Report of
the UNESCO-ICOMOS Monitoring Mission to
ABU MENA (Egypt)

12–19 November 2005

by
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and
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1 Background

1.1 The site

Abu Mena (Fig. 1) is located south of Alexandria, between Wadi el-Natrun and Alexandria itself. The church, baptistery, basilicas, public buildings, streets, monasteries, houses, and workshops in this early Christian holy city were built over the tomb of the martyr Menas of Alexandria, who died in AD 296. Menas, who was an officer in Diocletian's army, refused to kill any Christians after they had been defeated by his army, and declared his Christianity publicly. Legend has it that after his martyrdom Menas's remains were brought back from Phrygia by camel and buried where the animal refused to walk any more. Water welled up in the desert there, making it possible to grow vines and olive trees, as a result of which it is known as St Menas’s Vineyards.

![Figure 1](image-url)  
**Figure 1** Location of Abu Mena archaeological site
Archaeological excavations since 1900 have revealed that Abu Mena grew rapidly in the course of the 5th and 6th centuries. By 600 the oasis had become a pilgrimage city, centred on the great basilica complex. An entire town with houses and cemeteries has been revealed by excavation.

Constructed in the 5th century to accommodate the increasing number of Christian pilgrims, the Thermal Basilica was built to store the curative waters that were used for the heated baths and pools surrounding the Basilica. Pilgrims used to fill tiny flasks with water from the Basilica. The flasks, which were stamped with the seal of St Menas, showing the martyr standing between two kneeling camels, have been found widely distributed in the Roman world. During the 5th and 6th centuries many buildings were erected around the Thermal Basilica, including a monastery on its north side.

Abu Mena was inscribed on the World Heritage List as cultural property C 90 by the UNESCO World Heritage Committee at its 3rd Session, held at Cairo and Luxor in 1979. At its 25th Session in Helsinki in 2001 the Committee inscribed Abu Mena on the List of World Heritage in Danger. It was reported that a land-reclamation programme for the agricultural development of the region, funded by the World Bank, had caused a dramatic rise in the water table over the previous decade. The local clay soil was hard and capable of supporting buildings when in a dry state, but became semi-liquid with excess water. The destruction of numerous cisterns, located in various parts of the city, had led to the collapse of several overlying structures. Huge underground cavities had opened in the north-western region of the town. The risk of collapse was so high that the authorities were forced to fill the bases of some of the most endangered buildings, including the crypt of Abu Mena with the tomb of the Saint, with sand and close them to the public.

1.ii Objectives of the mission

A mission was sent by the UNESCO World Heritage Centre in September 2002 to assess water-related damage and adverse effects on the World Heritage Sites of Ancient Thebes and Abu Mena (see Annex B for details). The report of this mission commented favourably on the work carried out at the Luxor and Karnak Temple sites, which has subsequently proved to have solved the problems there completely. The report, however, expressed grave concern about the situation at Abu Mena, where the nearby land reclamation and irrigation project had created a severe problem which required a more drastic and costly solution.

Reports were submitted by the State Party to the Committee at its 28th and 29th Sessions, in Suzhou (China) and Durban (South Africa) respectively. At the latter meeting, in 2005, the Committee expressed its concerns (in document Decisions 29 COM 7A.17) over the deterioration of the property caused by the rising groundwater levels and other threats. It invited the international community to support the State Party in its efforts towards removal of the property from the List of World Heritage in Danger, urging the State Party to adopt long-term and sustainable measures along the lines of those recommended in the 2002 Report.

The Committee Decision went on to request the State Party to invite a joint mission of the World Heritage Centre and ICOMOS to the property in order to:
a) Assess the situation of the property – both in terms of the state of conservation of the archaeological remains and in terms of the hydrological issue;

b) Evaluate the loss of outstanding universal value of the property and of its integrity;

c) Review the proposed project and assess its potential effects on the site;

d) Determine the necessary steps towards the implementation of recommendations made in the 2002 Report, including the setting up of benchmarks with a time frame for their fulfilment, the setting up of an emergency plan while the project is taking place, and the formulation of proposals for a buffer zone;

e) Provide the necessary elements to orient the Committee in recommending a programme of corrective action, identifying possible alternative technical solutions that would minimise the water problems in Abu Mena.

The World Heritage Centre’s expert on the mission, which took place between 12 and 19 November 2005, was Professor Marcello Benedini, who spent thirty years with the Water Research Institute of the Italian National Research Council in Rome, retiring in 1999. The ICOMOS expert was Professor Henry Cleere, who was Director of the Council for British Archaeology from 1974 to 1991 and World Heritage Coordinator of ICOMOS (International Council on Monuments and Sites) in Paris from 1992 to 2002.
2 Organization and programme of the mission

2.i Organization

The nomination of experts and the funding of the mission were organized jointly by the World Heritage Centre of UNESCO (Arab States Section) and the World Heritage Secretariat of ICOMOS. Preparation and implementation of the programme was the responsibility of the Egyptian National Commission for UNESCO, working with the Supreme Council of Antiquities, the University of Alexandria, the Mar Mena Monastery, and other stakeholders.

