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December 7, 1939

OFFICE OF INDIAN AFFAIRS
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UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF INDIAN AFFAIRS
IRRIGATION SERVICE

ASSISTANT DIRECTOR
OF IRRIGATION
EIGHTH & FIGUEROA BLDG.
LOS ANGELES, CALIF.

Navajo
Hopi Mesas

Irrigation
~~9065-36~~

File 9056-D
WJT

December 7, 1939

Mr. A. L. Wathen
Director of Irrigation
Office of Indian Affairs
Washington, D.C.

Dear Mr. Wathen:

Receipt is acknowledged of your letter of November 28 requesting me to make a study of the question of pumping water to the various Hopi Mesas and give you my reactions and a rough estimate of cost.

I appreciate your statement that I am a great deal more familiar with the Hopi country than anyone else in the Service, but feel that it is necessary to decline the honor because of the fact that my familiarity only extends to about a half-dozen brief visits.

I am not quite clear as to whether you wish me to make a field study and survey, or whether my personal reactions and ideas as to cost are what you desire at this time.

As you know, there are three Hopi Mesas - First, Second and Third, separated by broad valleys and large washes:

First Mesa, on the east, is some 8 miles east of Second Mesa, and Third Mesa is about 12 miles northwest of Second Mesa.

First Mesa lies between Polacca Wash and Wepo Wash and includes the villages of Walpi, Hano and Tewa on top, with Polacca at the eastern base.

Second Mesa lies between Wepo and Oraibi Washes. Here are the villages of Mishongnovi, Shipaulavi and Shungopovi on top, with Toreva at the eastern edge.

Third Mesa lies between Oraibi and Dinnebito Washes and includes the villages of old Oraibi, Bacobi and Hotevila, with the new town of Oraibi on the eastern slope.

Polacca and new Oraibi, also Tewa I believe, being located near the foot of the Mesas, have been provided with domestic water in connection with the schools.

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RG 75, BIA
CCF 9056-1936-341, Part D
Hopi
Box 20

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The above names are taken from the latest Navajo map. There seems to be some confusion in regard to the names of the villages. The Annual Cost Statement in Superintendent Fryer's Supplemental Report for 1939 shows Chimopovy, Oraibi and Toreva schools, on which construction had been done on water development in the amounts of $1,715, $5,815 and $2,139, respectively, all prior to 1939. This is the same as in the Annual Cost Statement June 30, 1938. The District 5 Annual Report for 1932, Vol. 1, page 89, shows that a spring was redeveloped and a concrete storage reservoir constructed for the Chimopovy day school on the Second Mesa; also a spring was redeveloped and a concrete reservoir built and a new pump and gasoline engine installed at the Toreva day school. The Statistical Supplement to the Commissioner's Annual Report for F.Y. 1938 lists Indian schools as follows: Chimopovy, 95 children, 6 to 18 years; Hotevila-Bacobi, 171; Oraibi, 210; Toreva, 122; Polacca, 245. It was my understanding that there were only three villages on each Mesa, aside from the newer towns located below, and I am unable to clarify the apparent location of Chimopovy as being on the Second Mesa, unless the name has been changed on the map.

Assuming that we are to supply domestic water to all the villages on top of the Mesas, it would appear to be necessary to provide at least one good well for each Mesa. It is possible that water could be developed by the gravel-screen caisson process near the main washes, but it is more likely that it would be necessary to drill a deep well in each case. In this event, two alternatives suggest themselves: The first would be to drill the wells in the bottoms of the valleys and pump the water through pipe lines to the tops of the Mesas. The second is to drill wells directly on top of the Mesas at some central point for each group of villages. The latter possibility is believed to have considerable merit because it would avoid the long pipe lines and consequent friction losses and future maintenance required under alternative No. 1. I do not know whether it is probable that water could be secured in sufficient quantity by wells so located, but it is believed that the same water-bearing strata could be tapped at these points as would be found under the valleys. Considerable geological study would be advisable before reaching a decision on this point. It would be very helpful to have the advice of Mr. A. H. Womack, formerly and for many years in charge of water development on this reservation, now retired; also Mr. John J. Schwartz, supervisor of water development under the Navajo jurisdiction; and others who have had actual experience in well drilling in this vicinity.

If the first alternative is followed, a deep-well pump and storage tank would be necessary at each well, with a booster pump and a long pipe line to deliver the water to a central storage tank on each Mesa, in addition to which a distribution line to each village and several outlet stands would be required.

Assuming that water could be developed by drilling on top of the Mesas, at least three wells would be required. A storage tank should be provided at each well and a booster pump and pipe line probably would be required to deliver the water to the various villages, and several outlet stands should be supplied in each village.

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Supplying water to the several villages on the three Mesas is not at all a simple proposition. In the first place, the wells would likely have to be several hundred feet deep, even in the valleys; and, if drilled from the tops of the Mesas, would be several hundred feet deeper. The villages, except on First Mesa, are widely scattered, some of them several miles apart, and the terrain is very rough and rocky. The pipe lines would have to be laid up steep slopes over rough, rocky ground, and, in the case of Second and Third Mesas, probably would have to be two or more miles in length. The pipe lines should be covered to prevent freezing and excessive expansion and contraction, and to do so in that rough ground would be very expensive. The pipe lines themselves, if of steel, would be subject to considerable deterioration, depending upon the quality of the water, and if of cast iron would be still more expensive.

