will be distributed to the central and southern Qazvin plain through stage 1 and 2 of new canal system.

Water Allocation under the Scenario-3

Beneficial Sub-Basin	Source of Water	Allocated Water (MCM)
Tehran City	Karaj Dam	270
	Latian (Lar) Dam	400
	Taleghan Diversion	310
	Ground Water	250
Sub-total		**1,230**
Tehran Area	Small Streams	170
	Re-Used Water	250
	Groundwater	640
Sub-total		**1,060**
Karaj Area	Karaj Dam	165
	Re-Used Water	100
	Groundwater	775
Sub-total		**1,040**
Hashtgerd Area	Kordan River	60
	Groundwater	320
Sub-total		**380**
Qazvin Plain	Taleghan Diversion	140
	Almout Diversion	250
	Northern Streams	60
	Southern Rivers	140
	Groundwater	1,330
Sub-total		**1,920**
Total		**5,630**

5.5 Necessity of Water Diversion from Taleghan and Almout

At present, about 910 MCM of water are being supplied for domestic uses in Tehran City. Preliminary projection of future demand of water supply was made on the basis of current situations of water use and conditions employed in the “National and Regional Water Resources Master Plan” prepared by the Ministry of Energy, as summarized below:

Projection of Water Supply Demand in Tehran City

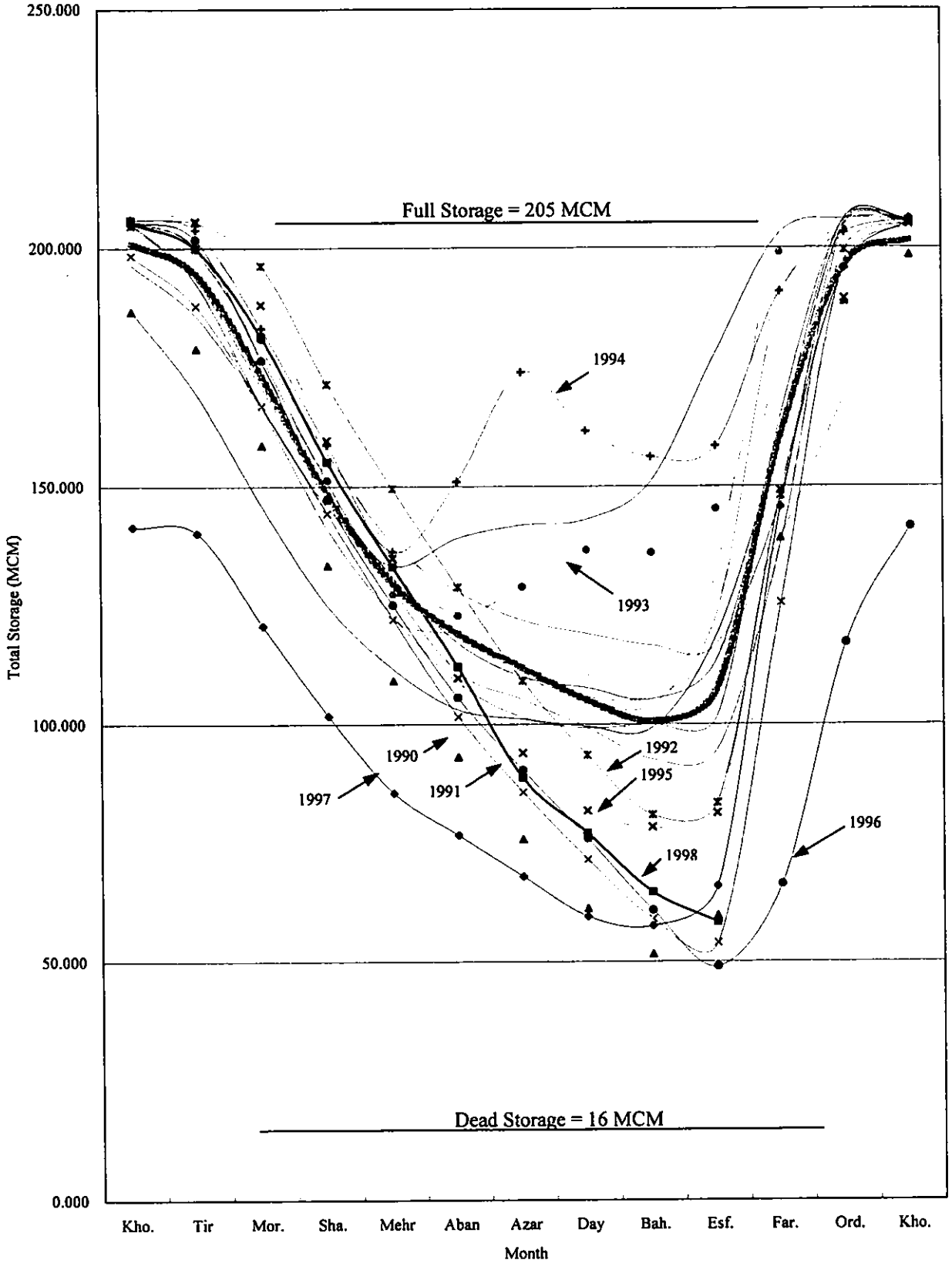
Year	2001	2006	2011	2021
Population (1,000 person)	7,492	8,287	9,137	10,725
Per Capita Demand (lit/day/person)	330	330	320	315
-do- (cu.m/person/year)	120	120	118	115
Annual Demand (MCM)	910	1,020	1,080	1,230
Increment (MCM)	0	110	170	320

Followings can be summarized from the above figures:

- Of the present annual demand of 910 MCM, 300 MCM are supplied from Karaj dam, 340 MCM from Latian dam and 270 MCM from groundwater.
- Even if some measures are taken to save per capita demand of water, and yet water demand would increase to 1,230 MCM that is 320 MCM greater than the current consumption.

- There is almost no room for additional supply of water from the both Karaj and Latian dams, while extraction of 270 MCM of groundwater from about 160 wells is too much excessive and therefore consumption of groundwater is preferable to be reduced in future.
- Under the short-term development plan of Scenario-1, about 120 MCM of annual water will be transferred from Taleghan to Karaj through a water pipeline at present under construction. This water would be consumed to supply for irrigation in the Karaj area, and no contribution could be expected to Tehran city since there is no way to convey this water from Karaj to Tehran.
- Under the medium-term development plan of Scenario-2, it is expected that 450 MCM of annual water could become available by the construction of proposed Taleghan storage dam on Taleghan river. As regards utilization of this water, a plan has been made so as to allocate 300 MCM to Qazvin and remaining 150 MCM to the western areas of the capital Tehran. Therefore, this plan would not improve the situation of Tehran city to a great extent.
- Since the proposed location of water resources development, Taleghan river at Sangban and Almout river at near Baghkalyeh, belongs to Qazvin province and the province itself has a strong desire for additional supply of water especially to irrigate the central and southern Qazvin plain, Taleghan water has to be distributed to Qazvin province with a priority.
- Only one remaining and practicable plan of water resources development is the diversion plan of Almout river water to Qazvin plain, providing a possibility to convey all or most of Taleghan water to the western areas of the capital Tehran.

Figure 5.1.2.1 Past Operation of Karaj Dam
(Total Storage at the End of Month)



Karajopeout.xls

Figure 5.1.2.2 Operation Record of Karaj Dam (Total Storage, Inflow and Outflow)

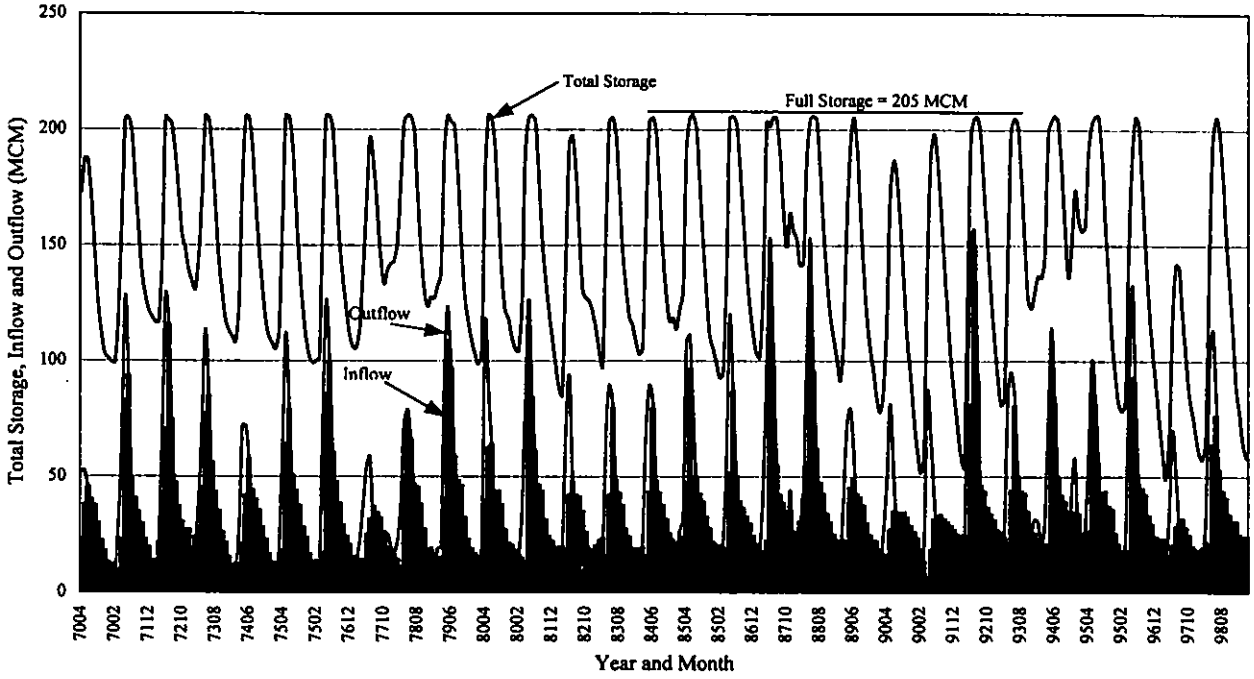


Figure 5.1.2.3 Annual Change of Volume of Water Released from Karaj Dam

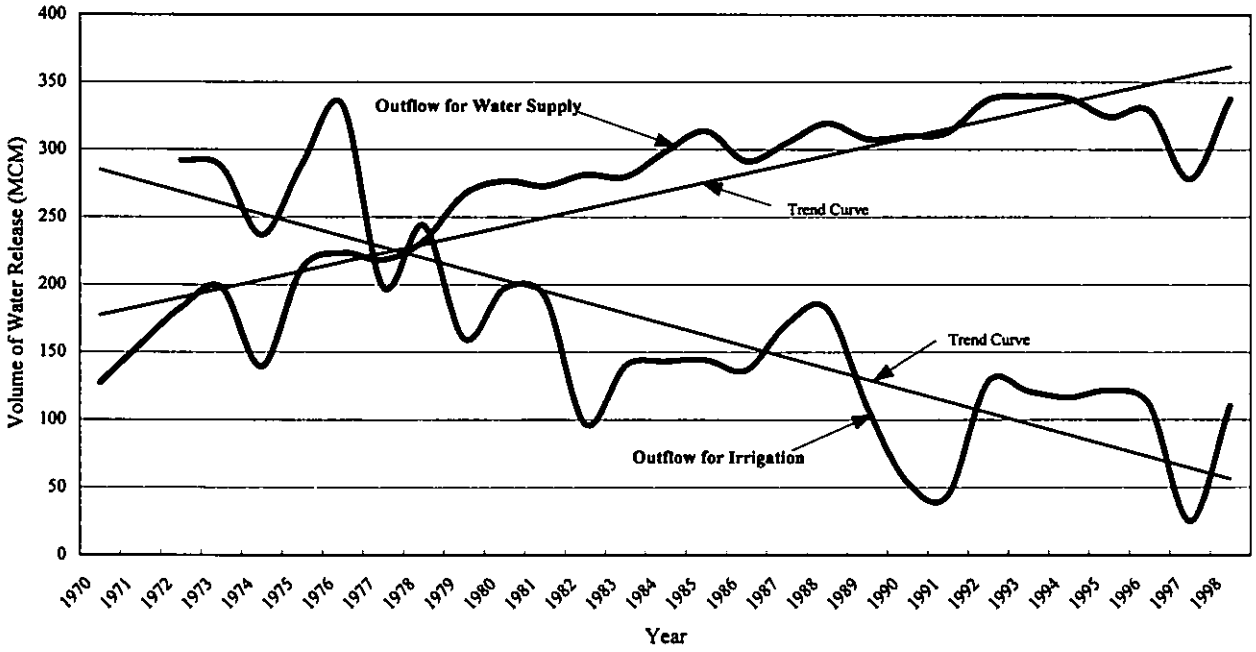


Figure 5.1.2.4 Karaj Dam Future Operation (w/o Rule Curve)

