WEST DELTA WATER CONSERVATION PROJECT IMPACTS ON ROSETTA BRANCH

Sherine S. Ismail

Associate Prof., Nile Research Institute (NRI), Egypt
E-mail: sherine_shawky@yahoo.com

ABSTRACT

The West Delta Water Conservation and Irrigation Rehabilitation Project is a major response project to protect some major investments in West Delta area and to add more cultivated land to this region. The water requirements for this project are estimated by about 12 million cubic meters per day forming an annual demand of 4.2 billion cubic meters. The water intake for this project is planed to be located on Rosetta Branch. Due to the future excess discharge for the project through Rosetta Branch, this study is performed by the author as a part of serial studies conducted in Nile Research Institute for the project. These studies include the selection of the suitable location of the intake on Rosetta Branch and the water quality in the branch and its effect for the water demand of the project.

The objective of this paper is to study the effect of constructing the West Delta Project on Rosetta Branch. The author has performed this study in two major parts. The first part was to study the current demands and releases of Rosetta Branch and the future expected water demands of the project. The study proposed a frame of water management for the releases and demands for Rosetta Branch leading to water save of about more than 2.0 billion cubic meters per year. This part of the paper is illustrating, for the decision makers, the possibility of saving the required additional amounts of water for this national project. The second part of the study represents one of the first environmental studies for this major project that was conducted before the project operation. This study highlighted the impacts of the project on Rosetta Branch by using a 1-D computer model, HEC-RAS, to compute water levels related to the required discharge.

Keywords: West Delta Project, Conservation and Irrigation Rehabilitation Project, Cultivated Land, Rosetta Branch, Water Save, Water Management.

PROJECT CHARACTERISTICS

The West Delta Water Conservation and Irrigation Rehabilitation Project will implement a surface water conveyance system that extracts water from the River Nile to connect commercial farmers that lies in the southern part of the West Delta area.

The surface water will be distributed over the area by a buried pipeline network. This project will resolve the problem of excess groundwater exploitation, as it will make up for the shortage of The Nobaria Canal water discharge and to provide more water for new lands. The Project location is shown in Figure 1. It is located between Cairo and Saddat City at both sides of the Desert Highway Cairo-Alexandria (West Delta Project, 2007).