2.ii Programme

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<tr>
<th>Date</th>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>Saturday 12 November</td>
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<td>Arrival of experts in Cairo</td>
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<tr>
<td>Sunday 13 November</td>
<td>am</td>
<td>Initial briefing meeting with Abu Mena working committee at offices of Egyptian National Commission for UNESCO</td>
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<td></td>
<td>pm</td>
<td>Meeting at offices of Supreme Council of Antiquities with Dr Zahi Hawass (Secretary General)</td>
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<td>Travel by car to Alexandria</td>
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<tr>
<td>Monday 14 November</td>
<td>am</td>
<td>Travel by car to Abu Mena</td>
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<td></td>
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<td>Visit to World Heritage site</td>
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<td>Lunch by invitation of Mar Mena community</td>
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<td>Discussions with representatives of Mar Mena community and members of the Abu Mena working committee</td>
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<td>Return to Alexandria by car</td>
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<tr>
<td>Tuesday 15 November</td>
<td>am</td>
<td>Visit to archaeological sites in Alexandria</td>
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<td></td>
<td>pm</td>
<td>Return to Cairo by car, with facility visits* to Coptic monasteries of Wadi el-Natrun (Deir-al-Surian, Deir Akua Bishoi, and Deir al-Bardamus) en route</td>
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<tr>
<td>Wednesday 16 November</td>
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<td>Working meetings of experts to discuss results of site visits, to prepare for further meetings with working committee, and draft outline of eventual report</td>
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* ‘Facility visits’ were organized by the working committee to enable the mission experts to study comparable sites and monuments and to evaluate the conservation and restoration works in progress.
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<tr>
<td>Thursday 17 November</td>
<td>am</td>
<td>Final formal meeting with Abu Mena committee, to clarify aspects of project and to request additional information</td>
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<td>Facility visit to Citadel area</td>
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<td>Working dinner on Nile boat with members of working group</td>
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<tr>
<td>Friday 18 November</td>
<td>am</td>
<td>Facility visits to Cairo Museum and Coptic churches in Coptic Museum area in Cairo, currently being restored</td>
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<td>Saturday 19 November</td>
<td>am</td>
<td>Meeting of Professor Benedini with hydrological experts</td>
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<td>Departure of Professor Cleere to London</td>
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<td></td>
<td>pm</td>
<td>Departure of Professor Benedini to Rome</td>
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3 The present position and the identification of the threats

3.i Hydrological issues

The hydrological characteristics of the site are strictly related to the geographical reality into which it is inserted.

Abu Mena is located at the border of Western Sahara, 48 km south-west of Alexandria, 17 km from the Mediterranean Sea and about 97 km from the Rosetta Branch of the Nile Delta. The main archaeological discoveries, which are concentrated in an area of about 100 ha, are at an average elevation of 40 m a. s. l., where the ground surface is in the form of flat land with some smooth dunes and depressions, slightly sloping towards the north-east.

As a result of such a location, the climatic pattern of the area can be explained as the combined effect of different climatic zones, and also having some particular characteristic subject to change over the centuries relevant to the past and present history of the site.

The vicinity of the sea guarantees sufficient mitigation of the extreme characteristics of the desert, while the Nile can be still exercising an influence by virtue of its beneficial environmental effects.

Since the area still maintains the Mediterranean climatic pattern, it is reasonable to assume that in the site of Abu Mena as well the actual conditions result from the changes experienced in the rest of the basin. They consist essentially of a reduction in annual precipitation with an increased number of short-duration and high-intensity rainfall events, and an increase of the average temperature.

Consequently, it is also reasonable to say that the environmental aspects of Abu Mena during the early centuries of the Christian era, the period of its most important development, were different from those of the present day, with positive effects not only on the living conditions, but also on the availability of water.

From the geological point of view the site belongs to the Egyptian Western Desert Groundwater System, flanked by the Mediterranean coastal zone to the north and the Wadi El-Natrun area to the south-east. The source of groundwater in the deepest layers is the Nubian Sandstone aquifer, common to a large part of northern Africa, with a movement normally in a northerly direction.

There are salt-water-bearing formations in the vicinity of Alexandria resulting from seawater intrusion from the Mediterranean.

The upper aquifer belongs to a Quaternary and late Tertiary formation, covered by a few centimetres of sand, silt and clay, and a layer of sedimentary rocks, mostly limestone, 80 m thick and based on the Moghra Formation of sandstone with clay. Rainfall is the main source of recharge for this aquifer.

All the area has an average annual precipitation of 100–140 mm, mostly in late autumn and winter. Three-quarters of the total amount of rainfall is from November to February.
Precipitation occurs normally in the form of short-duration high-intensity events, which give rise to a surface runoff that eventually accumulates in the local depressions, from where water is removed by evaporation and percolation.

The average daily temperature is 26°C in summer and 12°C in winter.

A reliable hydrological balance would require more information based on direct measurements relevant to both the soil and the precipitation. Some estimates carried out by the Egyptian Research Institute for Groundwater refer to high values of potential evapotranspiration, of the order of 1.5–7.5 mm/day, as an average including desert and cultivated land. Accordingly, in the uncovered desert the fraction of the total rainwater that percolates through the soil during the rainy days should be relatively small.

This meteorological pattern, typical of the southern Mediterranean coast, could be the ultimate result of a progressive climate change lasting some centuries. The archaeological discoveries have in fact brought to light the existence of activities such as wine production, which require the presence of crops that need a considerable quantity of water, which at that time was available only from rainfall. The climate change, together with the advancement of desert which still today characterizes all the Sahara zones, could have contributed to the decay of the ancient urban settlement.

The presence of groundwater in the area is related to the particular geology and climatic characteristics. The percolating water reaches the layer of limestone, which is 80 m deep and relatively permeable, giving rise to a free-surface aquifer. Some intercalated lenses of clay produce intercalated confined aquifers of limited extension. In normal conditions the water table settles between 15 m and 40 m below ground level, with a productive depth of the order of 50 m. Following some investigations carried out by the Research Institute for Groundwater, the transmissivity can be assessed between 500 and 5000 m²/day. For the productive thickness considered, such values correspond to a permeability of between 10 and 100 m/day, characteristic of an aquifer with acceptable conditions.

