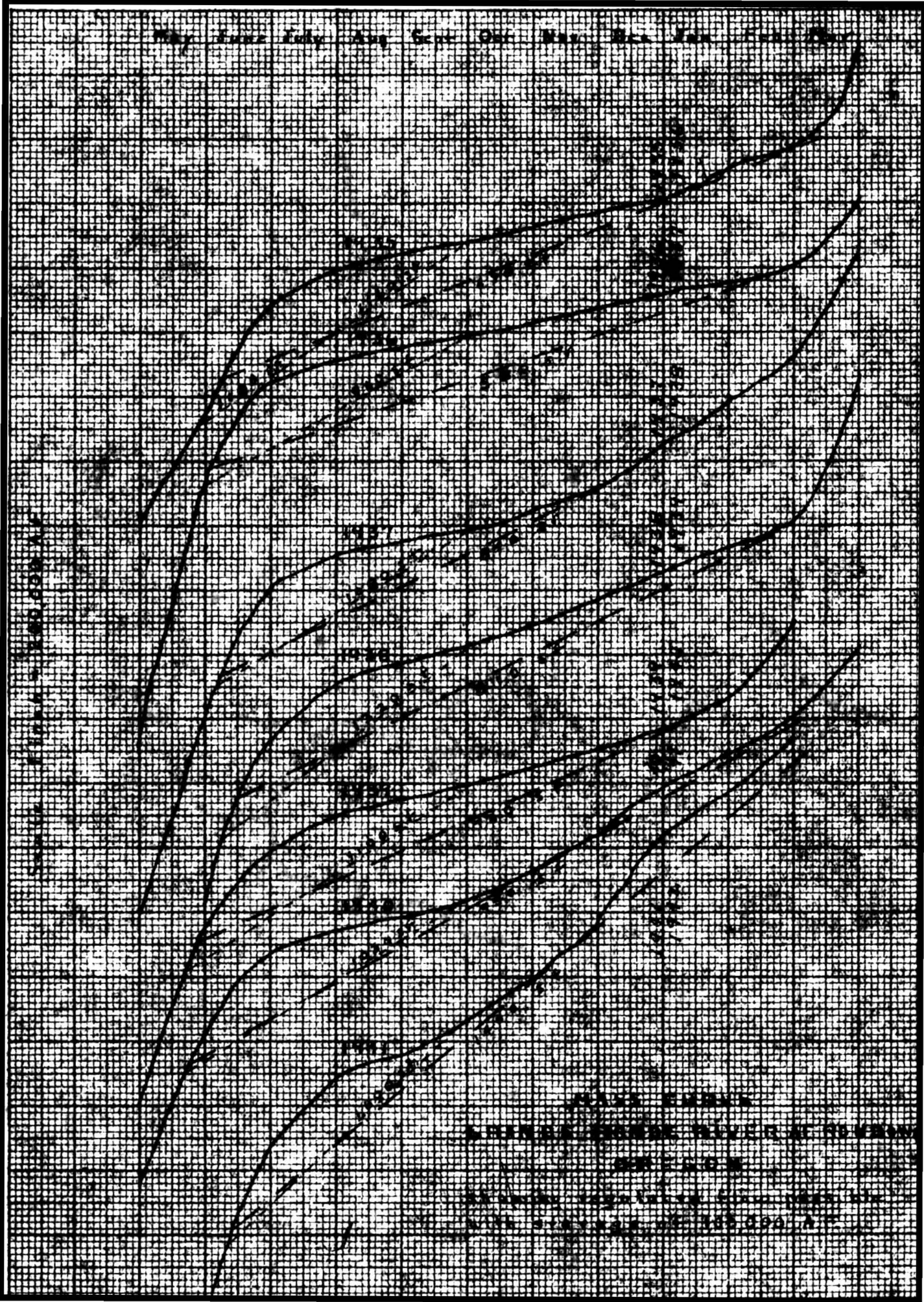




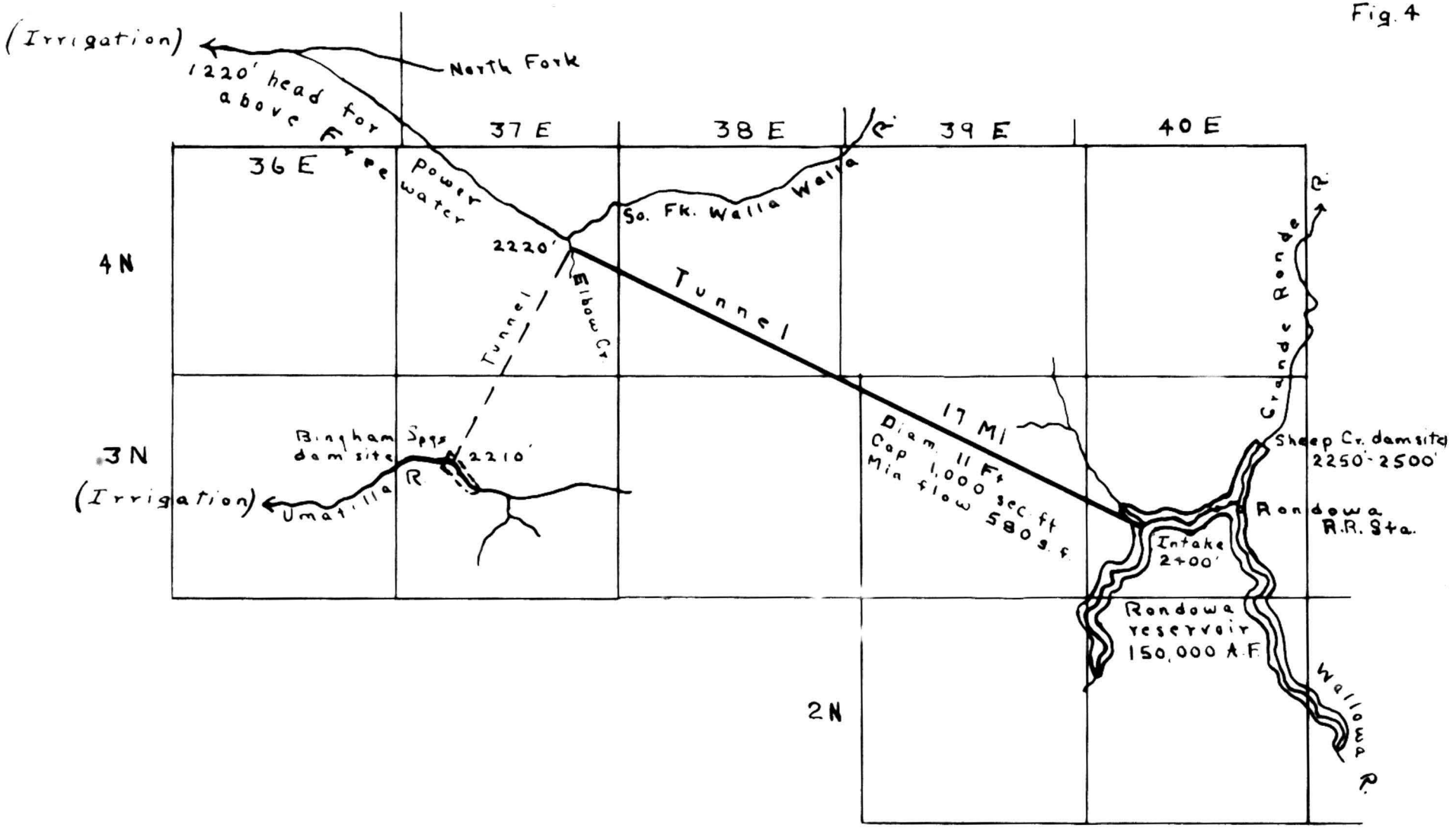


NOTE: Use curves make no allowance for evaporation and seepage losses.
Use curves based on storage of 400,000 A.F.

ROH




May Jun Jul Aug Sept Oct Nov Dec Jan Feb Mar Apr
MASS CURVE
OREGON
ROH



MAP OF SECTIONS OF GRANDE RONDE WALLA WALLA AND UMATILLA RIVERS SHOWING A PLAN FOR DIVERSION FOR POWER AND IRRIGATION

R.D.H. 1-6-44

Sec. 1-4 (mean)

	Oct	Nov	Dec	May	July	Aug	Sept
Troy	603	713	685	7,676	1895	703	676
Rondout	462	548	463	5843	1603	543	494
Diff.	141	165	222	1833	292	160	182

Gr Rondout at Rondout	Umatilla R	
1960	305	July 5 1928
1500	268	"
732	206	29
1740	314	March 11, 1930

Comments

Have read the report, and have only a few minor comments:

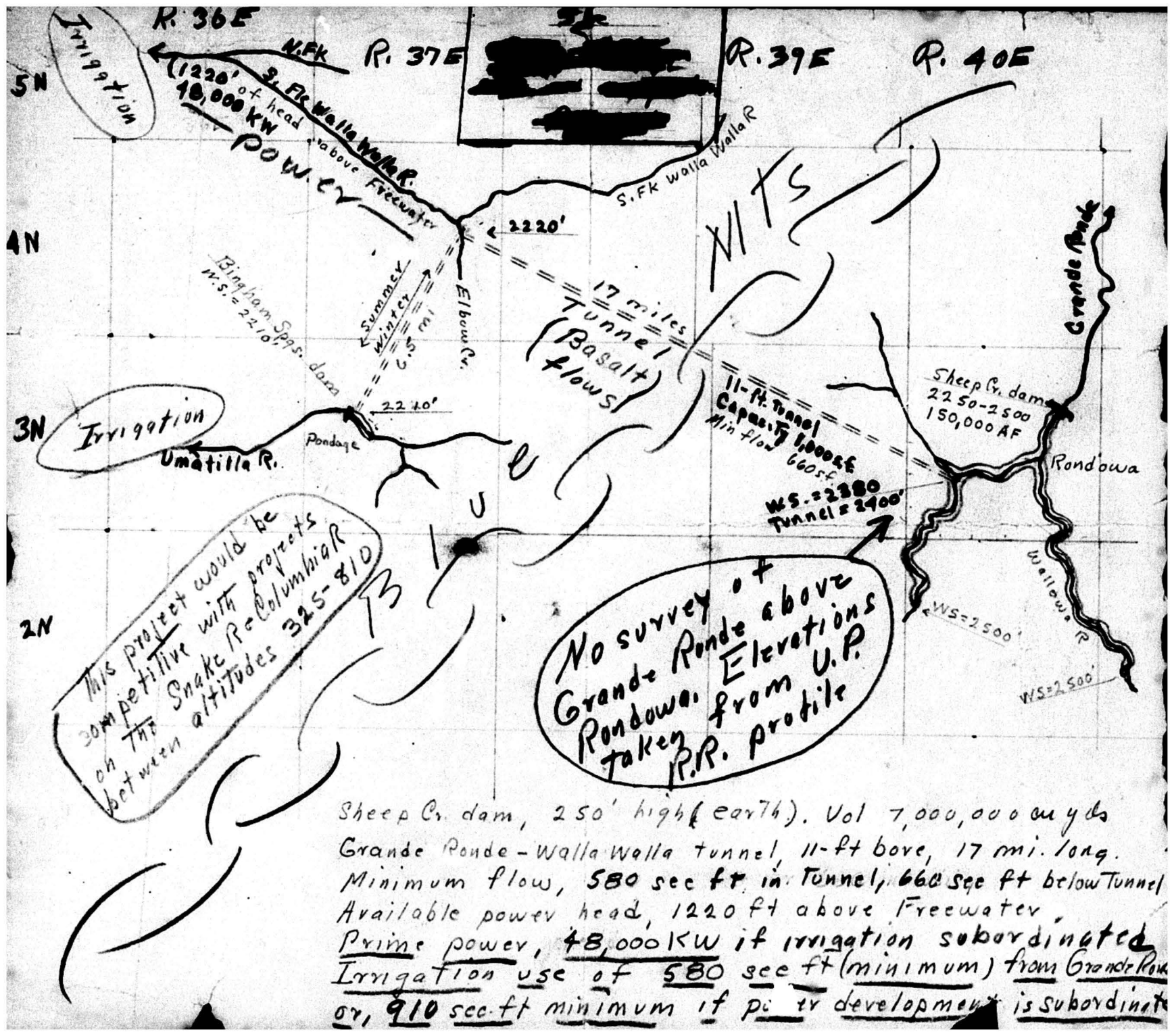
1. On pages 1 and 5 -- and a couple other places are references to the peaks in the Wallowa Mountains being snow-capped throughout the year, resulting in a more sustained late-summer flow in Wallowa River than in Grande Ronde River above the mouth of the Wallowa R. I lived in the Wallowa River valley for many years, and as I recall, the peaks that were visible from the valley usually were bare by late summer. I have climbed those mountains in various places in mid- and late-summer, and encountered no snow except isolated drifts on sheltered slopes. I am not questioning Mr. Holland's comparison of the low-flow characteristics of the Wallowa and Grande Ronde Rivers (above their junction), but I am wondering whether he is not implying an over-emphasis on the late-summer contribution from the snow remaining in the Wallowa Mountains. Although that contribution may be greater than I realize, I wonder whether it might be that the Wallowa River basin is more absorptive and retentive, and hence contributes more subsurface (and groundwater?) flow during late summer than the upper basin of Grande Ronde River.

2. Wouldn't it be an advantage to plat, on the map the gaging stations listed on page 7, at least the active stations. If both active and inactive stations were platted, a distinguishing symbol could be used. A serial number -- 1, 2, 3, etc -- could be assigned whereby the stations could be identified on the map.

3. In the middle of page 8 a statement is made to the effect that some land "may be receiving too much water for optimum results, and that a smaller supply for these lands would give better results." What is meant, I presume, is that there is plenty of water and the irrigators simply apply too much.* That could be corrected by the exercise of better judgment on the part of the farmer, without any steps being taken to reduce his supply. It is a well-known fact that, when there is no restriction on the use of water, the farmer tends to apply more than he needs, oftentimes to the detriment of his land.

C. D. Bue
12-1-53

* Precisely
ROH



Sheep Cr. dam, 250' high (earth). Vol 7,000,000 cu yds
Grande Ronde - Walla Walla tunnel, 11-ft bore, 17 mi. long.
Minimum flow, 580 cfs ft in Tunnel, 660 cfs ft below Tunnel
Available power head, 1220 ft above Freewater
Prime power, 48,000 KW if irrigation subordinated
Irrigation use of 580 cfs ft (minimum) from Grande Ron
or, 910 cfs ft minimum if pr tr development is subordinate

FORM E-123 ISH 7-46

OREGON
STATE HIGHWAY COMMISSION
SALEM

April 13, 1946

U. S. Department of the Interior
Geological Survey
214-A Old U. S. Courthouse
520 S. W. Morrison Street
Portland 4, Oregon

Attention: Mr. R. O. Helland

Dear Mr. Helland:

Complying with your request of April 11 for plan and profile of the highway between Milton and Athena, we are mailing you today, under separate cover, prints of our map from Athena to Washington State Line, scale 1" = 400', and two profiles covering this section.

The profile drawing No. 4C-20-1 has not been revised to show the new work in the South Milton Section. The profile drawing No. 9C-13-13 is the profile of the revised section from Station 4+22.80.

There will be no charge to you for these maps.