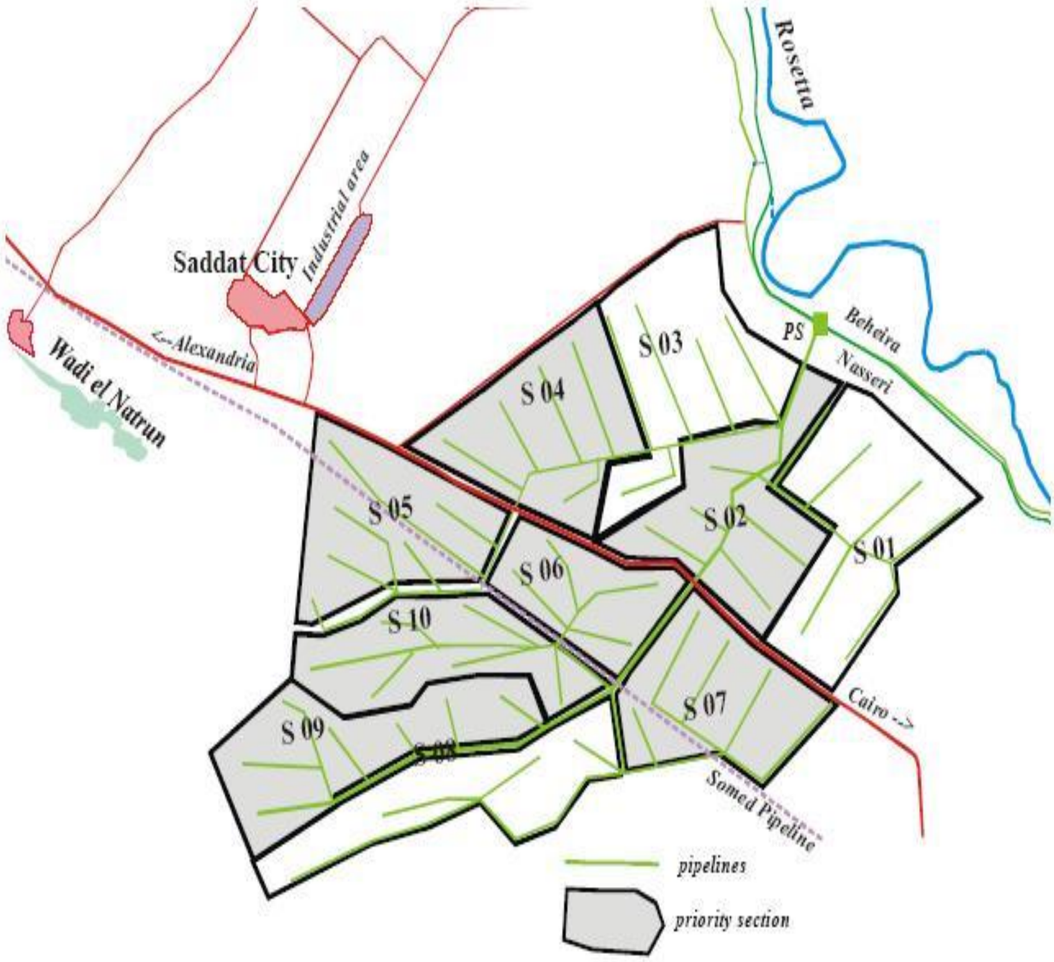

Figure 1. Project Location (West Delta Project, 2007)

PROJECT WATER DEMANDS

The project water demands consist of different project component demands such as Nobaria canal, present cultivated areas, and future cultivated areas demands. These demands will be added to Rosetta Branch present water demands to form the future water demands for the branch.

Nobaria Canal Water Shortage

The Nobaria Canal water shortage is estimated by about 3 million cubic meters per day. The total water demand for this part is about 1.1 billion cubic meters per year.

Present Cultivated Areas

The second region that will be served by the project is an area of about 255,000 feddans (equivalent to 107,000 ha), located approximately 60 kilometers north of Cairo to the west of the Nile Delta, noticeable agricultural growth through exploitation of groundwater has been realized over the past 25 years. The major purpose of the project is to protect the huge investments and job opportunities created by this region by providing enough water for this region and to protect the ground water from more descending in quantity and quality. The water requirements for this region are shown in Table 1 for different months.

Table 1. Water Demand for the 255,000 Feddans.

Month	***Monthly discharge (million m^3)***
January	84.24
February	117.73
March	171.84
April	181.2
May	153.86
June	233.21
July	266.31
August	223.88
September	126.7
October	103.51
November	83.95
December	80.18
Total	**1826.61**

The minimum water demand is computed for December with a value of 80.18 million cubic meters per month and the maximum water demand is computed for July with a value of 266.31 million cubic meters per month. The total water demand for this region is about 1.83 billion cubic meters per year.

Future Cultivated Area Water Demand

The third region that will be served by the project is an area of about 170,000 feddans. The computed water requirements for this region are shown in Table 2.

Table 2. Water Demand for the 170,000 Feddans

Month	***Monthly discharge (million m^3)***
January	55.71
February	76.29
March	103.37
April	95.88
May	62.53
June	125.37
July	162.29
August	135.09
September	77.66
October	56.39
November	50.17
December	50.62
Total	**1051.37**

The minimum water demand is computed for November with a value of 50.17 million cubic meters per month and the maximum water demand is computed for July with a value of 162.29 million cubic meters per month. The total water demand for this region is about 1.1 billion cubic meters per year.

ROSETTA BRANCH PRESENT WATER DEMANDS

The present monthly water demand for Rosetta Branch is studied for the period from 1996 to 2006. Figure 2 shows the total monthly demand for Rosetta Branch in addition to the average monthly demand for this period (NRI, 2006). It can be concluded from this figure that the minimum average water demand is for January with a value of 129.78 million cubic meters per month and the maximum average water demand is for June with a value of 628.08 million cubic meters per month. This water demand part represents the -before the project- case.

