MANAVGAT RIVER WATER AS A LIMITED BUT ALTERNATIVE WATER RESOURCE FOR DOMESTIC USE IN MIDDLE EAST

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ABSTRACT

The water potential of the Mediterranean part including Aegen coastal zone of Turkey is at a level of mean annual about 8.2 x 10^9 m^3. The size of irrigable land, in this part of the country is about 1.8x10^6 ha, and there is very high tourism potential in the region. The main water courses along Mediterrenean coast of Turkey, from east to west, include Ceyhan, Seyhan, Goksu, Koprucay, Manavgat, Aksu, and Esencay rivers. All together they have 35x10^9 m^3 annual outflow.

Starting from 1992, Turkish State Hydraulics Work; DSI was authorized to develop a water supply project for domestic use, from the Manavgat river which has an average 147 m^3/sec runoff rate. The project consists of a river intake structure of 5.8 m^3/sec water from Manavgat river, and a pumping station having 7 booster pumps each with 967 l/sec capacity, and a set of two supply pipes of 1200 mm diameter, of 1057 m length, reaching to water purification plant situated at 84 m above msl. The plant does both chemical and physical water treatment to fullfill WHO standarts. The total storage capacity of the project is 500 000 m^3, half of it is treated-purified- and the second half as raw water. The annual source of fresh water available at present, of 180x10^6 m^3 water can also be transported as completely raw water. There are two pipes of 1600 mm diameter, and about 11 Km length, to transport water to control station located aoın the coast. From there on, the water is transferred 2 SPM –one for purified and the other for raw water- filling floats.

Till now, water has been being transported to northern Cyprus. On March 4, 2004 , agreement for water purchase was signed in Tel Aviv. Pursuant to the agreement, Israel shall purchase 50x10^6 m^3/year water

from Turkey for 20 years. It is hoped that the neighbouring Middle Eastern States will get the benefit of this limited alternative source of water for their domestic needs.

KEYWORDS: Manavgat River Water Supply Project, Middle East, Turkey, Water transportation by sea ,Water sale

MANAVGAT RIVER WATER SUPPLY PROJECT

INTRODUCTION

Manavgat River that starts from the eastern slopes of Western Taurus Mountain flows into Mediterranean Sea after following about 90 km distance to south. There is Oymapınar and Manavgat Dams over Manavgat River. "Manavgat River Water Supply Project" is located near Manavgat town, Antalya province of Mediterranean Region. The project was started in 1992, it cost approximately 150.000.000 $ and it was completed in 1999. With this project, 250 000 m³ refined and 250 000 m³ raw water, totaling 500 000 m³ water will be transported down to the sea coast by means of pipelines and it will be loaded into tankers . It was considered that this water would meet the partial water need of some coastal towns and tourist investments in this region of Turkey, some Middle Eastern countries and Northern Cyprus (DSI,2001).

PROJECT OF WATER EXPORT FROM MANAVGAT RIVER

Maximum flow of the Manavgat River is 500 m³/sec and its minimum flow is 36 m³/sec with an average of 147 m³/sec (DSI, 1999). When the average flow is taken into account, annual capacity of Manavgat River corresponds to $5x10^9$ m³ approximately. Since the export water will amount to $180x10^6$ m³/year, this amount is a very small portion of the water that flows into Mediterranean .

Water problem in Middle East

In Middle East that is one of the poorest areas of the world in terms of water, water problem is increasing day by day. The countries of this area try to meet the need of drinking water by refining the seawater and underground water and pay large costs for it. According to the 1992 data, $15.6x10^6$ m³ salty water is refined per day (WDRTS, 1994). This situation leads the countries to alternative water resources.

Water Sale To Israel And Alternatives Countries For Marketing Of Water from Manavgat River Water Supply Project

As a result of the negotiations with Israel carried on from 2002 to today, agreement for water purchase was signed in Tel Aviv on the date of March the 4th 2004. Pursuant to the agreement, Israel shall purchase $50x10^6$ m^3/year water from Turkey for 20 years (www.mfa.gov.tr). While the cost of the water has not been specified yet, facility outlet price is 0.25 USD (Yıldız, 2003) , transportation cost is thought to be 0.80 USD . It is not certain yet which country will award the contract for the transportation procedures.

