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Appendices

MAIN POINTS OF THE ADVICE

The Commission for Environmental Impact Assessment considers the following points in its advice as most important:

1. The technical and financial feasibility study with respect to the pilot project

- The monitoring programme should be executed in such a way that it becomes clear to what extent the discharge capacity can be increased by application of the Hypofors bituminous lining system.

2. The EIS with respect to the large scale application of the intended activity

- A water balance should be established.
- The scope of the EIS and the financial and economic study should be determined on basis of the results of the pilot project.
- Alternatives addressed in the advice should be elaborated in detail as far as necessary to determine and compare the impacts of the alternatives with the impacts of the intended activity.
- The impacts of lining positive as well as negative should be considered adequately in quantitative terms, as much as possible. For the comparison of the alternatives at least the criteria presented in table 2 should be used.

1. INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Introduction

Description of the intended activity
A request for an ORET grant ('Ontwikkelingsrelevante Export Transacties', Export Transactions relevant for Development) has been made by Bitumarin for delivery of materials and equipment for the lining of one kilometre of the Ismailia Canal in Egypt. The transaction is to be considered as a pilot project, which if successful, may find a large scale application in lining the Ismailia canal in particular and of other irrigation canals in the Nile Delta in general.

The Ismailia canal flows from Cairo to the Suez canal near Ismailia, see appendix 4. In the NEI study[1]] the following remarks are made with respect to leakage and discharge capacity of the Ismailia canal. Of the total length of 124 kilometres, over some 112 kilometres leakages occur which are most severe in a canal section of 30 kilometres (between 45 and 75 kilometres). The estimated loss of water in this part is 13% of the total discharge of the canal (estimated discharge 33.5 mln m^3/day). Of the total flow, 28.5 million m^3/day is used for irrigation purposes and 5 million m^3/day for drinking water supply. For both purposes additional capacity is required in the future as the Government of Egypt is implementing further developments of irrigation alongside the Ismailia canal. Seepage results in increase of ground water levels, leading to water logging, salinization of (potential) agricultural lands, flooding and the occurrence of water borne diseases.

In a pilot project Bitumarin will have the opportunity to introduce the Hypofors lining material, which has been developed for the Dutch Delta Works and which finds many forms of applications in hydraulic constructions. The combination of concrete blocks and an impermeable Hypofors bituminous liner (HB lining system) is suitable for construction of linings for irrigation canals under wet conditions. The pilot project (testing of the HB lining system on a trial of one kilometre) will present information necessary to judge the technical feasibility of this lining system.

The pilot project (lining of 1 kilometre of the Ismailia canal) will be approved mid 1996. The duration of the execution of the pilot project is approximately 1 year and the start has been planned mid 1996.

Objectives of the intended activity
In the ORET application two objectives are mentioned:
1. Main objective: To test the lining system on the possibilities of wide scale application in order to prevent present substantial leakage in those sections of the canal situated in sandy soils and, at the same time to reduce maintenance costs of the canal.
2. Second objective: The expansion of the discharge capacity of the canal.

According to the NEI study, the main objective may prove not to be the prevention of leakage/seepage as suggested in the application, but rather the expansion of the discharge capacity of the canal at lower costs than by realisation of this aim in the traditional way of widening the canal profile by excavation works.

Request for the advice
In a letter dated 29 March 1996 (see appendix 1) The Netherlands Minister for Development Cooperation has requested the Commission for Environmental Impact Assessment (EIA) in the Netherlands to advise on Terms of reference (TOR) for the preparation of an Environmental Impact

1 Netherlands Economic Institute; Partial lining of the Ismailia canal, Egypt. ORET 94/69. Final report.

Statement (EIS)/technical feasibility study for the project involved. During a meeting of the Commission for EIA and DGIS concerning a draft of this advice on 10 April 1996, DGIS requested the Commission to extend the advice with ToR for the execution of a financial and economic study.

The advice has been prepared and will be submitted to the Netherlands Minister for Development Cooperation by a working group of the Commission for EIA. The composition of the working group is, together with project information, presented in appendix 2.
The pilot project will provide insight into the technical and financial feasibility of lining. To get insight into the environmental and socioeconomic impacts of lining the trial (pilot project) is not suitable because the trial is not representative for the Ismailia canal. In the EIS the environmental and socioeconomic impacts of lining will be studied for the Ismailia canal as a whole, assuming that lining will be applicated on a large scale.