The particular problem of Abu Mena preservation concerns primarily the physical and quantitative aspects of groundwater control. Direct measurements in surging groundwater, also repeated during the visit to the Abu Mena site, have highlighted a content of salt in the aquifer, the presence of which can be also confirmed by visible traces on the soil surface, after the evaporation of the water rising by capillarity. The salt content in water, which contributes to the degradation of buildings by activating chemical reactions in the stone and the mortar, originates from local interaction of percolating water with the mineral components in the subsoil.

3.ii  Main threats to the archaeological site

The massive irrigation programme of the Egyptian government also includes the area surrounding the Abu Mena site, and more than 160,000 ha can already make use of water taken from the Nile and from the local aquifer. Irrigation is in practice the only means to improve agriculture, a fundamental activity for economic development, which also concerns the reclamation of large desert zones.
As indicated in Fig. 2, the agricultural zones with intensive irrigation around Abu Mena are:

- The **Bahig area**, consisting of the fields located to the north-east, to which water is conveyed from the Bahig Canal;
- The **Bangar el Sukkar area**, with the fields located to the south and south-west, where water comes from the El Nasr Canal.

Both canals originate from the Nile and belong to a complex network, equipped with pumps and able to convey several m³/s.

In the agricultural districts the irrigation is carried out using traditional practices, and a large quantity of water is delivered to areas of intensive cultivation which are capable of producing two harvests per year. Sugar beet is the most common crop, for the cultivation of which there are subsidies from the government. The average annual water demand is of the order of 17,000 m³/ha.

![Fig. 2. Irrigation around Abu Mena: A = Bahig area; B = Bangar el Sukkar area](image)

The most commonly used watering technique is flooding, water being released to the crop with little control. There is always a large amount of water that is not used by the plants, and this percolates through the upper soil layer. Other watering techniques, such as sprinkle and drip, with a lower water consumption, and an attempt to adopt more rational criteria for using the available water in the best possible way, have not yet been received favourably by the farmers. This is the main explanation of the increased water.
replenishment of the subsoil. Another cause is seepage from the numerous canals, which have been dug without any form of lining. The effect of all these man-made interventions combines with the natural replenishment due to the percolation of rainwater.

Since the start of irrigation late in the 1960s, the water table has risen remarkably in all the areas of interest. Both inside and around the archaeological site a rise of 35 m has been observed and the actual water table can be found just 10 cm below the ground surface.

Accurate monitoring of the aquifer has been carried out, with measurements taken from several piezometers spread across the area. In late spring and summer 2001 the water table was almost stabilized between 36.00 and 34.00 m a.s.l., very close to the ground level.

Another survey has been carried out inside the Monastery. In summer and autumn 2005 the average elevation of the water table was about 29.40 m a.s.l. where the ground surface is around 30.00 m a.s.l.

3.iii Archaeological issues

As a result of the disastrous rise in the level of the water-table below the World Heritage Site, there has been total or partial inundation of excavated structures. In those areas that are not inundated, there is evidence of the movement upwards by capillary action of groundwater, containing salts that can be seen to have an adverse impact on walling, flooring, and other materials (stone, fired bricks, mortar, plaster rendering, etc). This is particularly visible in those structures that were exposed by excavation in the earlier part of the 20th century, where hard cement mortar has permitted more serious damage owing to the low permeability of this material, thereby allowing the saline water to rise higher and attack the interiors of stone and brick, causing them eventually to disintegrate.

Some low-lying excavated areas have been completely submerged beneath the rising water, and it is inevitable that these will have undergone damage and deterioration. More recently excavated areas have been backfilled by the excavator, Professor Peter Grossman of the Deutsches Archäologisches Institut, Cairo. Whilst this action will have afforded some degree of protection to the excavated remains, it will not have returned them to the environmental near-equilibrium that protected them before excavation.

A further threat to the archaeology of the site relates to the inevitable disturbances to the buried structures and occupation layers from the forthcoming dewatering operations. The use of heavy equipment to sink wells and dig water channels will damage archaeological features unless prior geophysical survey is carried out, followed either by relocation of the engineering interventions to avoid archaeological structures or by full excavation and recording in advance of engineering works. It is essential therefore that there should be a full non-excavational survey programme using techniques such as radar, magnetometer, or resistivity (and preferably at least two of these methods) on all the areas where engineering interventions are planned. No engineering projects should be initiated until the geophysical survey has been carried out and any necessary rescue excavation carried out (or, alternatively, adjustments made to the lines of channels or the location of wells).
4 Justification for continued World Heritage Listing

4.i Criteria for inscription

Abu Mena was one of the earliest sites to be inscribed on the World Heritage List, in 1979. At that time the requirements of the World Heritage Committee were simpler than they are now. The nomination dossier is slight by comparison with those regularly submitted at the present time – a six-page form, a general map of the site, five plans of individual buildings, and a number of photographs. No evaluation mission was sent to the property, and the recommendation made by the cultural experts consulted did not justify the reason for inscription under the terms of cultural criterion iv. At that time this criterion required the nominated property to “… be among the most characteristic examples of a type of structure, the type representing important cultural, social, artistic, scientific, technological, or industrial development.” (Following several changes in the intervening period, this criterion now refers to “… an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history.”)

