Thomas Roby
John Stewart
Martha Demas
Livia Alberti

The Reburial of Mosaics

Literature Review and Training and Planning Documents

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Conservation
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Thomas Roby
John Stewart
Martha Demas
Livia Alberti

Getty Conservation Institute
Los Angeles

The Getty Conservation Institute
1200 Getty Center Drive, Suite 700
Los Angeles, CA 90049-1684
United States
Telephone (+1) 310 440-7325
Fax (+1) 310 440-7702
Email: gciweb@getty.edu
www.getty.edu/conservation

The Getty Conservation Institute (GCI) works internationally to advance conservation practice in the visual arts—broadly interpreted to include objects, collections, architecture, and sites. The Institute serves the conservation community through scientific research, education and training, field projects, and the dissemination of information. In all its endeavors, the GCI creates and delivers knowledge that contributes to the conservation of the world's cultural heritage.

MOSAIKON is a partnership of four institutions: the Getty Conservation Institute, the Getty Foundation, ICCROM, and ICCM. The aims of the project are to strengthen the network of professionals concerned with the conservation, restoration, maintenance, and management of mosaic heritage in the southern and eastern Mediterranean region; provide training to a variety of individuals involved in mosaics conservation and, more generally, with the management of archaeological sites and museums with mosaics; work with national and international bodies to provide a more favorable legislative, regulatory, and economic environment for the conservation of mosaics in the Mediterranean; and promote the dissemination and exchange of information.

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PREFACE

Thomas Roby

Reburial is a protective intervention measure to preserve excavated site remains for the future and has been an important component of the archaeological site conservation work carried out by the Getty Conservation Institute (GCI) since its beginnings in the 1980s.

The reburial of mosaics has been a topic specifically addressed in GCI training courses in 1990 and 1993 in Paphos, Cyprus, and then during the GCI Reburial Colloquium in Santa Fe, New Mexico, with presented papers published in 2004. Since then, reburial of mosaics has been a component of training courses for site managers and for conservation technicians in Tunisia in collaboration with the Institut National du Patrimoine (INP) in the 2000s. Similarly, subsequent regional training courses under the umbrella of the MOSAIKON Initiative in different locations in the Mediterranean area addressed reburial as a key conservation planning strategy and practice for conserving mosaics on sites. The last of these, in Amman, Jordan (2022), was designed to address mosaic reburial specifically. The MOSAIKON Bulla Regia Mosaic Conservation Field Project has provided an example of sitewide mosaic conservation planning and of reburial of an entire ancient building not to be presented to visitors and of selected mosaics of a building to be presented to visitors.

This publication provides a literature review on mosaic reburial as an indicator of advances in mosaic reburial theory and practice since 1975 (Part I). It also compiles a selection of the mosaic conservation planning and reburial planning, monitoring, and maintenance documents produced during these GCI training courses and field projects since 2010 (Part II). We trust that the literature review and documents provide tools and examples to disseminate the knowledge of the GCI, its consultants, and colleagues in the broader conservation field in order to expand and improve the practice of mosaic reburial.

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INTRODUCTION

For more than three decades, the work of the GCI has focused on the conservation of archaeological sites, and within these projects, reburial has been a core concern and activity.

The GCI has been a leader in the field of reburial research and dissemination. In the 1990s, two projects—the conservation of hominid trackways at Laetoli in Tanzania and the conservation of architectural remains at Chaco Canyon in New Mexico—used reburial as the principal conservation measure. Neville Agnew and Martha Demas led these projects, as well as the organization of GCI's Reburial Colloquium in Santa Fe, New Mexico, in 2003 (https://www.tandfonline.com/toc/ycma20/6/3-4), which included a session specifically on mosaic reburial, one of the components of a third GCI project, Mosaics in Situ. Within the context of this project, a literature review of mosaic reburial and protective covering was carried out on publications through 2008 (Demas 2013). This publication includes that review and carries it forward to include literature through 2024.

Another component of the Mosaics in Situ project was training and capacity building for site directors in the conservation and management of archaeological sites with mosaics, building on the experience of similar GCI courses in Paphos in the early 1990s. The courses in the 2000s were held at or near different sites with mosaics in Tunisia in collaboration with the Institut National du Patrimoine (INP), and these short, three-week courses were undertaken to raise awareness about the particular conservation problems and threats to mosaics on sites. They also were designed to highlight the work that the technicians were being trained to do and the support that the technician trainees required to be able to carry out and document their work to conserve and maintain mosaics on sites. The conservation technician training courses that the GCI and INP organized at sites aimed to create a new profile of practitioners among the government employees based at sites, some of them newly hired in order to be trained. Therefore, these courses were much longer, generally four modules of four to six weeks over two years, with in-between module practical work assigned to the trainees. Reburial was a significant part of the training of both the site managers and the conservation technicians, and the technician courses included both lessons on reburial and experience in carrying it out.

These Tunisian training courses, between 2001 and 2009, included didactic materials and planning and assessment documents produced for them by the instructors. When similar courses were organized by the GCI, sometimes in collaboration with the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), in subsequent years between 2010 and 2022, and in other countries within the framework of the MOSAIKON Initiative, many of these documents were further developed and revised, and some of them were translated into Arabic and French. This publication brings together the latest version of the documents regarding mosaic reburial used in the Tunisian and then the MOSAIKON training activities. In addition, the MOSAIKON Bulla Regia Mosaic Conservation Field Project has also produced a mosaic rapid survey form and reburial planning document, which have been included. The extensive glossary of terms and instructions that accompanies the Bulla Regia Project rapid survey form has not been included but is found here: www.getty.edu/conservation/publications_resources/pdf_publications/bulla-regia-mosaic-conservation-project.html.

The documents in Part II complement a guidance document on reburial revised by Historic England in 2024 (https://cms.historicengland.org.uk/images-books/publications/preserving-archaeological-remains/). The suite of mosaic reburial documents produced by the GCI for its training and field projects before and during the MOSAIKON Initiative provides a useful compilation of planning and evaluation tools for conservation professionals of different profiles and for field archaeologists.

PART I

A Review of the Literature on the Reburial and Protective Covering of Mosaics

LITERATURE REVIEW (1973–2008)

Martha Demas

Introduction

Any attempt to understand the rationale, techniques, and methods of reburial as a preservation strategy for excavated archaeological remains must have recourse to a broad range of related literature, from soil science to microbiology, hydrology, and site stabilization techniques. This overview is focused specifically on the published literature that relates to the protection of mosaic pavements by reburial or shallow protective coverings; it does not cover the broader range of literature, nor publications on reburial of other types of archaeological remains, much of which is directly pertinent to reburial of mosaics. The reason for focusing on mosaics is to have a clearer understanding of past practices and current issues within the arena of mosaic conservation. An indispensable reference for reburial of archaeological sites generally is the publication of papers from a colloquium organized in 2003 by the Getty Conservation Institute (GCI), the U.S. National Park Service, and the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) in Santa Fe, New Mexico (see CMAS 2004). Also to be noted are the publication of the PARIS (Preserving Archaeological Remains In Situ) conferences (PARIS 1, PARIS 2, and Paris 3 were published within the chronological scope of this literature review). These publications address challenges related to both buried and reburied archaeological remains and in which mosaic reburial has begun to make an appearance (see Stewart et al. 2004 and Nardi and Schneider 2004 in PARIS 2).

Conservation literature on mosaics that is specific to reburial or protective coverings is relatively more extensive than for other categories of archaeological sites. The reason is principally due to the role of the ICCM conferences as a forum for discussing problems and sharing information among professionals. The eight ICCM conferences published through 2007 provide the majority of mosaic-related publications. The conference proceedings are thus an important source of information about reburial as a conservation intervention and a means of gauging the trends in its practice over the last thirty years.

A comprehensive review of the literature on mosaics through 1988 was undertaken in connection with development of the first course on mosaic conservation at ICCROM (Melluco et al. 1994 and Nardi 1994). In their interesting and trenchant review of the state of practice and thinking about mosaic conservation as reflected in the literature, the authors make clear that the emphasis had been on lifting and relaying of mosaics (67%) and "super projects," with a lack of interest in "soft interventions" such as reburial (only 8 articles of some 400 under review). A divergence between reality (that is, actual practice in the field) and the literature (what conservators chose to report on)

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was also emphasized. Such a divide is especially pertinent to reburial, which is practiced far more often than reported. The authors point out that the 1990 ICCM conference (Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos), at which these papers were read, showed signs of a change in attitude which, from the vantage point of two decades, has proven prescient. A division of the literature pre-1990 and post-1990 is therefore a useful way to review what has been written and published on reburial and surface protection of mosaics.

The terminology used in the literature to describe the act of covering a mosaic for its protection has varied over time. In English, the term "backfilling" has been prevalent; also used are phrases such as "re-covering with earth" or "surface protection" and "protective covering" for shallow, often temporary protection. More recently, the term "reburial" has gained wider acceptance, and it is used in this review (see, however, CMAS 2003, 140 for the term's other associations in the context of archaeology in the Americas and Australia). Frequently used terms in French are réenfouissement, couverture, protection; in Spanish: rentierro, cobertura; and in Italian: reinterro, copertura, protezione.

