

Rural Domestic water supply

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To be included with  
the preliminary draft  
of Subproblem 12,  
Problem No. 28

RURAL DOMESTIC WATER SUPPLY

Means to Minimize the Financial Commitments  
of Rural Settlers in Obtaining  
Domestic Water

Tentative Draft  
of Final Report

Subproblem 6  
Problem No. 9b  
Joint Investigations  
Columbia Basin Irrigation Project

Prepared under the Leadership of the  
Washington State Planning Council  
Olympia, Washington

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This tentative draft is submitted for review and criticism.

## FOREWORD

This is one of a series of seven reports on Problem No. 9b of the Joint Investigations, Columbia Basin Irrigation Project. It is concerned with the means that might be adopted or created to minimize the financial commitments of needy settlers in providing suitable rural domestic water supplies.

Leadership for the investigation of this subproblem was assumed by the Washington State Planning Council. The study has been made and the report written by L. J. Crampon with the assistance of Richard Wakefield and James M. Berkey.

Special acknowledgment is given to Arthur Piper, Senior Geologist, United States Geological Survey; H. A. Parker, Irrigation Engineer, United States Bureau of Reclamation; Walter Duffy, Regional Director, Farm Security Administration, Lars Langloe, Hydraulics Engineer, Department of Conservation and Development; and Gerald Hall, Consulting Engineer. Their suggestions and comments have added greatly to this report.

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FINDINGS AND RECOMMENDATIONS

1. The average per unit cost of the well and the pumping equipment required to supply domestic water to the settlers of the Columbia Basin will be at least \$1,000 and may exceed \$2,500.

It is recommended that special attention be given to the water table maps and other aids in order to minimize the cost of the wells and pumping equipment.

It is further recommended that distribution systems and storage equipment be used to permit utilization of the full capacity of each well and so to divide the cost of each among an optimum group of users.

2. The total purchases of equipment during the developmental period will very probably exceed \$4,000,000.

It is recommended that the purchase of equipment be centralized and controlled by a single agent in order to obtain maximum savings from quantity purchases.

3. A proper selection of materials and equipment will reduce the cost per farm served.

It is recommended that particular attention be given to specific requirements in order that the systems may be designed to avoid waste.

It is further recommended that the relative length of life of various materials be considered simultaneously to price quotations in order to obtain a minimum cost per year.

It is further recommended that the cost of maintenance and operation of various equipment be examined and weighed along with initial outlays.

4. Certain machine labor, such as is used in trenching, pipe laying, and backfilling, is less expensive than hand labor.

It is recommended that machine labor be used for these operations in preference to hand labor.

5. The relatively rapid rate of development permits the construction of water systems on a wholesale basis.

It is recommended that, all things being equal, contracts for large units of work be given to private companies but;

It is further recommended that, if greater savings accrue to the individual settlers, the installation be performed by governmental or cooperative agencies.

6. The cost of distributing water per farm served increases with an increase in the distance over which the water must be carried.

It is recommended that the farmstead be located on the section of the farm nearest the well.

It is further recommended that, other factors permitting, e.g., irrigation requirements, the farm plats be arranged and shaped in such a fashion as to provide the shortest possible distance between well and farmstead.

7. The lowest possible cost per service is obtained by combining and equalizing distribution systems so that each will serve those farmsteads to which it can deliver water at the lowest cost.

It is recommended that the distribution systems be equalized between the wells.

8. With an increase in the number of farms served, the cost per farm of the well and the pumping equipment will decrease whereas the cost of distributing the water will increase.

It is recommended that adequate studies and tests be made in the field to discover the optimum number of farms that can be economically supplied by any given well and that the systems be constructed in light of such findings.

It is further recommended that such studies and tests be modified by the actual experiences of early settlers in drilling wells in the districts.

9. The administrative and bookkeeping expenses of the agency operating the systems can be reduced by combining these functions with those of other agencies supplying similar public needs.

It is recommended that these functions be combined with those of another agency, e.g., the agency supplying irrigation water.

10. Economies result from the reduction of unnecessary use and waste of water.

It is recommended that water meters be installed at each service to reduce such wastes.