The justification for inscription in the report of the 3rd Session of the UNESCO World Heritage Committee held at Cairo and Luxor in 1979 reads simply: “Abu Mena is an outstanding example of an architectural ensemble which illustrates a significant stage in human history,” without the detailed citation specifying how this criterion is met by the individual property, as is the case at the present time.

It is interesting that only criterion iv was used in this case. It is difficult to comprehend why criterion vi was not applied in support of the inscription on the World Heritage List. This criterion is defined as being applicable to a site or monument which is:

- directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance.

(Operational Guidelines, 2005, para 77)

It might have been expected that this criterion, which has subsequently been applied to other pilgrimage sites such as Santiago de Compostela or Canterbury, was not used to justify the inscription on the World Heritage List of one of the most significant Christian pilgrimage sites in the Near East for many centuries.

4.ii Potential loss of ‘outstanding universal value’ and integrity

There is an implication in the terms of reference for the mission contained in Decision 29 COM 7A.17 of the 29th Session of the World Heritage Committee (see 2.i above) that the current threats to Abu Mena may have resulted in a significant loss of the “outstanding universal value” (the fundamental criterion for World Heritage Listing) of the property and of its integrity.
The report on the site prepared by the UNESCO World Heritage Centre that was presented to the Committee at its 29th Session in Durban ends with the following words:

Should the situation continue to deteriorate and should no concrete action be taken by the State Party as regards the implementation of the recommendations [made in the 2002 Report], the Committee could envisage, according to paragraphs 192 to 198 of the Operational Guidelines, the possibility of removing the site of Abu Mena from the World heritage List in the future.

Paragraph 192 of the Operational Guidelines specifies the reasons for removing a property from the List as follows:

a) Where the property has deteriorated to the extent that it has lost those characteristics which determined its inclusion on the World Heritage List;

b) Where the intrinsic qualities of a World Heritage site were already threatened at the time of its nomination by action of man and where the necessary corrective measures as outlined by the State Party at the time have not been taken within the time proposed.

The latter situation is not relevant in this case, since the rise of the water-table is a phenomenon of the last decade, and so any case of removal from the List must be based on a) above. There can be no question of the characteristics for which Abu Mena was originally inscribed having been lost: within the broad justification used in 1979, which characterizes it as “an outstanding example of an architectural ensemble which illustrates a significant stage in human history,” nothing has been irretrievably lost and, indeed, much more has been learned about the site from excavations over the past two decades. Moreover, should the Committee consider the possibility of applying criterion vi to Abu Mena, the case for removing it from the World Heritage List on the grounds of loss of outstanding universal value would be further weakened.

So far as loss of integrity is concerned, the case is somewhat stronger, though not sufficient to justify removal from the List. This quality is defined in the Operational Guidelines (para 88) as:

a measure of the wholeness and intactness of the natural and/or cultural heritage and its attributes. Examining the conditions of integrity therefore requires assessing the extent to which the property:

a) includes all elements necessary to express its outstanding universal value;

b) is of adequate size to ensure the complete representation of the features and processes which convey the property’s significance;

c) suffers from adverse effects of development and/or neglect.

The next paragraph goes on to specify that:

The physical fabric of the property and/or its significant features should be in good condition, and the impact of deterioration processes controlled.

It is indisputable that the physical fabric is not in good condition and that the impact of deterioration processes is not at present controlled. However, as this report will
demonstrate, active and effective steps have been taken by the State Party to reverse the impact of deterioration processes and plans are being prepared to restore the physical fabric to an acceptable level.
5 The projects currently being implemented

5.i Technical issues

In a joint effort with the Ministry of Agriculture and the Ministry of Water Resources and Irrigation, and with appropriate scientific support, the Ministry of Culture has developed an ambitious project, with the intention of lowering the water table in the archaeological site and keeping it under control.

The project is based on the possibility of draining groundwater by means of open ditches. Drained water will be brought to some centralised tanks, from which it will be raised by pumps and discharged again into the main canals originating from the Nile. The project outlines are sketched in Fig. 3. It concerns about 4.20ha in the core of the monumental area.

The draining ditches will be dug at an appropriate level to draw water around and below the basements of the monuments. The water collected will be conveyed to some intermediate tanks through a network of collection pipes, and then into a large primary tank at the end of the drainage area. Finally, a set of pumps connected to a 1.20 km long pipeline will discharge the water into the main canals of the Bahig Area. Special technical solutions will be adopted in order to facilitate the capture of water through the bed and banks of the ditches. Furthermore, the collection pipes over a total length of about 9.00 km will be made from porous material and placed in the ground at an appropriate depth, in order contribute to the drainage.

Figure 3 Outlines and operational principles of the project developed by the Ministry of Culture. In the irrigation areas A a large amount of water percolates through the soil and recharges the aquifer. The drainage ditches B produce the drawdown d from the original water table level. The drained water is conveyed through the pipes C to the collection tank D, where the pump p raises it to the main canal E that supplies the irrigation area by gravity.
The final flowrate to remove from the area is estimated at 0.42 m³/s, corresponding to a total volume of 13 Mm³ per year.

The project is designed in accordance with the local topography and elevation in order to benefit from the natural slope of the ground surface. It comprises all the directions for a correct implementation, taking into account the particular situation and all the constraints present in the area.

The construction of the various works will entail digging and moving about 180,000 m³ of earth. Electrical equipment, connected to the main 500 kV distribution network, will provide the necessary power for the pumps and other relevant services. In case of emergency, a diesel generator of 250 kW will be available.