Very truly yours,

C. B. McCullough
Assistant State Highway Engineer

212 Old U. S. Courthouse
Portland 4, Oregon
March 5, 1945

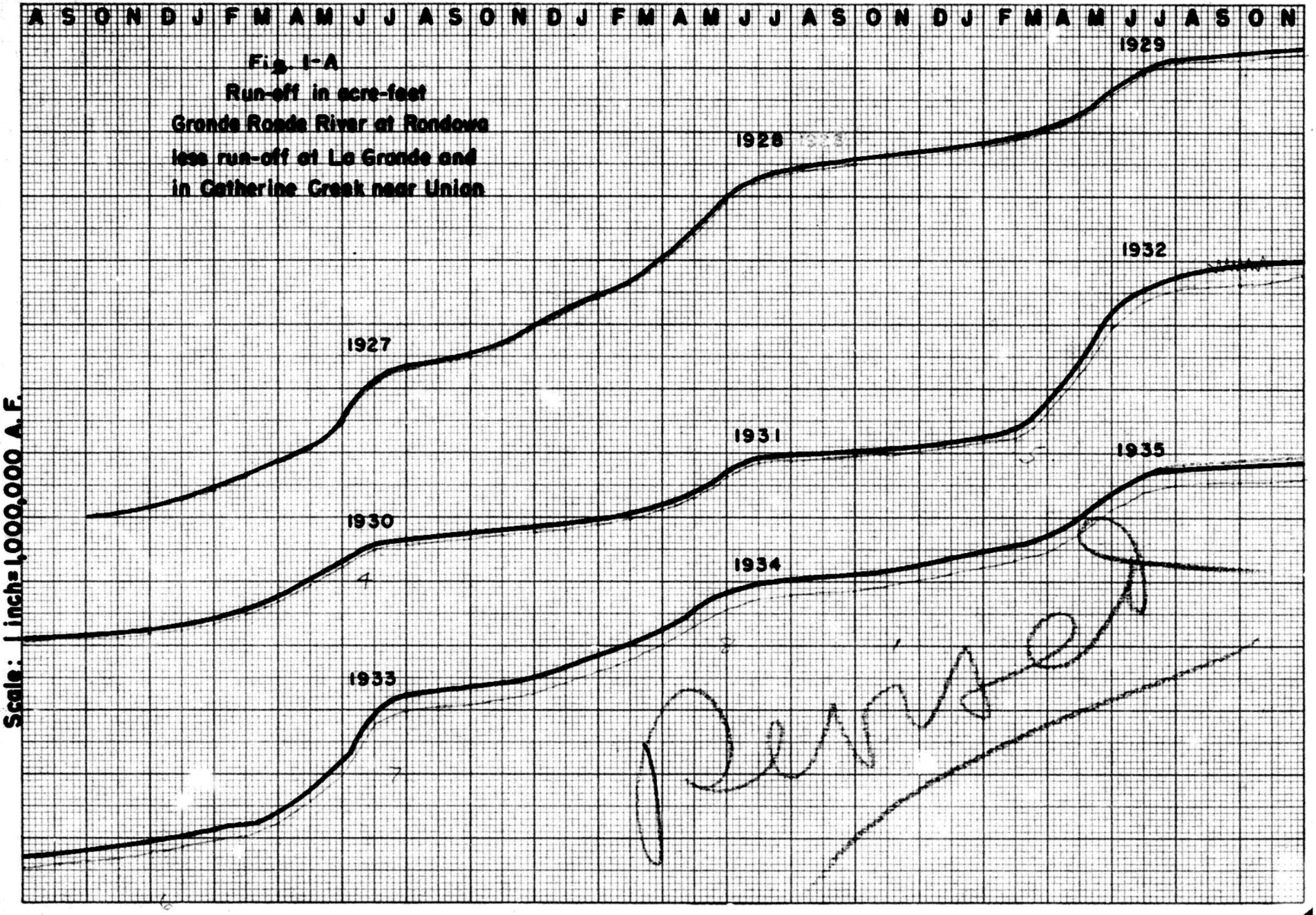
Mr. F. C. Hart, Engineer,
Bureau of Reclamation,
P.O. Box 499,
Grants Pass, Oregon.

Dear Mr. Hart:

Thank you for your letter of March 3, 1945, relating to proposed diversions from Grande Ronde River for irrigation: Your letter arrives in sufficient time so that full use can be made of the information therein, which is much appreciated.

Very truly yours,

R. O. HELLAND,
Hydraulic Engineer.



9-207a. July 1937

Daily Gage Height, in Feet, and Discharge, in Second-Feet, of TOUCHET **River**

Near TOUCHET, WASH. **for the Year Ending September 30, 1942**

Drainage Area 736 **Square Miles. Water-Stage Recorder** Stevens continuous **Ratio** 1.6

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

WATER RESOURCES BRANCH

1942

Gage Read to ______ **Once / Twice a Day by** Orval Warner

File Number Washington **District** 568

Used rating table dated Nov. 26, 1941; Mar. 2, 1943

Gage heights used to half tenths between 3.4 **and** 4.8 **feet; hundredths below and tenths above these limits.** above 4.1 (11-26-41)