INTRODUCTION

Problem No. 9b of the Joint Investigations, Columbia Basin Irrigation Project, poses the question: "What feasible means could be adopted or created . . . to minimize the financial commitments of needy settlers in providing suitable and essential improvements?" One improvement needed by every rural settler is a domestic water supply.

The problem thus set forth is one of developing certain principles that will enable the settlers to obtain water at the lowest possible cost. The report is not an attempt to state exactly the cost of a specific domestic system. Any definite costs or prices included are only for the purpose of proving or explaining various suggestions.

A. The Demand for Domestic Water

The supply of water should be sufficient (1) to satisfy the personal demands of the settlers including the operation of plumbing facilities, (2) to water livestock, (3) to occasionally sprinkle lawns and small gardens, (4) to process farm products, and (5) to provide some fire protection. Although the total daily requirement of the average farm may be only 200 gallons during the early years, it will expand to probably 1,500 gallons during mature development.<sup>1</sup> Table No. 1 on page 4 presents an estimate of the amount that will be required to satisfy these needs of several classes of rural consumers. In the table, for example, the consumption of dairy cattle includes water used in the milk house. To supply the peak demands and provide some fire protection, the essential minimum should be 5 gallons per minute.<sup>2</sup> A pressure of approximately 30 pounds per square inch should be maintained.

B. The Supply of Domestic Water

Irrigation ditches and canals, rivers and creeks, rain catchments, and underground strata are possible sources of water. Ditches and canals could probably furnish water only during the irrigation seasons, and, in common with supplies from rivers and creeks, would require careful filtration and treatment to guard against possible pollution. Except for areas

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<sup>1</sup> Taylor, George C., Jr., Summary of Ground-water Conditions in Parts of the Columbia Basin Project Area with Respect to Development of Domestic and Livestock Water Supplies, p 1. Note: He suggests 1,000 gallons as the ultimate maximum. Walter A. Duffy, Farm Security Administration, in a letter to P. Hetherton, May 20, 1942, states, "During summer months, the garden and lawn will require substantial amounts of water, probably five gallons per minute for an average of six hours per day. Some provision should also be made for processing farm products. If a dairy enterprise is engaged in, provisions must be made for more water than is shown."

<sup>2</sup> Farm Security Administration, Region XI, Analysis of Plans and Costs for Domestic Water Supplies and Farm Buildings Plan of Joint Investigation, Columbia Basin Irrigation Project, Problem 9 (preliminary report) p 4.

Table I  
ULTIMATE DAILY RURAL WATER CONSUMPTION  
(in gallons)

Consumers	Average Number On Farm/a	Consumption per Head/b		Total Consumption	
		Low	High	Low	High
Human	4	40	85	160	340
Livestock					
Dairy Cattle	24	20	25	480	600
Other Cattle	33	6	10	198	330
Hogs & Pigs	26	2	3	52	78
Horses	5	7	10	35	50
Sheep	45	1	1.5	45	68
Chickens	150	0.025	0.025	4	4
TOTAL				974	1,470

/a This is the mean of the number estimated to be on the farm for which land-use maps have been prepared by the Soil Conservation Service in conjunction with the Bureau of Agricultural Economics.

/b Consumption per head has been estimated based upon the following sources:  
 Taylor, George C., Jr., Summary of Ground-water Conditions in Parts of the Columbia Basin Project Area with Respect to Development of Domestic and Livestock Water Supplies, p 1.  
 Pittsburg Steel Company, Fence Guide, p 14.  
 Fairbanks, Morse, and Company, 1933 Shallow and Deep Well Equipment Catalogue, p 83.

adjacent to the Columbia River, Rocky Ford Creek, and Moses Lake, the topography limits the possibility of these sources. Rain catchments are excluded by the low annual precipitation, the long-term average for seven stations in or near the Basin being only 8.0 inches per annum. <sup>1</sup>

The remaining choice is to tap the underground supplies. The occurrence, movements, quantities, and qualities of these waters have been assigned for special study to investigators of Problem No. 22. They report that residents of the Quincy Basin and the Wahluke and Pasco slopes have stated that the ground waters are pleasing to taste and satisfactory for all purposes including human consumption. They also report that the underlying strata are capable of yielding sufficient capacities to sustain community water systems. <sup>2</sup>

<sup>1</sup> Parker, H. A., Irrigation Engineer, Bureau of Reclamation, in a letter to P. Hetherton, dated May 14, 1942 in which he quoted the study made in connection with Problem No. 4 of the Joint Investigations. Washington, "The Evergreen State", published by the Secretary of State, Olympia, 1938, listed 9 stations in the Basin at which the mean average precipitation varied from 4.64 inches at Pasco to 9.22 inches at Hatton.