The full implementation of the project is expected to be completed in three years at a cost of 2.3 M€, entirely contributed by the Egyptian Government.

In parallel the Mar Mena Monastery has commissioned a qualified engineering firm to develop a project for its precinct. The project is based on accurate monitoring of the water table, which in this area is now very close to the ground level, creating a grave risk to the stability of the basilica and all the other buildings in the complex. The main buildings will be surrounded with a ring of porous pipes, connected to a collecting duct equipped with a pump and discharging into the drainage canals outside the Monastery. The discharged flow will be handled together with that covered by the general project of the Ministry of Culture for the archaeological site.

The goal of both the projects is to lower the water table to about 5m below the actual level. This measure is deemed sufficient to avoid any threats to the buildings, so as to make it possible to start archaeological excavations again in less hazardous circumstances.

The anticipated lowering of the water table will also remove all risk of deterioration of the basements and underground structures as an effect of chemical activity due to the presence of salt in groundwater.

5.ii Archaeology

The impression was gained that few, if any, steps have been taken to draw up a comprehensive conservation programme to be implemented once the water-level problem has been resolved and is in the course of coming into service. In a sense this is a wise precaution, since it would be inadvisable to begin elaborate conservation works that may be jeopardized as the drainage project progresses. A vague general impression was given that standard Supreme Council procedures would begin when the de-watering began.

A great deal of experience has been obtained in this field by the Supreme Council of Antiquities as a result of the successful work carried out at the Luxor and Karnak Temples. There are, however, significant technical differences between the archaeology and hydrological aspects of Upper Egypt and the Delta and so a group should be set up as soon as possible, perhaps involving foreign as well as Egyptian experts, to prepare an overall conservation plan for the Abu Mena site.
6  Potential effects of the projects and possible alternative solutions

6.i  The efficiency of the project

From the documents collected during the mission, as well as from the information given by the technical experts of the Ministry of Culture, the project appears to have been developed with a high level of expertise. The proposed solutions reveal a knowledge of valuable technological innovations which will guarantee good working conditions. Groundwater drainage by means of permeable unlined ditches and porous pipes and canals could be very effective. If the water in the ducts can be kept at a low level, a sufficient drawdown in the aquifer can be obtained.

An accurate evaluation of the drawdown would require much more information on the subsoil and the groundwater, given that the behaviour of a free aquifer is always difficult to quantify. Following a rough estimate, in the typical conditions of the area, the design flowrate of 0.42 m³/s will guarantee the anticipated lowering by 5 m.

The efficiency of the project is strictly dependent on the pumps, which must run permanently throughout the year. At an estimated cost of 1 € for 1 m of elevation, the achievement of the planned flowrate will necessitate considerable financial resources being available.

The insertion of the project into the overall irrigation schemes will activate a form of closed circle, as the water drained from the subsoil is returned to the main canals, from which, in turn, it is delivered to the crops in a way that enhances the percolation and the recharge of the aquifer. The risk of raising the water table again could be very high. The success of the project will be fully assured when the quantity of water extracted from the aquifer matches that brought in by the main irrigation canals.

6.ii Alternative solutions

As confirmed by the technical experts of the Ministry of Culture during the mission, the project has been already approved and its implementation will start shortly. The organizational machinery has been already put into motion and any proposal that might significantly change the actual method of proceeding would be likely to cause unpredictable troubles. It should be accepted that the Egyptian authorities have explored a number of possible solutions to the problem before developing the present project.

Nevertheless, it is reasonable to examine whether there are other feasible procedures which might be considered in order to achieve the principal objective, that of lowering the water table in the archaeological site. In this way a background that might well prove useful for future developments can be established, not only in case the present project experienced some failures, but also in order to provide a more general perspective for rational water management in the whole area.

In Egypt the available water resources are limited and the Nile cannot meet a demand that is continuously increasing. A number of physical and environmental constraints are imposed on water withdrawal. Scientific investigations on the future of Egyptian water
resources have predicted a possible shortage of usable water, and the Nile itself is expected to suffer from the effects of the frequent droughts occurring in its upper catchment areas in central Africa.

A general policy of water economy, combined with the need to reclaim the desert in order to create a prosperous agriculture, should be of supreme interest to the Egyptian authorities. The preservation of archaeological sites is also a part of this policy, in a larger context that associates water management with all the initiatives aiming at economic development and environmental protection.

The most effective alternative could be a radical change in agricultural practice, adopting ‘dry’ crops, at least in a zone around the site. This is mainly a political issue, to be implemented only after delicate and most likely prolonged negotiations between the government and the people concerned. This decision ought to be integrated with initiatives covering the entire territory of Egypt, handled by the national government for implementation over a long period of time, the benefit becoming apparent only after several years.

As an alternative to the cultivation of dry crops, a positive result might also be achieved with irrigation techniques capable of delivering a limited amount of water, to be applied only after the requirements of the chosen crops have been determined accurately. This would mean taking into account the availability of resources, the environmental conditions, and the economic aspects of a form of agricultural activity carried out using the best technological solutions. Sprinkle and drip irrigation can contribute not only to decreasing the percolation in the cultivated land but also to saving water.

An effective alternative can be the withdrawal of groundwater by means of pumping wells. Once again in this case, the lack of more precise hydrogeological information does not at present permit a reliable evaluation of the results that might be achieved. Several pumping wells would be necessary, working together simultaneously, in such a way that the result would be the combination of all the individual pumps, with the possibility of the overall cost being shared among the participating farmers.