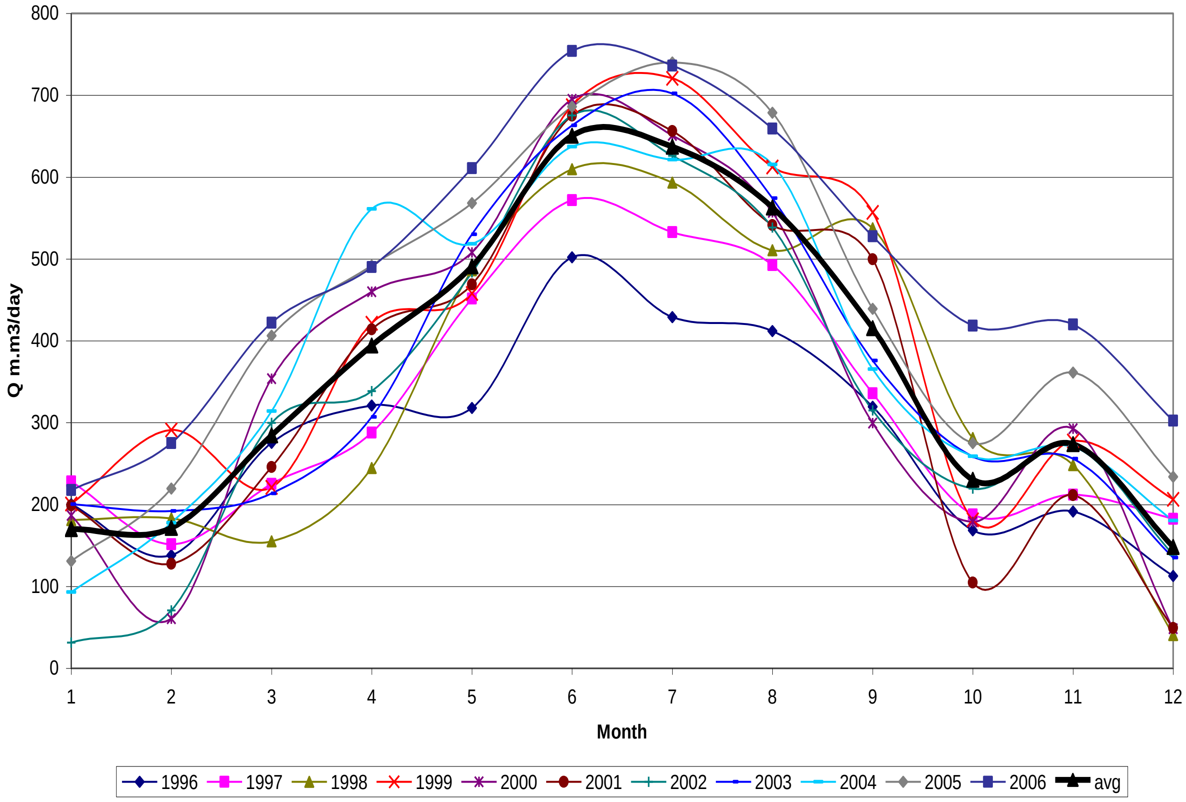

Figure 2. Present Rosetta water demand (NRI, 2006)

PROJECT PHASES

- Phase I of the project operation describes the present water demands in addition to Nobaria canal water demand. This phase is shown in Figure 3.
- Phase II of the project operation describes the present water demands in addition to Nobaria canal water demand and the 255,000 feddans water requirements. This phase is shown in Figure 4.
- Phase III of the project operation describes the present water demands in addition to Nobaria canal water demand, the 255,000 feddans and 170,000 feddans water requirements. This phase is shown in Figure 5. This phase represents the full project operation phase. The maximum water demand for this phase is 1261 million cubic meters per month for June or about 40 million cubic meters per day. This value represents the maximum required discharge in Rosetta Branch after the project and the branch is carefully studied for this discharge.