Turkey, in various meetings, declared that it would provide water when demanded to the other Middle Eastern countries that need water, Northern countries and even to Greek islands. The alternatives for selling water from Manavgat are shown in Figure 1. In Memorandum of Understanding of VII Term Meeting of Turkey – Saudi Arabia Mixed Economic Commission, Turkey stated that it is ready to supply water to Saudi Arabia from Manavgat River. Also in the declaration performed by Turkish officials, some demands for Manavgat water other than Israel was stated and it was said that Algeria and Morocco were interested in the issue.

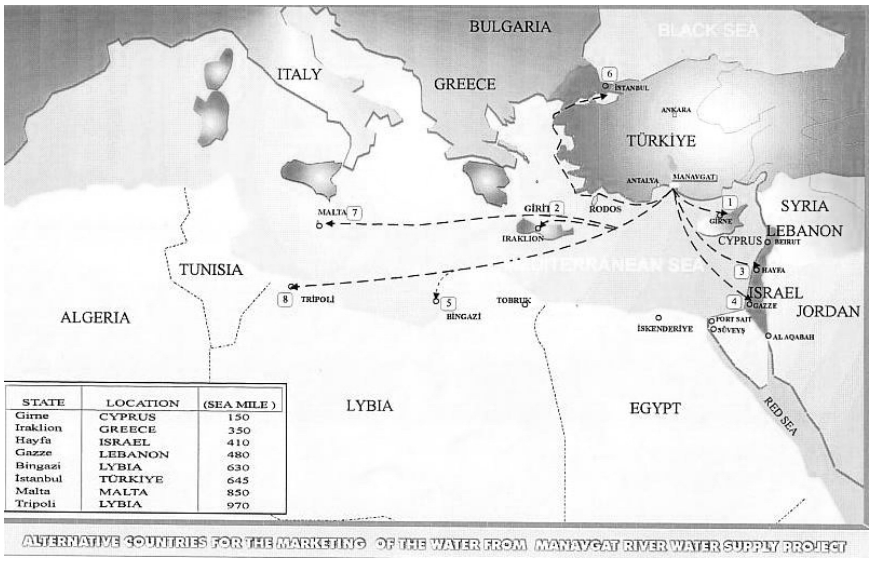

Figure – 1 : Alternatives Countries For Marketing of Water from Manavgat River Water Supply Project (DSI, 2001)

COMPONENTS OF THE PROJECT

The project is mainly composed of the following work units:

- Water Intake Structure and Raw Water Pumping Structure
- Pumping Mains
- Treatment Plant
- Gravity Mains
- Valve Control Chamber and Pumping Station
- SPM (Single Point Mooring) Structure

Hydraulic flow diagram of Manavgat Project is given in Figure 2.