Pre-1990 literature

Methods and materials

Prior to 1990, the meager literature on reburial consists principally of articles recommending or describing methods and materials for long- or short-term protection of mosaics. These references are in the context of general articles on the problems of conserving mosaics in situ and the range of options available (Veloccia 1978; Bassier 1978; Mosaics 2; Mora 1984; a useful overview of these methods, which includes references after 1990, is provided in Altieri et al. 1999 and Laurenti and Altieri 2000). Recommendations for short-term protection against weather and plant growth call for polyethylene (plastic) sheeting on the mosaic covered with a shallow layer of sand or pozzolana. Long-term protection dispenses with sheeting, whose role is taken by a layer of sand, pozzolana, or expanded, fired "ceramic pellets" or "clay pellets" (argilla espansa), followed by layers of earth. The importance of depth of fill for long-term protection is addressed in Mosaics 2 and in Bassier 1978 with respect to the insulating capacity of soil against freeze–thaw cycles. Only the work plan in Mosaics 2, which takes a more holistic approach, mentions the need for maintenance of a reburied mosaic, recommending herbicide treatment or annual weeding. The dangers inherent in the use of polyethylene sheeting over the long term (creation of a micro-environment by the impermeable membrane) are also addressed.

The most fulsome coverage on reburial prior to 1990 is that of Mora 1984, who incorporates guiding principles into a proposed "backfilling" strategy for wall paintings and mosaics: backfill material should be insulating and impermeable to liquid water, but permeable to water vapor; consideration needs to be given to the ease of removing materials (e.g., sand and clay become compacted and heavy when wet); and the surface of the backfill must be stabilized. Mora clearly puts to rest the use of plastic sheeting in a reburial, recommending instead the use of plastic netting (or mesh) as a separator material between the mosaic and the bulk fill, which will also facilitate removal of fills, if needed. The purpose of clay pellets (loose or in small bags) as the first layer of fill is not clearly explained; the bulk fill is earth, covered with a bentonite (expansive clay) layer to prevent penetration of rainwater, followed by earth and shallow rooted plantings to stabilize the surface. The proposed sequence was said to be subject to experiments to check its efficacy, but no follow-up was published.

Nardi (1982, see below) and Mora are the earliest mentions of the use of plastic netting and clay pellets together. This is a combination that was to become ubiquitous in the Mediterranean region in the 1980s and 1990s, especially for shallow covering of mosaics, and most often without the overburden of soil that is a critical protective component in the reburial recommended by Mora.

A roundtable discussion on in situ conservation organized at the Soria conference in 1986 (Mosaics 3, 345–365) brought forth numerous examples of past attempts to protect mosaics with various coverings, some as long ago as the mid-nineteenth century. These range from the rational to the absurd, including pure sand, geotextiles, straw and wood, concrete, bitumen/tar paper, and expanded polyurethane—most with disastrous results. However peculiar some of this anecdotal evidence is, it highlighted the near absence within the literature of careful evaluation of past treatments and testing of different methods and materials.

Experimental testing

The only experimental testing work published in this period is that done by Nardi to find a method of temporary protection for mosaics (Nardi 1982). Testing was done in situ on a small area of mosaic (2 m. sq.), employing plastic netting, expansive clay pellets, soil and sand in four different combinations. Testing was aimed at verifying characteristics and behavior of clay pellets: compressive strength/resistance, ability to impede plant growth, durability, practicality, and re-usability. The results showed that the clay pellets were inert, were not subject to compression, do not impede root growth, and were durable, practical, and recyclable. The most important observation after one year of testing was that penetration of roots occurred in all test areas; the need for more study of this problem, which the author acknowledged as one of the most important for reburial, was emphasized. The observation that clay pellets in one test area that rested in standing water showed no signs of intake of water has been the general perception about clay pellets, but it is not a reflection of their true characteristics (see below experimental lab testing after 1990).

Evaluation of past treatments

The need for evaluating past treatments is brought to the fore in the article by Stanley-Price (1985) that looks at patterns of survival of mosaics. This was done from a literature survey of a corpus of mosaics within a specified region (the Levant) and chronological period (Byzantine). While the number of mosaics reburied was significant (25% of the total surveyed), this did not reflect an enlightened trend, but rather the result of many mosaics from a single site having been backfilled after their initial excavation in the 1920s. The methodology of trying to discern patterns of preservation and deterioration requires a large sample, but as the author points out, the results must remain tentative and provisional pending in situ evaluation of the effectiveness of the treatment in question. Nevertheless, this type of analysis is an important complement to the major trends in the literature on mosaics, which focus on the details of individual mosaics rather than an investigation of more regional patterns.

The literature from 1990 to 2007

Methods and materials

The methods and materials most commonly referred to in the literature from 1990 onward are clay pellets and plastic netting, and increasingly geotextiles. Plastic netting and geotextiles are used in combination with clay pellets or in variations incorporating layers of pozzolana or soil (Martinelli 1994; Roby 1995; Costanzi Cobau 1994; and see Altieri et al. and Laurenti and Altieri 2000 for an overview of materials commonly used in reburial of mosaics). The use of "pillows" or "mattresses" made mainly with geotextiles filled with clay pellets becomes rather common in the 1990s, especially for temporary or seasonal reburial. The main criteria for their use are the ease of removal and reuse (Aoyagi and Foschi 1997; Bedello and Spada 1995; Demitry 1994). Roby (1995) records the unsuccessful use of perlite for temporary covering (the perlite produced fine particles that were difficult to remove from the mosaic), one of the rare mentions of other materials; and Bedello and Spada record the use for temporary protection of a geocomposite to inhibit root growth, but with no details on its function.

Alberti et al. 2006 report on an unusual reburial technique proposed to protect a mosaic covering the top of a domed sepulcher (in an archaeological park on the Appian Way), some five meters below ground level. With a restricted area for reburial and no way to easily contain loose fill, the authors proposed the use of geotextile and expanded clay pellets covered with a layer of pozzolanic mortar applied at a slight incline to shed water. No information is provided about the type of geotextile, mortar used, or implementation of the proposed reburial.

A unique example of "underwater reburial" of mosaics was employed at the site of Zeugma, Turkey which was under threat of inundation from the construction of a nearby dam. The intervention, which was aimed at trying to preserve the excavated remains in situ rather than resorting to the more common solution of detachment and removal of selected pieces to storage, was carried out in an area of 8,700 m^2 that was to be submerged or exposed to lapping waves. Following conservation, mosaics were covered with a 5 cm lime wash, followed by a 50 cm layer of soil and sand (dampened and compacted to prevent shrinkage), and finally by an average 50 cm thick layer of river pebbles and stone (depending on the slope of the trench). A few months after the reburial, further conservation and stabilization efforts were undertaken as the pebbles and stones were heavily disrupted by wave action and unexcavated areas were uncovered (Nardi 2005 and Nardi and Schneider 2004).

Separator materials, which serve primarily to separate the substrate from the bulk fill and secondarily as a means of facilitating removal of the fill during re-excavation, show a clear evolution from plastic sheeting to plastic netting to geotextiles. Although geotextiles make their first debut in brief mentions prior to 1990 (e.g., the discussion in Mosaics 4), they begin to have a real impact on reburial strategies for mosaics in the literature published in the 1990s, taking over to a large extent the role played by plastic netting. Geotextiles were initially favored for their characteristics of water permeability, as a defense against or deterrent to root intrusion, and as an insulator. Nowhere in this literature, however, is there a clear exposition of the characteristics and variations among geotextiles, their function and their potential drawbacks; the article by Laurenti and Altieri 2000 includes a brief review of their characteristics and points out the difficulties of comparing different geotextiles based on manufacturers' data.

With so little reliable information in print, it is not surprising that the selection and application of geotextiles has been fraught with problems from the beginning. The two major problems associated with use of geotextiles on mosaics, as reported in the literature and the conservation grapevine, were that they concentrate moisture and thereby promote root growth and microbiological activity, and that they may adhere to the tessellatum, causing damage when removed (this problem has been encountered in nonmosaic contexts as well, and with the use of netting material on mosaics, see Nardi 1982 for netting). Water retention was reported in testing by Petriaggi (1994) at Ostia, and anecdotally by Munday (1991) at Carranque: "it was apparent that this material [geotextile], rather than allowing the mosaic to breathe whilst resisting water, was in fact saturated with water and was sustaining plant growth." The specifications of materials used are most often lacking, making such evaluations part of the problem rather than contributing to a solution. Anecdotal information and direct experience of many of the "geotextiles" used in the Mediterranean reveals that most of these materials are quite thick (1–3 cm), felt-like non-woven fabrics, which tend to retain water and act as a sponge (see also Neguer 2004). Thus, as with so many product technology transfers, lack of knowledge and inappropriate application are often the source of problems. The overview of geosynthetic products published from the Reburial Colloquium in 2003, and their applications in many of the non-mosaic-specific case studies, began to directly address this problem (CMAS 2004, 377–93).

Experimental testing

Experimental testing, both field and lab, is more prominent in the literature of this period. Two short-term, small-scale field tests were reported at the 1990 Palencia conference (Petriaggi 1994; Rodríguez González 1994). Petriaggi employed geotextiles and plastic netting in combination with clay pellets and observed that the geotextile absorbed water and led to root growth below the fabric while the plastic netting remained dry. Rodríguez González also tested the use of geotextiles in conjunction with clay pellets or soil as a temporary protection, but no results have been reported.