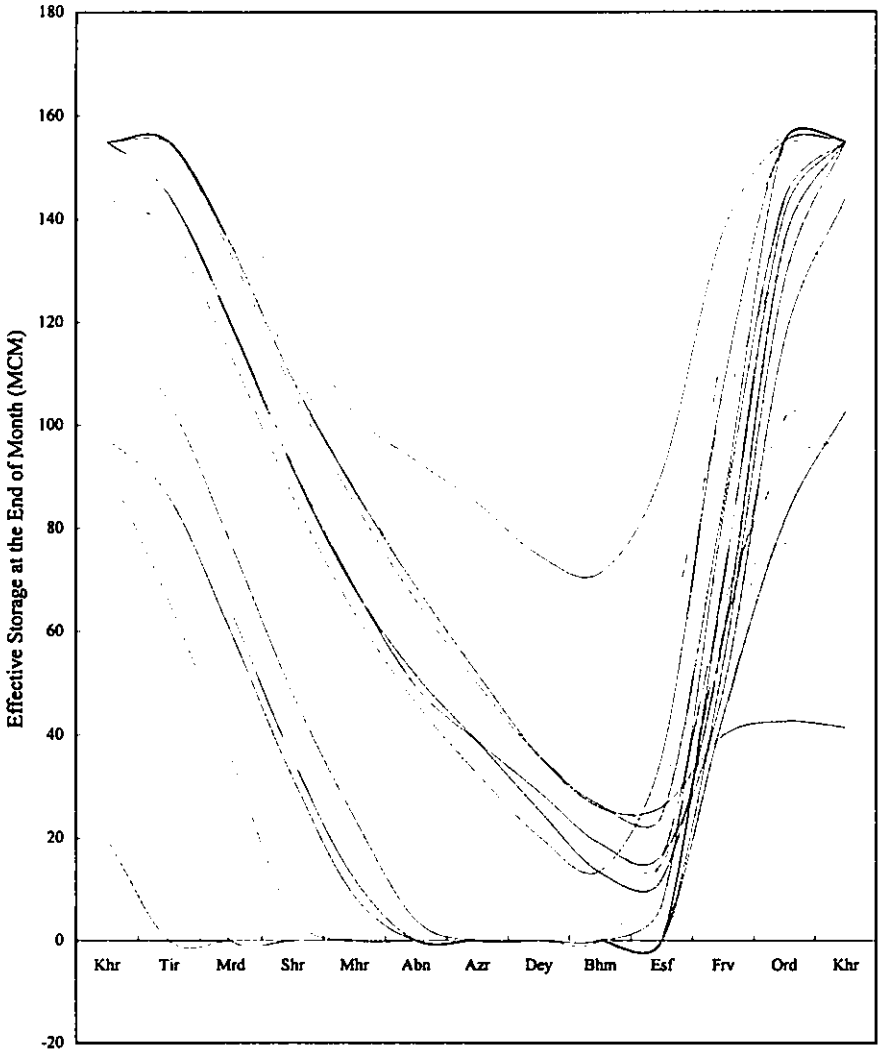
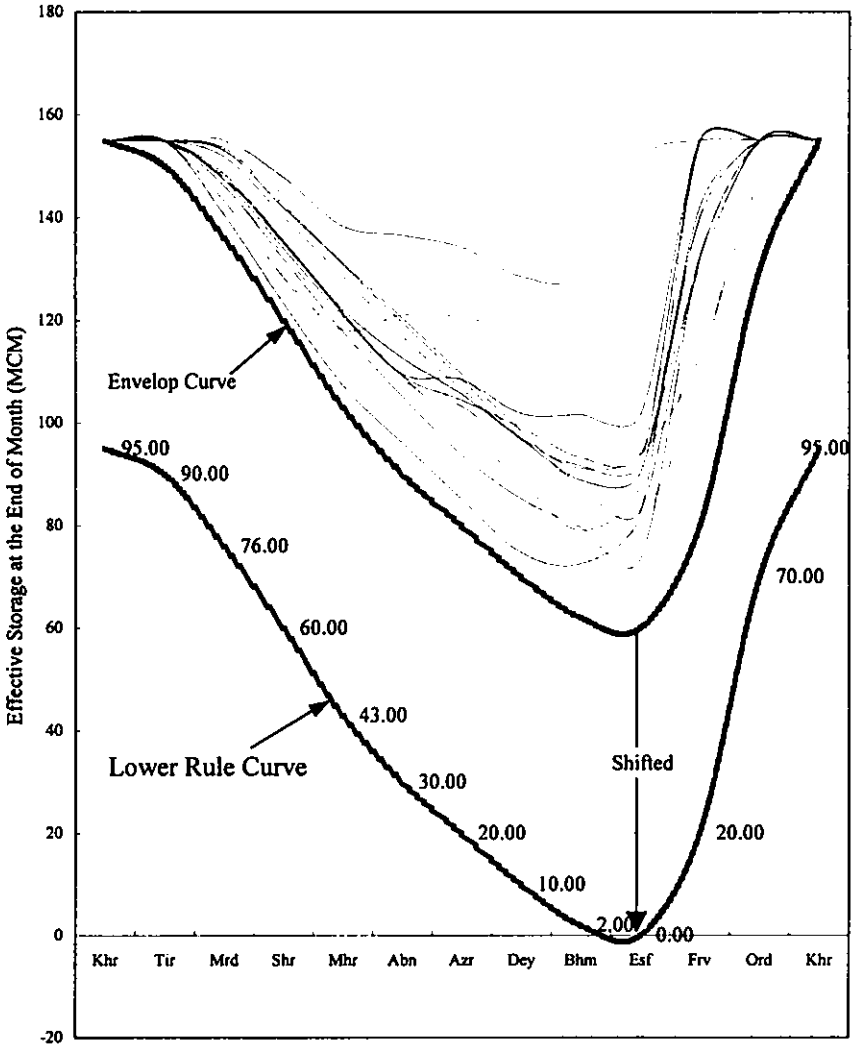
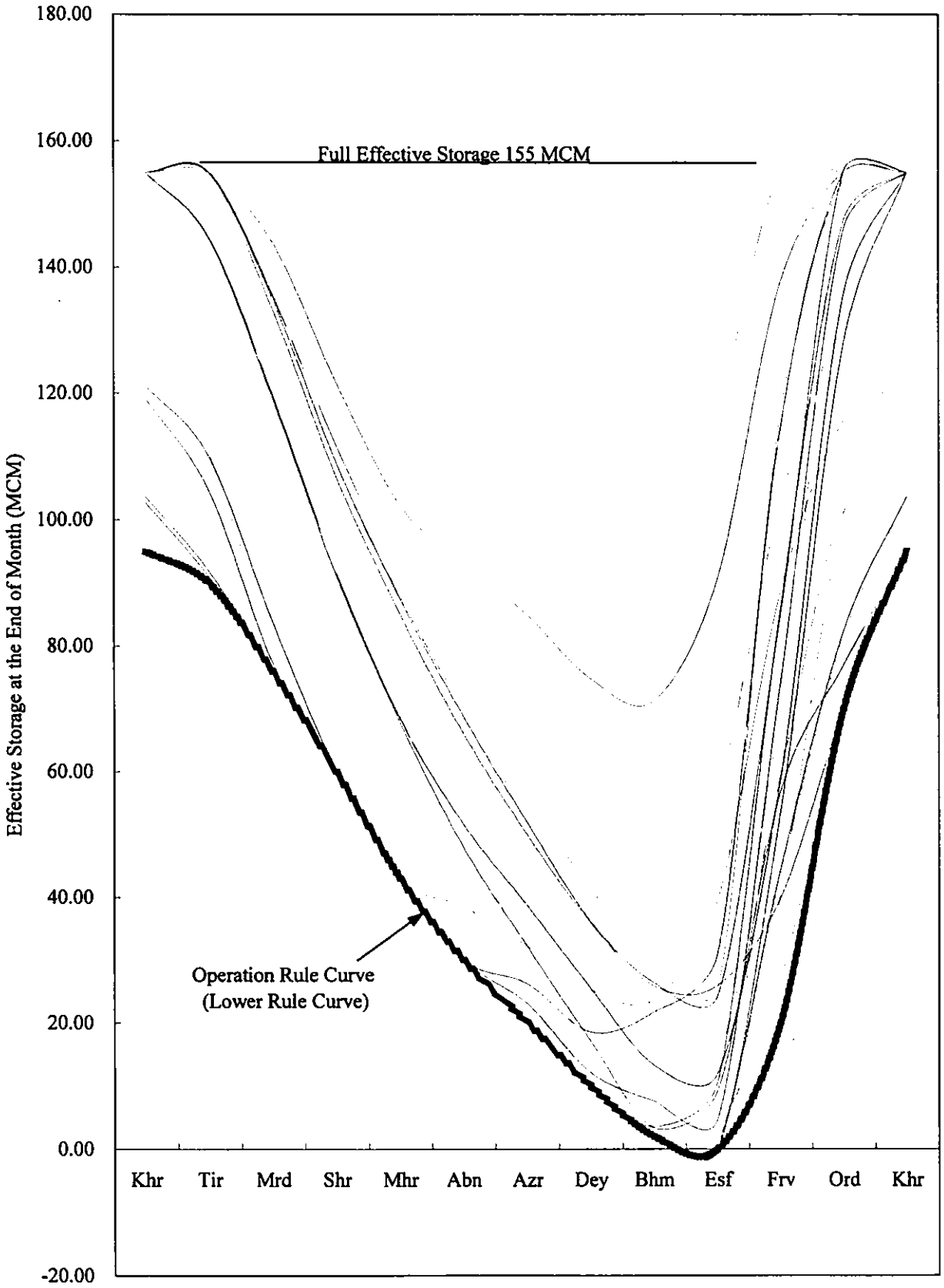


Figure 5.1.2.5 Karaj Dam Future Operation (w/o Rule, Irrig = 0.0)



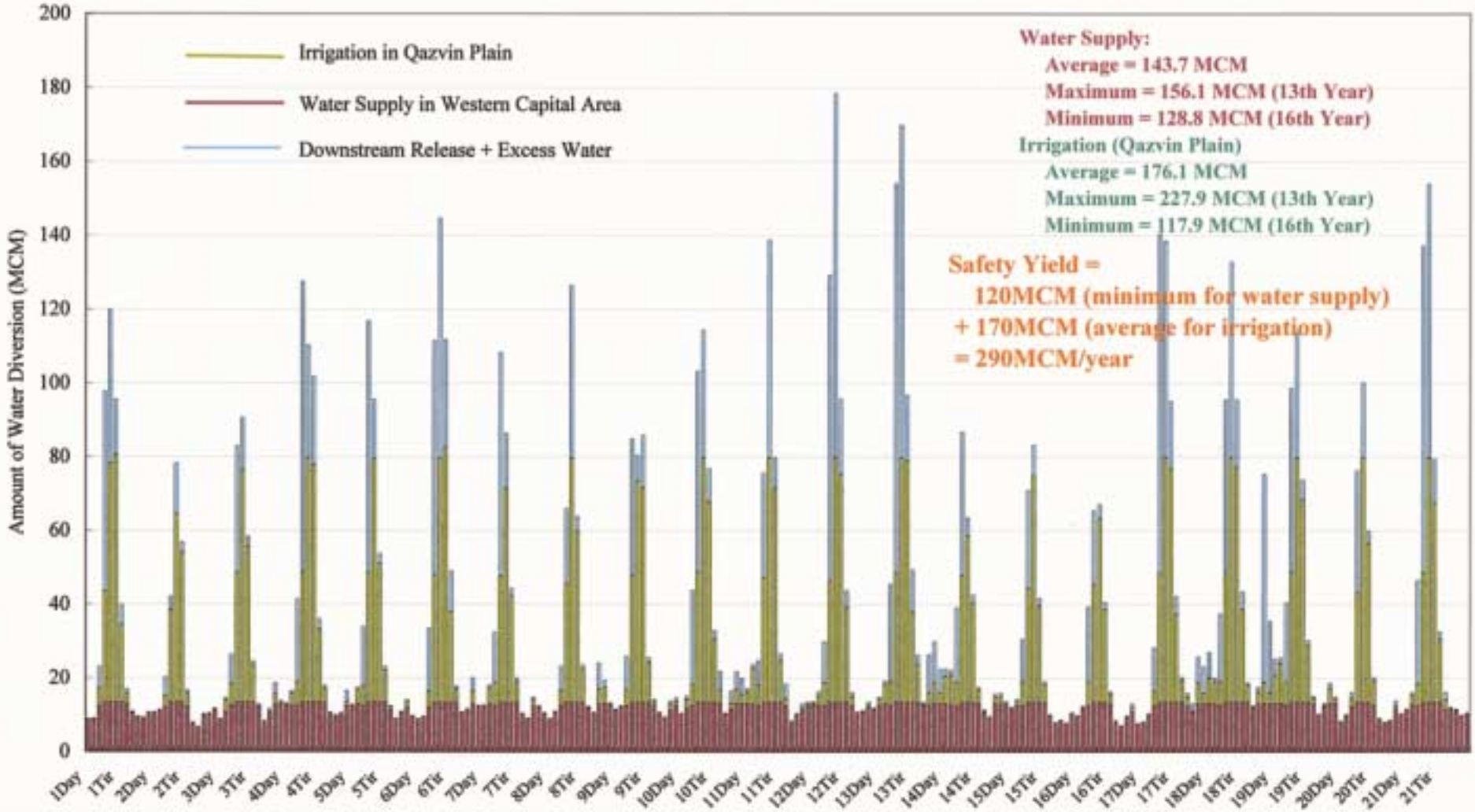
Karaja0out2.xls

Figure 5.1.2.6 Karaj Dam Future Operation (with Rule Curve)



Karajrclout2.xls

Figure 5.1.3.1 Water Balance at the Existing Taleghan Diversion Dam (Priority: Water Supply)



ExistTaleghanOpeDFR

Figure 5.1.3.2 Water Balance at the Existing Sangban Diversion Dam (Priority : Irrigation)

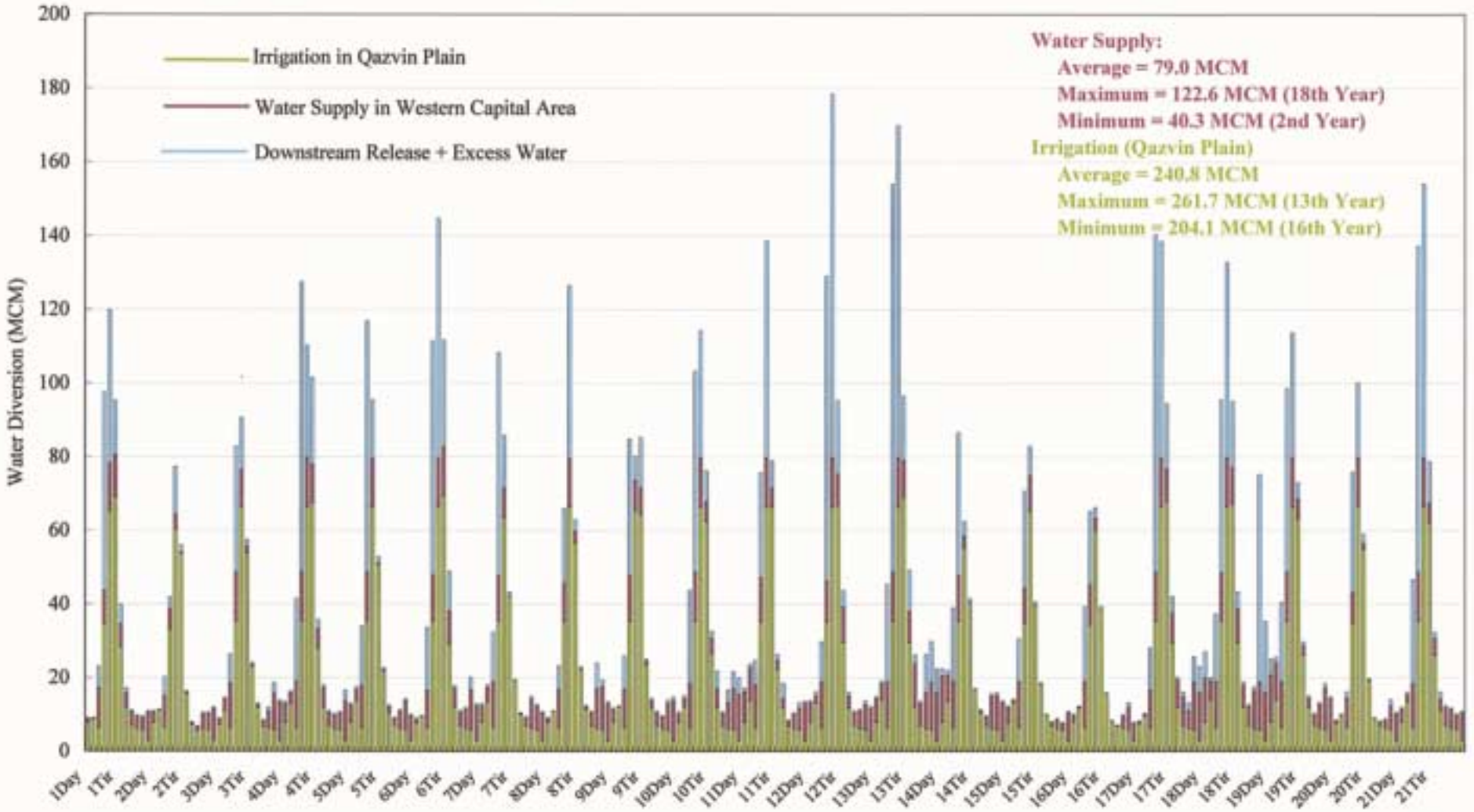


Figure 5.1.4.1 Taleghan Dam Operation (w/o Rule)

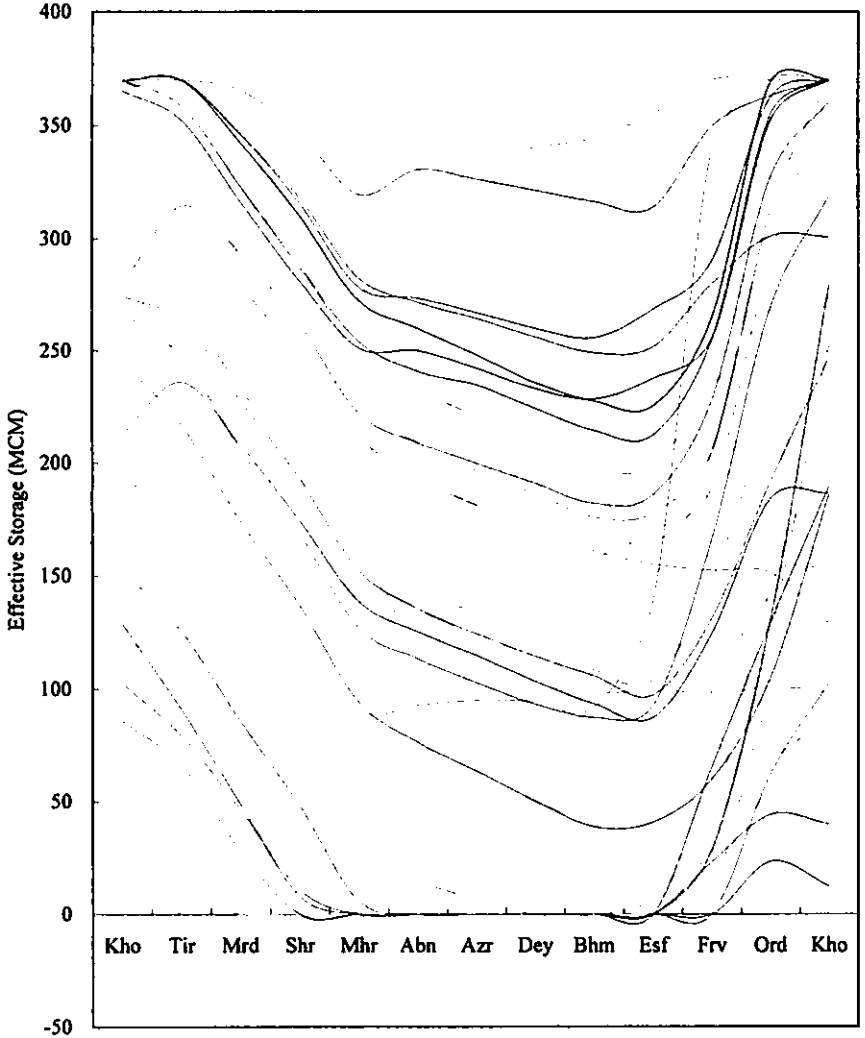


Figure 5.1.4.2 Taleghan Dam Operation (w/o Rule, Irrig=0.0)