In this way water extracted from the subsoil would be used directly on the spot, without any need for main conveying canals. Obviously, since the extracted water will percolate again into the water table, a new closed circuit will be created. In this case, the closed circuit will be controlled by the farmers themselves, who will withdraw the necessary quantity of water from the aquifer lying beneath their own crops alone.

The success of such an alternative depends upon the establishment of a correct water balance, because percolation must be less than withdrawal, at least in the transition phase, in order to lower the water table to the desired level and to achieve a sufficiently stable situation. After some years, the quantity of water extracted from the subsoil could become insufficient for the local crops: only in this case would an integration become necessary, involving the withdrawal from the main canal of a quantity of water which, in any case, would be much less than that removed at the present time.

This alternative involves persuading the farmers to rely upon their own ability to obtain water without the supply from the main canal. They will bear the cost of the amount of
water they use, and so some financial contribution on the part of the public authority might be necessary.

This alternative would be beneficial both for solving the local problem of preserving the archaeological site and, on a larger scale, for more general problems of water resources management. The amount of water delivered today in the surroundings of Abu Mena could be used for the reclamation of other desert areas.

In addition to the alternatives described above, which entail a radical change in the traditional practice of Egyptian agriculture, some minor intervention might also be considered in order partially to solve the problem of groundwater control. One very action would be to line the main canals with impermeable material: geomembranes and geotextiles can reduce bed and bank permeability by up to 80 %
7 Aspects of site management

7.i Buffer zone

Examination of the plans accompanying the nomination dossier lodged in the ICOMOS Documentation Centre in Paris gave no indication of the existence of a definite buffer zone at Abu Mena. This is not surprising, since in the early years of the Convention there was no requirement for the establishment of a buffer zone to protect the setting of nominated sites. The area nominated (and eventually inscribed on the World Heritage List) is defined on the basis of an area delineated by five fixed points on a 1:25,000 map, forming an irregular quadrilateral, one side of which consists of two sections on slightly varying alignments, but there appears to be no plan relating these points to the buildings established by excavation. The nomination dossier gives simple geographical coordinates to the site, but these appear to relate only to a central point, not the fixed points of a two-dimensional area. Recent planning documents supplied to the mission showed the ‘Abu Mena Site’ unhelpfully as a regular rectangle, which are no doubt adequate for the engineering project, but which expose the World Heritage site to possibly damaging interventions. Other plans and maps given to the mission show further variations of the boundaries.

When on the site, the mission was told that the World Heritage site was defined by the line of the walls of the ancient settlement, which were not easily identifiable on the ground. It was also clear that there is a substantial area lying outside these limits which contain important archaeological remains (for example, the excavated Eastern Basilica), indicating that the central monastery complex was the site of considerable permanent settlement and agricultural activities. This is roughly defined by the raised track and ditches created by the Mar Mena Monastery.

Whilst the main monumental area is of unquestioned significance, there is another area of equal significance, namely the settlement that grew up around the pilgrimage site. This represents an exceptional example of a very early pilgrimage centre, a type of urban site that is still imperfectly understood. Having been abandoned without later construction overlying it, the settlement will retain an unusual level of completeness.

It has already been stated that there is an urgent need for a detailed geophysical survey of the overall site before engineering works are initiated. This survey should serve a double purpose, since it makes it possible to redefine the area of archaeological significance and revise its boundaries, whilst at the same time permitting the establishment of an effective buffer zone.

7.ii Technical aspects of a buffer zone

A strip of land surrounding the archaeological site and providing the necessary control on groundwater presents an interesting solution. To ensure reliable protection, such a strip must be free from any agricultural activity capable of interfering with the aquifer. It makes no sense to devise a zone provided with its own drainage system in form of drainage pipes or ditches, which will of necessity be much larger than that foreseen in the
project of the Ministry of Culture. Alternatively, the strip could be equipped with an intensive set of pumping wells, combined with irrigation practices that would make it possible to lower and control the water table within the archaeological site.

The main problem from the technical point of view is how broad the strip should be. Only in the case of the use of pumping wells can some values be estimated, taking account of the influence radius of the pump. Tentatively, assuming that the effect of a pump can be effective within a radius of 200–300m, a reasonable number of wells, sited in several rows around the archaeological site, would be able to assure an efficient control of the water table.

7.iii Emergency measures

In general terms, there are two potential risks for the archaeological site:

- During the implementation of the project, estimated to take three years, if the delivery of water to the irrigation districts is carried out without any form of control, or if the irrigated area were to further increase;
- Once the project is completed, should there be a temporary failure (breakdown or reduced efficiency of the pumps, clogging of drainage pipes) or if the present conditions on which the project is based were to change (increase of the irrigation area, request for a further lowering of water table – for example, deeper excavation around one of the historic buildings).

In both the cases the water table would be likely to rise again to a level that would threaten the monuments. To deal with such an eventuality, a rapid intervention would be necessary, coupled with the modification of certain aspects of the project.

The emergency measures can be based on the alternative solutions already described, namely:

- Temporary interruption of all the irrigation actions in the areas closer to the site, long enough to permit more efficient and permanent works to be carried out.
- The drilling of a set of pumping wells capable of controlling and lowering the water table in the more sensitive zones.

Both these measures entail effective participation by the farmers and the existence of a strong authority able to convince those concerned of the need for action of this kind and providing, if necessary, financial compensation and incentives.