An experimental project initiated in 1998 by the Istituto Centrale per il Restauro and the Soprintendenza Archaeologica per l'Etruria Meridionale at the site of Civitavecchia (the Thermae Taurine) focused on the comparative testing of temporary reburial systems applied to mosaic floors and plastered walls (Altieri et al. 1999; Laurenti and Altieri 2000). The testing included the use of geotextiles in combination with mattresses filled with clay pellets (two types of geotextile used—Typar and Reemay), and a sheet of Gore-tex (GORE textile) as a covering for the mosaic and floors. Gore-tex makes its first published debut here as a material for protecting mosaics. Its composite structure with a knitted polyamide base and "teflon" coating makes it impermeable to liquid water but permeable to water vapor, thus combining, theoretically, the good aspects of an impermeable membrane (to prevent the infiltration of rainwater) without the drawbacks (trapping of moisture below the membrane).

Preliminary testing carried out by the Soprintendenza and W.L. Gore & Associates at Lucus Feroniae in January 1997, and planned for Ostia, remains unpublished (Belluci and Cristofoli 1997), but preliminary results were published in Altieri and Laurenti 2000. A predictable result was the rapid deterioration of the exposed geotextile (assumed to be a polypropylene geotextile), which is known to be UV-sensitive and is intended only for sub-surface applications. The Gore-tex was shown not to have any ameliorating or stabilizing effect on the microenvironment below the sheet, as did the geotextiles in combination with pellets. The potential effect on microbiological growth of the reburial regime was being monitored and was difficult to interpret because of the many variables that affect such growth.

Related field testing reported by Altieri et al. 2006 is also of interest. This study evaluated geotextile materials and Gore-tex for use in temporary (seasonal) reburial at three archaeological sites: Terme Taurine at Cittavecchia and the Villa Romana Casignana near Reggio Calabria in Italy, and at Tas Silg in Malta. At the Italian sites, environmental conditions including air temperature, relative humidity and solar radiation levels were recorded. Sensors were also placed between the mosaic paving and the geotextile to measure temperature and humidity at the mosaic surface.

In the testing at Terme Taurine (initial phase reported by Altieri and Laurenti 2000) in situ mosaics with black and white tesserae were reburied using two geotextiles, Typar 3337 (a non-woven polypropylene) and Reemay 2033 (a non-woven polyester), covered with a 10 cm thick layer of expanded clay pellets. In a second study, two mosaics were covered with only geosynthetics: one with Reemay 2033 and a geodrain, the other using only Gore-tex. The reburials with geotextile and expanded clay pellets promoted a constant relative humidity and surface temperature. The system using only geotextile and a geodrain promoted the growth of algae on both the mosaic surface and the geotextile, attributed to the light color of the geotextile and geodrain, both of which allow moisture to penetrate to the mosaic surface but do not significantly reduce exposure to light. The dark-colored Gore-tex did not promote biological growth.

The second phase of study in Italy compared two mosaics in different states: one relaid on cement, the other on its original support. In both cases reburial was done with Gore-tex and Reemay 2033 in direct contact with the mosaic, and a layer of Geodren EdilFloor (a non-woven geotextile) above. The study found that humidity levels at the surface of the mosaic were much higher in the mosaic on original support, attributed to the transfer of moisture through the more permeable lime mortars. The testing at Tas Silig, Malta (which was visually monitored only) evaluated the reburial of a mosaic using Reemay 2033 covered with only 5 cm of calcareous gravel. After the two-year period of study, the gravel covering had eroded, revealing a fine layer of calcareous deposit on the surface of the mosaic.

The authors conclude that understanding site-specific conditions is essential for determining the correct reburial system and note the importance of adequate drainage lest the mosaic retain moisture at its surface. While undoubtedly true, the emphasis should perhaps have been equally placed on the dangers of using geotextiles with only clay pellets, shallow coverings, or no further covering of sand or soil, which has been amply demonstrated in other attempts at temporary coverings noted above and in the lab testing reviewed subsequently. Further evaluation of the use of Gore-tex is clearly warranted as a potentially useful material for shallow reburials or coverings.

An experimental lab test was undertaken by Podany et al. (1994) to examine the characteristics of materials commonly used in the reburial of mosaics. In particular, the testing focused on addressing potential problems associated with the use of geotextiles and clay pellets by examining how these materials (in various combinations) assisted or hindered the transmission by capillarity of salt-laden water across the interface between the mosaic surface and the reburial fill. The results showed that soil in direct contact with the mosaic, or with a geotextile interface, was the most efficient transport medium. The use of clay pellets, which allow large aerated spaces at the mosaic surface, resulted in surface or subsurface salt efflorescence. These findings point to a conflict with the main trends in reburial of mosaics, in which lightweight materials that allow aerated spaces (specifically clay pellets) are favored for practical reasons. The use of clay pellets in conjunction with pozzolana or as a first layer, covered by earth (e.g., Costanzi Cobau 1994, 135), is a means of mitigating these problems, but they require the use of soil. Although lacking in details, the reburial of mosaic pavements of brick and limestone at the site of Velia in Campania employed geotextile, sand, and gravel, but with a final deep layer of soil to protect the pavements from moisture accumulation (Ferrucci et al. 2006). The lab testing also demonstrated the ability of clay pellets to take up water (after 72 hours immersion, clay pellets absorbed 30–40% of their weight while still retaining their buoyancy), also pointed out by Altieri and Laurenti (2000). The potential for microbiological growth under conditions of slow release of moisture from clay pellets has yet to be demonstrated but could be problematic.

Beginning in 1999 a testing initiative by the Israel Antiquities Authority and the Getty Conservation Institute was begun at the site of Caesarea Maritima to evaluate the role of maintenance in preserving mosaics (Piqué et al. 2003; Neguer 2004). Mosaics were protected with four common interventions (surface treatment, sheltering, shallow coverings, and reburial), and half of each test area was maintained. The tests were monitored and documented over a three-year period. The reburied mosaic was unchanged over three years, with vegetation removal being the only maintenance required; shallow-rooted vegetation grew in the unmaintained reburial fill but had not affected the mosaic in the three-year period. The shallowly covered mosaic (incorporating sandbags) was more difficult to maintain, requiring replacement of sandbags, and lack of maintenance resulted in some deterioration of the mosaic.

The use of non-UV-stabilized polypropylene materials for sandbags or other types of "pillows" is common in temporary coverings, but given the propensity of such material to degrade in sunlight, in combination with the tendency for the temporary to become long term, caution is advised. The differences between cheaper non-UV-stabilized polypropylene materials and more expensive polyester (inherently resistant to UV degradation) applies equally to geotextiles and is one that is not sufficiently recognized in the applications described in the literature.

Environmental monitoring and evaluation of past treatments

With the exception of testing applications where environmental monitoring and performance evaluation is inherent in the design, there is an absence of reporting on these crucial activities in the literature of this period. Stewart et al. 2004 describes an integrated monitoring initiative at Chedworth, England, that was targeted principally at understanding the environment of sheltered mosaics, but information on two reburied mosaics was also collected and pointed to the importance of depth of burial in maintaining a stable environment. An exception to the lack of follow-up assessment is Neguer (2004), noted subsequently. Francovic et al. 2007 is a useful reminder of what happens to shallow reburial of mosaics intended to be temporary but left in place for several decades. The mosaics were covered with "nylon" (presumably polyethylene plastic sheeting based on the reported condition) and sand. In an all too familiar scene, sand layers (20 cm thick) were found to be sprouting vegetation or had been blown away, and the "nylon" had become brittle and cracked and was retaining moisture at the mosaic surface and promoting growth of vegetation.

The Reburial Colloquium of 2003

A landmark in the literature on reburial of archaeological sites was the convening of a colloquium in 2003 dedicated to reburial of archaeological sites, which culminated in the publication in 2004 of twenty selected papers in a volume of Conservation and Management of Archaeological Sites (CMAS 2004). The aim of the colloquium was to bring together professionals from a variety of disciplines with practitioners to focus on the methods, materials, and challenges of reburial of archaeological sites. The topics of papers cover decision-making, understanding the burial environment, practice in the field, testing, monitoring of the reburial environment, and the characteristics of geosynthetic materials. Three of the published papers are specific to reburial of mosaic pavements (Roby 2004, Stewart 2004, and Neguer 2004).

Roby's paper provides an introductory overview of the practice of reburial of mosaics and a comprehensive review of commonly used materials (e.g., fills and separation layers) with a table of their advantages and disadvantages. The review of materials includes discussion of unintended consequences (especially root growth) and the basic parameters that should be followed in designing a reburial, such as permeability and capillary transport, and depth of burial. In deference to the disparate audience for this publication, Stewart begins with a description of the components of mosaics and review of the main causes of deterioration. This is followed by the environmental, functional, and programmatic criteria for their reburial. The section on environmental criteria looks at principles, that is, the aims of reburial in addressing deterioration and criteria for achieving them; functional requirements take into account seasonal reburial, vandalism, and potential alternative uses of a reburied site; and programmatic criteria address intended duration of the reburial. Issues of planning for reburial, maintenance, and monitoring of reburied mosaics conclude the paper. Case studies of reburied mosaics in Israel (Tel Itztaba, Khirbet Minya/Horvat Minnim, and Caesarea Maritima) are presented by Neguer and impart important object lessons, especially with regard to vegetation, the use of separator materials, and maintenance, that are so critical to successful reburial.