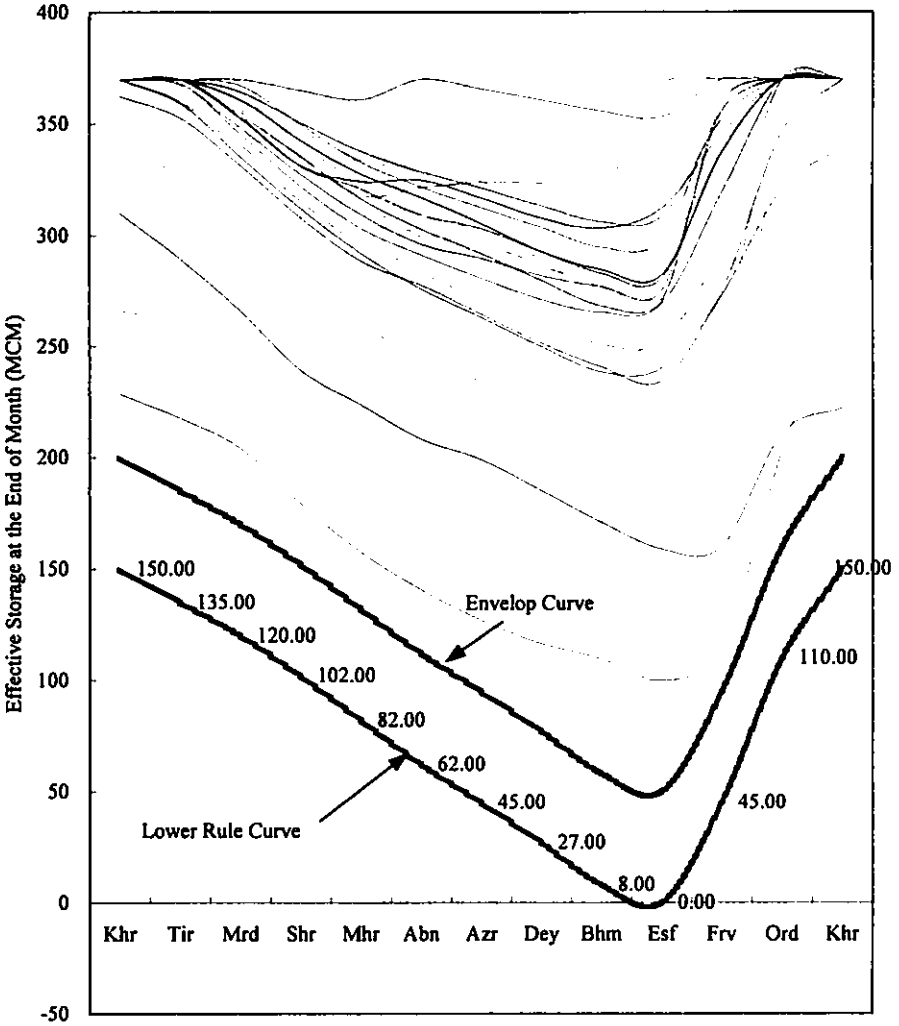


Figure 5.1.4.3 Taleghan Dam Storage Operation (with Lower Rule Curve)

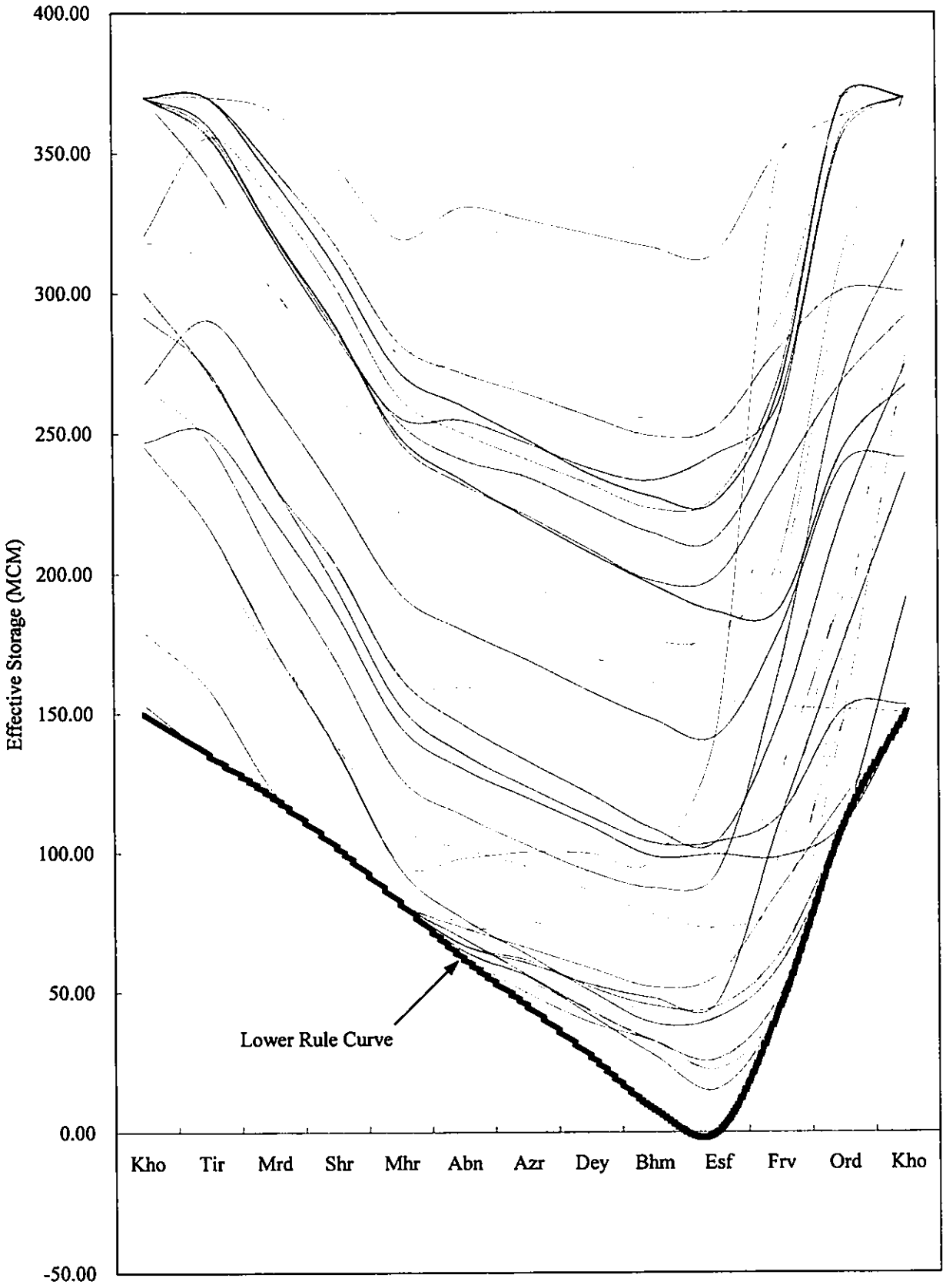


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Table 5.1.5.1 Residual Runoff from Downstream Basin of Taleghan/Almout

	Annual Runoff (MCM)						Specific Runoff Yield (mm)			
Station	Galinak	Baghkalyeh	Siahdasht	Diversion	Siahdasht2	Downstream	Galinak	Baghkalyeh	Siahdasht2	Downstream
C.A	775.00	678.00	2,445.00			992.00				
Year	(1)	(2)	(3)	(4)	(5)=(3)+(4)	(5)-(1)-(2)				
68/69	1,144.76	805.67	2,677.69	0.00	2,677.69	727.26	1,477.1	1,188.3	1,095.2	733.1
69/70	348.12	242.95	619.77	0.00	619.77	28.70	449.2	358.3	253.5	28.9
70/71	441.47	276.21	794.73	0.00	794.73	77.05	569.6	407.4	325.0	77.7
71/72	578.32	407.09	1,141.80	0.00	1,141.80	156.39	746.2	600.4	467.0	157.7
72/73	434.91	331.99	813.84	0.00	813.84	46.94	561.2	489.7	332.9	47.3
73/74	335.87	263.65	664.98	0.00	664.98	65.46	433.4	388.9	272.0	66.0
74/75	408.30	330.51	723.76	0.00	723.76	-15.05	526.8	487.5	296.0	-15.2
75/76	409.02	361.84	691.84	0.00	691.84	-79.02	527.8	533.7	283.0	-79.7
76/77	266.44	186.42	435.70	0.00	435.70	-17.16	343.8	275.0	178.2	-17.3
77/78	345.92	438.31	646.94	75.36	722.30	-61.93	446.3	646.5	295.4	-62.4
78/79	461.51	394.46	831.41	89.76	921.17	65.20	595.5	581.8	376.8	65.7
79/80	358.84	334.52	652.09	108.72	760.81	67.45	463.0	493.4	311.2	68.0
80/81	517.13	374.62	953.27	125.85	1,079.12	187.37	667.3	552.5	441.4	188.9
81/82	330.00	234.54	531.58	115.82	647.40	82.86	425.8	345.9	264.8	83.5
82/83	370.90	271.99	690.89	111.32	802.21	159.32	478.6	401.2	328.1	160.6
83/84	359.52	257.60	746.24	115.60	861.84	244.72	463.9	379.9	352.5	246.7
84/85	458.88	358.70	867.42	134.11	1,001.53	183.95	592.1	529.1	409.6	185.4
85/86	399.24	215.03	598.11	147.44	745.55	131.28	515.1	317.2	304.9	132.3
86/87	527.47	355.16	818.81	151.16	969.97	87.34	680.6	523.8	396.7	88.0
87/88	617.15	446.78	1,303.63	176.82	1,480.45	416.52	796.3	659.0	605.5	419.9
88/89	304.51	211.26	515.10	154.29	669.39	153.62	392.9	311.6	273.8	154.9
89/90	281.50	240.85	444.75	132.61	577.36	55.01	363.2	355.2	236.1	55.5
90/91	261.23	188.10	451.21	132.51	583.72	134.39	337.1	277.4	238.7	135.5
91/92	553.63	345.70	1,098.76	120.09	1,218.85	319.52	714.4	509.9	498.5	322.1
92/93	354.24	234.16	540.83	143.05	683.88	95.48	457.1	345.4	279.7	96.3
93/94	543.30	429.79	1,010.30	262.10	1,272.40	299.31	701.0	633.9	520.4	301.7
94/95	560.62	366.60	1,039.78	261.30	1,301.08	373.86	723.4	540.7	532.1	376.9
95/96	441.09	334.60	866.85	188.50	1,055.35	279.66	569.1	493.5	431.6	281.9
96/97	307.21	211.91	403.75	184.10	587.85	68.73	396.4	312.6	240.4	69.3
97/98	487.92	284.14	674.47	217.90	892.37	120.31	629.6	419.1	365.0	121.3
Mean	440.30	324.51	808.34	104.95	913.29	148.48	568.13	478.62	373.53	149.68
Maximum	1,144.76	805.67	2,677.69	262.10	2,677.69	727.26	1,477.11	1,188.30	1,095.17	
Minimum	261.23	186.42	403.75	0.00	435.70	-79.02	337.07	274.96	178.20	

Figure 5.1.5.1 Outline Location of Almout Water Diversion Plan (Final Plan)

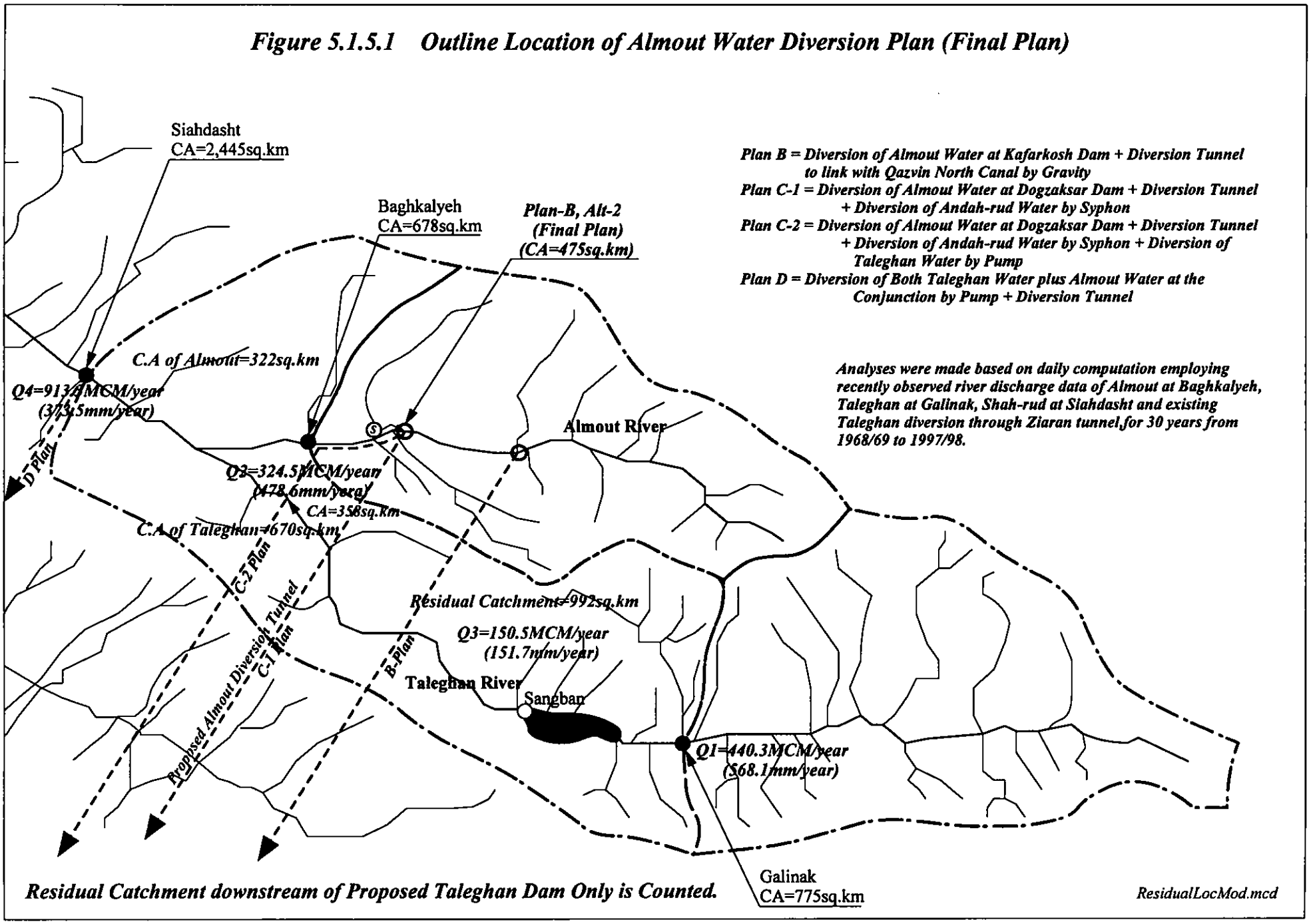


Figure 5.1.5.2 Discharge Through Almout Diversion Tunnel
(Cace C-1 with Syphon Intake w/o Taleghan Diversion)

(Unit: cu.m/sec)