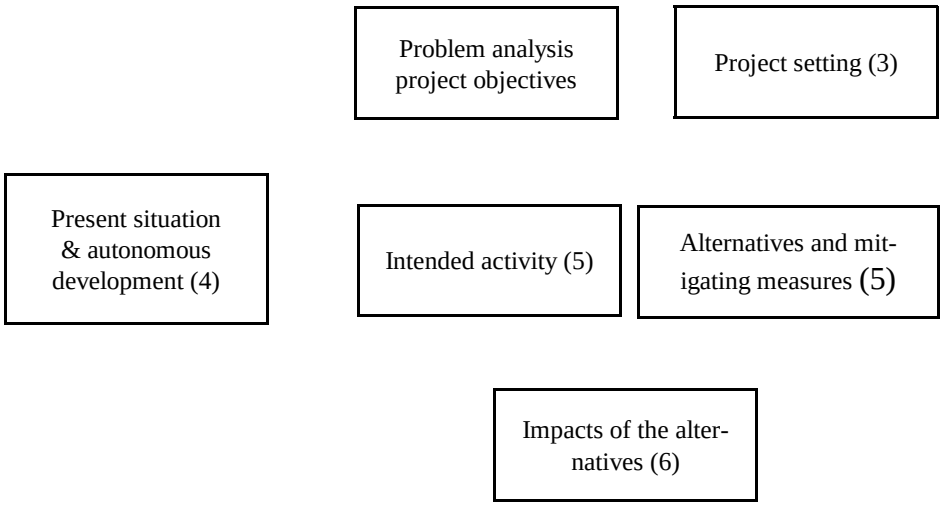
Objectives of this advice
This advice presents the Terms of Reference for the execution of:

- The technical and financial feasibility study with respect to the pilot project. The aim of this study is to determine the technical and financial feasibility of the intended activity (application of the HB lining system) on basis of the trial.
- A financial and economic study with respect to the large scale application of the intended activity and alternatives in the Ismailia canal. The results of this study should be used in the EIS.
- The EIS concerning the large scale application of the intended activity. The aim of the EIS is to determine the environmental and socioeconomic impacts of the intended activity (in case of large scale application of the HB lining system) and alternatives, and to propose mitigating measures.

Structure of this advice
The ToR for the technical and financial feasibility study are elaborated in appendix 3 of this advice. The ToR for the financial and economic study are executed in section 5.4. ToR for the EIS are elaborated in the following chapters. For the structure of these chapters see figure 1.

1.2 Justification of the approach

Figure 1: Structure of the EIS



Comparison of the alternatives (7)

* Between brackets is shown in which chapter of this advice the subjects will be dealt with.

The following main problems and objectives are considered as points of departure on basis of which the Commission prepared her advice. The main problems according to the NEI study are (i) leakage of Nile water from the Ismailia canal, resulting in waterlogging, salinization and standing water (occurrence of water borne diseases) due to seepage and (ii) shortage of water for irrigation, urban and industrial use. Main objective according to the NEI study is wide scale application of the lining system in order to:

1. prevent substantial leakage in those sections of the canal situated in sandy soils and at the same time, to reduce maintenance costs; According to the Commission this objective should be extended with, prevent substantial leakage and *associated environmental problems* in those.....costs.
2. expand the discharge capacity of the canal.

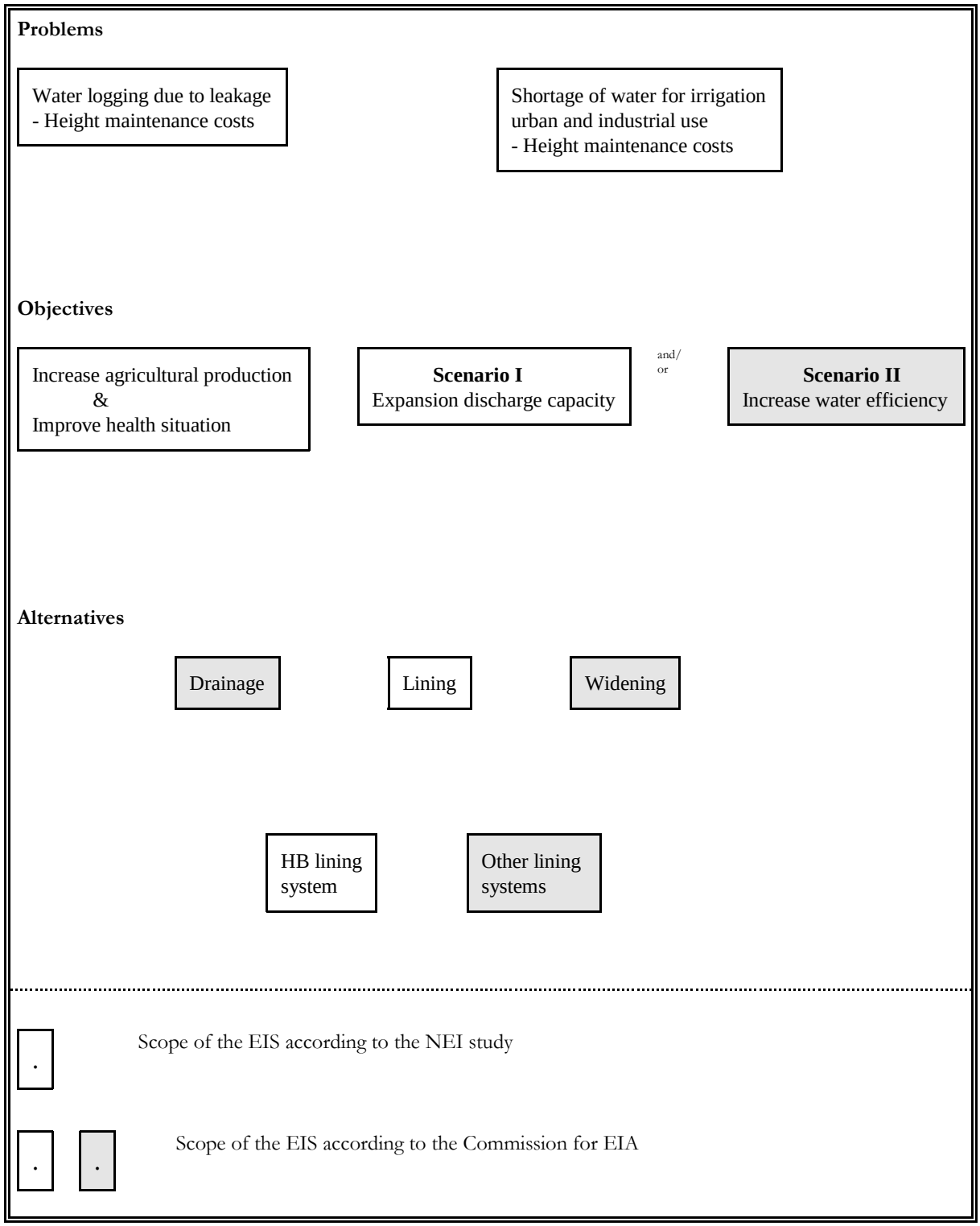
With respect to a sustainable solution of the main problems mentioned above, the Commission is of the opinion that besides lining with the proposed lining system other alternatives should be taken into consideration[2]]. If these alternatives are elaborated mutually, a well-informed decision making is possible, in which sustainable/long term availability of water (of acceptable quality) is fully considered. The scope of the EIS is presented in figure 2. The alternatives to be elaborated are presented in § 5.2 and 5.3.