Together these three papers provide the most comprehensive and current overview of how reburial of mosaics has been practiced, the problems encountered, and the challenges to be met. The main challenges may be summarized as twofold: a better understanding of the effects of a designed reburial environment on the mosaic (only then can the proper selection of materials be advocated); and a means to ensure maintenance and monitoring of reburied mosaics, especially against the growth of vegetation.

Concluding remarks

Interest in reburial among mosaic conservation professionals is strong. This stems in large part from the exceptionally large number of mosaics exposed in sites throughout the Mediterranean and Europe over the last century and more. Nevertheless, this interest pales in comparison with the interest, as demonstrated in the published literature, in sheltering as an intervention. This reflects a well-known reluctance on the part of archaeologists and managers to carry out reburial—an intervention that removes the "artefact" from view (see CMAS 2004, 143–44, for a deeper exploration of objections to reburial of archaeological sites). Nor are there obvious advocates for reburial as exist for sheltering, namely architects and those with an interest in promoting tourism. The 9th ICCM conference (published in 2008, Ben Abed et al. 2008) revealed a distinct lack of papers related to reburial, despite its theme—Lessons Learned—which would seem a natural fit for reburial studies, especially following upon considerable experimental testing work in the last decade.

One of the principal observations to emerge from the literature review is the far stronger interest in temporary reburial options (shallow coverings is a more appropriate way to describe this form of protection) rather than long-term reburial. Temporary solutions are sought typically for seasonal protection of mosaics against winter rain and freezing conditions in some areas, or pending continued excavation and study of a site, final conservation treatment, or the approach of the tourist season. Most of the testing and implementation examples in the literature are aimed at addressing this need. The criteria set forth emphasize lightweight, easily removable, and reuseable materials (e.g., clay pellets, netting, and geotextiles). The problems that emerge in the use of these materials are finally receiving their due in the literature; that is, that temporary reburials (and this applies equally to any temporary intervention) often become permanent and that the lightweight materials favored for temporary covering are those that are unlikely to protect the mosaic in the long term. As with most conservation treatments or intervention failures, lack of maintenance and monitoring is the main culprit.

With few exceptions, the overall approach to reburial or protective covering in the literature is one based on searching for the quickest and easiest solution; ease of removal takes precedence over protection. Lacking are in-depth case studies with a clear articulation of the design of a reburial or covering based on an understanding of principles of preservation through reburial, and a rigorous approach to selection and characterization of materials, testing, and follow-up evaluation of results. With the exception of the CMAS 2004 papers, rarely does the literature directly address the question of what type of reburial environment is best for a mosaic (e.g., are absence of light and stability of temperature and moisture important; is continuity of capillarity between mosaic substrate and fill required in order to prevent crystallization of salts on the surface; or which reburial conditions must be met for temporary or short-term reburial and which for long-term?).

Evaluation and follow-up of current work is particularly lacking in the literature, but there are other forms of evaluation that need also to be considered. Evaluations of long buried mosaics, such as those surveyed on a regional level through the literature by Stanley-Price (1985), or the well-known example of the Orpheus mosaic of the Roman villa at Woodchester in England, which was periodically uncovered from 1880 to 1973 (Smith 1973), would provide important information to better understand mosaics in the reburied environment. Although there has been considerable experimental testing, the time frame for such testing has been relatively short, and the results, while tantalizing, remain somewhat ambiguous. Reburial practice would gain from further refinement of the testing.

One aspect of reburial about which there is no ambiguity is the need to control growth of vegetation. This problem is repeatedly raised in the literature and is undoubtedly one of the greatest dangers of reburial, but the solutions generally suggested are the use of herbicides or geotextiles. Both have a potentially useful role to play, but ultimately routine maintenance is the only foolproof solution to this problem.

Given the pressures on those responsible for managing and protecting sites, it is not surprising that easy, one-off solutions are sought, but experience (rather than the literature) has taught that these types of solutions are rarely effective or sustainable in the long run. This highlights the need to bring interventions such as reburial into the context of management decisions for the site as a whole: How might reburial be used as one strategy among many to protect a site? How does it relate to other decisions taken for the site? What are the necessary conditions (both technical and managerial) to make reburial or protective covering a viable conservation strategy?

Lastly, a review of the literature on mosaics indicates the need for greater awareness of, and better integration with, the larger body of knowledge and practice related to reburial that was referred to at the outset of this paper. The practice of mosaic reburial has been pursued largely in isolation and would benefit from engagement with professionals from other fields and reburial work on other types of sites. This was the purpose of the Reburial Colloquium in 2003. The PARIS conferences offer an on-going forum for practitioners of mosaic conservation to learn from and contribute to this needed dialogue.

References (1973–2008)

Alberti, Benedetta, Livia Giammichele, Lucia Morganti, and Gianluca Tancioni. 2006. Il mosaico sommitale del mausoleo rotondo sulla via Appia Antica: Diffusione di una tipologia e intervento. In *Pavimentazioni storiche: Uso e conservazione: Atti del convegno di studi, Bressanone 11–14 luglio 2006*, eds. Guido Biscontin and Guido Driussi, 157–66. Scienza e Beni Culturali, 22. Marghera-Venezia: Arcadia ricerche.

Altieri, A., M.C. Laurenti, and A. Roccardi. 1999. The conservation of archaeological sites: Materials and techniques for short-term protection of archaeological remains. In *6th International Conference on "Non-destructive Testing and Microanalysis for the Diagnostics and Conservation of the Cultural and Environmental Heritage" Rome, May 17th–20th 1999: Proceedings*, 673–87. Rome: Agfa.

Altieri, Antonella, Carlo Cacace, Maria Concetta Laurenti, and Ada Roccardi. 2006. Il rinterro temporaneo: Dalla sperimentazione verso una metodologia analitica normalizzata. In *Pavimentazioni storiche: Uso e conservazione: Atti del convegno di studi, Bressanone 11–14 luglio 2006*, eds. Guido Biscontin and Guido Driussi, 177–86. Scienza e Beni Culturali, 22. Marghera-Venezia: Arcadia ricerche.

Aoyagi, M. and E. Foschi. 1997. I mosaici pavimentali della villa romana di Cazzanello (Tarquinia): Problemi di datazione e di restauro conservativo. In *Atti del IV Colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico, Palermo, 9–13 dicembre 1996*, 815–28. Ravenna: Edizioni del Girasole.

Bassier, Claude. 1978. Some problems in the conservation of mosaics. In *Mosaics, no. 1: Deterioration and Conservation, Rome, November 1977: Proceedings of the First International Symposium on the Conservation of Mosaics*, ed. Forrest Selvig, 67–80. Rome: ICCROM.

Bedello Tata, Margherita and Laura Spada. 1995. Progetto di Restauro per il Complesso Musivo delle Terme dei Cisarii ad Ostia. In *Atti del II Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico, Roma 5–7 Dicembre 1994*, eds. I Bragantini and F. Guidobaldi, 229–34. Bordighera: Instituto Internazionale di Studi Liguri Bordighera.

Bellucci, Gaetano and Silvana Cristofoli. 1997. New materials for the excavation, maintenance and restoration of archaeological remains: Tests in progress at Lucus Feroniae. Unpublished report (January 1997).

Ben Abed, Aïcha, Martha Demas, and Thomas Roby, eds. 2008. *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29-December 3, 2005 = Leçons retenues: Les enseignements tirés des experiences passées dans le domaine de la conservation des mosaïques: Actes de la 9ème conference de l'ICCM, Hammamet, Tunisie, 29 novembre–3 decembre 2005*. Los Angeles: Getty Conservation Institute.

CMAS 2004: Burch, Rachel, ed. 2004. Site Reburial. Special issue, *Conservation and Management of Archaeological Sites*. 6 (3 & 4).

Costanzi Cobau, Andreina. 1994. The Roman Forum: On-site conservation of floor surfaces during excavation. In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, eds. ICCM and ICCROM, 127–38. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Demitry, Luca. 1994. Misure preventive di conservazione in situ di mosaici pavimentali durante uno scavo di emergenza. In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, eds. ICCM and ICCROM, 161–71. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Ferrucci, Fabiano, Antonella Fiamminghi, Maria Letizia Amadori, Sara Barcelli, and Giuliana Raffaelli. 2006. Aspetti tecnologici e problemi di conservazione delle pavimentazioni della Casa degli Affreschi di Velia. In *Pavimentazioni storiche: Uso e conservazione: Atti del convegno di studi, Bressanone 11–14 luglio 2006*, eds. Guido Biscontin and Guido Driussi, 187–98. Scienza e Beni Culturali, 22. Marghera-Venezia: Arcadia ricerche.

Frankovic, Maja, Danijela Stojilkovic, and Dusan Maksimovic. 2007. The condition of mosaics on the archaeological sites in Serbia from the point of view of preventive conservation. In *Condition of the Cultural and Natural Heritage in the Balkan Region: Proceedings of the Regional Conference Held in Kladovo, Serbia, From 23th to 27th October 2006*, ed. Mila Popovic-Zivancevic, 149–56. Belgrade, Serbia: National Museum Belgrade.