Year	Mehr	Aban	Azar	Dey	Bah.	Esf.	Far.	Ord.	Kho.	Tir	Mor.	Sha.
1	3.79	4.59	5.33	3.40	2.15	3.94	12.16	22.50	22.50	16.22	4.90	2.89
2	4.72	1.80	4.35	4.84	4.59	4.99	4.89	14.01	15.52	3.04	0.90	0.97
3	1.72	8.75	12.38	6.28	5.97	4.84	22.07	22.50	12.86	0.83	1.69	3.57
4	6.32	6.47	5.92	5.85	3.72	11.73	14.83	18.28	21.70	16.60	5.88	2.92
5	2.64	2.95	2.70	5.76	8.96	9.25	17.90	21.74	15.62	5.25	3.08	1.63
6	2.71	5.00	3.63	3.37	2.67	3.88	14.99	22.50	22.50	22.32	9.83	4.00
7	2.84	3.68	3.17	2.98	2.98	4.10	10.22	22.06	14.70	8.02	4.39	1.99
8	3.82	5.03	3.85	2.44	1.52	1.70	9.38	19.43	12.07	5.63	3.45	2.56
9	2.20	2.77	3.85	2.91	3.27	6.50	9.44	14.58	13.81	8.85	4.99	2.40
10	3.77	4.96	5.83	3.35	4.52	4.77	19.56	21.49	18.98	9.25	0.70	1.16
11	2.20	2.49	3.78	5.15	7.50	5.69	6.62	13.38	14.36	7.62	2.49	0.20
12	3.26	3.18	3.75	4.18	3.32	3.36	11.11	22.50	18.46	8.88	4.61	2.20
13	4.71	9.42	5.83	6.57	4.75	6.59	14.12	22.50	20.10	15.44	6.97	3.54
14	3.58	3.70	3.82	5.73	6.94	8.60	8.05	13.09	11.13	3.79	1.33	0.82
15	1.88	3.70	3.04	3.07	3.32	4.63	10.18	17.06	12.40	4.88	1.78	1.47
16	2.03	3.28	2.66	2.61	2.82	5.22	11.81	10.41	7.11	4.02	1.25	0.92
17	1.76	7.17	6.56	3.14	2.50	3.65	16.59	22.38	21.85	15.35	6.47	4.12
18	3.50	7.76	9.72	7.75	5.91	6.01	10.84	19.26	19.07	12.75	4.85	2.85
19	1.37	2.31	2.43	4.65	4.70	5.41	13.91	22.07	17.59	10.09	3.17	1.83
20	2.19	2.86	3.33	2.41	2.34	4.64	13.87	20.25	16.98	10.57	2.99	1.77
21	3.12	4.65	4.89	2.94	2.54	2.99	4.61	5.73	3.71	1.12	1.76	0.38
Mean	3.05	4.60	4.80	4.26	4.14	5.36	12.24	18.46	15.86	9.07	3.69	2.10

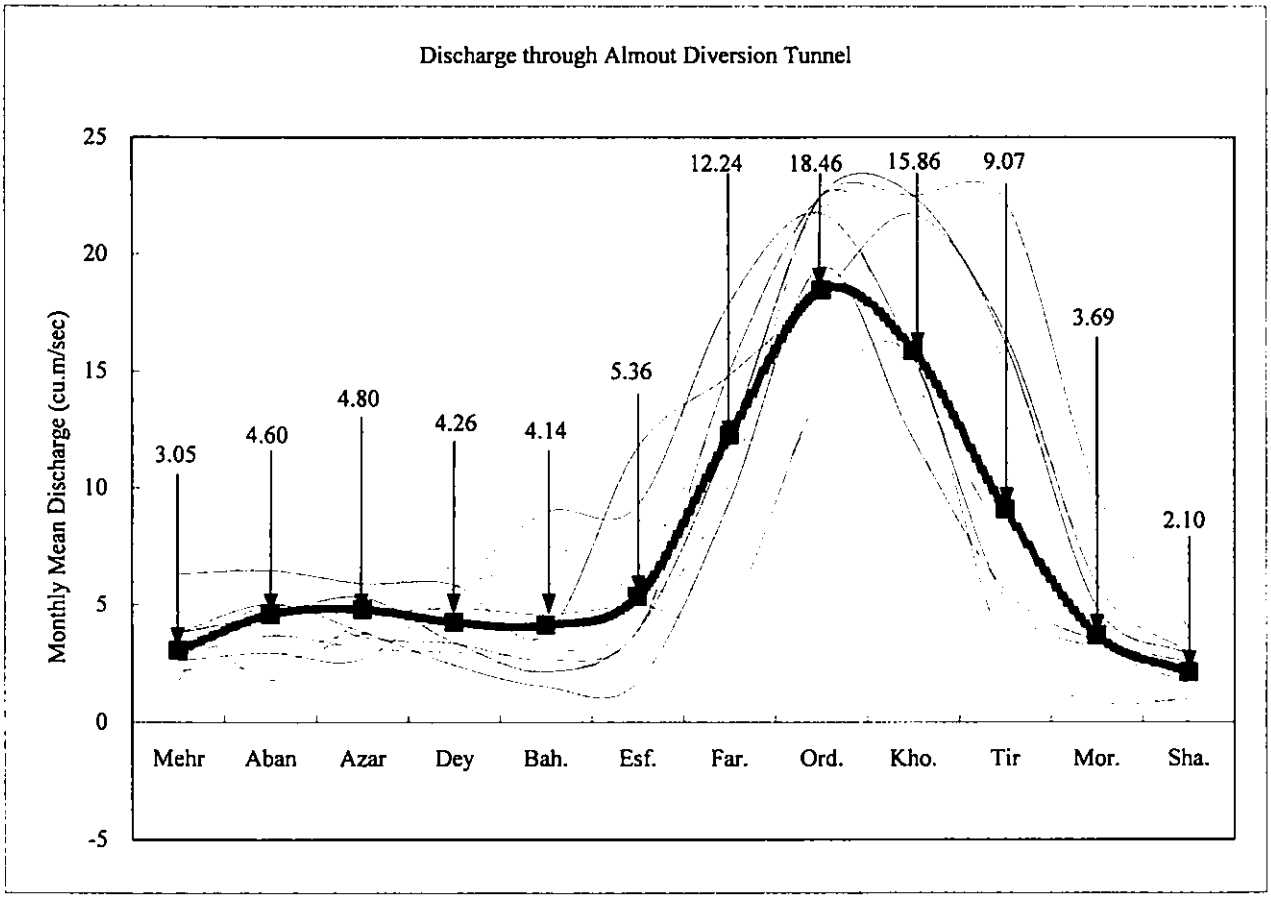


Figure 5.2.2.1 Result of Simulation (case 1,industrial and domestic use)

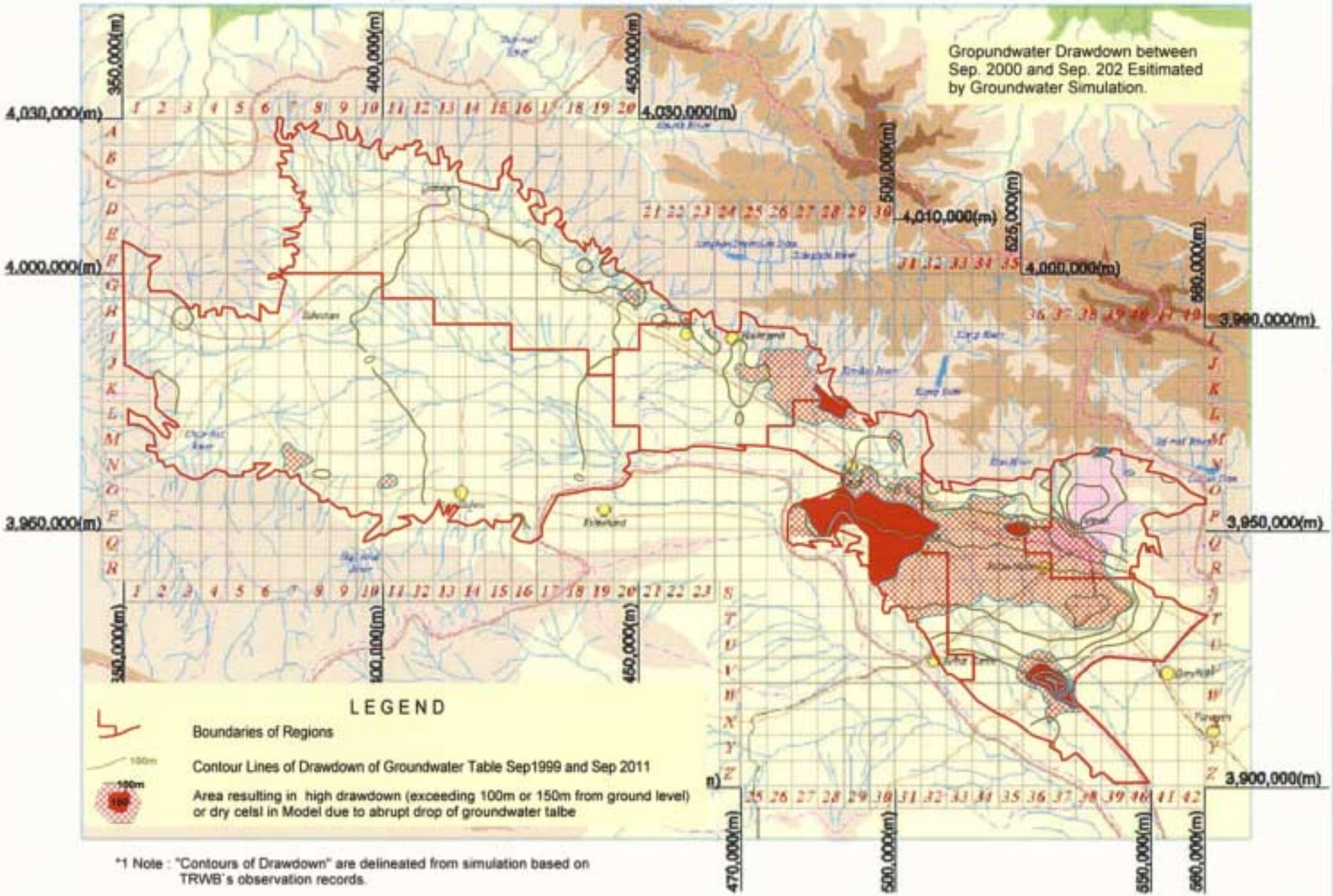
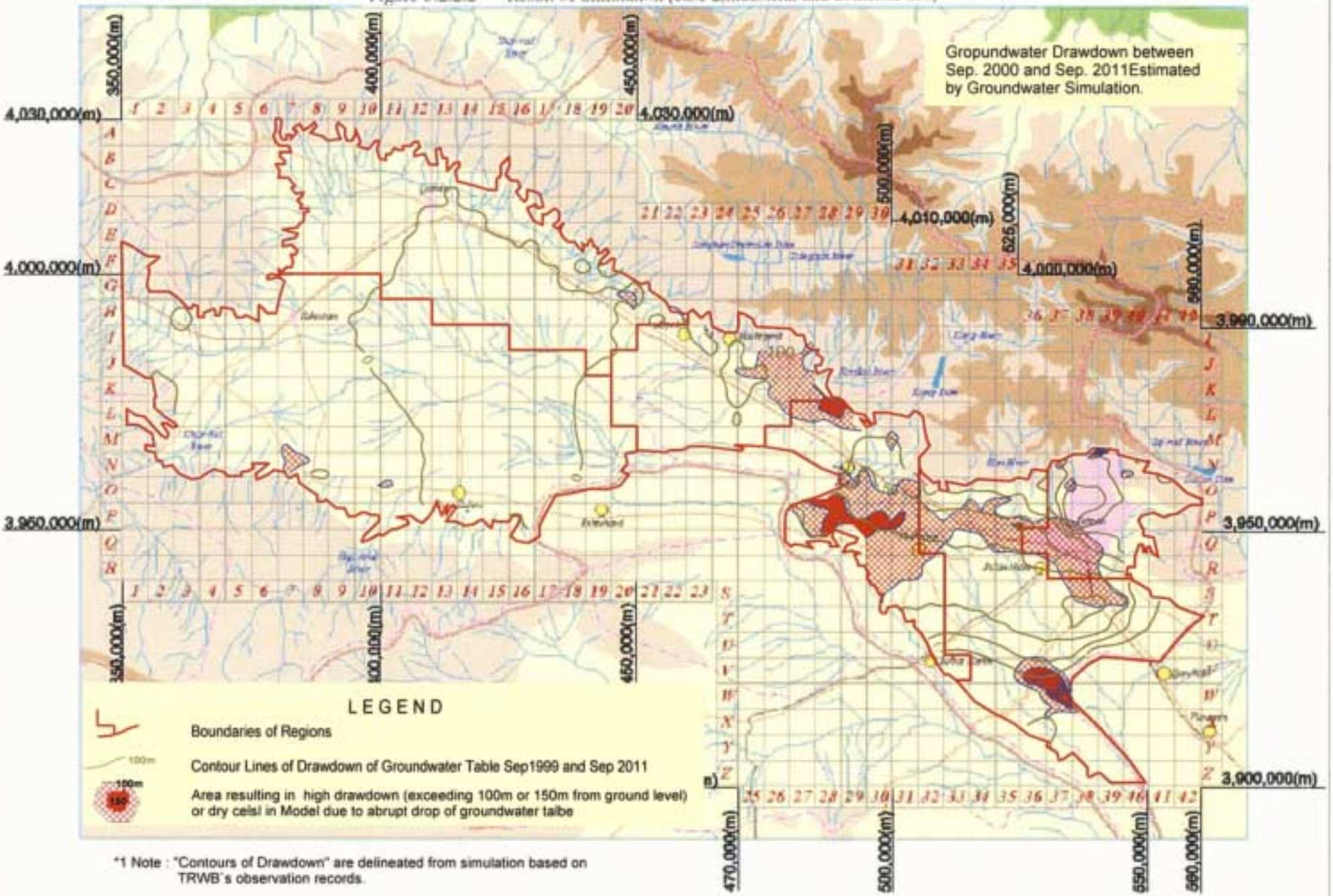


Figure 5.2.2.2 Result of Simulation (case 2,industrial and domestic use)



*1 Note : "Contours of Drawdown" are delineated from simulation based on TRWB's observation records.