Scope of the study area

The Commission is of the opinion that the study area of the EIS should be limited to the Ismailia canal because the information asked for in the EIS will only be suitable for judgement of application in the Ismailia canal which is situated in sandy desert soils. It seems that the Ismailia canal is not representative for or comparable with (i) the Nubariya canal because this canal is not primarily used for shipping and irrigation and (ii) other irrigation canals in the Nile Delta because these canals are constructed in clay instead of in sand. This means that the EIS is probably not suitable for decision making about lining of other canals. On basis of the experience with the pilot project it is expected that judgement of the technical feasibility for wide scale application of the HB lining system in the Nile Delta is possible.

2 With regard to this project sustainability can be defined as a guaranteed availability of water of acceptable quality for future generations.

Figure 2: Scope of the EIS



1.3 Limitations encountered

The working group has not visited Egypt. The advice is prepared on basis of the best practical knowledge and the study prepared by the NEI; Partial lining of the Ismailia canal, Egypt (ORET 94/69 final report). As a consequence it could be possible that more information is asked for than strictly necessary. Furthermore, the Commission will be hampered in reviewing the EIS because she cannot judge if the presented information is complete and correct.

2. PROBLEM ANALYSIS AND PROJECT OBJECTIVES

The two distinguished problems (i) leakage of Nile water from the Ismailia canal, resulting in waterlogging, salinization and standing water (occurrence of water borne diseases) due to seepage and (ii) shortage of water for irrigation, urban and industrial use should be analysed and quantified as much as possible.

It should be motivated in what way the distinguished problems can be solved by the wide scale application of the HB lining system. With respect to the solution of problems the Commission recommends to study also a number of alternatives next to application of the HB lining system. The alternatives to be taken into consideration are mentioned in chapter 5.

The following points of departure should be elaborated and motivated in the EIS and a choice should be made, because development of alternatives is only possible if these points are set:

- The proposed expansion of the discharge capacity. (The Ministry of Public Works estimates that proper lining will increase the discharge capacity of the canal with 40%)[3]. This should be verified in the pilot study.
- The maximum allowed leakage loss on basis of cost-effectiveness (e.g. 0% or <5%).

3. PROJECT SETTING

The river Nile contributes 95 percent of the country's total water supply and originates outside Egypt's borders. Presently some 55 billion cubic metres are available per year, of which some 12 billion cubic metres are drained to the lakes and sea. Government policy is to increase the reuse of drainage water (with 80 percent by the year 2025) and to reclaim desert areas for agricultural purposes, in order to step up food supplies. Introduction of efficient irrigation methods and practices (drip, sprinkler) and use of treated waste water should further economize on water. In the planning figures the losses to lakes and sea are expected to be reduced to half by the year 2025[4]].

The steady population increase coupled with the development of agricultural and industrial sectors makes the pressure every year higher: present per capita availability of water is in the order of 1000 cubic metres per year, which means a stress situation. It is anticipated that despite the government policies, water availability may drop to 630 cubic metres per year by 2025, which would bring the country even to scarcity level: a position that only some 10 countries in the world would reach[5]].