Day	October Gage height	October Discharge	November Gage height	November Discharge	December Gage height	December Discharge	January Gage height	January Discharge	February Gage height	February Discharge	March Gage height	March Discharge
1	1.96	38	2.11	58	2.30	90	a	b 110	3.56	482	2.45	156
2	1.98	40	2.10	56	2.28	87	(2.18)	90	3.75	552	2.46	158
3	1.98	40	2.10	56	3.315	386	2.52	70	3.67	516	2.62	198
4	2.28(1) 2.61(7)	144	2.15	64	3.37	338	3.02	50	4.045	659	2.56	183
5	2.31	92	2.17	68	3.24	299	3.09	40	4.60	[12] [13] 861	2.51	170
6	2.20	72	2.12	60	3.325	337	2.81	[11] 40	4.28	750	2.48	163
7	2.13 [8]	61	2.11	58	3.33	325	3.13	60	3.93	623	2.46	158
8	2.12	60	2.10	56	3.15	275	3.43	90	3.64	516	2.45	156
9	2.13	61	2.09	55	3.02	243	3.78	100	3.46	448	2.50	168
10	2.10	56	2.08	53	2.92	220	3.90	100	3.34	411	3.445	450
11	2.09	55	2.09	55	2.81	195	3.93	90	3.25	382	3.68	534
12	2.07	52	2.09	55	2.71	173	3.70	90	3.17	357	3.78	569
13	2.08	53	2.10	56	2.64	159	3.75	80	3.09	332	3.61	499
14	2.07	52	3.095 [9]	319	2.63	156	3.65	80	3.00	305	3.47	448
15	2.06	51	3.55 4.03	458	2.765	189	3.40	80	2.93	285	3.48	465
16	2.05	49	4.07	633	3.685	521	3.17	70	2.89	273	3.33	408
17	2.04	48	3.73 [10]	471	4.10 3.75	558	3.28	70	2.79	245	3.32	405
18	2.04	48	3.25	302	4.14 4.22	688	3.31	70	2.70	220	3.22	372
19	2.06	51	3.03	245	4.56	902	3.19	70	2.66	209	3.13	344
20	2.08	53	2.86	206	4.28	739	3.12	70	2.64	204	3.07	326
21	2.07	52	2.74	180	4.02	600	2.88	70	2.63	201	3.07	326
22	2.06	51	2.65	161	3.72	466	2.91	70	2.60	193	3.11	338
23	2.05	49	2.56	142	3.66	442	2.84	70	2.56	183	3.04	317
24	2.05	49	2.51	131	3.37	338	3.05	80	2.53	176	2.97	296
25	2.05	49	2.46	121	3.18	283	3.41	80	2.52	173	2.91	279
26	2.06	51	2.41	111	3.04	248	4.995	100	2.48	163	2.86	262
27	2.07	52	2.38	105	2.85	200	6.135	b 450	2.46	158	2.78	242
28	2.08	53	2.36	102	2.76	184	4.515	824	2.46	158	2.74	231
29	2.15	64	2.34	98	2.73	178	3.87	587	~		2.69	217
30	2.19	71	2.32	94	2.66	163	3.60	499			2.69	217
31	2.14	63			2.60	b 130	3.42	431			2.70	220
Total		1,780		4,629		10,112		4,781		10,035		9,275
Mean		57.4		154		326		154		358		299
Second-feet per square mile												
Run-off in inches												
Run-off in acre-feet		3,530		9,180		20,060		9,480		19,900		18,400
Maximum		144		633		902		824		861		569
Minimum		38		53		87		40		158		156

Day	April Gage height	April Discharge	May Gage height	May Discharge	June Gage height	June Discharge	July Gage height	July Discharge	August Gage height	August Discharge	September Gage height	September Discharge	Year
1	2.88	270	2.48	163	2.79	245	2.82	254	1.80	29	1.72	19	
2	3.08	329	2.50	168	2.62	198	2.65	206	1.80	29	1.72 [17]	19	
3	3.05 [14]	320	2.46	158	2.55	180	2.51	170	1.79	28	1.72	19	
4	3.00	305	2.50	168	2.48	163	2.40	144	1.78	27	1.72	19	
5	2.98	299	3.08	329	2.44	154	2.34	130	1.76	24	1.71	18	
6	2.98	299	2.88	270	2.41	146	2.32	126	1.75	23	1.71	18	
7	2.96	293	2.83	256	2.39	142	2.24	108	1.74	22	1.71	18	
8	2.92	282	2.79	245	2.38	139	2.20	100	1.73	21	1.70	17	
9	2.88	270	2.92	282	2.38	139	2.15	90	1.73	21	1.70	17	
10	2.88	270	3.10 3.55	408	2.45	156	2.11	82	1.72	19	1.70	17	
11	2.89	273	3.31	401	2.38	139	2.08	76	1.71	18	1.70	17	
12	2.91	279	3.35	414	2.37	137	2.07	74	1.70	17	1.71	18	
13	2.91	279	3.38 [15]	424	2.31	123	2.07	74	1.68	15	1.72	19	
14	2.97	296	3.25	382	2.26	113	2.04	69	1.67	14	1.72	19	
15	2.96	293	3.14	347	2.25	110	2.02	65	1.67	14	1.72	19	
16	2.87	268	3.22	372	2.29	119	2.10	80	1.66	13	1.72	19	
17	2.96	293	3.07	326	2.28	117	2.14	88	1.66	13	1.71	18	
18	2.91	279	2.97	296	2.24	108	2.15	90	1.66	13	1.71	18	
19	2.82	254	2.89	273	2.22	104	2.09	78	1.66	13	1.71	18	
20	2.76	237	2.81	251	2.20	100	2.03	67	1.66	13	1.72	19	
21	2.74	231	2.73	228	2.17	94	2.01	63	1.66	13	1.72	19	
22	2.73	228	2.92d	282	2.15	90	1.98	58	1.66	13	1.73	21	
23	2.73	228	5.40d	1,170	2.12	84	1.92	47	1.67	14	1.73	21	
24	2.67	212	3.05d	320	2.09	78	1.90	44	1.67	14	1.73	21	
25	2.66	209	3.08	314	2.16	92	1.89	42	1.67	14	1.73	21	
26	2.61	196	3.315	410	f 3.03	314	1.86	38	1.67	14	1.72	19	
27	2.57	186	3.08	329	a	800	1.85	36	1.67	14	1.72	19	
28	2.54	178	2.92	282	a	630	1.84	35	1.68	15	1.72	19	
29	2.56	183	2.84	259	a	460	1.83	34	1.68	15	1.72	19	
30	2.50	168	2.81	251	f 3.00 [16]	305	1.82	32	1.69	16	1.72	19	
31			2.74	231			1.82	32	1.71	18			Year 1942
Total		7,707		10,009		5,779		2,632		546		563	67,848
Mean		257		323		193		84.9		17.6		18.8	186
Second-feet per square mile													
Run-off in inches													
Run-off in acre-feet		15,290		19,850		11,460		5,220		1,080		1,120	134,570
Maximum		329		1,170		800		254		29		21	1,170
Minimum		168		158		78		32		13		17	13