<sup>2</sup> Taylor, op. cit., pp 3-7. Note: Janssen, N.C., Ground Water Conditions in the State of Washington, 1937, asserted that in certain areas, as the uplands that form the east margin of the Quincy Basin, the unconsolidated materials are above the regional zone of saturation and are not water-bearing.

The existing 8-inch wells<sup>1</sup> vary from 5 to more than 80 gallons per minute in capacity and from 50 to 587 feet in depth. The water level is between 30 and 400 feet below the surface.<sup>2</sup> Though depth is an important factor, the cost of a well also depends upon the difficulty of drilling, the amount of casing required, the necessary transportation of equipment, and the availability of skilled labor. These factors are usually combined in a unit cost per foot of finished well which has varied from \$5.00 to \$7.00.<sup>3</sup> To this must be added the cost of the pump unit which increases directly with the depth to water and the rate at which the water is lifted. Estimates of costs of pump units for wells of varying capacities and water levels, are presented in Table II, page 6. This pump unit includes the pump, pump motor, drop pipe, cylinder, rod, pressure tank, and connecting piping.

If the water is to be carried from the well to the farm, the cost of the pipe and labor must be added. The cost of 1½-inch galvanized pipe is \$.15 a foot.<sup>3</sup> To dig the trench, lay the pipe, and fill the trench by machine will cost \$.05 a foot.<sup>4</sup> If distributing to more than one farm, larger pipe may be required.

This report concerns itself with the means to reduce financial commitments. The selection or suggestion of the agency or agencies that will secure adoption of the recommendations and will insure economic maintenance and operation of the systems is the subject of a subproblem of Problem No. 28.

<sup>1</sup> The necessity of reducing the size of the casing as the depth of the well increases makes an 8-inch diameter at the surface the minimum size that will insure a diameter at the water level sufficient to receive the drop pipe and cylinder.

<sup>2</sup> Taylor, *op. cit.*, pp 4-6. Note: Although artesian flows have been found in the Cold Creek district of Benton County, they are not expected in the Basin. N. C. Jensen has stated that some wells may be as deep as 1,000 feet, but A. M. Piper believes that this is probably excessive for the greater part of the area for wells yielding no more than 50 gallons per minute.

<sup>3</sup> Taylor, *op. cit.*, p 7, and Farm Security Administration, *op. cit.*, p 4. Note: Parker, H. A., Irrigation Engineer, Bureau of Reclamation, in a letter to P. Hetherton, September 18, 1941, and Langloe, Lars, Hydraulics Engineer, Washington State Department of Conservation and Development, suggest a graduated scale inferring that the cost of drilling the first 100 feet is less than the last. For example, the cost of drilling the first 100 feet might be \$300; the second 100 feet, \$400; the third 100 feet, \$500, etc. A. M. Piper in a comment accompanying a letter to P. Hetherton, May 9, 1942, basing his suggestion on the fact that certain of the costs of drilling are relatively fixed, such as cost of moving in, erecting and striking, and that the basalt found in the Basin includes zones that drill rapidly and zones that drill very slowly, stated: "A 100-foot well can encounter a high percentage of dense rock and cost the driller more per foot than a 300-foot well that encounters a high percentage of less resistant rock."

<sup>4</sup> Farm Security Administration, *op. cit.*, p 8 estimates that the cost of machine trenching would be two cents per foot. Parker, H. A., *op. cit.*, estimated that the cost for backfilling should be about one-half that amount, or one cent per foot. The estimate of two cents for laying pipe is his but he states in a letter to P. Hetherton, May 14, 1942, "This would apply only to steel pipe and not to transite or cast iron which would be considerably higher."