3 As mentioned in the NEI report. The NEI report refers to the report of Darwish Engineering Consultants.

4 Source: Environmental Management of Ground Water Resources. RIGW, July 1994.

5 Population action international (1993);Sustaining water. Population and future of renewable supplies.

By legislation it is required to use in newly reclaimed areas irrigation of a pressurized type only (drip and sprinkler) and the irrigation authority allocates water accordingly. Excessive loss of water by non application of drip- and sprinkler methods may have accelerated the rise of the ground water level, and therefore the felt need for lining. The EIS should review the policies and its applicability and enforcement.

4. THE PRESENT SITUATION AND AUTONOMOUS DEVELOPMENT

4.1 General

The remarks made under this heading are relevant for the two distinguished objectives, (i) prevention of leakage and associated environmental problems and (ii) expand the discharge capacity. Due to the two objectives a number of different alternatives will be developed. Therefore the impacts and study area will differ considerably although there will be some overlap.

Determination of the study area. With respect to the objective prevention of leakage and associated environmental problems the study area is limited to the areas where less or substantial waterlogging occurs due to leakage.
With respect to the objective increase of discharge capacity the size of the study area can be determined as follows:

- Out of the sections distinguished representative sections should be selected, because it is not necessary to describe the present situation for the total length of the canal (see § 5.3.2 for the method to select the sections).
- Describe the present situation and autonomous development for the selected sections.

Description of the present situation. The EIS should contain a description of the present situation for the study area as far as relevant for the forecasting of the environmental impacts of the intended activities and alternatives. This description serves as basis for comparison of the environmental effects of the various alternatives.

Description of the autonomous development: The development of the study area should be described in case the intended activity will not be executed. The information about the autonomous development of the environment is important to get clear what the contribution of lining will be in relation to the expected environmental quality in the future in this region.

The Commission asks attention for the following aspects. All the aspects are mentioned once and if relevant they should be described for the present situation and the autonomous development.

p = the present situation
a = the autonomous development
. = means no description asked for

4.2 Physical environment

For the total length of the Ismailia canal a water balance should be established for a period of one (representative) year. The following aspects should be taken into account:

- discharge capacity along the total length of the canal;
- water inflow from the Nile;
- discharge to secondary irrigation systems along the canal;

- discharge to Ismailia (e.g. command area);
- leakage/seepage;
- water use for agricultural and other purposes;
- evaporation.

Water is a major constraint to development in Egypt. Except limited areas along the Northern coast where some rainfall may occur, the country is fully dependent on the river Nile. Ground water resources are limited as well, and in the Nile delta region these are directly related to the Nile flow, because of sub-surface waterflows to the ground water reservoir. Seepage of water from the Nile branches, from the numerous irrigation channels and by percolation from irrigated lands, forms an important contribution to the replenishment of the ground water.

Due to a considerable population increase in the delta and an increased water use per capita during the last decades, the ground water table has gone down, resulting not only into higher pumping costs, but also into salt water intrusion. This, together with the need for more efficient use of the Nile winterflows, which are partly discharged into the Mediterranean sea, has prompted the Government to study on pilot scale in desert areas possible artificial recharge of the ground water reservoir with surface water.

The EIS should therefore pay attention to the following hydrological aspects:

p/. ! interrelated processes of seepage and ground water flow;

p/a ! occurrence of water logging as a result of seepage from the Ismailia Canal and adjacent irrigation canals or caused by over-irrigation and lack of drainage in irrigated lands;

p/a ! salt water intrusion into ground water aquifers in order to enable an impact description of reduced future seepage of canal water as a result of the lining activity;

p/a ! occurrence of standing water and water borne diseases;

p/a ! quality of canal and ground water in view of possible contamination of ground water by hazardous elements from reused or polluted canal water;

p/a ! occurrence of canal vegetation on bottom and embankments, allowing fish and other aquatic life in the canal;

p/a ! percentage of the Nile water flowing into the Ismailia canal (summer and winter);

p/a ! occurrence of possible secondary wetlands.

Several of the above mentioned aspects would require regular study of ground water levels and -quality at a number of sites. Such a monitoring system would have to be established well ahead of the start of the lining experiment (see chapter 8).

4.3 Socioeconomic environment

In the EIS the following socioeconomic aspects, including gender aspects as far as relevant, should be addressed:

p/a ! a description should be given of surface and ground water use by different socioeconomic groups in the areas neighbouring the canal and those being influenced by canal seepage. Special attention should be given to the waterlogged areas, that are expected to be the result of canal seepage. This includes agricultural, domestic and possible industrial uses.

p/a ! despite the construction of the Aswan Dam in the Nile river, irrigation canals in Egypt still carry a certain amount of silt. Through regular cleaning of the canals by draglines, backhoes and dredging equipment, the excavated material is often used by farmers to increase soil fertility. Especially in sandy desert soils this practice can increase land productivity. Since this may be influenced by the intended lining activity, the possible silt use in agriculture should be studied.

p/a ! employment situation, the direct (execution civil works, maintenance) and indirect effects (agricultural labour) due to the intended activities;
p/. ! the suitability for navigation should be described.

