

J. L. Savage  
Consulting Engineer  
1651 Dahlia Street,  
Denver 7, Colorado.

O  
P  
Y

Mr. John S. Cotton,  
Consulting Engineer,  
28 Brookside Drive,  
San Anselmo,  
California.

Dear Mr. Cotton,

This will acknowledge your letter of March 6, 1954, and a letter from Mr. S. Blass, dated March 1, 1954, both relative to your Volume 1 Report dated February 1954, entitled "Plan for the Development and Utilization of the Water Resources of the Jordan and Litani River Basins". It is noted that comments are desired regarding the Volume 1 Report prior to completion of a final draft of the Report.

It happens that these letters and the draft copy of your Volume 1 Report have reached me very shortly after my return from consultation visits in South Africa and Afghanistan, and just before a scheduled visit to the Cleveland Dam in Canada which will be followed by a scheduled visit to projects in Australia, Singapore, Formosa and Japan. With this situation in mind the time available for reviewing your report has been very limited, however, I have read the report carefully and desire to express my general concurrence in the report and particularly in the subject matter of the report as quoted hereinbelow:

#### Pertinent Statements

"Not until recently has serious consideration been given to utilization of the water and power resources of the Jordan and Litani rivers. For centuries these resources have been utilized only in minor degree even though there has always been great need for the water in the region. It would have been possible to utilize much of these resources even with the primitive methods. Why this was not done is not known. Suffice to say that with modern practices all of these resources can be effectively utilized without waste, and that the States of Lebanon, Israel, Syria and Trans-Jordan would benefit in high degree, in perpetuity. In such a unified development, the problems of engineering, finance and construction can in time be surmounted by the concerted efforts of all concerned".

"In scope this report covers the description, precipitation and hydrology of the basins; the amount of usable water; duties of crops; amounts of irrigable lands; irrigation and power developments, and finally the proposed plan of development and utilization, including capital costs, stages of development, annual costs and benefits, and economic feasibility".

"The plan is considered as a whole in this report as far as capital costs, annual costs and benefits, power use and credit are concerned, as it would be futile to divide these intricate costs between the various States at this time. However, the extent of lands to be irrigated and water allotments are shown tentatively for each State".

## Basic Considerations and Objectives

"(a) The water and power resources of the Jordan and Litani river basins are considered in this report. Water resources outside of these basins are not considered.

"(b) Boundaries of the States, i.e. Lebanon, Israel, Syria and the Trans-Jordan, are taken into account.

"(c) Utilization of the water resources of irrigation and power production are not limited by topographic boundaries of river basins.

"(d) Water from high elevation sources are used to irrigate high elevation irrigable lands. Irrigation supply is by gravity, except in a few cases where pumping is necessary or desirable.

"(e) Each State, except Israel, would receive sufficient water to fully supply its economically irrigable lands. In the case of Israel, the amount of irrigable lands far exceeds the water supply.

"(f) Lebanon would be compensated, either in money or electrical energy, for net power benefits foregone due to exporting excess Litani water to the Jordan basin.

"(g) Power produced under the plan would be used for irrigation pumping and the surplus power would be applied as a credit to the cost of all irrigation development.

"The objective of this plan is to develop and utilize, without undue waste, the large quantities of water now not being utilized in the Jordan and Litani river basins, for optimum irrigation and power development in the States of Lebanon, Israel, Syria and Trans-Jordan, and possibly in Gaza Strip".

## Irrigable Areas and Water Duties.

"The States adjoining the Jordan river are water deficiency areas, i.e., the available water resources are not sufficient to irrigate all the available lands. The reverse is true for the Litani river in Lebanon. Water is the limiting factor in agricultural development of the region even though the excess waters of the Litani are utilized. These basic facts necessitate:

"(a) Utilization of all waters in the region even though trans-mountain diversions are required.

"(b) Careful planning of the water conservation and conveyance features, with the view of conserving the meager resources and preventing any avoidable waste.

"(c) Careful determination of the location of the most suitable lands for irrigation regardless of location or water-sufficiency, with a view of optimum combined utilization of land and water resources.

"(d) Careful planning of the agricultural aspects of water utilization, in order to insure optimum crop production from available water resources.