Events requiring emergency measures can suddenly occur at any time and there is no way of forecasting them. The responsible authority should be therefore prepared to intervene immediately and in the most efficient way. Continuous monitoring of the water table in the archaeological site could provide the information needed to plan the appropriate intervention. To this end, one of the piezometers already in operation should be equipped with a recording device that would raise the alarm as soon as the water level exceeds a safety threshold.
7.iv  Management plan

It is clear that there is no management mechanism of the type prescribed in paras 108–118 of the Operational Guidelines in force at Abu Mena. Each World Heritage property is required to “have an appropriate management plan or other documented management system which should specify how the outstanding universal value of a property should be preserved, preferably through participatory means (para 109).” The purpose of such management systems is “to ensure the effective protection of the nominated property for present and future generations” (para 110). Such management systems “may vary according to different cultural perspectives, the resources available and other factors. They may incorporate traditional practices, existing urban or regional planning instruments, and other planning control mechanisms, both formal and informal” (para 110). Common elements of an effective “management system” could include:

a) a thorough shared understanding of the property by all stakeholders;
b) a cycle of planning, implementation, monitoring, evaluation and feedback;
c) the involvement of partners and stakeholders;
d) the allocation of necessary resources;
e) capacity-building; and
f) an accountable, transparent description of how the management system functions” (para 111).

A more comprehensive overview of managing World Heritage sites is to be found in Management Guidelines for World Cultural Heritage Sites, by B M Feilden and J Jokilehto, 2nd edition, Rome 1998 (ICCROM, UNESCO, and ICOMOS).

At the present time the site is somewhat forlorn. There is no interpretation or presentation of any kind, apart from that in the unsightly insubstantial building erected by the monks of the Mar Mena community at the Basilica. It is also not protected, and the mission was told that clandestine excavation and removal of architectural elements take place regularly.

Given the large number of pilgrims and tourists visiting the Mar Mena monastery complex, it is highly desirable that the management of the World Heritage site should be given high priority.

7.v  Identification of stakeholders

The World Heritage site is the property of the Egyptian Supreme Council for Antiquities, part of the Ministry of Culture, which is entirely responsible for its protection, conservation, and management. However, there are other bodies that might be deemed to have an interest in the well-being of the site and who should therefore be involved in the preparation and implementation of an effective management plan.

At governmental level there are Ministries other than the Ministry of Culture, such as those for Agriculture, Tourism, and Water Resources and Irrigation. Lower-tier
governmental authorities (for example, the Burg al-Arab District) are also concerned with infrastructural changes relating to roads and other public services upon which developments at the World Heritage site are likely to have an impact.

It is very important also not to overlook the non-governmental sector. Local landowners and farmers are major stakeholders in that activities affecting the World Heritage site and its environs have the potential to make an impact on their lands and their sources of income. Another major stakeholders is the modern Coptic monastery of Mar Mena, which was created in 1959 by Pope Kyrillos VI to honour the martyr St Menas and to provide facilities for the many hundreds of thousands of the faithful who each year make a pilgrimage to Abu Mena, one of the most sacred sites for Coptic Christians.

Another stakeholder that should be closely involved in the preparation of management plans is the German Archaeological Institute (Deutsches Archäologisches Institut) in Cairo. Excavations and conservation works have been carried out by archaeologists from this Institute each year since 1961, and it is likely that this association will continue.

Experience at other major archaeological sites around the world has demonstrated the value of involving a wide range of stakeholders of this kind in various ways in the management of major archaeological sites. It is, furthermore, the policy of the World Heritage Committee to encourage the participation of local communities in all aspects of management planning on World Heritage sites.

For example, at the Monte Alban archaeological site in Mexico, local high-school students for an enthusiastic and well informed group of voluntary guides, whilst retired local men and women have for many years worked voluntarily as guides at the many historic properties owned by the National Trust in the United Kingdom. The monastic community at Mar Mena already provides excellent guiding services at Abu Mena, for both pilgrims and tourists.

It is suggested therefore that a working group with representatives from bodies of the kind listed above should be set up to assist in the preparation of a management plan and its implementation.
8 Conclusion and recommendations

8.i Engineering aspects

Protecting the Abu Mena site from rising groundwater requires the lowering of the water table that is at the present time rising as a result of intensive irrigation in the nearby areas, supplied by the main canals coming from the Nile. The water table should be lowered at least 5 m; it is equally important that threats from future rises must be avoided.

The Egyptian Ministry of Culture has developed an outstanding project, aiming at lowering the water table by means of draining ditches and pipes, inside and around the archaeological area. Drained water will be conveyed by gravity into collecting tanks, from which, by means of pumps and through a long pipeline, it will be returned to the main canals coming from the Nile. The drainage ditches and pipes will also collect the water drained in the precinct of the Mar Mena Monastery, for which an ad hoc project will be developed.

The implementation of the projects will start very soon, and development of the technical, managerial and financial aspects has already begun. Completion is expected in about three years.

The projects are well designed and promise to be effective. Their operating conditions should be considered along with more general aspects of the management of water resources in a very large area of Egypt. Economic and political aspects must be considered because a large amount of financial resources will be required, not only in the implementation phase, but also during the eventual working conditions. Moreover, the projects will succeed only if the farmers involved ensure their active participation, while all the state and regional authorities responsible for water management and irrigation also confirm their cooperation.

The problem of the preservation of Abu Mena is very complex. Further complexities can be added by the nature of the hydrological events, as well as by the difficulty of forecasting the evolution of the economic and social aspects that can occur in the area. The responsible authorities should therefore continuously monitor the various components that make up the problem and its solution. Supplementary and alternative measures, both technical and managerial, may well become necessary.