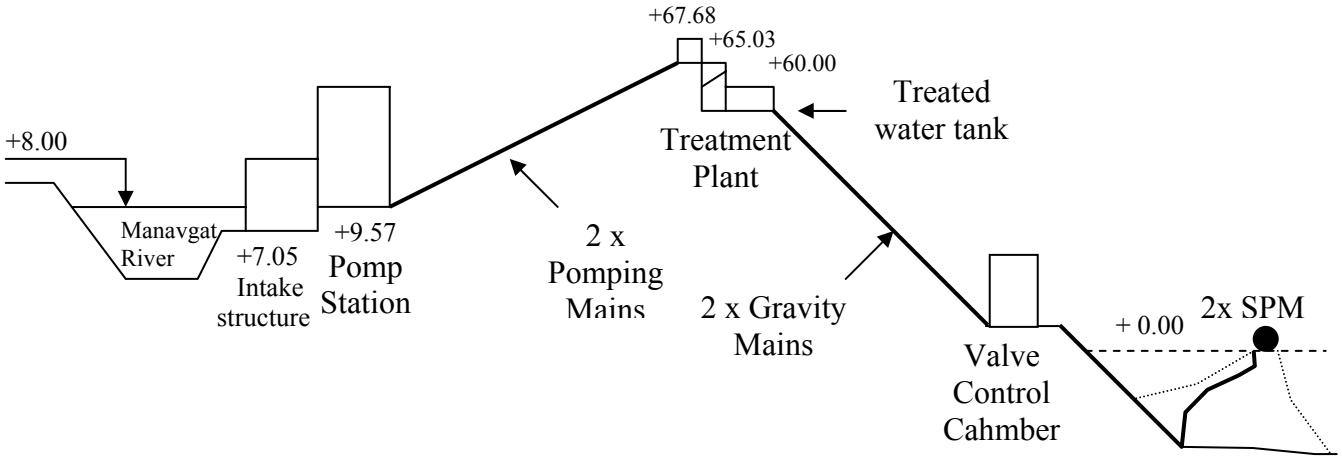

Figure – 2 : Hydraulic Flow Diagram of Manavgat River Water Supply Project (DSI, 2001)
The Flow Chart of the Manavgat water supply project is given in Figure 3. The details of each step is explained below.

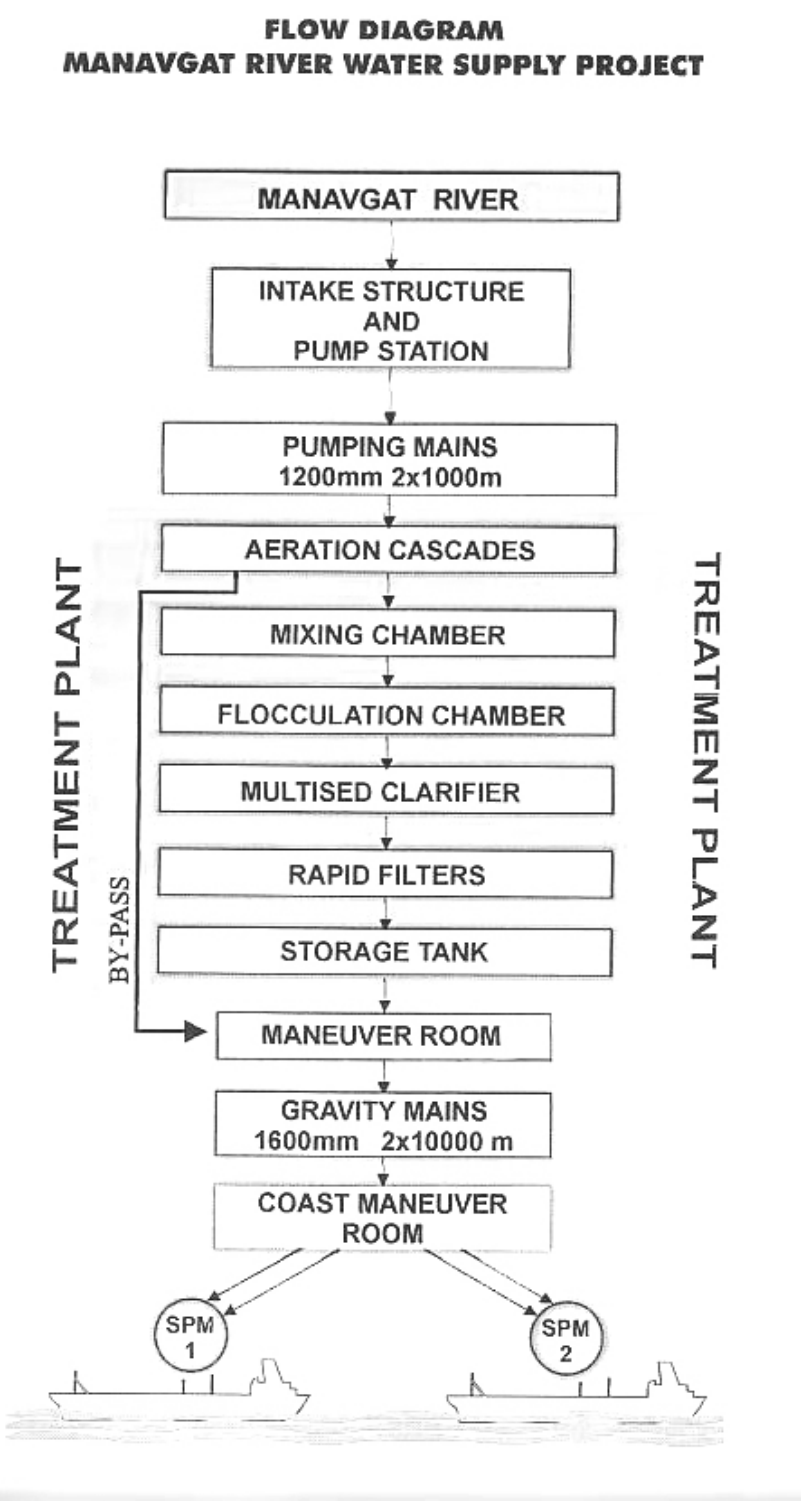

Figure – 3 : The Flow Chart of the Manavgat project (DSI, 2001)

