TABLE 3-1

SUMMARY OF FLOW MEASUREMENTS IN THE JORDAN VALLEY REGION

Stream	Place of Measurement	Approximate Drainage Area Square Kilometers	Average Annual Runoff MCM	Approximate Period of Record	See Reference
River					
Hasbani	Ed Dilba Bridge		162	Oct. 39-Sept. 43	(1)
Banyas	1.25 km south of Town of Dan		162	" "	(1)
Dan	Tel el Qadi		265	" "	(1)
Jordan	Jisr Banat Yacov	1400	628	Oct. 35-Sept. 43	(1)
Jordan	Outlet of Tiberias	2700	538	Oct. 25-Sept. 46	(1)
Yarmuk	Near Junction with Jordan	7250	475	Oct. 26-Sept. 46	(1)
Jordan	Below Powerhouse at Yarmuk River	9990	964	Jan. 34-Dec. 43	(1)
Jordan	Allenby Bridge	16730	1007	Oct. 32-Sept. 43	(1)
Jordan	3.5 km north of Dead Sea	17300	1079	Feb. 39-Mar. 43	(1)
Wadis and Springs					
East Side					
Arab	Near Entrance to Ghor	290	15	Dec. 37-Jan. 39	(2)
Ziqlab	" " " "	116	8	" "	(2)
Jurm	" " " "	—	11	" "	(2)
Yabes	" " " "	115	5	" "	(2)
Kafrinje	" " " "	119	6	" "	(2)
Rajeb	" " " "	96	5	" "	(2)
Zerka	At Sweilih-Jerash Road	2960	45	Jan. 33-Dec. 38	(2)
Sha'eb	At Jisr Sha'eb	216	10	Dec. 37-Jan. 39	(2)
Kefrein	Near Entrance to Ghor	312	12	" "	(2)
Rama	" " " "	—	6	" "	(2)
West Side					
Faria	At the Ghor	330	45	—	(3)
Auja	" " " "	271	15	—	(3)
Qilt	" " " "	149	3	—	(3)
Jericho Springs	" " " "	—	15	—	(3)
Beisan-Herod Springs		—	67	—	(3)

Reference Number — (1) Continuous record at established gaging station. Mean of flows for period of record.
(2) Systematic spot measurements for a period of about one year. Perennial flow only.
(3) Estimates from various sources. Perennial flow only.

17

TABLE 4-1

ESTIMATED AVERAGE ANNUAL WATER AVAILABLE

JORDAN VALLEY REGION

Point and Tributaries	Estimated Tributary Flow MCM per Year	Estimated Total Flow MCM per Year
At Proposed Site of Hasbani Dam		
Total	130	130
At Point near Dan		
Flow from above	130	
Flow from intermediate Hasbani drainage area	27	
Flow from Dan River	258	
Flow from Banyas River	157	
Total	——	572
At Jisr Banat Yacov		
Flow from above	572	
Flow from intermediate drainage area	130 ·	
	——	
	702	
Less evaporation loss from Lake Huleh and marshes	−62	
Total	——	640

22

Point and Tributaries	Estimated Tributary Flow MCM per Year	Estimated Total Flow MCM per Year
At Outlet from Lake Tiberias		
Flow from above	640	
Flow from intermediate drainage area	198	
	———	
	838	
Less evaporation loss from Lake Tiberias	−300	
Total	———	538
At Junction of Yarmuk River		
Flow from above	538	
Flow from Yarmuk River	475	
Total	———	1013
At Allenby Bridge		
Flow from above	1013	
Perennial Flows		
East Side		
Wadi Arab	15	
Wadi Ziqlab	8	
Wadi Jurm	11	
Wadi Yabes	5	
Wadi Kafrinje	6	
Wadi Rajeb	5	
Wadi Zerka	45	
Wadi Sha'eb	10	
	———	105
West Side		
Beisan Springs	67	
Wadi Faria	45	
Wadi Auja	15	
	———	127
Flood flow from intermediate areas recoverable by reasonable construction		
East	45	
West	29	74
	———	
	1319	

Point and Tributaries		Estimated Tributary Flow MCM per Year	Estimated Total Flow MCM per Year
Flood flows, and flows from intermediate area not accounted for (to balance)		163	
		——	
		1482	
Less present use (assumed all perennial flows)		−232	
	Total	——	1250[1]
At Entrance to Dead Sea			
Flow from above		1250	
Perennial Flows			
East			
Wadi Kefrein	12		
Wadi Rama	6		
	——	18	
West			
Wadi Qilt	3		
Jericho Springs	15		
	——	18	
		——	
		1286	
Less present use (assumed perennial flow)		−36	
		——	
			1250[2]

[1]Adjusted average of record 1938-1943 inclusive.