4.4 Institutional environment

The Ministry of Public Works and Water Resources (MPWWR) is the 'owner' of (large) irrigation canals, and therefore in charge of its operation and maintenance. This includes all hydraulic structures and pumping stations along the canal. Regional directorates of MPWWR are charged with management of sections of a principal canal of with the entire canal, depending on local conditions. The EIS should survey institutional arrangements with regard to maintenance, including participation of local population.

5. THE INTENDED ACTIVITY, ALTERNATIVES AND MITIGATING MEASURES

5.1 Introduction

The alternatives to be elaborated must be developed along two lines as a result of the fact that two objectives are determined. The activities necessary to fulfill the two objectives differ too much to be combined in the development of alternatives (see figure 2).

The Commission prepared this advice on basis of the following assumptions;
- ! *lining of parts of the canal will result in a decrease of leakage and related problems and will result in an increase of discharge capacity at those sections where lining is applied;*
- ! *possibility that lined sections can be coupled to sections where widening will be applied;*
- ! *widening by excavation in combination with lining will be taken into consideration;*
- ! *lining will only be executed under wet conditions.*

5.2 Intended activity with respect to the prevention of leakage and associated environmental problems

General
Areas with leakage associated environmental problems should be identified and described. Both consequences and seriousness of environmental problems due to minor or major leakage should be determined. This will probably result in a number of sites along the Ismailia canal where different alternatives can be applied. The following four alternatives should be described.

Lining alternative
The intended activity is lining of the canal by the HB lining system in order to solve environmental problems like e.g. waterlogging caused by leakage. This intended activity should be described. The Commission is of the opinion that other lining systems should be described as well. The advantages and disadvantages of the different lining systems should be described. However a description of the impacts of lining can be limited to the impacts of the HB lining system only.

The following aspects of lining with the HB lining system should be described:
- ! method and equipment used for lining;
- ! hydrological and hydraulic aspects;

- its influence on regular maintenance;
- its influence on siltation and vegetation growth.

The EIS should describe which other lining systems can be applied. These systems should be elaborated at the same detail as the HB lining system. The following lining systems should be described and compared on headlines:

- application of clay;
- riprap stone (stones of different size) penetrated with colloidal concrete.

To maintain and/or improve the discharge capacity the EIS should describe the following aspects of maintenance of the canal:

- method and frequency applied to clean the canal and remove the existing vegetation;
- occurrence and disposal of silt (quality) and vegetation.

Presently manual weed control methods inclusive the clearance of aquatic vegetation from irrigation canals is being practised in many projects in Egypt. Partly to generate employment for local population in the various districts, partly for environmental reasons. The EIS should include a review of these and existing alternative canal maintenance methods together with its applicability for the large size canals, such as the Ismailia canal.

Drainage alternative

The Commission considers drainage of the waterlogged areas to be a realistic alternative for lining, if only environmental problems caused by leaking are to be solved. Therefore, a drainage alternative should be elaborated at the same level as the lining alternative.

The EIS should describe the following aspects of drainage:

- the opportunities for application of drainage;
- construction of drainage ditches along the canal and sub-surface tile drainage systems in waterlogged areas, the activity itself, but also its operation and maintenance aspects may have different impacts on the environment. Impacts of the various management options with regard to drainage of the affected areas should therefore be elaborated in the EIS.

No action alternative

The no action alternative (= autonomous development) describes the situation that develops if the intended activity will not be executed. The EIS must describe how and to what extent the objectives of the project can be achieved without the initiative and how the region will develop in this case. The no action alternative is equal to the autonomous development and must be considered as a reference situation.

Alternative most friendly to the environment

The lining or drainage alternative combined with mitigating measures may become the alternative most friendly to the environment.

Mitigation measures

Measures to reduce the negative short term and long term impacts of lining, drainage and/or maintenance should be described. A mitigating measure with respect to lining is for example: supply of water to farmers/communities which have become dependant on leakage water.

5.3 Intended activity with respect to the increase of the discharge capacity

5.3.1 Description of alternatives

The Commission is of the opinion that the main problem, shortage of irrigation water could be solved by the implementation of two different scenarios or a combination of both; scenario I, expansion of the discharge capacity of the canal and scenario II, increase of the efficiency of water use in the command areas, see figure 2. Elaboration of scenario I is subject of the EIS but elaboration of scenario II is not taken into consideration. Despite the fact that this latter scenario is beyond the scope of the present study this scenario must be compared on headlines (maximum two pages) with scenario I, increase of the discharge capacity of the canal.

The intended activity is lining of the canal by the HB lining system in order to increase the discharge capacity of the canal. The discharge capacity can (theoretically) be increased by:

- increasing the cross section surface or adjusting cross section surface over the whole length of the canal in order to maximize the present capacity (widening, maintenance) ;
- decrease of leakage (lining, maintenance) ;
- optimalization of the discharge capacity by increasing the velocity (lining, maintenance).