Figure 5.2.2.3 Result of Pathline analysis (case 1, forward)

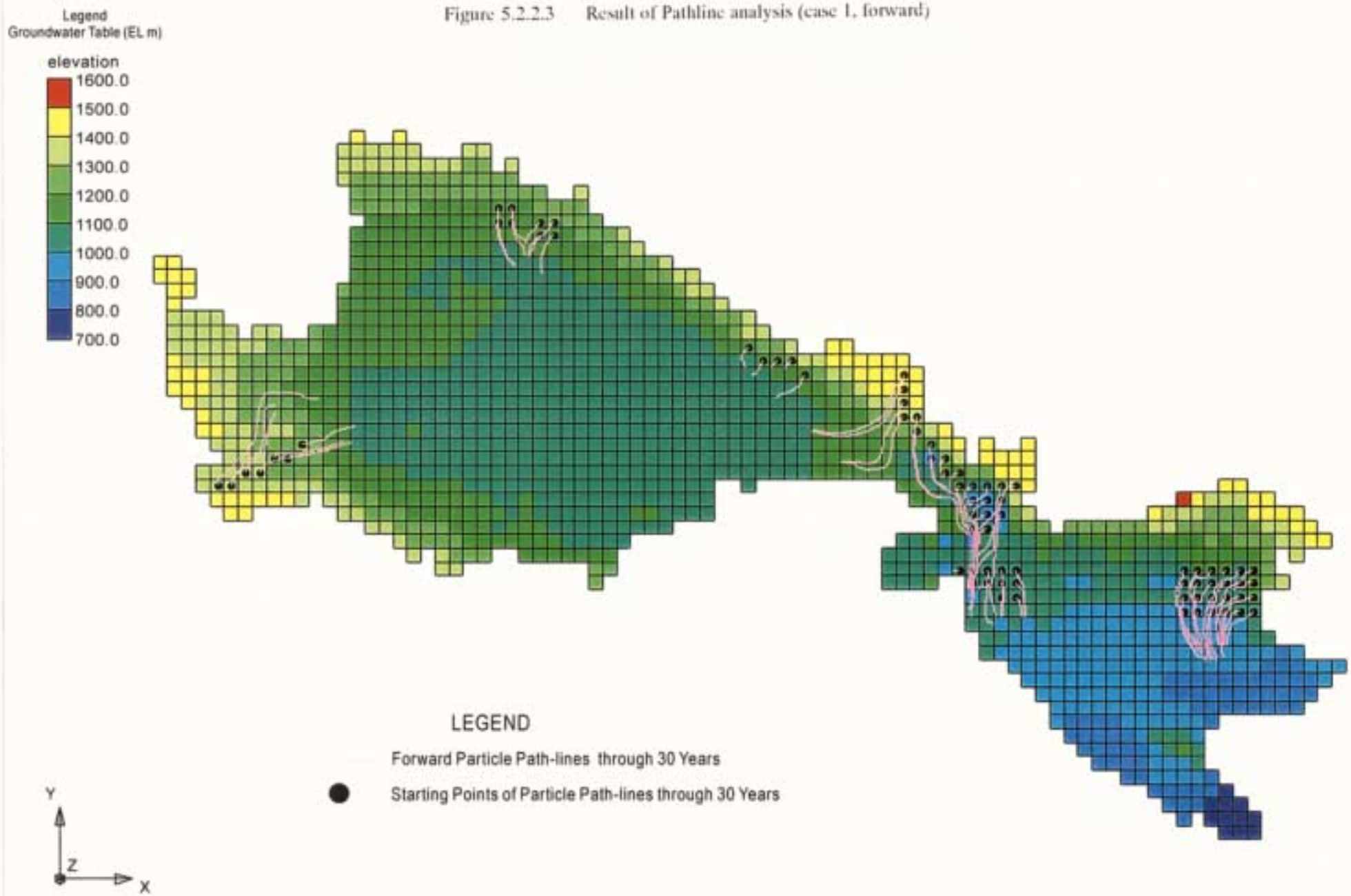


Figure 5.2.2.4 Result of Pathline analysis (case2, inverse)

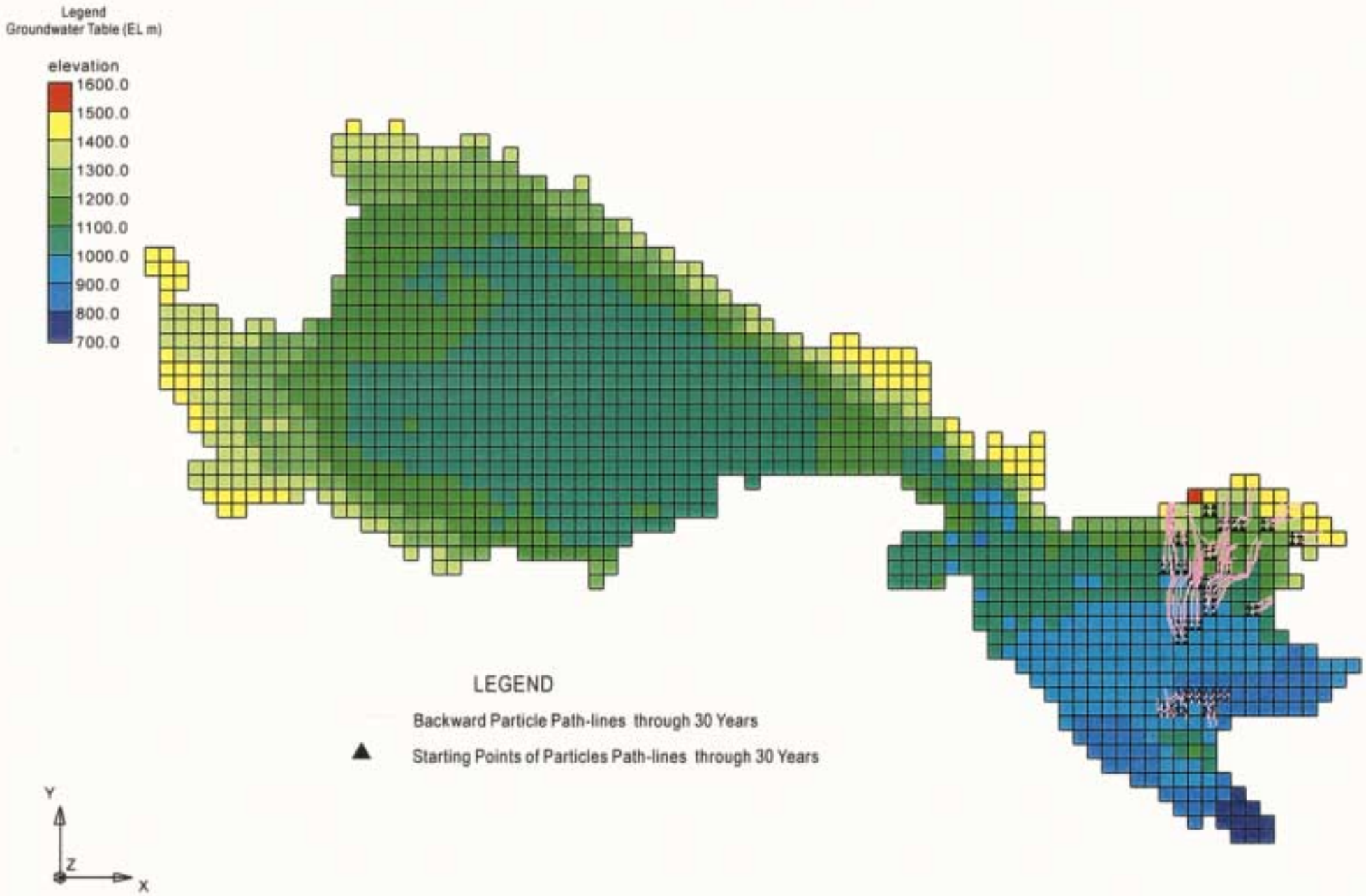


Figure 5.4.1.1 Potential and Available Surface Water Resources in the Study Area

Rivers	Water Resources (MCM)		
	Potential	Present Use	Usable
Taleghan River at Damsite	480	200	450
Taleghan River (Downstream)	40	-	250
Almout River at Damsite	325	-	
Small Streams in Tehran Region	200	170	170
Karaj River at Bileghan	490	435	435
Kordan River at Dehsommeh	120	60	60
Qazvin North Streams	95	60	60
Thee Rivers of South Qazvin Area	250	125	140
Jajrud at Latian Dam (Lar Included)	460	340	400
Total	2,460	1,390	1,965

Table 5.4.1.1 Future Water Demand and Allocation Plan in the Master Plan

Unit: MCM

Water Demand	2001	2006	2011	2021	Water Sources	2001	2006	2011	2021
1. Tehran City					Lar Dam	180.0	180.0	180.0	50.0
Domestic Water	907.9	1,019.3	1,080.6	1,233.1	Lar Dam Leakage	-	-	-	199.0
					Latian Dam	159.1	157.3	154.5	146.2
					Karaj Dam	300.0	300.0	300.0	250.0
					Taleghan 1	-	137.0	137.0	137.0
					Taleghan 2	-	-	-	205.0
					Groundwater	220.7	196.9	261.0	197.8
					Groundwater Reserved	48.1	48.1	48.1	48.1
Total	**907.9**	**1,019.3**	**1,080.6**	**1,233.1**	**Total**	**907.9**	**1,019.3**	**1,080.6**	**1,233.1**
2. Tehran Region									
Domestic Water	90.1	97.6	105.2	122.3	Groundwater	90.1	97.6	105.2	122.3
Industrial Water	54.3	59.2	64.2	73.4	Groundwater	54.3	59.2	64.2	73.4
Sub-total	**144.4**	**156.8**	**169.4**	**195.7**	**Sub-total**	**144.4**	**156.8**	**169.4**	**195.7**
Greenery Water	25.0	25.0	25.0	25.0	Karaj water	10.0	10.0	10.0	10.0
Agriculture	686.4	791.0	692.2	846.8	Small Stream	160.0	160.0	160.0	160.0
Sub-total	**711.4**	**816.0**	**717.2**	**871.8**	**Sub-total**	**170.0**	**170.0**	**170.0**	**170.0**
Total	**855.8**	**972.8**	**886.6**	**1,067.5**	Reuse Water	-	-	-	500.0
					Groundwater Greenery	15.0	15.0	15.0	15.0
					Groundwater Agriculture	526.4	631.0	532.2	216.8
					Total	**855.8**	**972.8**	**886.6**	**1,097.5**
3. Karaj Region									
Domestic Water	195.3	218.9	245.1	302.6	Groundwater	195.3	218.9	245.1	302.6
Industrial Water	219.1	236.7	256.9	293.5	Groundwater	219.1	236.7	256.9	293.5
Sub-total	**414.4**	**455.6**	**502.0**	**596.1**	**Sub-total**	**414.4**	**455.6**	**502.0**	**596.1**
Agriculture	568.0	252.2	342.4	250.0	Karaj Water	135.0	135.0	135.0	135.0
Sub-total	**568.0**	**252.2**	**342.4**	**250.0**	Groundwater	433.0	390.2	342.4	250.0
Total	**982.4**	**707.8**	**844.4**	**846.1**	**Total**	**982.4**	**980.8**	**979.4**	**981.1**
4. Hashtgerd Region									
Domestic Water	22.1	38.4	50.4	73.8	Ground water	22.1	38.4	50.4	73.8
Industrial Water	10.0	18.9	27.0	43.0	Ground water	10.0	18.9	27.0	43.0
Sub-total	**32.1**	**57.3**	**77.4**	**116.8**	**Sub-total**	**32.1**	**57.3**	**77.4**	**116.8**
Agriculture	319.8	308.8	298.3	277.8	Kordan Water	32.0	32.0	32.0	32.0
					Ground water	287.8	276.8	266.3	245.8
Sub-total	**319.8**	**308.8**	**298.3**	**277.8**	**Sub-total**	**319.8**	**308.8**	**298.3**	**277.8**
Total	**351.9**	**366.1**	**375.7**	**394.6**		**351.9**	**366.1**	**375.7**	**394.6**
5. Qazvin Region									
Domestic Water	70.0	78.1	87.2	104.3	Ground water	70.0	78.1	87.2	104.3
Industrial Water	21.3	37.2	50.7	74.8	Ground water	21.3	37.2	50.7	74.8
Sub-total	**91.3**	**115.3**	**137.9**	**179.1**	**Sub-total**	**91.3**	**115.3**	**137.9**	**179.1**
Agriculture	1,403.0	1,381.3	1,723.2	1,685.0	Taleghan Water	144.0	144.0	122.0	122.0
					Almout Water	-	-	308.0	308.0
					Tributary Water	185.0	185.0	185.0	185.0
					Ground water	1,074.0	1,052.3	1,108.2	1,070.0
Sub-total	**1,403.0**	**1,381.3**	**1,723.2**	**1,685.0**	**Sub-total**	**1,403.0**	**1,381.3**	**1,723.2**	**1,685.0**
Total	**1,494.3**	**1,496.6**	**1,861.1**	**1,864.1**	**Total**	**1,494.3**	**1,496.6**	**1,861.1**	**1,864.1**

Table 5.4.1.2 Comparison of Water Demand and Allocation Plan between Master Plan and JICA Review

Item	Master Plan (Final)				JICA Proposal				
	2001	2006	2011	2021	2001	2005	2011	2016	2021
1. Tehran City									
(1) Demand									
Domestic/Industrial	**908**	**1,019**	**1,081**	**1,223**	**910**	**1,020**	**1,080**	**1,160**	**1,230**
(2) Supply									
Latian/Lar Dam	339	337	335	395	340	340	340	340	400
Karaj Dam	300	300	300	250	300	340	320	300	270
Taleghan Diversion		137	137	342			150	250	310
Sub-total	639	774	772	987	640	680	810	890	980
Groundwater	269	245	309	246	270	340	270	270	250
Total	**908**	**1,019**	**1,081**	**1,233**	**910**	**1,020**	**1,080**	**1,160**	**1,230**
2. Tehran Region									
(1) Demand									
Domestic/Industrial	144	157	169	196	150	160	170	170	190
Agriculture	711	816	717	902	710	710	720	805	870
Total	**855**	**973**	**886**	**1,098**	**860**	**870**	**890**	**975**	**1,060**
(2) Supply									
D/I by Groundwater	144	157	169	196	150	160	170	170	190
Agriculture by:									
Small Rivers	170	170	170	170	170	170	170	170	170
Re-used Water				500			50	150	250
Groundwater	541	646	547	232	540	540	500	485	450
Sub-total	711	816	717	902	710	710	720	805	870
Total	**855**	**973**	**886**	**1,098**	**860**	**870**	**890**	**975**	**1,060**
3. Karaj Region									
(1) Demand									
Domestic/Industrial	414	456	502	596	415	460	500	550	600
Agriculture	568	525	477	435	565	520	480	460	440
Total	**982**	**981**	**979**	**1,031**	**980**	**980**	**980**	**1,010**	**1,040**
(2) Supply									
D/I by Groundwater	414	456	502	596	415	460	500	550	600
Agriculture by:									
Karaj Dam	135	135	135	185	135	95	115	140	165
Taleghan Diversion						120			
Re-used Water							100	100	100
Groundwater	433	390	342	250	430	305	265	220	175
Sub-total	568	525	477	435	565	520	480	460	440
Total	**982**	**981**	**979**	**1,031**	**980**	**980**	**980**	**1,010**	**1,040**
4. Hashtgerd Region									
(1) Demand									
Domestic/Industrial	32	57	77	117	30	60	80	100	120
Agriculture	312	309	298	278	350	320	300	280	260
Total	**344**	**366**	**375**	**395**	**380**	**380**	**380**	**380**	**380**
(2) Supply									
D/I by Groundwater	32	57	77	117	30	60	80	100	120
Agriculture by:									
Kordan Water	32	32	32	32	60	60	60	60	60
Groundwater	288	277	266	246	290	260	240	220	200
Sub-total	320	309	298	278	350	320	300	280	260
Total	**352**	**366**	**375**	**395**	**380**	**380**	**380**	**380**	**380**
5. Qazvin Plain									
(1) Demand									
Domestic/Industrial	91	115	138	179	90	115	140	160	180
Agriculture	1,403	1,381	1,723	1,685	1,455	1,455	1,630	1,730	1,740
Total	**91**	**115**	**138**	**179**	**90**	**115**	**140**	**160**	**180**
(2) Supply									
D/I by Groundwater	91	115	138	179	90	115	140	160	180
Agriculture by:									
Taleghan Diversion	144	144	122	122	200	170	300	140	140
Almout Diversion			308	308				250	250
Small Rivers	185	185	185	185	185	185	200	200	200
Groundwater	1,074	1,052	1,108	1,070	1,070	1,100	1,130	1,140	1,150
Sub-total	1,403	1,381	1,723	1,685	1,455	1,455	1,630	1,730	1,740
Total	**1,494**	**1,496**	**1,861**	**1,864**	**1,545**	**1,570**	**1,770**	**1,890**	**1,920**