An efficient system for monitoring the water table in the archaeological site and in the surrounding zones is essential, as its level will remain the most significant variable for assessing the effectiveness of the solution of the problem.

8.ii Archaeological aspects

1. Three preliminary tasks must be undertaken with the minimum of delay:
   – A **geophysical survey** must be initiated, concentrating in the beginning on areas where it is planned to undertake earth-moving operations connected with the measures to be taken to lower the water table on the site, and before this work has been started. Where archaeological deposits or structures are identified, two alternatives have to be
considered: either a rescue excavation should be carried out, to record the archaeological material before work starts, or agreement should be reached with the earth-moving contractor on a diversion of the line of the linear feature or the re-siting of wells.

– A rapid condition survey of all excavated remains should be carried out and urgent conservation carried in order to provide protection to structures during the vibration and other forms of damage likely to result from the use of heavy earth-moving equipment.

– Discussions must take place simultaneously with these emergency actions in order to establish the definitive boundaries of the World Heritage site and its buffer zone, taking into account the requirements of the World Heritage Committee as set out in the Operational Guidelines.

2. Once these three emergency activities have been successfully completed, the geophysical survey should continue over the entire site (including the buffer zone), to act as a guide to future research and management projects. At the same time, a conservation plan should be prepared, defining short-, medium-, and long-term objectives and establishing technical parameters (materials, techniques, etc).

3. Discussions should begin with stakeholders with the objective of preparing a management plan, to include inter alia research (including excavation and survey), presentation and interpretation, the role of stakeholders (e.g. the Mar Mena community), staffing, sponsorship, visitor facilities, access, etc.
9 Acknowledgments

The members of the mission wish to record their gratitude to the many Egyptian professional colleagues whom they met during their visit for the friendly reception and their readiness to answer questions and explain at length and in detail the projects on which they worked. A full list of these people is to be found in Annex A. Their special thanks go to Dr Samir Ghabbour and Mr Safwat Salem of the Egyptian National Commission for UNESCO, Dr Abdallah Kamel Moussa and General Essam Kamel of the Supreme Council of Antiquities, Dr Ahmed Khater of the Research Institute for Groundwater, and Father Paphnotios of the Mar Mena Monastery. They are also very grateful to Mr Ahmed Assaf and Mr Yasser El Zieb, their guide and driver throughout the mission, for their patience and helpfulness.
ANNEX A   List of people met during the mission

Ministry of Education: Egyptian National Commission for UNESCO

Dr Samir Ghabbour          Chairman
Mr M. Safwat Salem          Secretary General

Ministry of Culture: Supreme Council of Antiquities

Dr Zahi Hawass              Director General
Dr Abdallah Kamel Moussa   Chair, Sector of Islamic and Coptic Monuments
General Essam Kamel        Head of Projects Sector, Sector of Islamic and Coptic Monuments
Mr Saber Selim             General Director, West Delta
Mr Mohamed Salah el-Din    Head, Central Administration for Lower Egypt, Sinai, and North Shore
Dr Gamal Mahgoub           Head, Central Administration for Maintenance and Preservation
Eng. Nady Abdel Sayed      General Director for Engineering, Lower Egypt
Dr Hany Hanna Aziz Hanna   General Director, Department of Conservation
Dr A. Shawarby             National Project Director, Egyptian Antiquities Information System

Ministry of Water Resources and Irrigation: National Water Research Center, Research Institute for Groundwater

Mr Mohamed Hussein Ahmed   Secretary General
Dr Ahmed Khater            Director
Professor Alfy Morcos Fanos Director, Coastal Research Institute

Coptic Monastery of Mar Mena

Father Elia Ava Mina
Father Paphnotios Ava Mina
Father Abanoub Ava Mina
Father Polykarpos Ava Mina
Father Tedawes Ava Mina
Mrs Joanna Jones            Consultant

Faculty of Engineering, University of Alexandria

Professor Nazeih Younan

Faculty of Architecture and Urban Design, Cairo University

Professor Sami Sabri Shaker
ANNEX B  Documentation

The following are the main sources of written information studied by the members of the mission before, during, and after the mission.

**UNESCO**

*Assessment of water related damages and adverse effects on historic monuments: Mission to the World Heritage Sites at Ancient Thebes and Abu Mena, September 2002*


*Document WHC-05/29.COM.7A presented to the World Heritage Committee at its 29th Session in Durban (South Africa), July 2005*


**Ministry of Culture: Supreme Council of Antiquities**

*A report to be presented to the Head of the Islamic and Coptic Antiquities sector concerning the monumental area of Abu Mina [n.d.]*

*A technical report concerning the project of decreasing the underground water levels in the monumental area of Abu Mina [n.d.]*

**Ministry of Water Resources and Irrigation: National Water Research Center, Research Institute for Groundwater**

*Technical Report on the water logging problem in monumental city of West Abu Mina (Western Delta – Egypt) [n.d.]*

**Egyptian National Commission to UNESCO**

*A technical report concerning the project of decreasing the underground water levels in the monumental area of Abu Mina [summary of Ministry of Culture/SCA report of the same name, submitted to UNESCO on 25 January 2005]*

**Mar Mena Monastery**

*Technical Report [n.d.]*

**Deutsches Archäologisches Institut, Cairo**

*Grossmann, Peter On the water problems at Abu Mina [typescript report dated 12 November 2004]*
Other documentation


Hermans, Ine (2003) *Abu Mina: de opkomst en de ondergang van een koptisch bedevaartsoord*. Thesis submitted to the Catholic University of Leuven (Belgium)