The Commission agrees that lining can contribute to an increase of the discharge capacity with 40% in theory, as stated by Darwish Engineering Consultants and mr Fayek (chairman of the Ministry of Public Works and water Resources, verbal information). However, the Commission is of the opinion that lining can contribute to a small increase of the discharge capacity only due to an optimistic estimation of the assumptions[6]. On basis of the outcome of the pilot study a realistic estimation of the increase of the discharge capacity can be made. *If the contribution of lining to the increase of the discharge capacity is limited, the scope of the EIS should be reconsidered. Then the objective: expansion of the discharge capacity of the canal by lining, will probably not be realistic any more.*

If lining contributes considerably to the discharge capacity it is probably more realistic to combine lining at one section with widening for an other section[7]. Widening (increase of the cross section surface of the canal) should be taken into consideration as one of the alternatives for lining as far as relevant. The occurrence of leakage is related to local circumstances and therefore differs per section. Lining can be applied at those sections where substantial leakage occurs and widening can be applied where no leakages occur.

Furthermore, the Commission is of the opinion that other lining systems should be described as well. The advantages and disadvantaged of the different lining systems should be described. However, a description of the impacts of lining can be limited to the impacts of the HB lining system only. Because this information is already asked for in § 5.2, it is not necessary to describe it here again. The following alternatives should be described.

Preferred alternative
On basis of a combined application of lining and widening a preferred alternative could be developed. It should be motivated (criteria) why this alternative is the preferred alternative.

In this paragraph the description of lining is not asked for because this information is already asked for in § 5.2.

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6 An increase of the discharge capacity with 40% is based on e.g. the following assumptions: (i) the present canal bottom is rough; (ii) the lining will be applicated at a smooth underground and (iii) no coarsening due to e.g. vegetation growth or dumping of waste will occur.

7 The Commission assumes that widening could be a realistic alternative for certain sections of the canal to increase the discharge capacity.

With respect to widening by excavation works the EIS should describe the method and equipment used. Alternative methods for widening should not be considered. With respect to widening, the Commission advises to describe the impacts of widening only in case a choice must be made between application of lining versus widening. For all the sections where widening is the only realistic alternative it is not necessary to describe the impacts.

An improved maintenance can contribute to maintain discharge capacity, therefore the EIS should describe the following aspects of maintenance of the canal:
- method and frequency applied to clean the canal and remove the existing vegetation;
- occurrence and disposal of silt (quality) and vegetation.

No action alternative
The no action alternative (= autonomous development) describes the situation that develops if the intended activity will not be executed. The EIS must describe how and to what extent the objectives of the project can be achieved without the initiative and how the region will develop in this case. The no action alternative is equal to the autonomous development and must be considered as a reference situation.

Alternative most friendly to the environment
This alternative can be developed by selection of the most friendly alternative per canal section. On basis of the selected alternatives per section a coherent alternative for the canal as a whole can be developed. This coherent alternative combined with mitigating measures represents the environmentally most friendly alternative. Another opportunity for the development of the alternative most friendly to the environment is the preferred alternative combined with mitigating measures.

Mitigation measures
Measures to reduce the negative short term and long term impacts of lining and widening should be described.

5.3.2 Methodology to develop alternatives

Lining and widening will probably be applied at different sections of the canal dependant on the seriousness of leakage. Three steps can be distinguished in the preparation of one coherent alternative:

1. The canal should be divided into homogeneous sections on basis of the following criteria:
   - soil type;
   - % leakage;
   - use of the area adjacent to the canal (e.g. habitation and agriculture).

2. Per section two alternatives should be elaborated if relevant, lining and widening. Criteria should be determined on basis of which the choice for widening or lining could be made. At least the following criteria should be used:
   - % leakage;
   - use of the area adjacent to the canal.(Attention is asked for those canal sections where no substantial leakage occurs but where the area adjacent to the canal is used intensively for e.g. living);
   - costs of construction and maintenance.
3. In the third and last step one coherent alternative should be developed. This is necessary for the description of impacts. A coherent alternative exists of the preferred alternative per section eventually combined with a preferred maintenance alternative.

5.4 Financial and economic aspects of the intended activity and alternatives

A financial and economic analysis of the intended activity and the alternatives should be elaborated. A summary of the results of the financial and economic analysis is to be presented in the EIA with reference to the economic study. Summary results should at least show:

- the Financial Internal Rate of Return (fIRR);
- the Economic Internal Rate of Return (eIRR);
- the results of Sensitivity Analysis for the two different IRRs.

It is clear that within the economic context and in view of the substantial costs involved to upgrade the Ismailia canal, maximum value for funds to be expended must be sought - particularly in countries with low-income economies such as Egypt. Also, opportunities should be clearly identified to save costs without sacrificing quality and to enhance the economic and financial sustainability of the project.