Figure 5.4.2.1 Projected Water Demand by Region

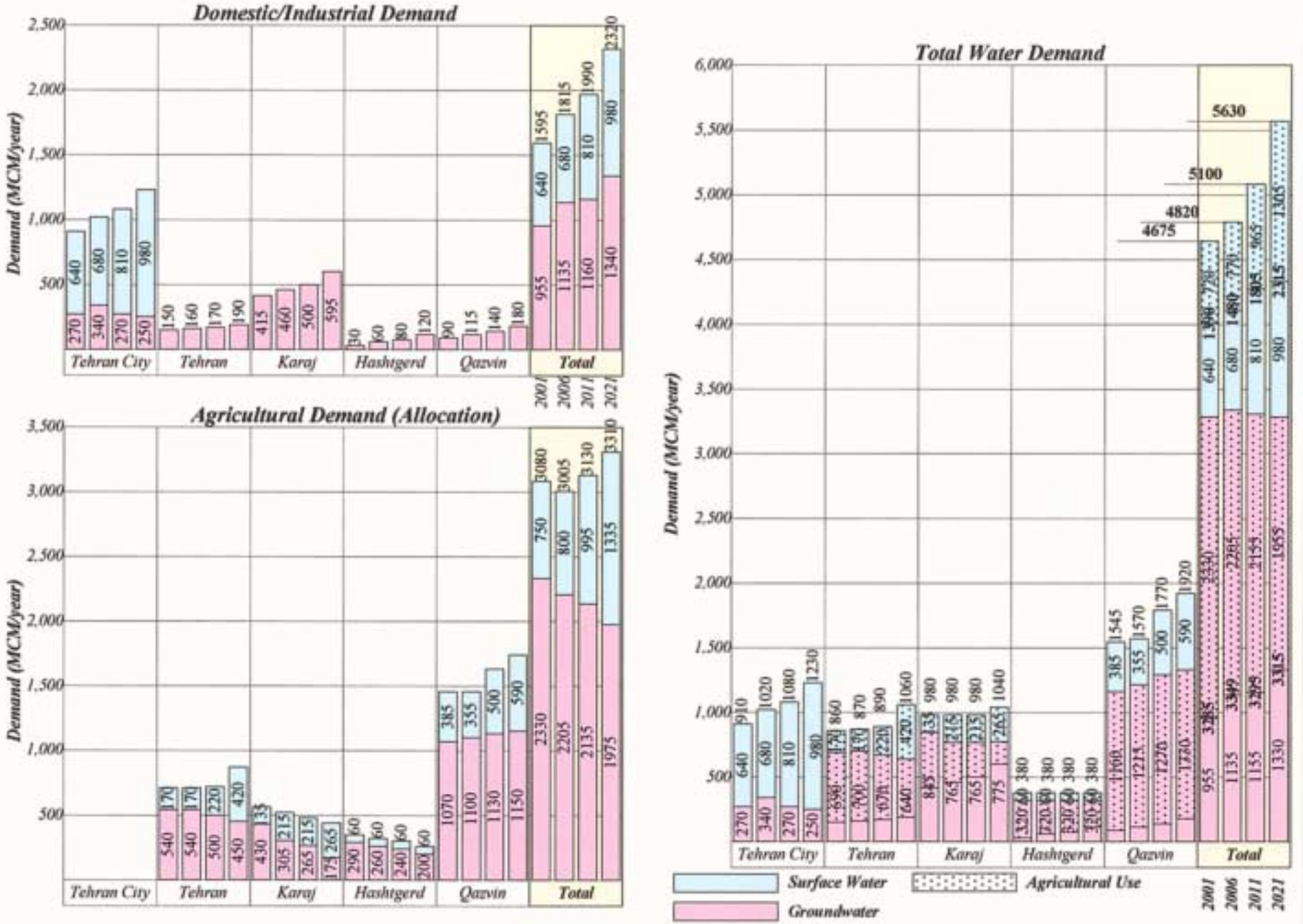


Figure 5.4.2.2 Water Demand and Water Sources (1/3)

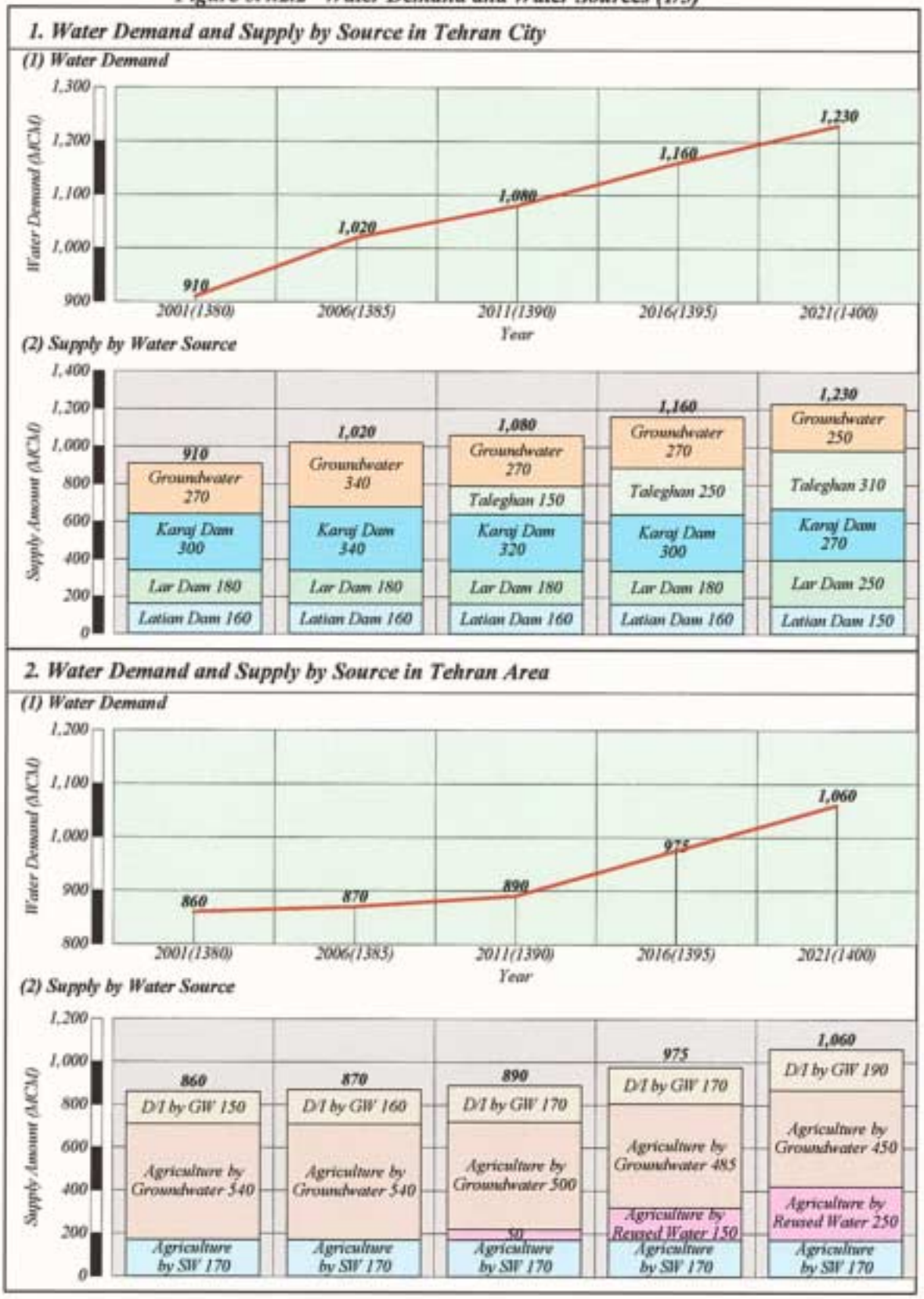


Figure 5.4.2.3 Water Demand and Water Sources (2/3)

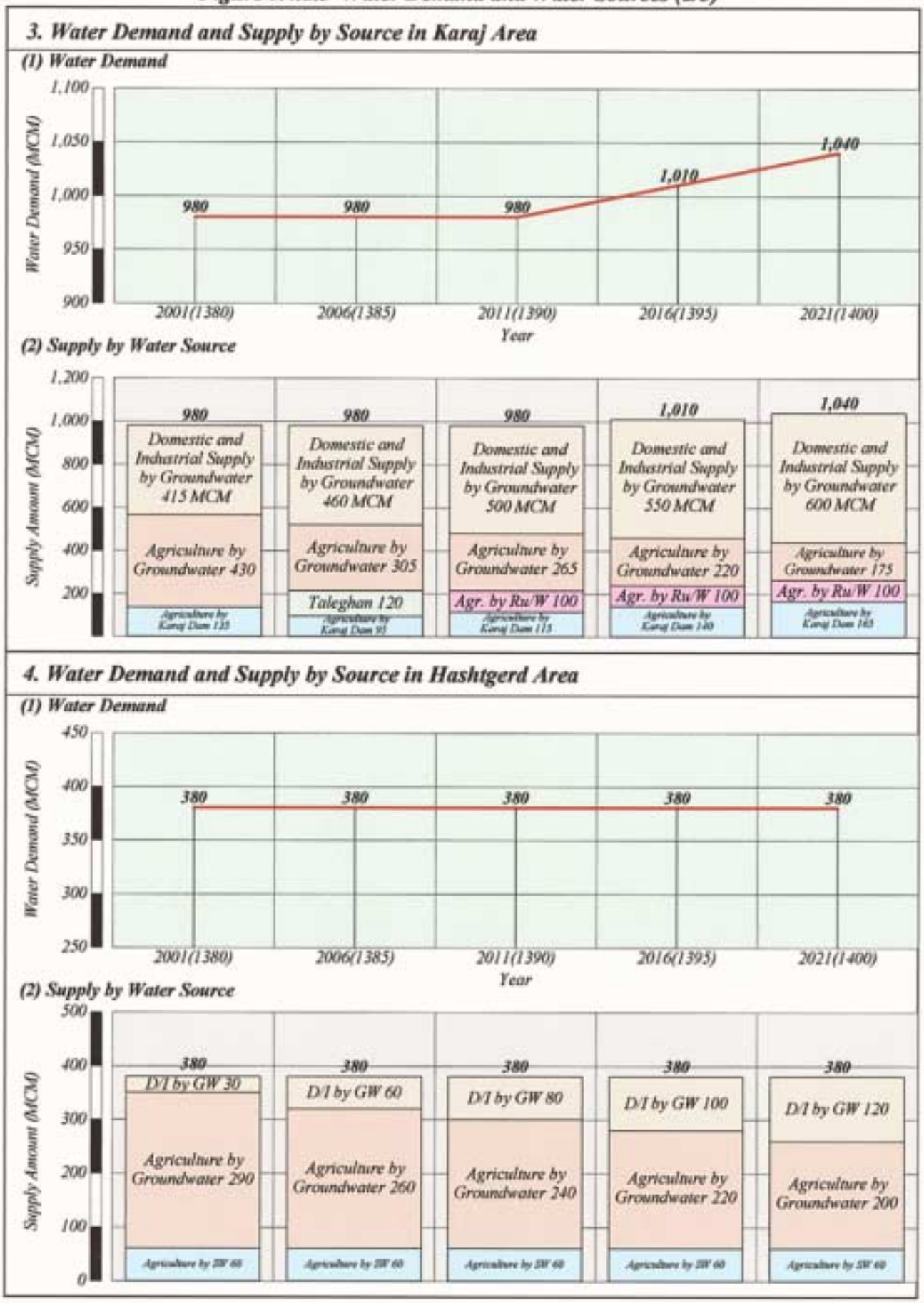
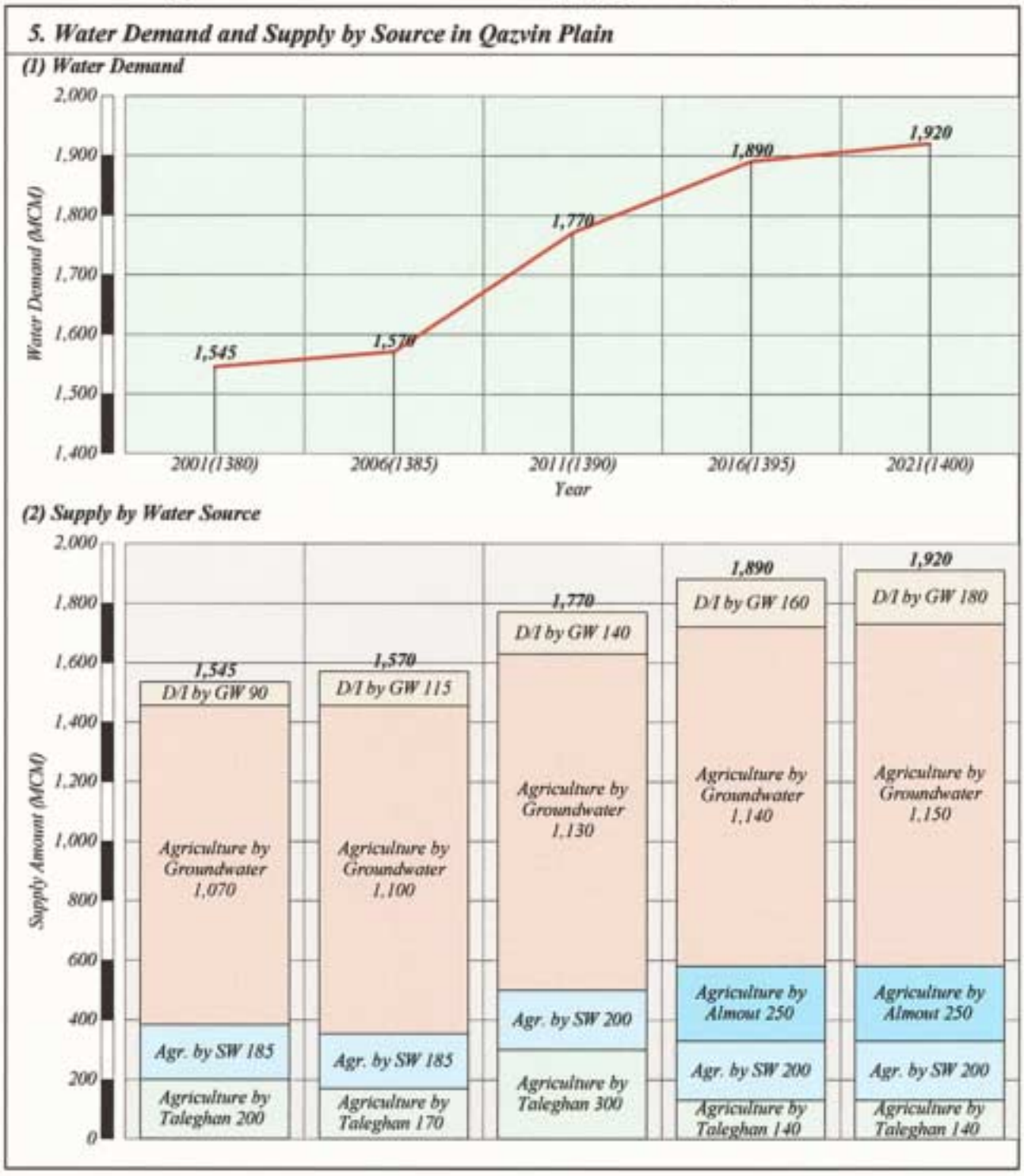


Figure 5.4.2.4 Water Demand and Supply by Source of Water (3/3)