Water intake Structure and Raw Water Pumping Structure

Water intake structure of Manavgat Dam is situated on approximately 800 m downstream. Water taken from the level of + 8.00 m is compressed into balancing and aerating tank that is approximately at the level of + 68 m (DSI, 2001).Water intake structure is given in Figure 4 and this unit details are given in Table 1.

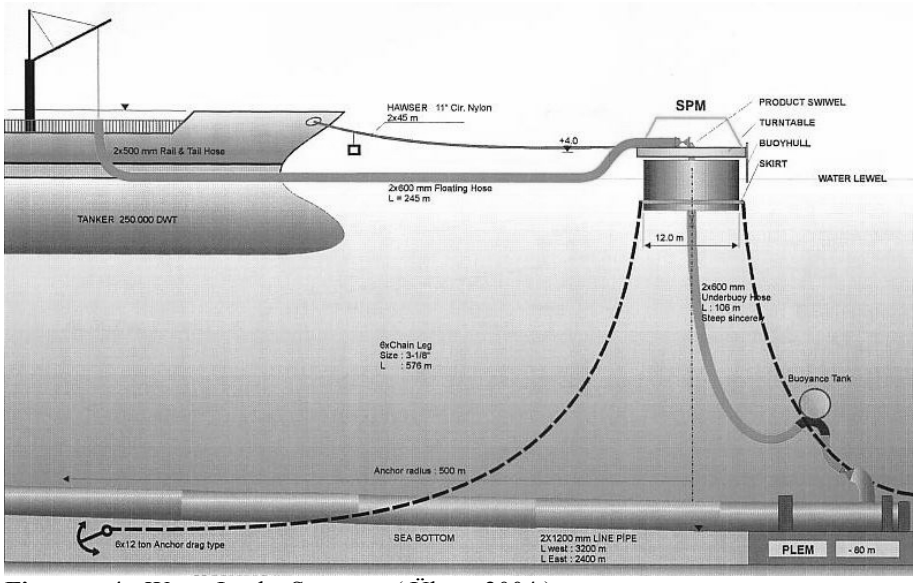

Figure - 4: Water Intake Structure (Ülger, 2004)

Table – 1 : Water intake structure and Raw water pumping structure details (DSI, 2001)

Number of Pumps:	7(1stand-by)	Suction Head:	2.15 m
Capacity of Pumps:	967 lt/sn	Number of Suction Pipes:	7
Effective Power:	900 Kw	Diameter of Suction Pipes:	800 mm
Total Pumping Head:	75 m	Diameter of Pumping Pipes:	700 mm
Number of Air Tanks:	2	Capacity of Air Tanks(2):	100 m³

Pumping Mains

Water taken from raw water pumping mains is transferred to the balancing and aerating tank by means of elevation line.Pumping mains details are given in Table 2.

Table – 2 : Pumping Mains details (DSI, 2001).

Number of Pipes	:	2
Diameter of Pipes	:	Φ 1200 mm
Wall Thickness	:	8.8 mm
Length of Pipeline	:	1057 m
Type of Pipes	:	Spiral Welded Steel Pipe

Inner Coating of Pipes	:	Icoment Added Concrete
Outer Coating of Pipes	:	PE

Treatment Plant

In the south of Bardaklar Beleni quarter of Ulukapı Village of Manavgat, it is situated on the hill that is on the level of 84 m. 250 000 m³ of the water brought to the balancing and aerating tank by means of elevation line is sent to directly to the coast facilities after the ventilation and pre-chlorination. The rest 250 000 m³ is processed by both physical and chemical refining phases. In the following, sections of the refinery are shown (DSI, 2001).