5.4.1 Identification of costs and benefits

In carrying out the study, the costs and benefits of the various proposed alternatives will have to be identified. In identifying the costs and benefits, it is understood that also the management and socio-economic aspects will have to be considered.

Benefits

In determining the benefits, a clear distinction must be made in direct benefits (for the geographical area and within the planning horizon of the wide-scale project under consideration) and indirect benefits (secondary, tertiary, et cetera).

The direct benefits of the project are defined here as possible agricultural production increases which are attributable to the works to be carried out, all evaluated in terms of opportunity costs. Also included in these benefits are water losses and damage avoided - which are or could have been caused had no plan been carried out - in the form of seepage, floods, salinization of agricultural land (i.e. loss of agricultural production), et cetera. In view of their high degree of tangibility, it is expected that most of these direct benefits can be expressed in monetary terms.

Indirect benefits of the project would be e.g. public benefits not readily expressed in monetary terms (e.g. improved standard of living, health, employment, et cetera), and which are often purely descriptive. It is proposed that in this case a rating is used identifying these benefits as high, medium and low.

According to each alternative, benefit models will have to be developed with regard to e.g. increases in crop production, water savings due to less seepage and improved efficiency in water usage by the irrigation sector, improved drinking water supply, et cetera. The models will present qualitative as well as quantitative (financial and economic) information on these benefits as much as possible. Information provided by the models, as well as information on both the investment costs and recurrent cost as presented in the project analysis and according to alternatives, will be used to present an estimate of the various rates of return on overall project investments according to alternatives proposed.

As such, the financial and economic viability of the various alternatives, including the preparation of realistic estimates of investment costs, operation and maintenance costs, as well as financial and economic benefits, will have to be shown.

Costs

All investment costs should be presented and an investment schedule should be made for each alternative, as well as the schedule of operation and maintenance costs of each alternative, including the "zero" alternative (i.e. without project case). Furthermore, an assessment should be made of the need to import certain investment goods and materials. This information is particularly relevant for carrying out the economic analysis.

In order to obtain a clear idea of investment as well as operation and maintenance costs, it is imperative that the different project alternatives are well defined and elaborated for the main components, such as: lining and additional infrastructure. In addition to this, a complete and realistic development plan for agriculture has to be in place, so that additional water capacity can be used immediately and optimally for irrigation purposes.

5.4.2 **Financial and Economic Analysis, Alternative Ranking**

The financial and economic viability[8]] of the various proposed alternatives, including the preparation of realistic estimates of both the investment, operational and maintenance costs, as well as the financial and economic benefits, should be carried out. Particular attention will have to be paid to the operational and maintenance costs for each alternative.

Based on the results of the financial and economic analysis, ranking of the various alternatives will have to be carried out. Ranking of the various alternatives will be helpful in the identification of the optimal (i.e. value for money) alternative during the optimalization stage. Ranking will be expressed not only in financial and economic Internal Rates of Return (fIRR & eIRR) and Net Present Values (NPV's), but also in terms of intangible benefits to be expected from the project and the degree of risk, by way of a sensitivity analysis, with regard to project sustainability.

At this stage, the financial and economic analyses to be carried out for each alternative will be indicative in order to facilitate first screening and preliminary selection procedure. More elaborate analyses will have to be carried out during the optimalization stage (i.e. with the pilot project), but only after the optimal scenario or scenarios have been identified and selected by way of an overall (wide scale) project analysis.

For practical reasons and to be used as reference point for the ranking of the various alternatives, the "zero" or no-action alternative should be defined as an initial step within the overall project analysis. The no-action alternative being in this case the status quo development of continuation at the present level of discharge, without any major investments in seepage prevention or capacity increases, but with sufficient operation and maintenance costs assumed to guarantee that the canal system and the related water outputs do not deteriorate significantly in the future. Such operation and maintenance costs should be carefully estimated, because much of these can be saved after completion of a lining programme (one of the benefits of the project).

In the no-action alternative, account should also be taken of possible decreases or increases in agricultural production due to deterioration or improvements in irrigation practices.

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8 The financial viability of the project is from the point of view of the investor, in this case the Ministry of Public Works and Water Resources of the Government of Egypt. This means that only cash flows are considered on current market prices. In the financial analysis, any subsidies, grants, etc. (provided by external sources) are to be deducted from the cost stream.
The economic viability of the project is from the point of view of the society as a whole. With the latter analysis, specific conversion factors are applied to the cost and benefit figures to better reflect the real costs and benefits and to minimize as much as possible any distortions which may be present in the country's economy. Such distortions may be substantial because of large subsidies, high taxes, the presence of a flowering parallel market for foreign exchange (shadow exchange rates which differ from official exchange rates). Within an economy with large distortions, the Economic and Financial Internal Rates of Return may substantially differ from each other.