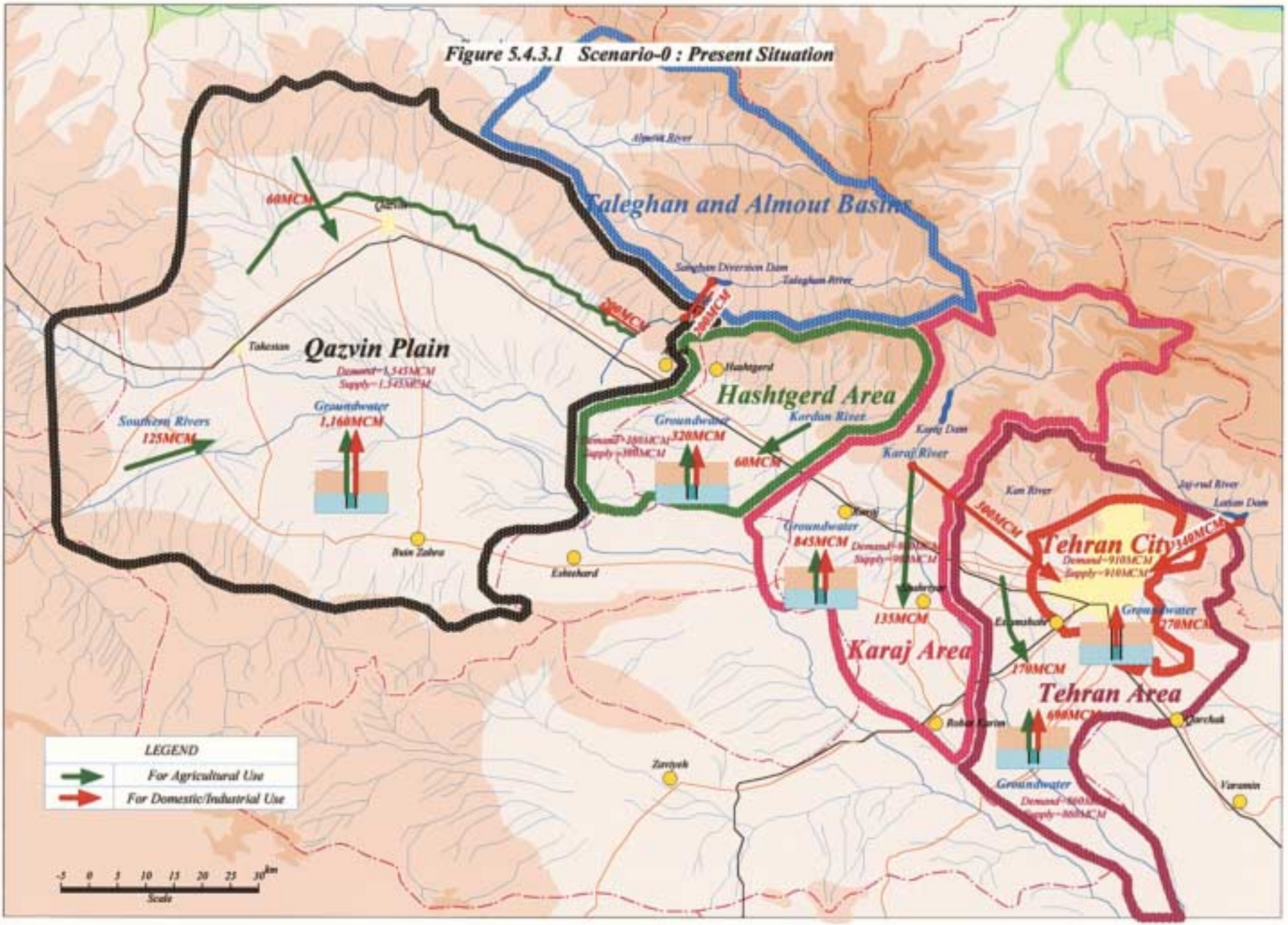
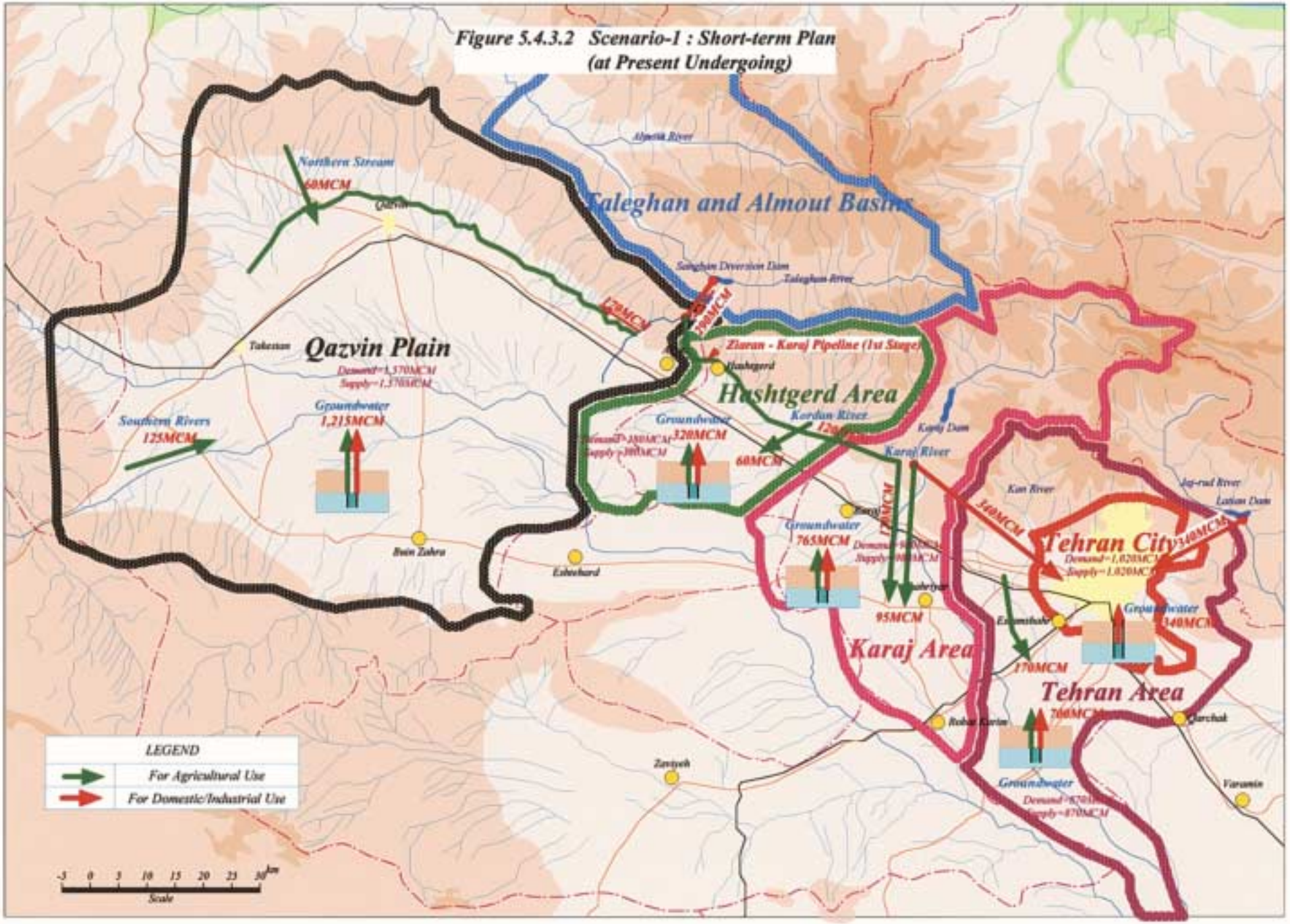


Figure 5.4.3.1 Scenario-0 : Present Situation

Figure 5.4.3.2 Scenario-1 : Short-term Plan (at Present Undergoing)



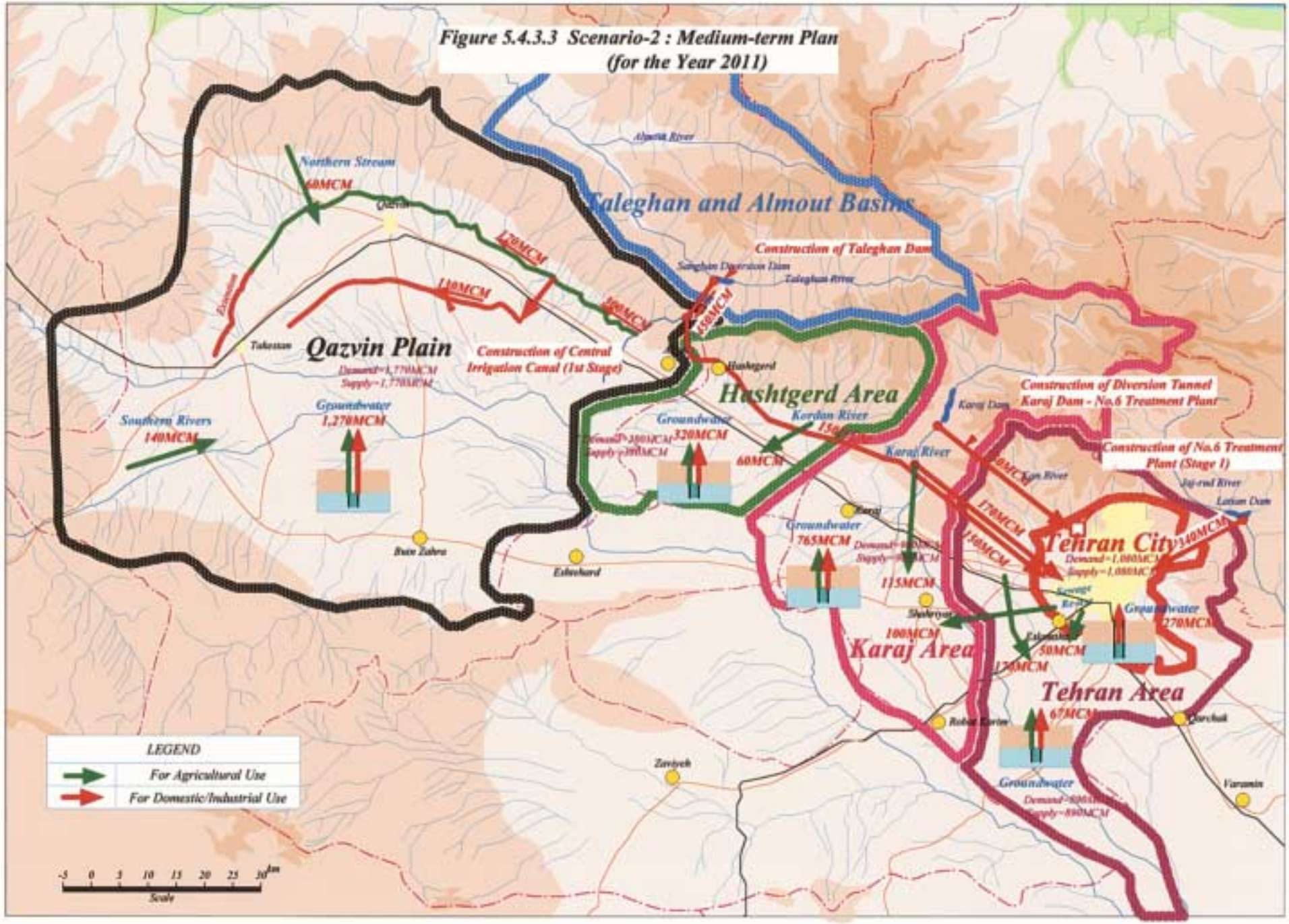
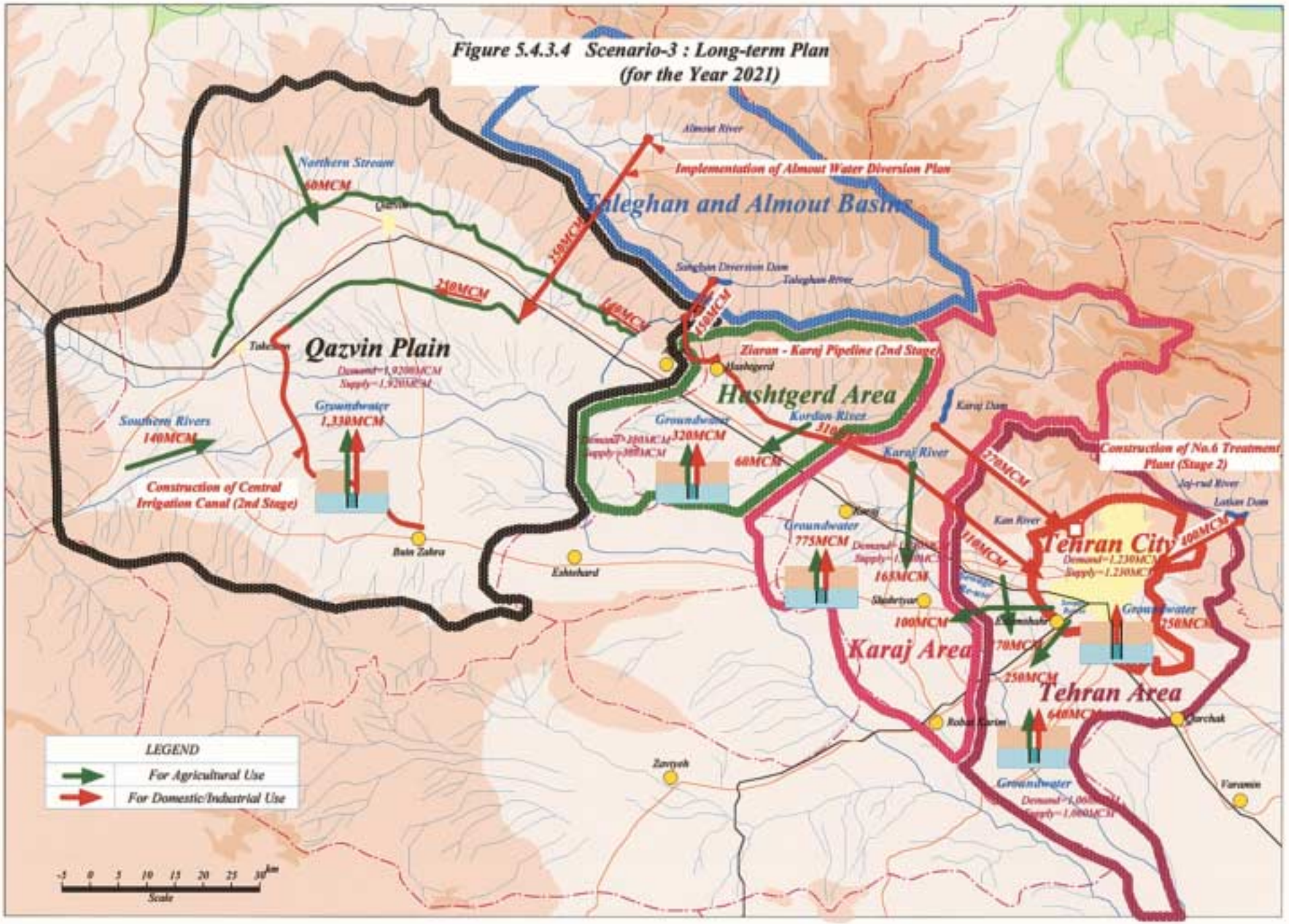


Figure 5.4.3.3 Scenario-2 : Medium-term Plan
(for the Year 2011)
Taleghan and Almout Basins
Construction of Taleghan Dam
Taleghan River
Northern Stream
60MCM
Qazvin
170MCM
110MCM
280MCM
150MCM
Qazvin Plain
Demand=1,770MCM
Supply=1,770MCM
Takestan
Construction of Central
Irrigation Canal (1st Stage)
Hashtgerd
Hashtgerd Area
Groundwater
320MCM
Demand=380MCM
Supply=380MCM
Kordan River
60MCM
Southern Rivers
140MCM
Groundwater
1,270MCM
Buin Zahra
Eshtehard
Construction of Diversion Tunnel
Karaj Dam - No.6 Treatment Plant
Karaj Dam
Karaj River
Construction of No.6 Treatment
Plant (Stage 1)
Jajrud River
Latian Dam
Groundwater
765MCM
Karaj
115MCM
Shahriyar
100MCM
Karaj Area
Tehran City
Demand=1,080MCM
Supply=1,080MCM
140MCM
170MCM
150MCM
Groundwater
270MCM
50MCM
170MCM
Tehran Area
67MCM
Groundwater
Robat Karim
Varamin
Zarrineh
Zavieh
LEGEND
For Agricultural Use
For Domestic/Industrial Use
-5 0 5 10 15 20 25 30km
Scale

Figure 5.4.3.4 Scenario-3 : Long-term Plan (for the Year 2021)



CHAPTER 6.

WATER RESOURCES AND WATER UTLIZING DEVELOPMENTP ROJECT

CHAPTER 6 WATER RESOURCES AND WATER UTLIZING DEVELOPMENT PROJECT

6.1 Surface Water Development Project

6.1.1 Potential and Available surface Water Resources

The potential and available surface water in the Study Area is summarized as follows based on the data in 3.3 “Surface Water”.

	Potential	Present Use	Available in future
Jajrud at Latian dam (Lar Included)	460	340	400
Karaj River at Bileghan	490	435	435
Kordan River	120	60	60
Taleghan River at Damsite	480	200	450
Almout River at Water Diversion site	365	0	250
Tributaries at Tehran Region	200	170	170
Tributaries at North Mountain in Qazvin	95	60	60
Three Rivers at South Qazvin	250	125	140
Total	**2,460**	**1,390**	**1,965**

- The surface water of Jajrud, Lar and Karaj rivers has been already used completely for Tehran urban water supply and irrigation at the Varamin and Karaj plain and has no more allowance to be used.
- Though the potential surface water of the Kordan river is 120MCM, its available water is only 60MCM, which is used for the irrigated agriculture in the upper basin because of the limited agricultural area to use the Kordan water in the upper basin.
  The remained Kordan water gets into underground at the large alluvial plain with deep depth in the middle basin and changes to groundwater.
- Taleghan water of 200MCM has been used for the irrigation in the north Qazvin plain by the Taleghan water diversion project but its available water will be increased to 450MCM by the Taleghan dam project under construction. The Taleghan reservoir water will be allocated to Tehran water supply and Qazvin irrigation in future.
- Though the potential surface water in the Almout is 310MCM at the proposed diversion site, the available diversion water to Qazvin is proposed at 250MCM taking into account the downstream outflow for irrigation and river maintenance.
- The surface water in tributaries is existing only in spring and available for irrigation use of winter crops but mostly used for groundwater recharge.