Max. G. H. 7.92 ft. at 8 a.m. on May 23

Min. G. H. 1.66 ft. on Aug 15-23

Maximum discharge 2260 Sec.-ft. at 8 a.m. on May 23 (G. H. 7.92 ft.)

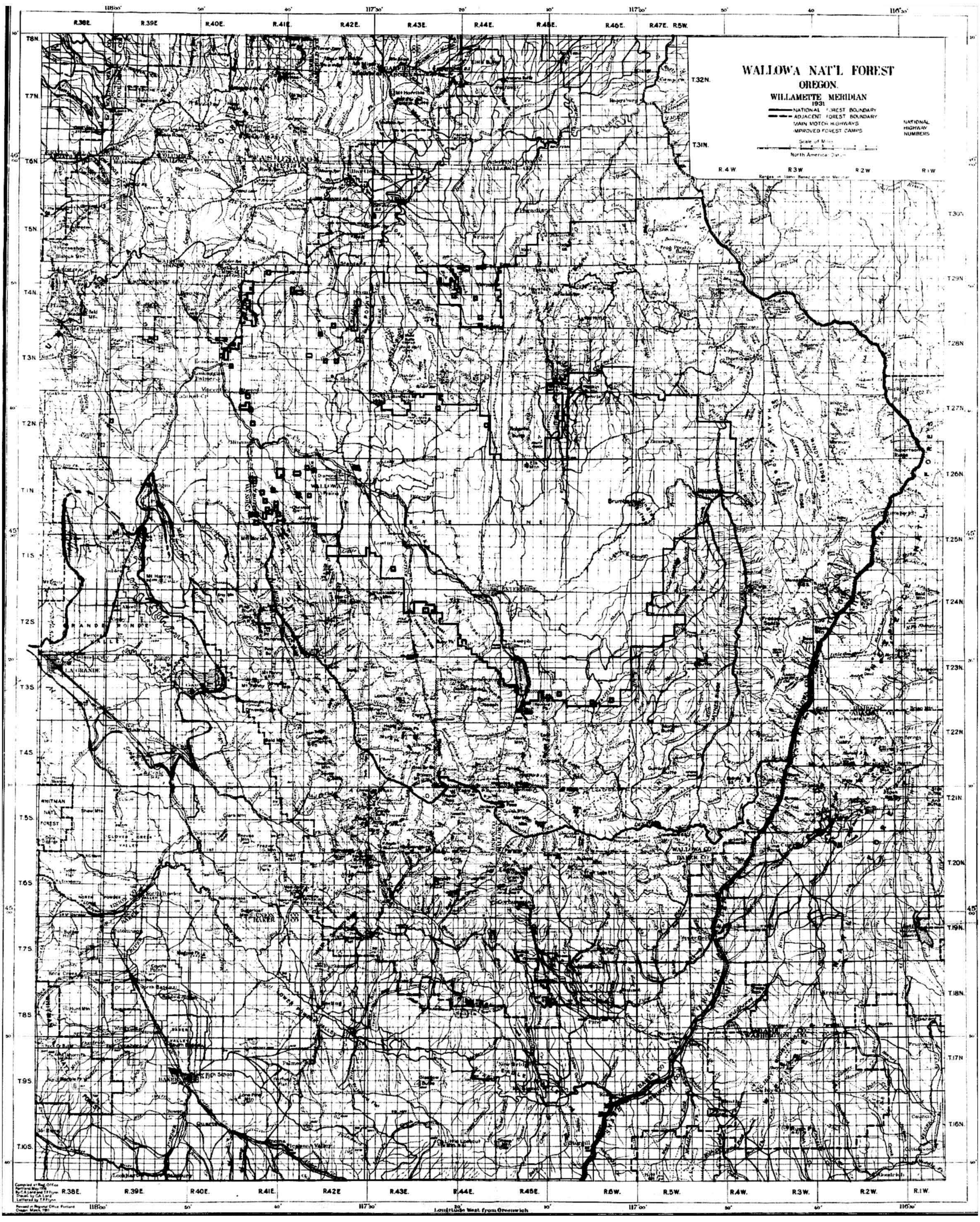
Minimum discharge 13 Sec.-ft. on Aug 15-23 (G. H. 1.66 ft.)

a Discharge obtained by averaging discharge for intervals of a day

b No gage-height record, discharge computed on basis of records for ... Touchet R. ...