Laurenti, Maria Concetta and Antonella Altieri. 2000. Materiali e tecniche per la protezione a breve termine dei mosaici pavimentali nelle aree archeologiche. In *Atti del VI Colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico: Con il patrocinio del Ministero per i beni e le attività culturali (Venezia, 20–23 gennaio 1999)*, eds. Federico Guidobaldi and Andrea Paribeni, 727–38. Ravenna: Edizione del Girasole.

Martinelli, Antonella. 1994. Un'esperienza di reinterro: La Villa Marittima di Cala Padovano. In *Conservation, Protection, Presentation: Fifth Conference of the International Committee for the Conservation of Mosaics: Proceedings = Actas, Faro e Conimbriga, 1993*, eds. Adilia Alarcao, Virgilio H. Correia, and Carlos Beloto, 21–30. Conimbriga: ICCM.

Melucco, A., G. de Guichen, and R. Nardi. 1994. Conservation of archaeological mosaics: The state of the problem in the light of a recent international course. In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, eds. ICCM and ICCROM, 333–40. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Mora, Paolo. 1984. Conservation of excavated intonaco, stucco and mosaics. In *Conservation on Archaeological Excavations: With Particular Reference to the Mediterranean Area*, ed. Nicholas Stanley-Price, 97–107. Rome: ICCROM.

Mosaics 2: Selvig, Forrest, ed. 1983. *Mosaics, no. 2: Safeguard, Carthage 1978, Périgueux 1980*. International Committee for the Conservation of Mosaics (ICCM). Rome: ICCROM.

Mosaics 4: de la Casa Martinez, Carlos, ed. 1987. *Mosaicos, no. 4: Conservación "in Situ", Soria 1986 = Mosaïque, no 4 = Mosaics, no. 4: Proceedings of the 3rd General Conference of the International Committee for the Conservation of Mosaics, Held in Soria, Spain, 1986*. Spain: Servicio de Investigaciones Arqueológicas, Disputación Provincial de Soria: Instituto de Conservación y Restauración de Bienes Culturales, Ministerio de Cultura.

Munday, Valerie W. 1991. Conference Reviews: Mosaics: The 4th General Conference of the International Committee for the Conservation of Mosaics held in Merida, Palencia and Sevilla, 15–21 October 1990. *Conservation News (United Kingdom Institute for Conservation of Historic and Artistic Works)* 44 (March): 40–41.

Nardi, Roberto. 1982. Couverture provisoire pour les mosaïques que l'on ne peut enlever. *Newsletter = Chronique (International Committee for Mosaics Conservation)* 5: 5–13.

Nardi, Roberto. 1994. Critical review of the specialized literature in mosaic conservation. In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, eds. ICCM and ICCROM, 341–52. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Nardi, Roberto. 2005. The conservation of Zeugma. In *8o Synedrio Diethnous Epitropes gia te Synterese ton Psephidoton (ICCM): Entoichia kai epidapedia psephidota: Synterese, diaterese, parousiase: Thessalonike, 29 Oktovriou–3 Noemvriou 2002: Praktika = VIIIth Conference of the International Committee for the Conservation of Mosaics (ICCM): Wall and Floor Mosaics: Conservation, Maintenance, Presentation: Thessaloniki, 29 October–3 November 2002*, ed. Ch. Bakirtzis, 331–46. Thessaloniki: Europaiko Kentro Vyzantinon kai Metavyzantinon Mnemeion.

Nardi, Roberto and Kristian Schneider. 2004. Zeugma archaeological project 2000: The conservation management programme. In *Preserving Archaeological Remains In Situ? Proceedings of the 2nd Conference, 12–14 September 2001*, ed. Taryn Nixon, 157–67. London: Museum of London Archaeology Service.

Neguer, Jacques. 2004. Reburial and protective covering of ancient mosaic pavements: The experience of the conservation department of the Israel Antiquities Authority. *Conservation and Management of Archaeological Sites* 6 (3 & 4): 247–58.

PARIS 1: Corfield, M., P. Hinton, T. Nixon, and M. Pollard, eds. 1998. *Preserving Archaeological Remains In Situ: Proceedings of the Conference of the 1st–3rd April 1996*. London: Museum of London Archaeology Service.

PARIS 2: Nixon, Taryn, ed. 2004. *Preserving Archaeological Remains In Situ? Proceedings of the 2nd Conference, 12–14th September 2001*. London: Museum of London Archaeology Service.

PARIS 3: Kars, Henk, and Robert M. van Heeringen, eds. 2008. *Preserving Archaeological Remains In Situ: Proceedings of the 3rd Conference 7–9 December 2006, Amsterdam*. Geoarchaeological and Bioarchaeological Studies, vol. 10. Amsterdam: Institute for Geo and Bioarchaeology, VU University.

Petriaggi, Roberto. 1994. Risultati di un esperimento di protezione di pavimenti in mosaico conservati all'aperto ne sito di Ostia Antica. In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, eds. ICCM and ICCROM, 255–66. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Piqué, Francesca, Jacques Neguer, and Bettina Lucherini. 2003. The role of maintenance in the conservation of mosaics in situ: Comparative field-testing methodology. In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 445–56. Arles: Musée de l'Arles et de la Provence antiques.

Podany, Jerry, Neville Agnew, and Martha Demas. 1994. Preservation of excavated mosaics by reburial: Evaluation of some traditional and newly developed materials and techniques. In *Conservation, Protection, Presentation: Fifth Conference of the International Committee for the Conservation of Mosaics: Proceedings = Actas, Faro e Conimbriga, 1993*, eds. Adilia Alarcao, Virgilio H. Correia, and Carlos Beloto, 1–19. Conimbriga: ICCM.

Roby, Thomas. 1995. Site conservation during excavation: Treatment of masonry, wall plaster and floor mosaics remains of a Byzantine church in Petra, Jordan. *Conservation and Management of Archaeological Sites* 1 (1): 43–57.

Roby, Thomas. 2004. The reburial of mosaics: An overview of materials and practice. *Conservation and Management of Archaeological Sites* 6 (3 & 4): 229–36.

Rodríguez González, José Luis. 1994. Una experiencia de cobertura temporal en contacto directo sobre el mosaico de la villa romana de Los Castillejos, en Magan, Toledo, Espana. In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, eds. ICCM and ICCROM, 219–30. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Smith, D. J. 1973. *The Great Pavement and Roman Villa at Woodchester Gloucestershire*. Woodchester, UK: Woodchester Pavement Committee.

Stanley-Price, Nicholas. 1985. Patterns of survival among some Byzantine floor mosaics in the Levant. In *Mosaics, no. 3: Conservation in Situ, Aquileia 1983 = Mosaïque no. 3: Conservation in situ, Aquileia, 1983*, International Committee for the Conservation of Mosaics (ICCM), 49–55. Rome: ICCROM.

Stewart, John. 2004. Conservation of archaeological mosaic pavements by means of reburial. *Conservation and Management of Archaeological Sites* 6 (3 & 4): 237–46.

Stewart, John, Sophie Julien, and Sarah Staniforth. 2004. An integrated monitoring strategy at Chedworth Roman Villa (Gloucestershire). In *Preserving Archaeological Remains In Situ? Proceedings of the 2nd Conference, 12–14 September 2001*, ed. Taryn Nixon, 179–87. London: Museum of London Archaeology Service.

Veloccia, Maria Luisa. 1978. Conservation problems of mosaics in situ. In *Mosaics, no. 1: Deterioration and Conservation, Rome, November 1977: Proceedings of the First International Symposium on the Conservation of Mosaics*, ed. Forrest Selvig, 39–46. Rome: ICCROM.

LITERATURE REVIEW (2008–2024)

Thomas Roby

Over sixty articles have been published that mention the protection of mosaics by reburial or protective covering since 2008. It therefore seemed the time was right to update the 1973–2008 review (previously published as Demas 2013) regarding this increasingly common mosaic conservation technique on archaeological sites. The compiled list of publications since 2008 includes both those that have a focus on mosaic reburial and those that mention it briefly in the context of articles primarily on excavation of mosaics or on mosaic conservation interventions. The inclusion of the latter in this review is intended to assist the researcher with an understanding of the variety and trends in recent practice of mosaic reburial. It is interesting to note that often what is described as standard or best practice by one author is not the same for another, especially if they are from a different country. An additional general observation is that many of the articles refer to the CMAS 2004 volume publication of the 2003 Reburial Colloquium discussed in the 1973–2008 literature review, indicating the continued importance years later of these mosaic reburial articles for subsequent authors and reburial practitioners.

Many of the articles are case studies reporting on reburials carried out, while others are the product of research in the field by evaluating past practices or by conducting experimental testing in order to determine best practices in the future. But what continues to be missing from the literature are in situ environmental monitoring studies aimed at determining the best reburial environmental parameters for the protection of mosaics. Nor does one see published laboratory studies assessing reburial fill materials and their optimum depth, or separation membranes used to prevent fills from mixing or to act as a horizon marker.

Many articles report what seems to be the increasing use of geotextiles as a separation membrane or horizon marker, but the type of geotextile and manufacturer is rarely reported. One suspects that the membranes used were sometimes nonwoven fabrics manufactured for other uses, not for being buried underground for geotechnical purposes. In at least one case the authors know this to be the case.