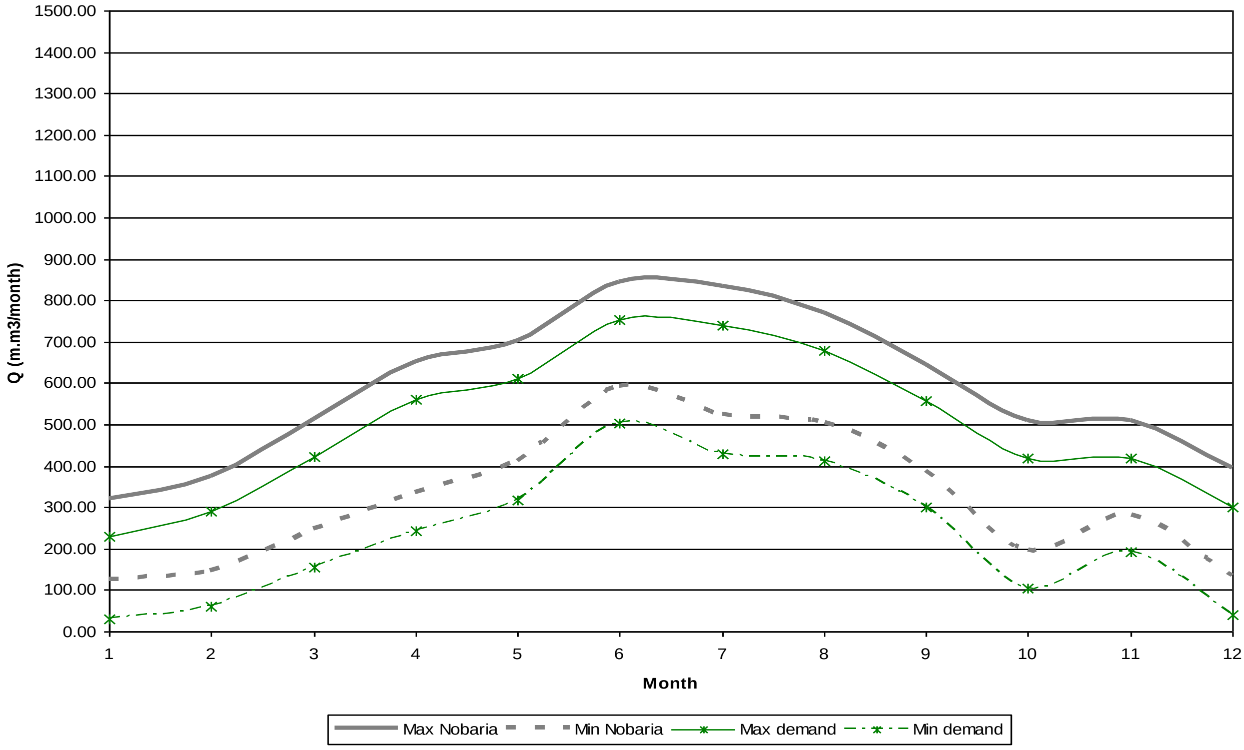

Figure 3. Present and Phase I demands

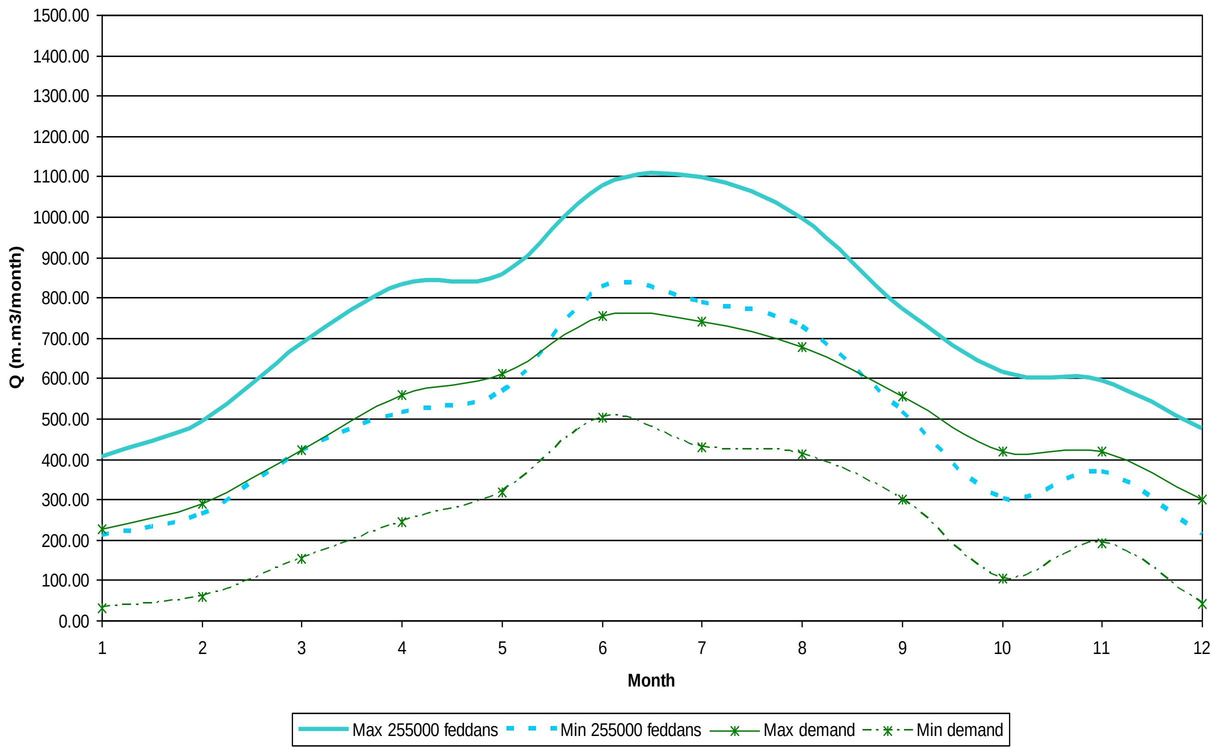

Figure 4. Present and Phase II demands

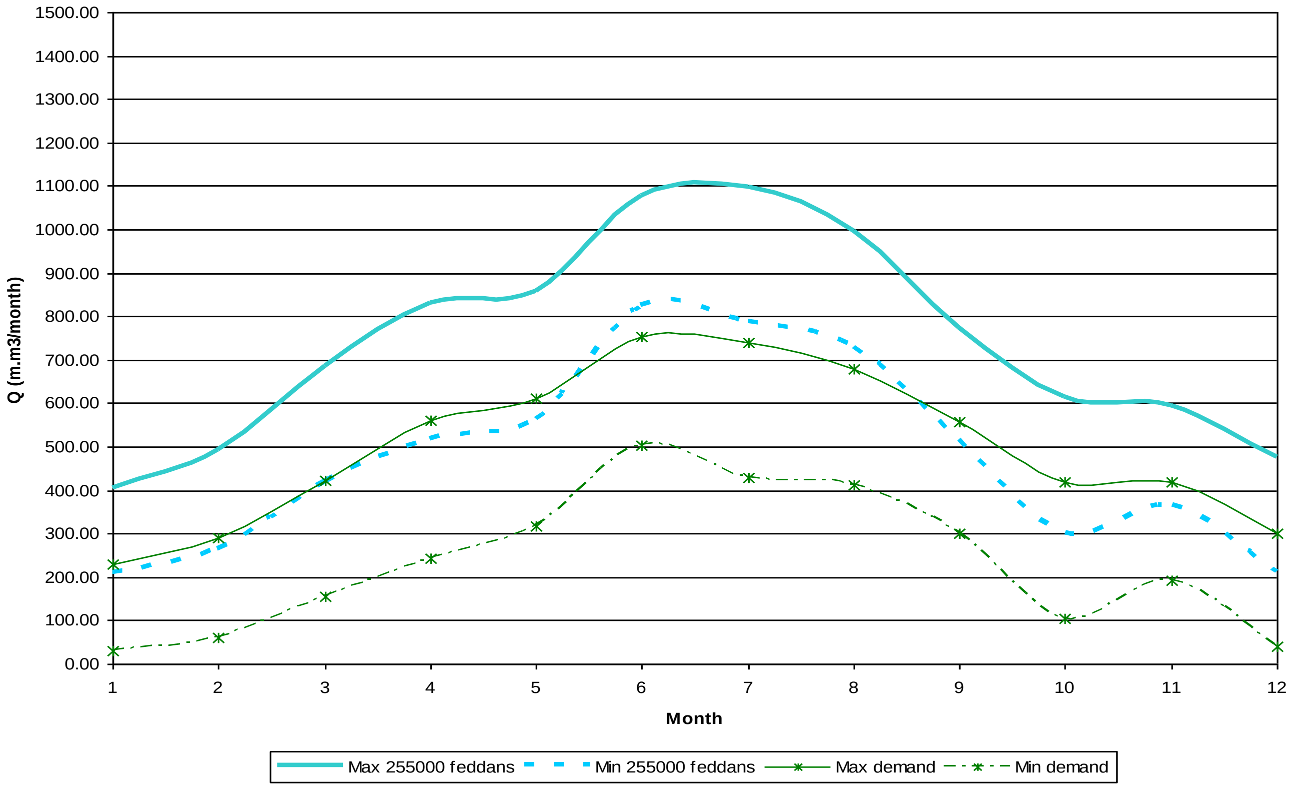

Figure 5. Present and Phase III demands

ROSETTA WATER RELEASES

Rosetta water releases are studied for the period from 1996 to 2006. Figure 6 shows the monthly water releases for this period in addition to the average water releases during the same period. It can be concluded from this figure that the maximum average water release is for September with a value of 687 million cubic meters per month.