6.1.2 Karaj Water Project

(1) Existing Karaj Water Project

Karaj water project, consisting of Karaj concrete arch dam, Karaj regulating dam, Bileghan diversion dam, water conveyance pipelines to Tehran and Karaj irrigation canal, has been completed in 1963 for supplying irrigation water to Karaj farmland and urban water to No.1 and No. 2 treatment plant of Teheran city. The major features of existing Karaj water project are as follows:

Major Features of Karaj Water Project Completed

Item	Type or Dimension	Remarks
1. Karaj Dam (Amir Kabir Dam)		
Dam Type	Concrete Arch Dam	
Dam Height	180 m	
Dam Length	390 m	
Dam Concrete Volume	750,000 m^3	
Effective Reservoir Capacity	195 MCM	
Gross Reservoir Capacity	205 MCM	
Annual Supply of Karaj Water	435 MCM*2)	
Installed Generator Capacity	91,000 kw	
Design Flood	1,450 m^3/sec	
2. Karaj Regulating Dam		
Location	1,200m downstream from Karaj dam	
Dam Type	Concrete Gravity Dam	
Dam Height	50 m	
Dam Length	110 m	
Dam Concrete Volume	125,000 m^3	
Gross Reservoir Capacity	850,000 m^3	
Design Flood	1,450 m^3/sec	
3. Bileghan Diversion Dam*1)		
Dam Type	Concrete Floating Type	
Dam Height	3.0 m	
Dam Length	20.5 m	
Weir Crest Elevation	EL.1,370 m	
Annual Water Supply to Tehran City	300 MCM*2)	Water Pipeline to Tehran city: 2,000 mm Dia. X 2 rows
Annual Water Supply to Karaj Farmland	135 MCM*2)	
4. Water Conveyance Pipelines		
No.1 Pipeline	ϕ1,000mm x 2, L=40 km, Qmax=3 m^3/sec	
No.2 Pipeline	ϕ1,800mm x 2, L=45 km, Qmax=10 m^3/sec	
5. Karaj Irrigation Canal*1)		
Right Main Canal	Qmax =12 m^3/s, L=12 km	
Left Main Canal	Qmax =6 m^3/s, L=26 km	
Lateral Canal	L=46 Km	

Note : *1) = Data given by TRWB, *2) = Figures estimated by JICA Study Team

(2) Proposed Karaj Water Conveyance Project to Tehran

In order to supplement the defiency of the urban water demand in Tehran city, the water pipeline works to convey the Taleghan water of 150MCM per annum from the existing Taleghan tunnel outlet in Ziaran river basin to the Bileghan site in Karaj river are going to be completed at the end of 2001. In the original plan, this Taleghan water shall be conveyed to the water treatment plant in Tehran city to cover the increasing urban water demand of Tehran city.

However, the new water conveyance facility between the Karaj and Tehran is still under studied and not implemented.

In accordance with the preliminary plan under study by Tehran W.S.C, the outline of new water conveyance facility is as follows;

- The new water treatment plant of No.6 shall be installed at the site with the elevation of 1,600m in the north west mountain foot area of Tehran city to supply the domestic water to residential area at the high land of Tehran city. Two plants with the design treatment capacity of 7.5m^3/sec per each is proposed, and could treat the Karaj or Taleghan water of about 300MCM per annum.

- There are two alternative water conveyance plans, one is the plan to convey the clean water released from Karaj dam by the tunnel of 24km from the Khuzan Kola site immediate downstream of Karaj regulating dam to the No.6 plant site at Tehran city.
  This plan has the advantage to take the clean reservoir water and convey to Tehran with gravity flow because the intake site is located at the elevation of more than 1,500m the reservoir outflow at the re-regulating dam is taken without pollution.
  However, this plan has disadvantage to require the high construction cost of about US$50 to 60 million and the long construction period of 5 to 6 years. The proposed tunnel alignment and tunnel section is shown in the Database Map.

- The other plan is to convey the Karaj or Taleghan water by the pipeline from the existing Bileghan site to No.6 plant by pumping up with total head of more than 200m.
  This plan will be constructed with the same cost but the shorter construction period than those in the tunnel plan. However the high pumping operation cost is required and the clean Karaj water can't be conveyed because the water released from Karaj dam will be polluted on the river course from the dam to Bileghan site.
  T.R.W.B intends to study very urgently this water conveyance plan and implement as early as possible, otherwise the Taleghan water to be conveyed to Bileghan site could not be used for Tehran water supply.

6.1.3 Taleghan Water Project

(1) Existing Taleghan Water Diversion Project for Qazvin Irrigation

The Taleghan water has been used for irrigation in the northern area of Qazvin plain since the Taleghan Water Diversion Project as Stage I consisting of Sangeban diversion dam, Taleghan diversion tunnel and Ziaran diversion dam as well as Taleghan conveyance canal (Qazvin North canal), has been completed in 1974. At present, the Taleghan water of 200 MCM is diverted annually to the Qazvin North canal. The major features of existing Taleghan water diversion project are as follows:

Major Features of Taleghan Diversion Water Project

Item	Type or Dimension	Remarks
1. Sangeban Diversion Dam*1)		
Dam Type	Concrete Floating Type	
Dam Height	14 m	
Dam Length	188 m	
Dam Concrete Volume	68,000 m	
Effective Reservoir Capacity	0.6 MCM	
Max. Water Level	EL. 1700.5	
Min. Water Level	EL. 1,698 m	
Annual Supply of Taleghan Water	200 MCM	
Design Flood	1,700 m^3/sec	
2. Taleghan Diversion Tunnel*1)		
Tunnel Type	Low Pressure Type	
Tunnel Length	8.8 km	
Tunnel Section	Standard Horse Shoe Type	
Internal Diameter	3.6 m	
Max. Discharge Capacity	30 m^3/sec	
Max. Intake Level	EL. 1700.5 m	
Discharge Water Level	EL. 1676.2 m	
3. Ziaran Diversion Dam*1)		
Dam Type	Concrete Gravity Type	
Dam Height	23.8 m	
Dam Length	180 m	
Dam Concrete Volume	29,000 m	
Effective Reservoir Capacity	0.23 MCM	
Max. Water Level	EL. 1450 m	
Min. Water Level	EL. 1443 m	
4. Qazvin North Canal*2)		
Main Canal	Qmax = 30 m^3/s, L=94 km	
Lateral Canal	L= 217 Km	
Irrigation Area	40,000 ha	
Annual Water Supply	200 MCM	

Note : *1) = Taleghan Multipurpose Water Development Project, Feasibility Report, Summary, Sanyu Consultants International, Inc., March 1967 (Esfand 1346)

*2) = Taleghan Water Conveyance Project, Design Report, Tahal-Hamkar-Honar Consulting Engineers, Nov. 1971 (Azar 1350)

However those water diversion facilities have been used in the period of more than 25 years and deteriorated. Since those facilities except Sangban diversion dam at the Taleghan river shall be used for the future water conveyance from Taleghan reservoir to Tehran urban water supply, the facilities shall be rehabilitated taking into account the following issues.

- The entrance of the existing tunnel shall be plugged to prevent the invasion of Taleghan reservoir water with the high pressure of 100 m.
- The concrete lining in the tunnel with the length of 9 km shall be surveyed and rehabilitated.
- Some water leakage at the tunnel outlet is found and shall be surveyed and improved.
- Telemetering system through tunnel between Sangban and Ziaran control house is completely broken and shall be improved.

(2) Taleghan Dam Project Under Construction

Taleghan river has an average annual runoff of 480 MCM and the river water of 450 MCM will be available for the beneficiary area in the Study Area by the Taleghan dam construction as Stage II Development of Taleghan project. At present, Taleghan dam is under construction and will be completed by 2006.

The major features of Taleghan dam are as follows:

Major Features of Taleghan Dam

Item	Type or Dimension	Remarks
1.Dam and Reservoir		
Drainage Area	1,100 km^2	
Reservoir Area	12.3 km^2	
Low Water Surface	EL. 1742 m	
Normal Water Surface	EL. 1,780 m	
High Water Level	EL. 1,784.21 m	H_d=4.21 m
Crest of Dam	EL. 1,785 m	
Dam Height	104 m	
Crest Length	1000 m	
Dead Storage	100 MCM	
Live Storage	320 MCM	
Gross Storage	420 MCM	
Embankment Volume	11 MCM	
2. Spillway		
Design Flood	1,230 m^3/sec	
Design Head	3.4 m	
Crest Length of Weir	140 m	
Spillway Type	Side Channel	
3. River Diversion		
Design Food for Diversion (50-year Flood)	480 m^3/sec	
Tunnel Diameter	7.0 m	

(3) Existing and Proposed Taleghan Water Pipeline

The ϕ 1,800mm dia. one row water pipeline works of approx. 60km long from the existing Taleghan diversion tunnel outlet to Bileghan diversion dam on Karaj river are almost completed as a part of necessary water supply system for urban water use of Tehran city. This water pipeline can supply Taleghan water of 150MCM/annum to Bileghan diversion damsite.

After the completion of Taleghan dam project, an additional pipeline will be installed along the pipeline mentioned above in order to supply Taleghan water of 310MCM/annum including 150MCM by the existing pipeline to Bileghan diversion dam.

6.1.4 Proposed Almout Water Diversion Project Proposed

The proposed Almout water diversion project is a plan for diverting the Almout and Andah-rud river water to the central Qazvin plain and major features of the project are as follows:

Major Features of Almout Water Diversion Project

Item	Type or Dimension	Remarks
1. Almout Diversion Dam Project		
Drainage Area	475 km^2	at Dozdaksar site
Inflow	250 MCM/year	not including inflow of Andah-rud tributary
Dam Type	Concrete Floating Type	
Dam Height	10 m	
Dam Length	56 m	
Concrete Volume	40,000 m	
Normal Water Surface	EL. 1,299 m	
Annual Water Supply to Qazvin Plain	250 MCM	incld. 40 MCM from Andah-rud tributary
Design Flood	230 m^3/sec	
2. Diversion Tunnel		
a) Andah-rud diversion dam	L=20 m, H=5 m	
Drainage Area	112 km^2	
Inflow	60 MCM/year	
b) Pipeline		
Main Pipeline	ϕ2,000mm x 3 rows, L=6 km	between Almout D. Dam and Tunnel Inlet
Branch Pipeline	ϕ1,800mm x 1 row, L=2.5 km	between Andah-rud D. Dam and Main Pipeline
c) Tunnel		
Tunnel Type	Gravity Flow	
Tunnel Length	33.8 km	
Tunnel Section	Circle and Standard Horse Shoe Types	
Internal Diameter	3.9 – 4.4 m	
Max. Discharge Capacity	22.5 m^3/sec	
Water Level at Downstream End	EL. 1,250 m	
Regulating Ponds	Concrete Lined Pond : 2 places	

6.2 Water Work Project in Tehran City

6.2.1 Urban Water Supply System

(1) Water Sources

There are the water resources development projects such as Darvazeh (Mamuluu) dam, Ab Ask dam and pumping station in Lar dam to use the leakage water at the dam. Those dam projects, however, are originally planned for the irrigation of the Varamin area and not clear to use the Tehran urban water supply.

(2) Water Works

As mentioned already in 2.4.2 (3) “Water Sources and Water Supply Facilities”, four water treatment plants with design treatment capacity of 19m^3/sec and average annual production of about 530MCM are under operation No.5 water treatment plant with the production capacity of 19MCM per month is under construction.

In order to supply the above treated water to overall Tehran city, 26 pumping stations with the lifting capacity of 33m/sec in total, the ductile iron pipe system of 8,700km, the regulating reservoirs of 50 units and the deep wells of about 200 units are constructed and under operation. However some pipeline system is deteriorated and under rehabilitation to prevent the water loss through the pipeline.

No.6 new water treatment plant is proposed at the north-west area of Tehran city. The plant is proposed with the design capacity of 12m^3/sec and pipeline length of 18km with diameter of 1.6m.

(3) Sewerage Treatment Plant

No.1 sewerage treatment plant with the treated capacity of 9.5m3/sec and No.2 with 13.9m3/sec are planned in Tehran city, as mentioned in 5.3.1 “Sewage Water Treatment Plant in Tehran”. This treated water will be used for irrigation at the Tehran south, Varamin and Karaj plain.

6.3 Irrigation Project

6.3.1 Qazvin Irrigation Project

(1) Existing North Irrigation Canal System

The north irrigation canal system is consisted of the canal network and the combined wells along the canals. According to the inventory survey for the canal system entrusted to the Lar Consulting Engineers, targeted irrigation area is 76,700 ha and total length of the main and secondary canal is about 94 km and 220 km, respectively. The number of beneficial farm household and population is 10,172 and 63,979, respectively. As for the appurtenant facilities, regulator, check gate and bridges are constructed along the canals.

Summary of Inventory of Canal Facilities

Canal network	Quantity	Remarks
Irrigation area	76,700 ha	
Number of farm household	10,172	Population, 63,979
Main canal	94 km	30.0 – 3.0 m^3/s
Secondary canal	220 km	7.4 – 0.6 m^3/s, 12 canals
Tertiary and Quarterly canals	810 km	
Appurtenant facilities	Regulator (94), Check or turn-out (175), Bridge (137), Drop (406), Siphon (231), Others (267)	

Total 63 combined wells are connected with the canals to supplement the irrigation water in summer season. Their outline is summarized as follows.

Summary of combined well

Items	Quantity
Total number	63
Constructed year	1969-87
Average depth of well	140 m
Average setting depth	70 m
Natural water table depth	34.1 m
Average pumping discharge	350 m^3/h
Structure	Casing 10～12 inch
Pump	Vertical turbine pump, 100～150kw

(2) Proposed Projects for Qazvin Irrigation Development

In order to increase the irrigation water use in Qazvin region the water resources and irrigation development projects have been studied preliminarily as follows.

(a) Study on Qazvin Central Canal System

According to the report prepared by THAL Consulting Engineers in 1966, the necessity of Qazvin central irrigation canal system is mentioned that when the additional Taleghan water by Taleghan dam construction will be supplied to Qazvin plain, the central and south agricultural area shall be irrigated taking into account the balanced irrigated agriculture in whole Qazvin plain. Accordingly the central canal system project to convey the additional water of Taleghan and Almout and to cover the central and south area in Qazvin Plain is proposed by JICA Team.

(b) Study on Qazvin South River Basin Development Plan

Agricultural area of Qazvin south is located in the three river basins of Khar rud, Abhar rud and Haji Arab. Several development studies of their rivers were conducted by related consulting firms. The Study were carried out from the viewpoint that is consisting of mainly water resources development to cover the water deficiency in the area. The Study outline is summarized as follows;

Study on Qazvin South River Basin Development Plan

Study	Contents
Study for Khar Rud Basin Development	- Construction of three diversion dams - Development area : about 21,500 ha
Study of Soil & Water Resources of Abhar Rud Basin	- Suitable cultivable land : about 20,000 ha - Cropped area of wheat 43 %, grape 31 %, alfalfa 12 %, etc.
Kineh Vars Reservoir Dam Construction	- Earth type of dam height 39 m - Annual run-off at dam site : 19.3 MCM - 16.4 MCM for drinking, 3.0 MCM for irrigation
Study on Water and Soil Resources Development of Khar Rud, Abhar Rud and Haji Arab	- Cultivable area : about 80,000 ha - 33.7 MCM for drinking and industry - Formulation of development alternatives consisted of construction of canal system and deep wells
Selection of Studies Conclusion Related to Water and Soil Resources Development in Abhar Rud Basin	Development Plan - Groundwater development - Canal construction from Khar Rud to Abhar Rud - Artificial recharge at Khar Rud : 45 MCM

These study result by the consultant is not approved yet by T.R.W.B because dam projects in three river basins will bring about a large impact to the existing groundwater recharge at the downstream area of three rivers, where many irrigated agriculture by deep wells is under progressed.

6.3.2 Irrigation System in Other Area

According to the Master Plan report, reuse of sewerage water and use of surface water from small rivers flowing into southern area of Tehran city are proposed to meet irrigation water demand

Study	Contents
Water Resources Improvement and Development in South of Tehran	- River discharge from seven small rivers : 504 MCM - Groundwater resources : Tehran aquifer 652 MCM, Varamin aquifer 273 MCM and Shahryar aquifer 87 MCM. - Cultivation area : Shahrerey 24,600 ha, Eslamshahar 10,600 ha and Varamin 13,300 ha