d Shifting discharge relation ... affected by ice

Computed / Checked / Date: 3-17-43; 3-8-43; 3-2-43


WALLOWA NAT'L FOREST
OREGON.
WILLAMETTE MERIDIAN
1931
NATIONAL FOREST BOUNDARY
ADJACENT FOREST BOUNDARY
MAIN MOTOR HIGHWAYS
IMPROVED FOREST CAMPS
NATIONAL HIGHWAY NUMBERS
Scale of Miles
North American Datum
R.38E.
R.39E.
R.40E.
R.41E.
R.42E.
R.43E.
R.44E.
R.45E.
R.46E.
R.47E.
R.5W.
R.4W.
R.3W.
R.2W.
R.1W.
R.6W.
T.8N.
T.7N.
T.6N.
T.5N.
T.4N.
T.3N.
T.2N.
T.1N.
T.1S.
T.2S.
T.3S.
T.4S.
T.5S.
T.6S.
T.7S.
T.8S.
T.9S.
T.10S.
T.32N.
T.31N.
T.30N.
T.29N.
T.28N.
T.27N.
T.26N.
T.25N.
T.24N.
T.23N.
T.22N.
T.21N.
T.20N.
T.19N.
T.18N.
T.17N.
T.16N.
LA GRANDE
ENTERPRISE
WALLOWA CO.
BAKER CO.
WHITMAN NAT'L FOREST
Longitude West from Greenwich

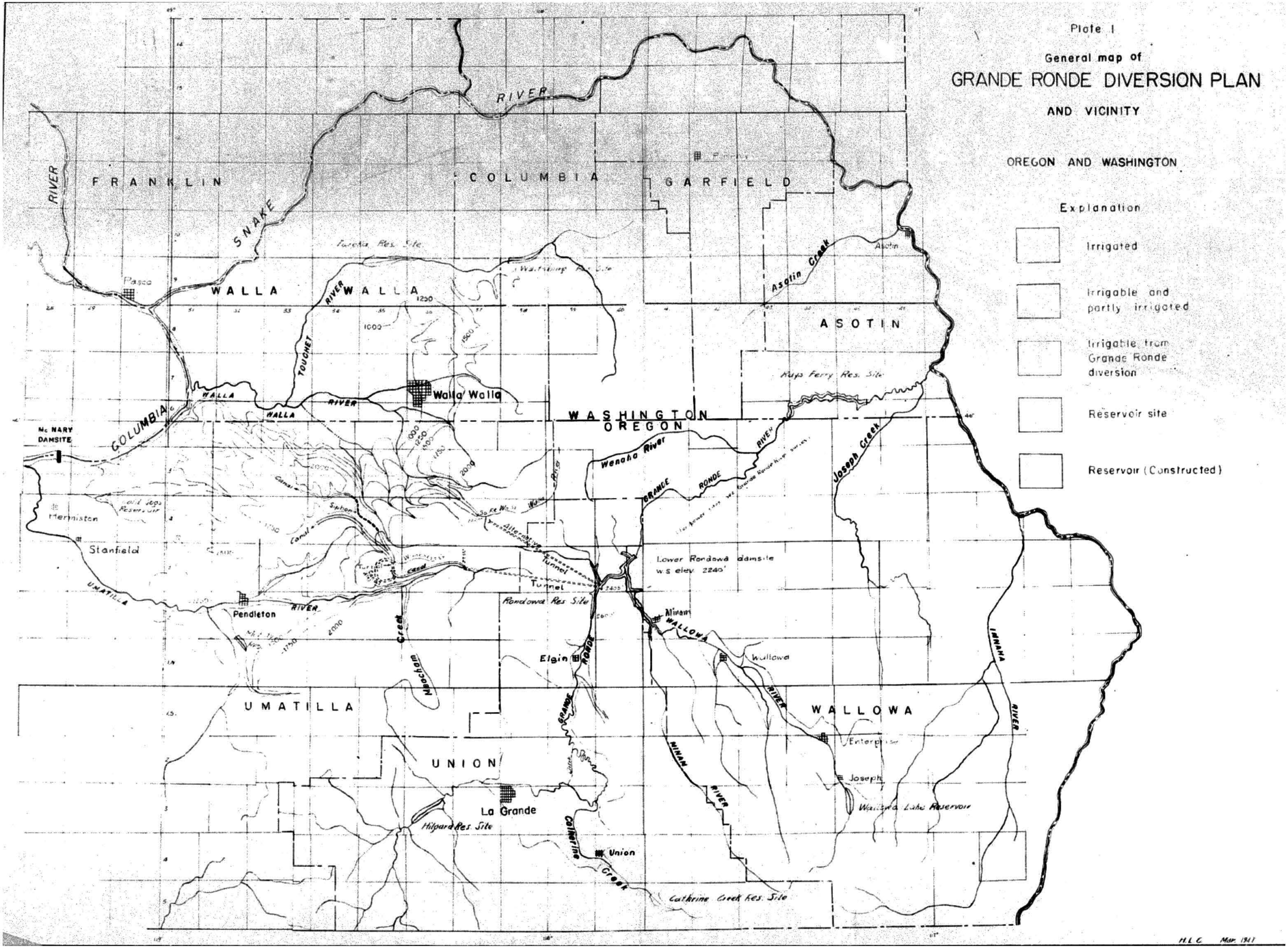
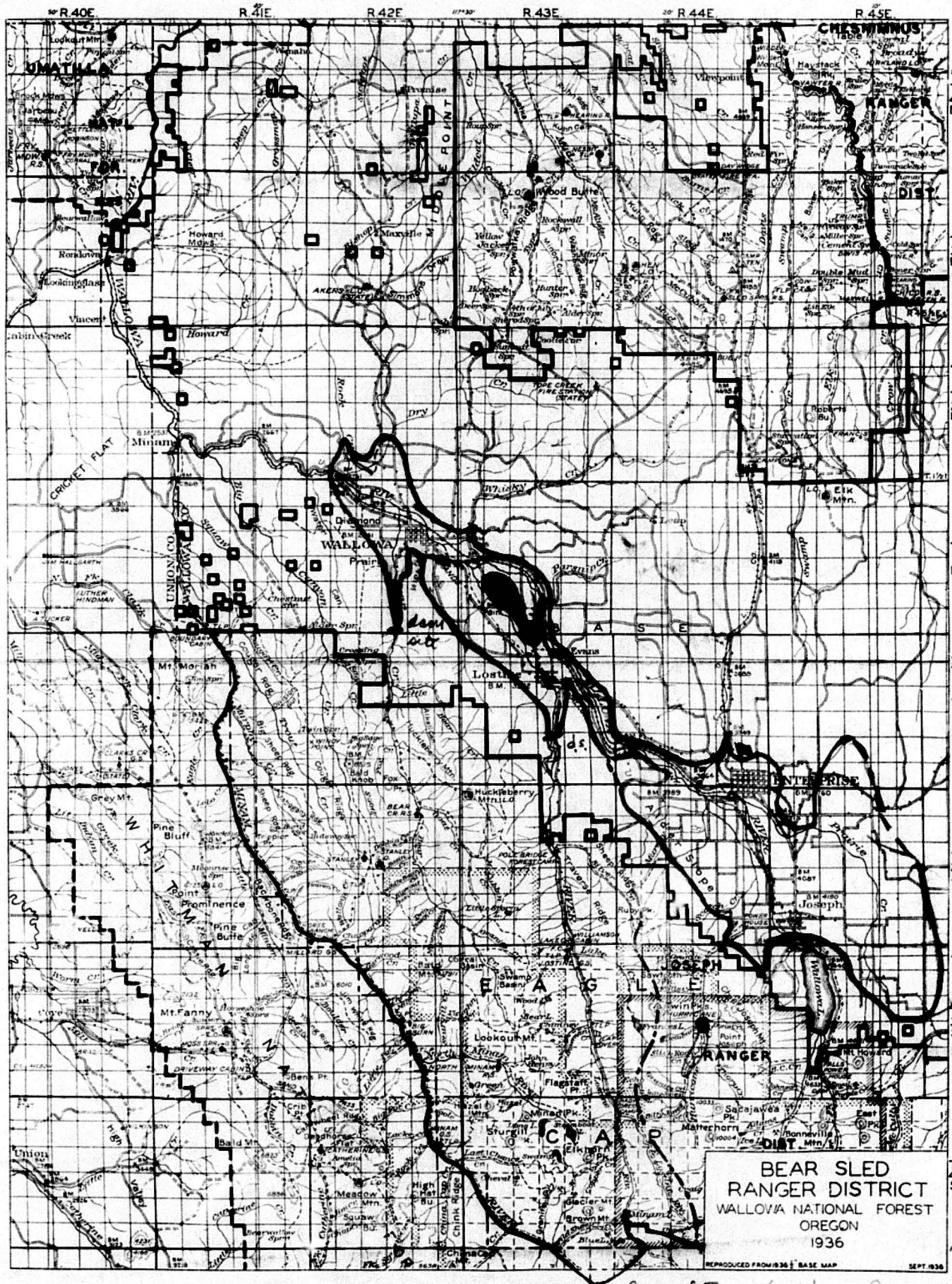