It is, of course, impossible, with so many undetermined factors, to give much of an idea of the cost. There are no surveys showing the detailed topography of this country from which to locate pipe lines or to determine the actual pumping lift, or even the depth at which water might be encountered.

Before a program of this kind is undertaken it is believed that it would be advisable, in fact necessary, to have a geologic study made to determine the probability of securing water in sufficient quantity and of suitable quality, and to make sufficient surveys to determine the pump lift, amount of water available or required & to locate the necessary pipe lines with reference to the villages on each Mesa, including tank sites.

I hesitate to submit even a guess as to the probable cost without such information, but realize that you would like to have some idea. I am therefore outlining a rough estimate of the various items for which I think it might be possible to provide a water supply:

Alternative No. 1 - Valley Wells.

3 Wells, 400 ft. deep, at $3,000 each	$ 9,000
3 Deep-Well Pumping Plants, gasoline driven, 20 g.p.m., at $1,800 each	5,400
3 - 10,000-gal. Concrete Tanks near Wells, at $500 each	1,500
3 Booster Pumps, gasoline powered, 20 g.p.m., with 400 ft. lift, at $1,000 each	3,000
6 miles of 2" Pipe Mains at 30¢ per ft.	9,500
6 miles of Pipe Laying at $750 per mile	4,500
3 miles of 1-1/4" Pipe Distribution Lines at 20¢ per ft.	3,200
2 miles of 1" Pipe Laterals at 15¢ per ft.	1,600

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5 miles of Pipe Laying at $600 per mile	$ 3,000	
3 - 50,000-gal. Concrete Storage Tanks on Mesas, at $2,000 each	6,000	
3 Pump Houses and Derricks at $1,000 each	3,000	
25 Hydrant Boxes at $20.00 each	500	
Total	$ 50,200	
Engineering and contingencies, 20 per cent	9,800	$ 60,000

Alternative No. 2 - Mesa Wells.

If the drilling of wells directly on the Mesas is found feasible, the cost of the wells would be increased and the lower storage tank, booster pumps and main pipe lines could be eliminated, making the cost somewhat as follows:

3 Wells, 700 ft. deep, at $6,000 each	$ 18,000	
3 Deep-Well Pumping Plants, gasoline driven, at $2,500 each	7,500	
3 - 50,000-gal. Concrete Storage Tanks at $2,000 each	6,000	
3 miles of 1-1/4" Pipe Distribution Lines at 20¢ per ft.	3,200	
2 miles of 1" Pipe Laterals at 15¢ per ft.	1,600	
5 miles of Pipe Laying at $500 per mile	2,500	
3 Pump Houses and Derricks at $800 each	2,400	
25 Hydrant Boxes at $20.00 each	500	
Total	$ 41,700	
Engineering and Contingencies, 20 per cent	8,300	$ 50,000

This indicates considerable saving in first cost by putting the wells on the Mesas, and it is certain that there would be a great saving in operation and there would be much convenience in having them so located.

As to the advisability of providing pumped domestic water for the Hopi villages on the Mesas, I can only say that, to me, it would seem even more desirable than in many other places where the inconvenience of not having water readily available does not work such a hardship.

Here, the population is quite concentrated in the various villages (total number of Hopis is given as 3,325, the majority of whom, I believe,

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live on the Mesas). Water at the sources is scarce and must be hauled many miles over roads that are none too good and up onto the high Mesas. Water consumption under such conditions is limited, the extent and hardship of such limitation can hardly be appreciated by any one who has always been used to an unlimited supply from faucets at every hand.

However, Indians who have been accustomed to hauling water and using it sparingly may not appreciate or desire such modern service. In fact, after water was first provided in pipes at Polacca and it was proposed to install a booster pipe line to the village of Walpi, high on the cliffs above Polacca, the Indians objected. It is understood that they did so on the ground that their women, who for ages had carried the water up the hill on their backs, would lose their vigor and be reduced to idleness and gambling in their leisure hours. Since then I believe most of the water is hauled in wagons by the men, and perhaps they would welcome piped water. Certainly there is a splendid opportunity for conservation of man-power and providing for more general use of water for domestic purposes and improvement of sanitary conditions thereby.

There is attached a print of part of a map of the Navajo country, showing the Hopi villages, for convenient reference.

If you so desire, I will follow up this matter and have a careful field investigation made, at which time more information can be secured as to the actual elevation of the Mesas, and the distances involved, and the cost of well drilling, pumping equipment, pipe lines, etc., can be more accurately estimated.

Copy of this letter is enclosed for transmittal to Superintendent Wilson if desired.

Very truly yours,

Herbert V. Clotts

Herbert V. Clotts,
Assistant Director

Enc.

HVC:AC

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