[2]Does not include intermediate flood flows below Allenby Bridge.

River Flows

The greatest potential source of water for irrigation in the Jordan Valley region is from the flows of the Jordan and Yarmuk Rivers. The long records of flow measurement of both streams just below Lake Tiberias give reliable data on the magnitude and the dependability of the flows available at this point. The shorter period records of the stream in the upper valley,

IRRIGATION FROM WADIS — LOWER VALLEY

Location	Duty Cubic Meters per Dunam per Year	Perennial Flow		Flood Flow	
		Area Irrigated Dunams	Water Required MCM per Year	Area Irrigated Dunams	Water Required MCM per Year
Eastern Ghor					
North	1330	34,000	45	15,000	20
Central	1440	35,000	50	12,000	18
South	1860	15,000	28	4,000	7
		84,000	123	31,000	45
Western Ghor					
North	1330	50,000	67	14,000	18
Central	1440	31,000	45	5,000	7
South	1860	18,000	33	2,000	4
		99,000	145	21,000	29

Irrigation from Wells: The estimated supply from wells, 20 MCM per year, is the net usable amount and will be used for irrigation as follows:

IRRIGATION FROM WELLS — LOWER VALLEY

Location	Duty Cubic Meters per Dunam per Year	Area Irrigated Dunams	Water Required MCM per Year
Eastern Ghor			
North	1330	3000	4
Central	1440	2000	3
South	1860	2000	3
		7000	10
Western Ghor			
North	1330	3000	4
Central	1440	2000	3
South	1860	2000	3
		7000	10

TABLE 9-1

ESTIMATED COSTS AND BENEFITS OF MAQARIN DAM
AT VARIOUS HEIGHTS AS STUDIED AS A PART OF THE BROAD PLAN (e)

(1) Reservoir Water Surface Elevation (d)	(2) Structural Height of Dam Meters	(3) Structural Height of Dam Feet	(4) Estimated Costs Dam	(5) Estimated Costs Power Facilities	(6) Estimated Costs Total	(7) Installed Capacity	(8) Energy Available per Year	(9) Storage Capacity	(10) Additional Yield for Irrigation	(11) Allocation of Construction Costs Power	(12) Allocation of Construction Costs Irrigation	(13) Unit Costs Per Kilowatt Hour	(14) Unit Costs Capital Cost per MCM Yield per Year
			Million Dollars			Kilowatts	Kilowatt-Hours	MCM	MCM per Year	Million Dollars		Cents	Dollars
51	28	90	1.5	7.0	8.5	15,200	97,200,000	24	9	8.5(a)	0	0.57	0
81	58	192	9.0	10.0	19.0	23,000	134,500,000	73	24	16.0(a)	3.0	0.77	125,000
101	78	255	16.0	13.0	29.0	30,700	173,700,000	133	41	21.0(b)	8.0	0.78	196,000
118	95	310	23.0	16.3	39.3	38,000	183,600,000	195	56	27.8(b')	11.5	0.97	205,000
137	114	375	34.0	16.3	50.3	38,000	183,600,000	280	73	27.8(c)	22.5	0.97	308,000
160	137	450	51.0	16.3	67.3	38,000	183,600,000	405	97	27.8(c)	39.5	0.97	410,000
175	152	500	66.0	16.3	82.3	38,000	183,600,000	500	114	27.8(c)	54.5	0.97	478,000

Notes: (a) Major construction cost charged to power.

(b) and (b') One-half dam costs allocated to irrigation.

(c) Allocation to power same as in (b') since no additional power benefits are received; balance of costs allocated to irrigation.

(d) The natural water surface of the river at the dam site has been assumed as elevation 46 meters above sea level.

(e) SEE TEXT FOR EXPLANATION OF THE COLUMN HEADINGS USED IN THIS TABLE.