As in the previous literature review, the majority of mosaic reburial publications have been produced in the context of triennial conferences of the International Committee for the Conservation of Mosaics (ICCM). And of those, a substantial number have been produced by partners and supporting institutions of the MOSAIKON Initiative, such as the GCI and the INP of Tunisia. Almost two decades of collaboration have produced a series of publications resulting from the technician training activities that began in 2000. Of particular importance, as it filled a gap in the literature observed in the previous review, is an assessment of mosaic reburial practice, in this case those carried out in Tunisia before 2009 (Roby et al. 2010), which was presented at the International Institute for Conservation (IIC) conference in Istanbul. This publication reported on an inspection of over fifty reburied mosaics at different sites across the country, revealing that many reburials employed a separation membrane/horizon marker in contact with the mosaic, including at one site using geotextiles. This practice was shown, particularly where membranes of limited water permeability were used, to have encouraged root growth under the membrane, and it showed that, in general, reburial fill layers of sand were thin and poorly maintained. In other examples, where mosaics relaid on reinforced concrete were reburied, the inspections revealed that corroded rebar continued to expand, causing the fracturing of mosaic panels despite their protection from environmental and visitor exposure.

Several years later, based on the experience of stabilizing and reburying mosaics in Tunisia in the context of the technician training program, the actual cost difference between maintaining a stabilized mosaic left exposed and of maintaining a stabilized and reburied mosaic was calculated (Roby et al. 2014). This study provided rare statistics to support the presumption that maintaining a reburied mosaic is less time-consuming and costly, and therefore more sustainable, than maintaining exposed mosaics.

The online publication of the technician training didactic materials—both the handbook (Roby et al. 2013) and the PowerPoint lessons (Alberti et al. 2020)—has provided an introduction to the basic principles of reburial for practitioners, as well as an introduction to the advantages and disadvantages of materials used in the reburial of mosaics and other inorganic archaeological remains.

And finally, as a capstone of the GCI-INP collaboration, the MOSAIKON Bulla Regia mosaic conservation field project produced several articles in ICCM proceedings (Roby et al. 2017, 2020; Rhouma-Ghmari and Chaouali 2017) and a GCI project report (Roby et al. 2024). Reburial was a central element in the multi-year conservation plan developed for the mosaics of the site. About half of the site's 400 mosaics were chosen to be temporarily reburied to provide the trained technicians employed at the site with the reduced workload to allow all the site's mosaics to be stabilized over seventeen years and then maintained over each year. And in terms of project implementation, one entire building, chosen to be presented, included selected mosaics stabilized then reburied; and in another entire building, chosen not to be presented, all the mosaics were stabilized and reburied for the long term as an example to be followed elsewhere at the site and at other sites. The reburial stratigraphy normally employed consisted of a layer of local quarried sand in contact with the mosaic, a nonwoven geotextile imported from Italy or plastic netting, and a covering layer of limestone gravel. A reburial field testing program was set up during the project that included environmental monitoring with temperature and humidity sensors, but unfortunately problems were encountered obtaining complete data from the sensors over time.

A recent article written by an INP employee (Hajji 2019) not involved in the GCI-INP projects provides a critical review of the state of the preservation of Tunisia's mosaic heritage, which includes a brief, general description of the practice of reburial at sites across the country. It mentions the collaboration with the GCI but does not cite any of the publications mentioned previously, nor does it describe the increased number and type of reburials carried out at different sites during the years of collaboration.

Articles addressing reburial produced through ICCM conferences since 2007 include an evaluation of past mortar coverings at the site of Nora in Sardegna (Zizola 2008), a survey of reburials using different materials and separation membranes in Cilicia in Turkey (Tülek 2008), monitoring of mosaics via selective re-excavation and surface temperature monitoring with buried sensors at Chedworth in England (Bethell 2008), and in situ experiments of different reburial stratigraphies at the Roman Villa of Rabaçal in Portugal (Gonçalves 2008). The latter is the most significant in that different reburial fill materials and separation membranes were employed, then inspected every three months and monitored over a year. The best results were obtained with a layer of sand in contact with a mosaic, then a geotextile membrane and another layer of sand on top. Unfortunately, no precise information was provided about either of the materials in this experiment. The testing did show that the worst result was obtained when a geotextile was laid directly on the mosaic, which led to the accumulation of moisture on the tessellatum and then plant root growth, which caused mechanical attachment between the geotextile and the mosaic.

Successive ICCM conferences continued to produce publications on reburial, most notably by E. Charalambous, by assessing past practices and also addressing short-term or seasonal reburials at a site in Greece and at sites in Cyprus as a compromise between the need to present mosaics to tourists and to protect them when visitation numbers are low in the winter (Charalambous 2014; Lysandrou and Charalambous 2017; Charalambous 2020; Krini et al. 2017; Krini and Pantazidou 2020). These articles indicate what personal knowledge of the authors of this literature review confirms—that sites in Cyprus and Greece have been increasingly practicing reburial and seasonal covering protection to reduce the amount of conservation work needed to maintain mosaics if they are left exposed and to reduce the number of mosaics slowly being lost due to exposure throughout the year. The use of seasonal protection may seem like a positive development, but it remains to be seen what the effect of this practice will be on the condition of mosaics. Each time a mosaic that has been reburied or covered is uncovered, there will be a rapid change in the environment similar to when the mosaic was first excavated, and the radical change in environment can cause rapid deterioration of a mosaic, both on the surface and under the surface.

Temporary or seasonal protection of mosaics has also been a subject of a few articles (e.g., Laurenti et al. 2013, 2018; Lugari and Schievano 2010; Lugari 2017), mostly by Italians, which follow on articles mentioned in the previous literature review that featured the use of Gore-Tex, a synthetic fabric with impermeable external characteristics but that is permeable internally and from below. Laurenti reports on the reburial testing program of Istituto Superiore per la Conservazione ed Il Restauro (ISCR) at various sites near Rome, using different covering membranes including different geotextiles, Gore-Tex, and a similar waterproof membrane called Delta-Lite. Lugari reports on the very positive use of this, compared to Gore-Tex, much less expensive membrane as a seasonal covering at the site of Villa dei Quintili and in the Tempio della Pace in Rome. A similar waterproofing roofing material product named Delta-Foxx Plus has been used at a site in Tuscany (Bueno and Cuniglio 2016).

Proceedings of the biannual Associazione Italiana per lo Studio e la Conservazione del Mosaico (AISCOM) conferences produced a number of articles (Onnis 2010; Pomicetti and Molinari 2016; Laurenti et al. 2018; Costanzi Cobau 2020) by private conservators and archaeologists from the ISCR in Rome. The authors are largely the same as those Italian practitioners and researchers that have published articles prior to 2008 and were reviewed in the previous literature review, indicating that Italy continues to be a significant contributor in the mosaic reburial field, especially regarding temporary coverings. Another significant publication by an Italian conservator follows on previous articles reporting on the mosaic conservation work in Zeugma in Turkey, reviewed previously (Nardi and Schneider 2013). This article describes the unusual case of protecting mosaics before being submerged because of a dam construction. The mosaics were protected first by a layer of lime wash, then a 5 cm thick layer of hydraulic lime mortar, then a layer of soil and sand topped with gravel, and then stones of increasing dimensions creating a layer of 50 cm over the soil and sand layer.

A few publications from authors from the Middle East have appeared in recent years, and this is, in part, a reflection of the support of the ICCM, the Getty Foundation, and the GCI under the umbrella of MOSAIKON to train technicians and site directors and to bring trainees to the ICCM conferences in an effort to build networks of professionals in the region. An article written by a group of Syrian site management course trainees (Al Taweel et al. 2017) presents a case study of conservation work they did on one mosaic following their participation in a MOSAIKON training course, which concluded with its reburial. In addition, other reburial activity has been reported in an article in the journal *Libyan Studies*, referred to as an "unprecedented" but essential conservation activity for Libyan archaeology (Buzaian and Hashem 2014; Buzaian 2015). This reburial of a mosaic in Tocra used a layer of compacted local soil in direct contact with the mosaic, then plastic netting over which was a coarse local soil, then another separation membrane of plastic netting and a final layer of gravel. Also in Libya, a training program for archaeologists and technicians in the conservation and management of their mosaic heritage included the topic of reburial (Wootton et al. 2015). Additional publications, specifically intended for a North African and Middle Eastern audience, have been produced by the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), one in English (Stewart 2016) and another an Arabic translation of articles concerning mosaic conservation including reburial (Antomarchi et al. 2019). From the Middle East, an Israeli case study of the Lod mosaic describes the reburial of that mosaic using the method of a layer of basalt powder in contact with the mosaic, then a membrane of plastic netting and a geotextile and about 2 meters of local soil. The reexcavation of the mosaic after more than ten years showed that it provided very successful protection (Neguer 2017). Rarely are such deep reburials reported, but it is not surprising that it provided good protection. More typical of reported reburials in the region are 25 cm of sieved soil (Al-Houdalieh et al. 2017) or less of sand for more short-term reburials (Chlouveraki and Mahamid 2015; Hamza and Smain 2015).