- Balancing and aeration chamber
- Rapid mixers and flocculation tanks
- Clarifiers (Clarifiers are given in Figure 5)
- Rapid sand filtration units
- Chlorination contact tank and clean water tank

Figure - 5: Clarifiers (Ülger, 2004)

Gravity Mains

Between the Treatment Plant and Valve Control Chamber and Pumping Station.Gravity mains details are given in Table 3.

Table – 3 : Gravity mains details (DSI, 2001).

Number of Pipes	2	Type of Pipes	Spiral Welded Steel Pipe
Diameter of Pipes	F 1600 mm	Inner Coating of Pipes	Icoment Added Concrete
Wall Thickness	12 mm	Outer Coating of Pipes	PE
Length of Pipeline	10 000 m		

Valve Control Chamber and Pumping Station

Valve Control Chamber is designed to load 250 000 m³ refined water and 250 000 m³ raw water or 500 000 m³ raw water simultaneously to two different tanks. Also there are totally 12 pumps with the capacity of 1 m³/sec, 10 mains and 2 substitutes to pump water to the tanks (DSI, 2001). Pumping station is given in Figure 6.

Figure - 6: Pumping Station (Ülger, 2004)

Off-Shore Pipelines

Between the Valve Control Chamber and the SPM terminals, they consist of 4 pipes whose diameter is 1200 mm, which are placed upon the sea base. Two of these four pipes go to eastern SPM that is 2400 m away from valve control facilities, and the other two go to western SPM that is 3200 m away (DSI, 2001). Off-Shore pipeline is given in Figure 7 .

Figure - 7: Off-Shore Pipelines (www.infar.com.tr)

SPM (Single Point Mooring) Structures

Water coming by means of two pipes shall be transferred to SPM terminals and tankers with the capacity of 60 000 – 250 000 dwt by means of floating hoses here. Movement of the SPM terminals is limited by 6 anchors of 12 tons. The ships are attached to SPM terminals from their nose parts(DSI ,2001). Since the ship-connected parts of SPM terminals can rotate 360˚, the movements of ship conform to the movements of SPM terminals in various weather conditions(Cengiz, 2004). SPM structure is given in Figure 8.

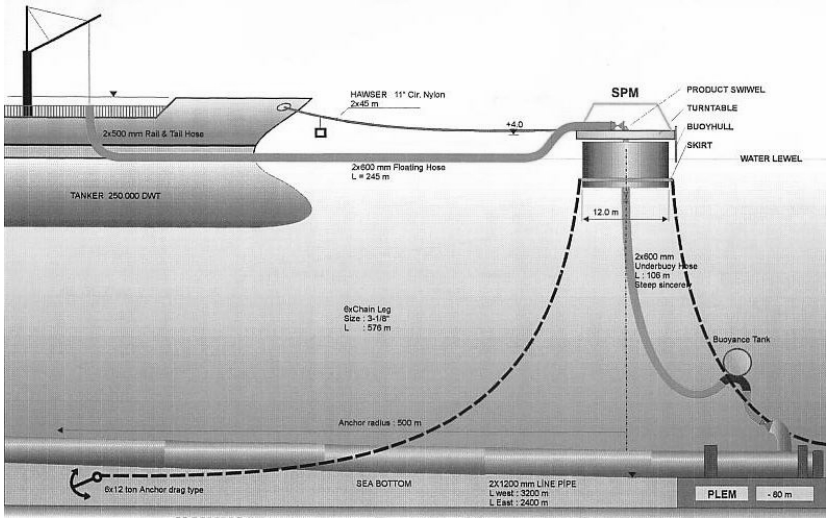

Figure – 8 : SPM Structure (DSI, 2001)

Loading from SPM terminals to the tankers can be performed according to the following options,

- From one SPM 250 000 m³/day refined, from the other SPM 250 000 m³/day raw water,
- From each pontoon, 250 000m³/day raw water
- From each pontoon, 125 000 m³/day refined water and total 250 000 m³ refined water

RAW WATER ANALYSIS REPORT

The water quality standards of the refined water from Manavgat water supply project is given in Table 4. and those standards are compared with other international standards in Table 5.

Table – 4 : Raw Water Analysis Report (DSI, 1999).