ESTIMATED MAGNITUDE OF COSTS

Based on Work in the United States — 1953

1.	Hasbani River Storage Dam	$ 12,600,000
2.	Banyas River Diversion Dam	1,400,000
3.	Dan River Headworks	200,000
4.	Canal from Banyas River to Galilee Hills	
	First Section	16,800,000
	Second Section	3,500,000
5.	Yarmuk Diversion Dam	4,000,000
6.	Yarmuk Diversion Canal	2,300,000
7.	Eastern Ghor Canal	
	First Section	5,700,000
	Second Section	5,000,000
8.	Eastern Ghor Headworks	200,000
9.	Eastern Ghor Feeder Canal	1,400,000
10.	Western Ghor Headworks	200,000
11.	Western Ghor Canal	
	First Section	5,700,000
	Second Section	5,300,000
12.	Lake Huleh Drainage Works	3,500,000
13.	Raise Lake Tiberias Dam	700,000
14.	Control Works and Canals for Perennial Wadi Flows	1,000,000
15.	Works for Conserving Flood Flows of Wadis	14,000,000
16.	Works for Developing Supply from Wells	1,000,000
17.	Yarmuk Plateau Irrigation Works	200,000
18.	Yavneel Valley Irrigation System	300,000
19.	Tel Hai Power Development	11,000,000
20.	Maqarin Dam and Complete Adasiya Power Development in Initial Stage	25,000,000
	Total Unified Development	$121,000,000

The estimated magnitude of cost of raising Maqarin Dam, if found to be justified, is $14,-000,000.

The estimated magnitude of cost of constructing the Dead Sea power development is $76,000,000.

The estimated magnitude of costs by stages of construction have been obtained directly from the above tabulation and are as follows:

ESTIMATED MAGNITUDE OF COSTS — BY STAGES

Based on Work in the United States — 1953

	Irrigation	Power	Total
Stage 1			
Banyas Diversion Dam and Headworks	$ 1,400,000		$ 1,400,000
Dan River Headworks	200,000		200,000
Canal from Banyas River to Galilee Hills (First Section)	16,800,000		16,800,000
Yarmuk Diversion Dam	4,000,000		4,000,000
Eastern Ghor Canal (First Section)	5,700,000		5,700,000
Western Ghor Canal Headworks	200,000		200,000
Western Ghor Canal (First Section)*	5,700,000		5,700,000
Lake Huleh Drainage Works	3,500,000		3,500,000
Yarmuk Plateau System	200,000		200,000
Yavneel Valley System	300,000		300,000
	$38,000,000	0	$ 38,000,000
Stage 2			
Eastern Ghor Canal Headworks	200,000		200,000
Feeder Canal (to Eastern Ghor Canal)	1,400,000		1,400,000
Yarmuk Diversion Canal (to Lake Tiberias)	2,300,000		2,300,000
Hasbani Storage Dam	12,600,000	0	12,600,000
Tel Hai Power Project	0	11,000,000	11,000,000
	$16,500,000	$11,000,000	$ 27,500,000
Stage 3			
Raise Lake Tiberias Dam	700,000		700,000
Canal to Galilee Hills (Final Section)	3,500,000		3,500,000
Eastern Ghor Canal (Final Section)	5,000,000		5,000,000
Western Ghor Canal (Final Section)	5,300,000		5,300,000
Development of Wells in Ghor	1,000,000		1,000,000
Redevelopment of Perennial Flows in Wadis	1,000,000		1,000,000
	$16,500,000	0	$ 16,500,000

	Irrigation	Power	Total
Stage 4			
Development of Flood Flows of Wadis	$14,000,000	0	$ 14,000,000
Maqarin Dam (Initial Height)	3,000,000	6,000,000	9,000,000
Adasiya Power Project (Complete)	0	16,000,000	16,000,000
	17,000,000	22,000,000	39,000,000
Total for Broad Plan	$88,000,000	$33,000,000	$121,000,000
Stage 5			
Raise Maqarin Dam (if found to be justified)	$ 7,000,000	$ 7,000,000	$ 14,000,000

* If rugged terrain makes this portion of the work infeasible, water from Lake Tiberias may be brought to the lower western Ghor by a syphon from the eastern Ghor canal in the vicinity of Wadi Kafrinje.

Calculations based on the foregoing costs and on areas of land to be irrigated in the different parts of the region, show that the capital cost of the principal irrigation works per dunam will be approximately as follows:

Location	Area Irrigated Dunams	Capital Cost Dollars	Capital Cost Dollars per Dunam
Galilee Hills and Huleh Area	327,000	$38,500,000	$119
Lower Jordan Valley — East and West Ghor	579,000	$49,500,000	$86

The above figures are necessarily approximate since the cost of several features cannot readily be allocated accurately to the various areas; they do however give an indication of the comparative costs.