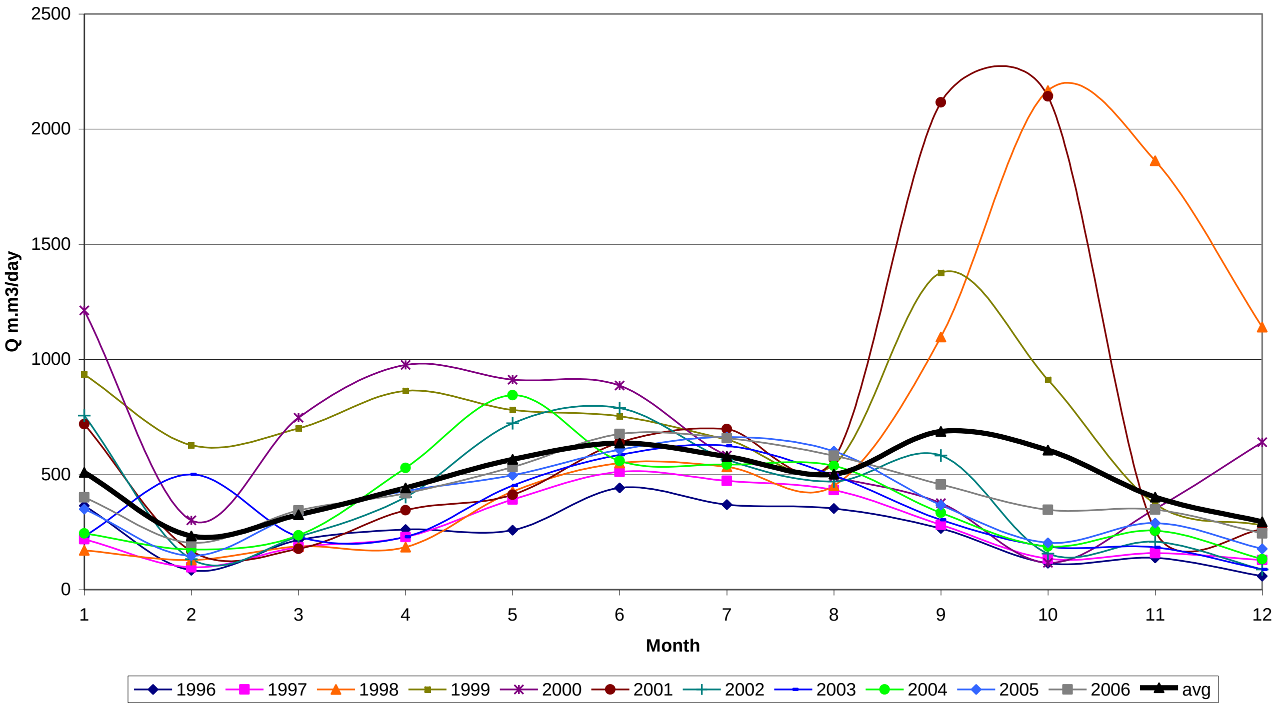

Figure 6. Water Releases

STUDY RESULTS

Figure 7 shows the average water demand before and after the project completion for every month in addition to the average current releases. Table 3 shows the study results as follows:

1- Current demand, for Rosetta Branch.
2- Future demand, for Rosetta Branch after project completion.
3- Average release, for the current conditions
4- Project effect, the summation of the required water for the project forming about 4 billion cubic meters per year
5- Water deficit, the months that have water demand more than releases, for the period February to August. The summation of the water deficit is about 2.1 billion cubic meters per year.
6- Water surplus, the months that have water demand less than releases, for the period January and September to December. The summation of the water deficit is about 2 billion cubic meters per year.

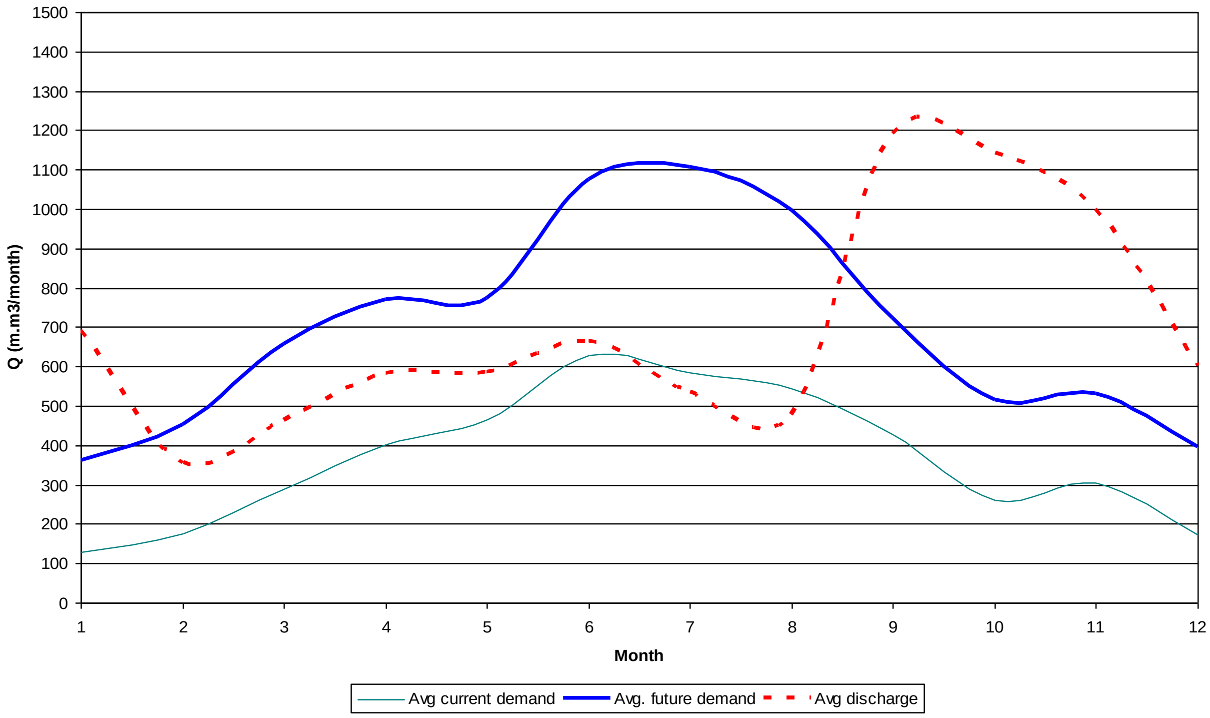

Figure 7. Average water demand and release

Water Save

It can be concluded from the previous study, that the project water requirement is about 4 billion cubic meters per year. However, the previous analysis showed that about half of this water could be saved because of using the surplus water in months of higher releases than demand. Moreover, the whole project water requirements of 4 billion cubic meters per year could be saved if a good water management plan is used to avoid any water release higher than the water demand. In this case, the 2 billion cubic meters per year of water deficit are compensated by the 2 billion cubic meters per year of water surplus. It has to be mentioned here, that the proposed water saving is considered using the same current minimum discharge conditions without any changes for the minimum conditions to avoid any impact of salt water intrusion or ground water changes near the northern coast. All the proposed water management changes occurred during high releases that do not affect salt water intrusion. All Etfina barrage discharges are the same as present conditions to achieve the previously mentioned conditions of salt water intrusion and ground water table.