6. IMPACT OF THE ALTERNATIVES

6.1 General

The remarks made under this heading are relevant for both objectives. With respect to the two distinguished objectives the impacts of the intended activity and a number of different alternatives should be described separately. The potential impacts should be described per alternative considered for the study area. This area may differ per aspect. Negative as well as positive impacts have to be described. Direct and induced impacts of the activity have to be described.

With respect to the objective increase of discharge capacity the impacts should be determined as follows:

- Describe the impacts of the alternatives to be elaborated for the selected sections. For the selection of the sections see § 5.3.2.
- The impacts described for the selected sections should be extrapolated for the total length of the canal.

6.2 Impacts on the natural environment

The EIS has to describe the impacts on:

- occurrence of water logging as a result of seepage from the Ismailia Canal and adjacent irrigation canals or caused by over-irrigation and lack of drainage in irrigated lands;
- salt water intrusion into ground water aquifers in order to enable an impact description of reduced future seepage of canal water as a result of the lining activity;
- occurrence of standing water and water borne diseases;
- quality of canal and ground water in view of possible contamination of ground water by hazardous elements from reused or polluted canal water;
- ecological aspects; occurrence of canal vegetation on bottom and embankments, allowing fish and other aquatic life in the canal; occurrence of wetlands as far as relevant along the canal;
- a brief description of the effects of the activity itself (exploitation and transport of materials) should be described;
- percentage of the Nile water flowing into the Ismailia canal (summer and winter).

Furthermore, a brief description should be presented of the direct and indirect down stream impacts on ground water level and ground water use (quantified if possible) if the capacity of the canal will be increased with a certain percentage (theoretically about 40%). A realistic estimation can be made on basis of the outcome of the pilot study. With regard to the possible wide scale application of lining these impacts should also be described if the capacity of the Nubaria canal and maybe other canals should be expanded (cumulative effects).

6.3 Impacts on the socioeconomic environment

The EIS has to describe the impacts on, as far as relevant gender specific:

- the surface and ground water use by different socioeconomic groups in the areas neighbouring the canal and those being influenced by canal seepage. Special attention should be given to the waterlogged areas, that are expected to be the result of canal seepage. This includes agricultural, domestic and possibly industrial uses;
- the health situation of the people in the study area (water borne diseases);

- ! the agricultural use of silt from the canal;
- ! employment situation, the direct (execution civil works, maintenance) and indirect effects (agricultural labour) due to the intended activities;
- ! the suitability for navigation.

7. COMPARISON OF ALTERNATIVES

With respect to the two distinguished objectives the comparison of alternatives must be split up. With respect to objective I (prevent leakage and associated environmental problems) the impacts of the following alternatives should mutually be compared: no action alternative (= autonomous development), lining alternative, drainage alternative and the alternative most friendly to the environment.

With respect to objective II (expansion of the discharge capacity) the impacts of the following alternatives should mutually be compared: no action alternative (= autonomous development), preferred alternative and the alternative most friendly to the environment.

It is recommended to present the comparison in the form of a table, an example is presented below. Impacts should be quantified as much a possible. The criteria selected for scoring should be motivated. The criteria presented in table 2 are indicative and they are the same for both objectives. It is strongly recommended to determine the cost-effectiveness of the distinguished alternatives. The application of multi criteria analysis does not seem necessary given the limited number of alternatives to be compared.

Table 2a and 2b: Comparison of the impacts of the alternatives

					Objective I
Autonomous	Lining development	Drainage alternative	Alternative most alternative	friendly to the env.	
Objective II	Autonomous development		Preferred alternative	Alternative most friendly to the env.	
					Criteria
Natural					
• discharge capacity					
• ha salt affected					
• ha water logged					
• ha flooded					
• availability of ground water downstream					
Socioeconomic					
• nr. of farmers					
• ha irrigated					
• (non-)beneficiary user groups					
• occurrence water borne diseases					
Economic					
. investments required					
. O&M costs					
. incremental costs and benefits					
. financial viability					
. economic viability					
. total agricultural output (in volume and in monetary terms)					
Institutional					

• capacity

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8. GAPS IN KNOWLEDGE AND MONITORING

The EIS should include a list of the gaps in knowledge and information which remain. Uncertainties in forecasting the environmental impacts should also be included. If essential information is lacking the set up of a monitoring system should be elaborated.

Aspects which should be measured:

- areas waterlogged due to seepage;
- areas in which salinization occurs due to high water table levels because of seepage;
- monitoring of ground water levels and quality adjacent to the canal in 'seepage' and 'non-seepage' sections of the canal.

9. MONITORING OF THE PILOT PROJECT

The advice on the Terms of Reference for the monitoring programme, in order to determine the technical and financial feasibility of the proposed lining system, is presented in appendix 3. Monitoring of the pilot project will provide the necessary information in order to judge the technical feasibility of large scale application of the HB lining system in the Ismailia canal and other canals in the Nile Delta. Monitoring before and after the implementation of the proposed trial project should form an essential input component for the assessment of the applicability of the HB lining system.

In the advice for the monitoring programme environmental and socioeconomic aspects are not considered as explained already in chapter 1.1.