Plate I
General map of
GRANDE RONDE DIVERSION PLAN
AND VICINITY
OREGON AND WASHINGTON
Explanation
Irrigated
Irrigable and partly irrigated
Irrigable from Grande Ronde diversion
Reservoir site
Reservoir (Constructed)
FRANKLIN
COLUMBIA
GARFIELD
WALLA WALLA
ASOTIN
WASHINGTON
OREGON
UMATILLA
UNION
WALLOWA
SNAKE RIVER
COLUMBIA RIVER
WALLA WALLA RIVER
TOUCHET RIVER
UMATILLA RIVER
GRANDE RONDE RIVER
WALLOWA RIVER
MINAM RIVER
IMNAHA RIVER
Asotin Creek
Joseph Creek
Wenaha River
Catherine Creek
Meacham Creek
Mc NARY DAMSITE
Pasco
Walla Walla
Asotin
Hermiston
Stanfield
Pendleton
Elgin
Minam
Wallowa
Enterprise
Joseph
La Grande
Union
Eureka Res. Site
Rogers Ferry Res. Site
Cold Springs Reservoir
Rondowa Res. Site
Lower Rondowa damsite w.s. elev. 2240'
Tunnel
Alternative Tunnel
Canal
Siphon
Hilgard Res. Site
Wallowa Lake Reservoir
Cathrine Creek Res. Site
H.L.C. Mar. 1941



~ = approx. limits of irrigable area in Wallowa River basin except for minor patches.

Dam site on Hurricane Cr. was about 1 mile below Thorpe Cr. and 1 mile above Falls Cr. A 100-ft dam might store 10 to 15 thousand A.F.

9-284 April, 1932

UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY (WATER RESOURCES BRANCH)

HYDROGRAPH FOR Grande Ronde R. at Troy (Boise) and Pondosa, Ore. (Automatic recorder) 1944-45

File No. { Washington / Field

47-32

October | November | December | January | February | March | April | May | June | July | August | September

Second-Feet

Plotted by..... Checked by..... Date.....

See Bul 8, Wenatchee R. surf. wtrs, p 493