In addition to these publications by authors from the Middle East, a substantial number were produced by Turkish colleagues (Yeşİl-Erdek 2020; Yeşİl 2021; Uğuryol 2013; Tülek 2008; Şener 2008; Şener et al. 2014; Kökten 2008, 2012). Kökten addresses the problem of rescue excavations in Turkey, and she also expresses the need for reburial standards that define the material characteristics and layering depth and duration of fills, as well as the need to regularly inspect and monitor reburials to ensure that they provide effective protection. Uğuryol's case study reports on a reburial using a geotextile in contact with the mosaic then covered with a layer of sand. When the sand was removed, it revealed that root growth had been promoted under the membrane. After treatments, the new reburial used a geotextile again in contact, but covered by soil to achieve better capillarity through the reburial. The article does not include references to reburial literature, which could explain the continued use of an unspecified geotextile in contact with the mosaic, despite the evidence of it promoting root growth under it. Similarly, at Torba, Şener's case study utilizes an unspecified geotextile in contact, then a layer of sand and layer of soil with geotextile between them as a temporary protective covering, understanding that in the longer term a geotextile in contact with the mosaic surface can create conservation problems due to weed root growth and crystallization or encrustation of salts at the interface.

One of the rare experimental testing studies of reburial has been undertaken as a thesis topic at the site of Perge by Yeşİl from 2017 to 2018. Her research included environmental monitoring and material analysis of six different reburial regimes commonly used in Turkey, comparing fill materials with and without a geotextile membrane. She found that the different systems have certain advantages and disadvantages depending on the parameter being assessed. The results of the moisture content, temperature, acidity, salt content, and plant growth testing provided useful data for reburial design and is the kind of instrumental monitoring study that reburial practice could benefit from greatly. Basic questions, such as the minimum depth of fill to create a stable moisture and temperature regime, and what happens at the interface with the surface, need to be answered with the aid of environmental monitoring.

At the Agricultural University of Athens, testing of different geotextiles and fill materials was carried out off site to determine the most effective way to eliminate weed growth, an important performance criterion for a reburial and one that the authors had addressed at the site of Eleusis through in situ testing using an unspecified geotextile over a layer of sand and under a layer of expanded clay pellets (30 cm) and then under a covering layer of gravel (Papafotiou et al. 2010). Contrary to common understandings about the advantage of nonwoven geotextiles over woven ones for reburial, the offsite testing showed that the woven geotextile (black polypropylene ground cover, Hellagro SA, Greece) provided excellent weed control and acted as an efficient root barrier, more so than the nonwoven ones tested (Ecofelt PES-SB 150 g/m^2, Ecofibre, Montale Italy) (Kanellou et al. 2017).

Also in Athens, at the National Technical University, a graduate student and his professor have published a summary of his thesis on a review of materials and techniques for mosaic reburial, which draws on the CMAS 2004 articles (Theodorakeas and Koui 2010).

Concluding Remarks

Methods and Materials

In terms of methods and materials for reburial, the case study examples and assessments of past reburials show a prevalence for the use of sand as a fill material rather than soil for a number of reasons. In some cases, this is because there is no longer any excavated soil left on site decades after the excavation, while in others it is because sand, being a "clean" material, is preferred because it will not "dirty" the mosaic surface. Expanded clay pellets (Leca) continue to be used because they are a lightweight material and the pellets are easy to remove, even though they do not provide capillary continuity. There is also an increasing use of geotextiles, either as a separation membrane between different types of fills, but more commonly in contact with the mosaic, to keep the fill material from entering into the mosaic surface where it could be time-consuming to remove, and to provide a horizon marker to warn the reexcavator that the mosaic surface is near. The use of the word "geotextile," while frequent in the literature, is rarely identified by type or characteristics (nonwoven or woven, spunbonded or needle punched, fiber type, thickness, weight, etc.), suggesting that the membrane material used may not be a true geotextile but another synthetic fabric not made for use underground for geotechnical engineering purposes. This lack of precision about the type of membrane material used will make any future performance unpredictable and evaluation virtually impossible. Future publications need to be far more rigorous in identifying the type of materials used, both as fills and especially as separation membranes, given the seemingly widespread use of membranes without sufficient justification.

The containment of reburial fill materials is often a practical problem faced in the field, especially when walls surrounding the mosaic are not well-preserved. Different solutions using different materials can be found when designing a reburial regime, but their pros and cons are rarely discussed in the literature.

Given the threat from climate change, especially to coastal sites due to rising sea levels, but also to inland sites as precipitation increases, reburial will become increasingly important as a sustainable response and protection measure in the near future. An assessment of the reburial experience from Zeugma and other water-covered or water-logged sites will be helpful to determine the most effective methods and materials to be used to protect mosaics that will become submerged or frequently inundated.

Experimental Testing and Environmental Monitoring

As mentioned previously, there are few publications reporting on experimental testing and environmental monitoring, both before 2008 and after. The onsite testing mentioned previously at Perge in Turkey, at the Roman Villa Rabaçal in Portugal, at Eleusis in Greece, and at the temporary covering testing at sites outside Rome by ISCR, as well as the offsite testing study in Athens, comprise all the tests found in the literature. While such testing studies are a positive development, there is still a need to better understand what type of reburial environment is best for a mosaic. For example, what depth of fill material is needed in different environmental contexts to attain stability of moisture and temperature? This is particularly important for shallow reburials used short-term or seasonally. And similarly, the monitoring of mosaic conditions, together with environmental conditions, after removal of short-term or seasonal reburials is needed to determine the risks involved in frequently changing the environment of a mosaic from reburied to exposed. As was mentioned in the previous literature review, much more could be learned from the literature on the reburial of archaeological sites in general. A fourth international Preserving Archaeological Remains In Situ (PARIS) conference (Gregory and Matthiesen 2012) continues to be a source of knowledge, along with the more than forty articles on reburial of sites published since 2008. Prior to 2008, the *CMAS* (*Conservation and Management of Archaeological Sites*) journal's 2004 volume on reburial remains a ground-breaking publication that, as mentioned previously, continues to be cited in many recent publications on both mosaic and site reburial.

Evaluation of Past Reburials

While more publications by archaeologists and conservators are reporting on mosaic reburials, many mosaics have been reburied without proper documentation, conservation, and testing. As a result, we are left to learn from past experiences of reburial by uncovering limited areas of reburied mosaics to document the methods and materials used and inspect and assess the condition of both the reburial materials and the mosaic. While an increasing number of publications have included the evaluation of past reburial practice, the mosaic conservation field would benefit from national surveys that could assess more broadly the methods and materials used in different environmental contexts and with different conservation threats.

References (2008–2024)

Al-Houdalieh, Salah H., Raed J. Khalil, and Mohammed R. Jawabreh. 2017. Conservation of the mosaic pavements of the Eastern Byzantine church of Khirbet et-Tireh: A preliminary report. In *Proceedings: Palestinian Mosaic Art—Comparing Experiences: Palestinian Mosaic Art International Conference, 11–13 May 2016 Jericho–Sebastia–Bethlehem (Palestine)*, edited by Osama Hamdan and Carla Benelli, 14–23. Al-Ram: Studio Alpha.

Al Taweel, Mohannad, Maher Jbaee, Nesreen Bouza, and Alaa Hammoud. 2017. The Al-Majdal mosaic: Documentation, study, urgent intervention, reburial. In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24–27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 45–56. Firenze: Edifir. https://iccm-mosaics.org/wp-content/uploads/2020/04/MEKNES-Proceedings.pdf#page=73

Alberti, Livia, Ermanno Carbonara, and Thomas Roby. 2020. "The conservation of in situ mosaics: Reburial." MOSAIKON Technician Training for the Conservation of Mosaics. Getty Conservation Institute, Teaching and Learning Resources. https://www.getty.edu/conservation/publications_resources/teaching/pdf/mosaics_conservation/mosaics_reburial_july2021.pdf

Antomarchi, Catherine, Aïcha Ben Abed, Zaki Aslan, and Sattar Izwaini, eds. 2019. *Qirā'āt fī al-ḥifāẓ 'alá al-fusayfisā': maqālāt mukhtārah mutarjamah ilá al-lughah al-'Arabīyah* [Readings in Mosaic Conservation: Selected Articles Translated into Arabic]. Rome: ICCROM; Los Angeles: The Getty Foundation. https://www.getty.edu/foundation/pdfs/mosaikon_readings.pdf

Arinat, Mahmoud. 2014. In situ mosaic conservation: A case study from Khirbet Yajuz, Jordan. *Mediterranean Archaeology & Archaeometry* 14 (2): 67–76. https://www.maajournal.com/index.php/maa/article/view/1100

Becker, Katherine. 2014. Preserving archaeological mosaic pavements: A discussion of context and access. *Chronika* 4: 51–64. https://www.chronikajournal.com/resources/Becker%202014.pdf

Bethell, Philip. 2008. 140 years of mosaic conservation at Chedworth Roman Villa, United Kingdom. In *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29–December 3, 2005 [Leçons retenues: les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques: actes de la 9e conférence de l'ICCM, Hammamet, Tunisie, 29 novembre-3 décembre 2005]*, edited by Aïcha Ben Abed, Martha Demas, and Thomas Roby, 230–37. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9780892369201.pdf#page=251

Blanc-Bijon, Véronique, and Patrick Blanc. 2017. Discovery, preservation, and study of mosaic pavements in the Gaza Territory. In *2016 Palestinian Mosaic Art International Conference « Comparing Experiences » (Jericho, May 2016)*, edited by Osama Hamdan, 40–46. Jéricho, Palestinian Territories. https://hal.science/hal-01448283

Bueno, Michele, and Lucrezia Cuniglio. 2016. I pavimenti romani e la loro tutela e valorizzazione: Prime considerazioni sull'esperienza toscana. *Restauro Archeologico* 22 (1): 37–55. https://doi.org/10.13128/RA-17952

Buzaian, Ahmed. 2015. Photographic documentation of the mosaic reburial at Tocra (Taucheira), Libya. *Mosaic: The Bulletin of the Association for the Study and Preservation of Roman Mosaics* 42: 36–39.