"(e) Development of hydro-power sites in the irrigation systems to provide power for (1) irrigation pumping, and (2) for credit to the cost of irrigation development.

"The region is poor and needs food projects which cannot meet these basic conditions".

"The adoption of any scheme which does not follow these basic principles would lead to serious waste of the limited water and power resources of the region".

Summary - Hydro-electric Power.

"Data concerning initial and ultimate developments of the entire power schemes are:

	<u>Initial System</u>	<u>Ultimate System</u>
"Gross head (ave.)	2324.6 m.	1889.6 m.
"Installed capacity	259,000 Kw.	265,500 Kw.
"Annual capacity factor	55.7	63.6
"Average output	144,330 Kw	168,580 Kw.
"Average annual energy delivered	1216.3 x 10 <sup>6</sup> Kwh.	1405.1 x 10 <sup>6</sup> Kwh.
"Estimated cost of power facilities	£ 83.8 millions	136.9 millions
"Estimated average cost per installed Kw. (incl. transmission) (1)	£ 324/Kw.	£ 515/Kw.
"Average cost of energy delivered to load center (2)	3.94 U.S. Mills	5.56 U.S. Mills
"Average value of energy at load center	12.0 U.S. Mills	12.0 U.S. Mills

"It is obvious that hydro-power<sup>developed</sup> in the irrigation system is very attractive. The average cost of energy in the initial system (Using Litani water in Dead Sea plants) is cheaper than in the ultimate system (using sea water in Dead Sea plants). However, it is not reasonable in this instance to use fresh water in perpetuity for power production if it is not recoverable for irrigation."

Conclusions.

It is desired to express my concurrence in your Conclusions as quoted below:

- "1. This plan <sup>would</sup> develop and utilize all water and power resources of the Jordan and Litani basins without undue waste of water or power possibilities.
- "2. All lands irrigable by gravity in Lebanon, Syria and in the Kingdom of Jordan would receive full water supplies. In the case of Israel, the amount of irrigable land far exceeds the amount of available water. Hence waters not needed in the other States are allocated to Israel.
- "3. Nearly all irrigation water would be delivered by gravity.
- "4. The plan is feasible from engineering and economic standpoints.
- "5. Under this plan, Lebanon, Israel, Syria and Kingdom of Jordan, and possibly the Gaza Strip, would benefit to the maximum degree, in perpetuity.

Recommendations.

It is desired to express my concurrence in your Recommendations as quoted below:

"Four stages of development are described in this report. The first stage of development is shown following:

	Approx. lands irrigated dunams.	Approx. cost of Primary Works (millions \$)
<u>"Stage I.</u>		
"a) Completion of Hula drainage scheme )	130,000	13.00
"b) Hula irrigation main conduit )		
and power scheme )		
"c) Tabgha power scheme	(151 x 10 <sup>6</sup> Kwh used for pumping)	7.50
"d) Irrigation works above Qaraoun, Lebanon.	230,000	11.80
"e) Irrigation works on Yarmuk, Syria	30,000	1.50
"f) Diversion of springs and wadi flows in Ghor, Trans-Jordan )		
"g) Yarmuk diversion dam and first section of Eastern Ghor Canal; Trans-Jordan )	200,000	7.57
"h) Beisan Tiberias Irrigation Canal	190,000	2.41
"i) Lower Jordan Battauf Canal, Battauf Reservoir (initial and Battauf pumping plant )		
"j) Initial conduit from Battauf reservoir to Negev. )	440,000 +	13.50
"Total Primary Works	1,220,000	112.28 = \$92.20/ dunam.

"The above is on the basis that the Yarmuk is not diverted to Lake Tiberias. If this diversion is made, the following would obtain:

"k) Balance of Lower Jordan develop- ment in Trans-Jordan.	227,000	27.50
GRAND TOTAL	1,447,900	139.78 = \$96.70/ dunam.

"It is recommended that the first stage of primary development be given serious consideration for early construction."

Sincerely yours,

J.L. Savage (-)  
Consulting Engineer

cc/ (2)  
Mr. S. Blass  
"D" Street No.6  
Hakiryah, Tel-Aviv, Israel