Table 3. Study results

Month	*(1) Current demand*	*(2) Future demand*	*(3) Average release*	*(4) Project effect*	*(5) Water deficit*	*(6) Water surplus*
1	129.78	362.73	691.63	232.95		328.90
2	175.86	453.88	355.91	278.02	97.97	
3	288.61	656.82	461.75	368.21	195.07	
4	402.73	769.81	580.30	367.08	189.51	
5	464.43	773.82	585.03	309.39	188.79	
6	628.08	1,076.66	664.40	448.58	412.26	
7	584.58	1,106.18	533.13	521.60	573.05	
8	545.33	997.30	476.53	451.97	520.77	
9	428.22	722.58	1,190.73	294.36		468.15
10	261.53	514.43	1,140.81	252.90		626.38
11	305.83	529.95	1,000.05	224.12		470.11
12	171.52	395.32	599.34	223.80		204.03
Sum				**3,972.98**	**2,177.41**	**2,097.56**

Project Impact on Rosetta Branch

The major project impact on Rosetta Branch is the impact of increasing water discharge in the branch to cover the project water requirements. As explained before, the maximum water requirements for the branch after project completion is about 40 million cubic meters per day. This part of the study is focused on the effect of passing the 40 million cubic meters per day. The water levels related to this discharge are computed using computer modeling.

Computer Model

The computer model HEC-RAS, was used during this study to compute water levels related to the required discharge. This model is developed by the US Army Corps of Engineers (US Army Corps of Engineers, 2001). It is a one-dimensional model able to simulate steady, unsteady and sediment transport for movable boundary conditions.

Model Calibration

The actual water level readings for gauging stations along Rosetta Branch were used for the calibration analysis. Table 4 shows the gauging station locations (NRI, 2007). The model calibration results are shown in Figure 8. From this figure, it can be concluded that there is a close agreement between measured and predicted water levels. This indicates that the selected roughness values are in good agreement with the actual values.

Table 4. Gauging stations location (NRI, 2007)

Gauging Station	***Km from EL-Roda***
D.S. Rosetta Weir	28.05
Khatatba	72.50
Abou ElKhawy	106.50
Kafr El-Zayat	140.50
Shobrakeet	177.50
Atef	208.50
U.S. Edfina Barrage	222.50