Period of Analysis February 1993 - April 1999

Parameter	**Unit**	**Symbol**	**Average**	**Min**	**Max.**
Flowrate	m³/sn	Q	147.2	35.78	500.0
Temperature	ºC	T	16.5	8.0	29.0
pH		PH	7.7	7.3	8.0
Elektrical Conductvity	µmhos/cm	EC	284	200	350
TotalDissolvedSolids	mg/l	TDS	164	110	210
Suspended Solids	mg/l	SS	9	1	17
Turbidity	NTU	Turb	2.3	0.3	9.5
Color	Pt-Co	Col	5	5	10
Methyl Orange Alkalinitesi	mg/l CaCO3	M-Al	128.8	76.0	157.5
Phenolphtalein Alkalinitesi	mg/l CaCO3	P-Al	0.0	0.0	0.0
Chlorine	mg/l	Cl	11.89	6.39	19.9
Nitrogenof Ammonia	mg/l	NH4 – N	0.10	0.00	0.54
Nitrogen of Nitrite	mg/l	NO2 – N	0.000	0.000	0.010
Nitrogen of Nitrate	mg/l	NO3 – N	0.47	0.00	2.39
Dissolved Oxygen	mg/l	DO	9.63	7.00	13.0
Permanganate Value	mg/l	PV	1.14	0.32	10.72

Biological Oxygen Demand	mg/l	BOD5	1.36	0.80	2.3
Total Hardness	mg/l CaCO3	TH	158	101	192
Orto Phosphate	mg/l	o-PO4	0.12	0.00	1.1
Sulphate	mg/l	SO4	15.41	3.50	23.9
Iron	mg/l	Fe	0.06	0.00	0.2
Sodium	mg/l	Na	1.77	0.69	7.2
Potassium	mg/l	K	0.33	0.10	0.8
Calcium	mg/l	Ca	48.91	24.85	64.1
Magnesium	mg/l	Mg	8.71	2.19	19.2

CURRENT STATE OF THE PROJECT

Project is ready to work and supply water with its every unit. Also it has been in the scope of privatization of Privatization High Council Decision dated 23.02.2004. It was decided that privatization procedures would be completed in 12 moths (www.oib.gov.tr).

CONCLUSİON

As a conclusion it can be stated that, for the water scarcity problem of Middle East countries, "Manavgat River Water Supply Project" can be viewed as an alternative but partial solution.

MANAVGAT RIVER WATER SUPPLY PROJECT COMPARISON OF SELECTED PARAMETERS OF RAW WATER AND TREATED WATER BY VARIOUS WATER QUALITY STANDARTS

Table – 5 : Manavgat River Water Supply Project Comparison Of Selected Parameters Of Raw Water And Treated Water by Various Water quality Standarts (DSI, 1999)

Parameters	Manavgat River Raw Water	Treated Water	EC Drinking Water Standard	WHO Drinking Standard	TS2666 Drinking Water Standard
PH	7,7 – 8,0	PHs-0,2	6,5-8,5	6,5-9,5	6,5-9,2
Electrical conductivity	284-350		400		400-2000
Permanganate Value, mg / l	1,14-10,72		2-5		2-5
Total Hardness , mg / l $CaCO_3$	158-192		min.150	100	150
Cholorine , mg Cl / l	11,9-19,9		25	250	25-600
Ammonium , mg NH_4 / l	0,1-0,54*		0,05-0,5	0,2	0,05-0,5
Nitrite, mg NO_2 / l	0,0-0,1**		0,1		0,1
Nitrate, mg NO_3 / l	0,47-2,39***		25-50	50	25-50
Phosphorous, mg P_2O_5 / l	0,0-1,1****		0,4-5,0		0,4-0,5
Turbidity, NTU	2,3-9,3	0,4	0,4-4,0	5	5-25
Iron , mg Fe / l	0,06-0,2	0,1	0,05-0,2	0,3	0,05-0,2
Aliminium, mg Al / l		0,05	0,05-0,2	0,2	0,05-0,2
Manganase, mg Mn / l		0,05	0,02-0,05	0,1	0,02-0,05
Coliform Bacteria, MPN /100 ml		none	None	none	None

NH_4 –N, Ammonium nitrogen, mg/l **NO_2-N, Nitrite, mg/l ***NO_3-N, Nitrate nitrogen, mg/l *PO_4-P, orto phosphate, mg/l**

Quality of the refined water conforms to all the specified requirements of Drinking Water Quality Guide of TSE (Turkish Drinking Water Standard) and WHO (World Health Organization).

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