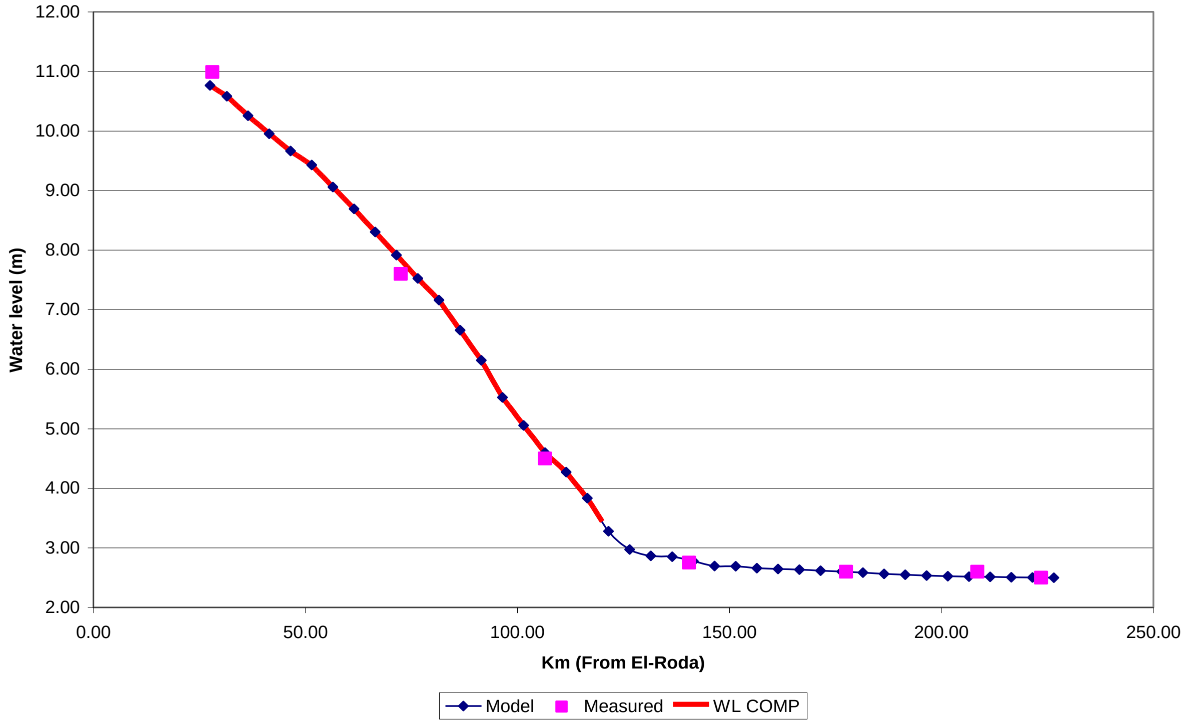

Figure 8. Model calibration and results

Model Results

Model results are shown in Table 5. This table shows the computed water levels for each km for the branch from Delta Barrage to the project Intake.

Table 5. Model computed water levels

Km	*W.L.*	*Km*	*W.L.*	*Km*	*W.L.*
28	10.74	59	8.88	90	6.30
29	10.70	60	8.80	91	6.20
30	10.65	61	8.73	92	6.08
31	10.61	62	8.65	93	5.96
32	10.55	63	8.57	94	5.83
33	10.48	64	8.50	95	5.71
34	10.42	65	8.42	96	5.59
35	10.35	66	8.34	97	5.48
36	10.29	67	8.26	98	5.38
37	10.22	68	8.19	99	5.29
38	10.16	69	8.11	100	5.20
39	10.10	70	8.03	101	5.10
40	10.04	71	7.95	102	5.01
41	9.98	72	7.88	103	4.92
42	9.92	73	7.80	104	4.83
43	9.87	74	7.72	105	4.74
44	9.81	75	7.64	106	4.64
45	9.75	76	7.56	107	4.57
46	9.69	77	7.49	108	4.50
47	9.64	78	7.41	109	4.44
48	9.59	79	7.34	110	4.37
49	9.54	80	7.27	111	4.31
50	9.50	81	7.20	112	4.23
51	9.45	82	7.11	113	4.14
52	9.39	83	7.01	114	4.05
53	9.32	84	6.91	115	3.96
54	9.24	85	6.81	116	3.88
55	9.17	86	6.70	117	3.78
56	9.10	87	6.60	118	3.67
57	9.02	88	6.50	119	3.56
58	8.95	89	6.40	120	3.44

The computed water levels are plotted on the recent topographic maps for Rosetta Branch to determine if any high hazard structure is located on these regions. Moreover, the days of passing a discharge higher than 40 million cubic meters per day are determined and tabulated in Table 6. Management lines are studied for the flooded area.

Table 6. Days of passing q > 40 million cubic meter per day.

Year	*Month*	*No of Days*
1998	February	1
1998	September	14
1998	October	31
1998	November	30
1998	December	13
2000	January	17
2000	February	1
2000	March	5
2001	January	3
2001	August	1
2001	September	30
2001	October	27
2002	January	6
2004	May	8
Total		**187**

Flooded Regions Study Results

The flooded regions due to the increase of Rosetta discharge to 40 million cubic meters per day are determined from the model results and plotted on the recent topographic maps for the branch. It was found that all of these regions have subjected to flooding during the past few years due to ordinary high water releases. From the management lines study, it was found that the branch management lines are determined to allow for a discharge of 220 million cubic meters per day. These lines determine the regions that no structure is allowed inside. From this analysis, it is clear that the flooded areas by the project impact are within the river management lines that no structure is allowed inside and no compensations are paid for any flooding occurrence within these regions. It can be concluded that no serious impact will occur due to the water requirements increase.

CONCLUSIONS

This study is performed by the author as a part of serial studies conducted in Nile Research Institute for the project.

From this study, it can be concluded that the project water requirement is about 4 billion cubic meters per year. However, this paper shows that about half of this water could be saved because of using the surplus water in months of higher releases than demand. Moreover, the whole project water requirements of 4 billion cubic meters per year could be saved if a good water management plan is used to avoid any water release higher than the water demands. The proposed water saving is considered using the same current minimum discharge conditions to avoid any impact of salt water intrusion or ground water changes near the northern coast. This part of the paper represents one of the first environmental studies for this major project that was conducted before the project operation and it is illustrating, for the decision makers, the possibility saving the required additional amounts of water for this national project.

The current study is performed, also, to determine the effect of passing the additional discharge on Rosetta Branch, It can be concluded that no serious impact will occur due to the water requirements increase.

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