Buzaian, Ahmed, and Mohamed Hashem. 2014. Reburial of a mosaic floor discovered at Tocra (Taucheira). *Libyan Studies* 45: 151–54. https://doi.org/10.1017/lis.2014.4.

Charalambous, Eleftherios. 2014. The in situ conservation of mosaics and the documentation of work at the archaeological site of Kourion, Cyprus. In *10a Conferenza del Comitato internazionale per la conservazione dei mosaici (ICCM): la conservazione: uno strumento di conoscenza [The 10th Conference of the International Committee for the Conservation of Mosaics (ICCM): Conservation: An Act of Discovery]*, edited by D. Michaelides, 375–81. Palermo: Regione siciliana, Assessorato dei beni culturali e della identità siciliana, Dipartimento beni culturali e della identità siciliana.

Charalambous, Eleftherios. 2020. Akrotiri village, district of Lemesos: Multidisciplinary and community cooperation for preventive conservation through reburial. In *What Comes to Mind When You Hear Mosaic? Conserving Mosaics from Ancient to Modern: The 13th Conference of the International Committee for the Conservation of Mosaics, Barcelona 15–20 October 2017*, edited by Roberto Nardi and Montserrat Pugès i Dorca, 381–90. Firenze: Edifir. https://iccm-mosaics.org/wp-content/uploads/2022/03/ICCM_BarcelonaActs-2.pdf#page=433

Chlouveraki, Stefania, and Basem Mahamid. 2015. Revising the reburial system of mosaics of the "Church of the Lions" at Um Er-Rasas in Jordan: Documentation, training and local community involvement. *ICCM Newsletter* 14: 8–10. https://iccm-mosaics.org/wp-content/uploads/2015/02/Newsletter-No.14.pdf#page=8

Costanzi Cobau, Andreina. 2020. Conservazione *in situ* e tecniche di interro artificiale. Problemi di metodo ed esperienze lavorative su mosaici pavimentali. In *Atti del XXV Colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico: con il patrocinio del Ministero per i beni e le attività culturali (Reggio Calabria, 13–16 marzo 2019)*, edited by Chiara Cecalupo and Marco Emilio Erba, 757–64. Roma: Edizioni Quasar.

Crespo Vergara, Raquel, and Diana Requejo Sueiro. 2008. Intervenciones de conservación-restauración en la Domus del Ninfeo del Yacimiento de Bilbilis [Conservation-restoration interventions in the House of the Nymphaeum at the site of Bilbilis]. *Kausis: Revista de la Escuela Taller de Restauración de Aragón II* 5: 28–30.

Demas, Martha. 2013. Reburial and protective covering of mosaics. In *Mosaics In Situ: An Overview of the Literature on Conservation of Mosaics In Situ*, edited by Thomas Roby and Martha Demas. Los Angeles: Getty Conservation Institute. [This review has been incorporated into the current volume (see pp. 12–24), and is no longer available online.]

Gonçalves, José Lourenço. 2008. Reburial versus sheltering: Experiments in preventive conservation of the mosaics in the Roman Villa of Rabaçal, Penela, Portugal. In *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29–December 3, 2005 [Leçons retenues: les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques: actes de la 9e conférence de l'ICCM, Hammamet, Tunisie, 29 novembre–3 décembre 2005]*, edited by Aïcha Ben Abed, Martha Demas, and Thomas Roby, 281–88. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9780892369201.pdf#page=302

Gregory, David, and Henning Matthiesen, guest eds. 2012. "Preserving Archaeological Remains in Situ: Proceedings of the 4th International Conference." Special issue, *Conservation and Management of Archaeological Sites* 14 (1–4). https://www.tandfonline.com/toc/ycma20/14/1-4

Hajji, Jamel. 2019. Le patrimoine mosaïstique en Tunisie: Un état de lieu [The Tunisian mosaic heritage: General diagnosis]. *Journal of Mosaic Research* 12: 75–106. https://doi.org/10.26658/jmr.614861

Hamza, Mohammed Cherif. 2014. Les mosaïques de la maison de la Tigresse travaux de restauration et de consolidation. *Revue d'études archéologiques* 12 (1): 26–36. https://www.asjp.cerist.dz/en/article/62249

Hamza, Mohamed Chérif, and Arab Smain. 2015. Consolidation préventive des mosaïques de Bir Kasdali Bordj Bou Arreridj [Preventive consolidation of the mosaics of Bir Kasdali Bordj Bou Arreridj]. *Newsletter = Chronique (International Committee for the Conservation of Mosaics)* 14: 10–11.

Kanellou, E., M. Papafotiou, P. Lefas, and A. Petrocheilou. 2017. Testing inert materials for reburial and paving purposes as a weed elimination method at archaeological sites. In *VI International Conference on Landscape and Urban Horticulture*, edited by M. Papafotiou, P. A. Nektarios, and A. T. Paraskevopoulou, 73–76. ISHS Acta Horticulturae 1189. Leuven: International Society for Horticultural Science (ISHS). https://doi.org/10.17660/ActaHortic.2017.1189.14

Keskin, Esra. 2015. Preliminary results of rescue excavations in 2013 at a Roman mosaic-paved building in the village of Yavru, Amasya province. In *Landscape Dynamics and Settlement Patterns in Northern Anatolia during the Roman and Byzantine Period*, edited by Winther-Jacobsen Kristina and Lâtife Summerer, 285–93. Stuttgart: Franz Steiner Verlag.

Kökten, Hande. 2008. Mosaic floors unearthed at rescue excavations in Turkey: A philosophical and ethical evaluation of the decision-making process. In *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29–December 3, 2005 [Leçons retenues: les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques: actes de la 9e conférence de l'ICCM, Hammamet, Tunisie, 29 novembre–3 décembre 2005]*, edited by Aïcha Ben Abed, Martha Demas, and Thomas Roby, 131–35. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9780892369201.pdf#page=152

Kökten, Hande. 2012. *In situ* preservation of ancient floor mosaics in Turkey. In *Preserving Archaeological Remains in Situ: Proceedings of the 4th International Conference*. Special issue, *Conservation and Management of Archaeological Sites* 14 (1–4): 303–9. https://doi.org/10.1179/1350503312Z.00000000026

Krini, Maria, and Kassiani Pantazidou. 2020. Seasonal reburial of mosaics at the site of Ancient Olympia: Assessment of potential strategies. In *What Comes to Mind When You Hear Mosaic? Conserving Mosaics from Ancient to Modern: The 13th Conference of the International Committee for the Conservation of Mosaics, Barcelona 15–20 October 2017*, edited by Roberto Nardi and Montserrat Pugès i Dorca, 659–62. Firenze: Edifir. https://iccm-mosaics.org/wp-content/uploads/2022/03/ICCM_BarcelonaActs-2.pdf#page=711

Krini, Maria, Kassiani Pantazidou, Georgia Sotiropoulou, and Ioanna Vitsou. 2017. Seasonal reburial of mosaics: At what cost? In *The Conservation and Preservation of Mosaics: At What Cost?: Proceedings of the 12th ICCM Conference, Sardinia, October 27–31, 2014 [La conservation et la préservation des mosaïques: à quel coût?: actes de la 12e conférence de l'ICCM, Sardinie, 27–31 octobre 2014]*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed, and Roberto Nardi, 369–71. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9781606065334.pdf#page=388

Laurenti, Maria Concetta, Antonella Altieri, Carlo Cacace, Maria Grazia Flamini, and Claudio Prosperi Porta. 2013. La conservazione preventiva nelle aree archeologiche. Le coperture architettoniche e il reinterro temporaneo [Preventive conservation in archaeological areas. Architectural coverings and temporary reburial]. In *Il restauro in Italia: Arte e tecnologia nell'attività dell'Istituto Superiore per la Conservazione ed il Restauro*, 139–47. Roma: Gangemi.

Laurenti, Maria Concetta, Francesca Gaia Romagnoli, Sara Iovine, Lucia Conti, and Antonella Altieri. 2018. Un pavimento in tessellato con inserti marmorei dalla villa romana delle "Terme degli Stucchi Dipinti": studio e restauro [A tessellated floor with marble inserts from the Roman villa of the "Terme degli Stucchi Dipinti": Study and restoration]. In *Atti del XXIII Colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico: con il patrocinio del Ministero dei beni e delle attività culturali e del turismo (Narni, 15/18 marzo 2017) [Proceedings of the 13th Colloquium of the Italian Association for the Study and Conservation of Mosaics: Under the Sponsorship of the Italian Ministry of Cultural Heritage and Activities and Tourism (Narni, 15–18 March 2017)]*, edited by Claudia Angelelli, Chiara Cecalupo, Marco Emilio Erba, Daniela Massara, Federica Rinaldi, and Sara Laboranti, 819–28. Rome: Edizioni Quasar.

Lugari, Alessandro. 2017. Temporary protecting covering system for mosaics in archaeological sites. In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24–27 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 183–88. Firenze: Edifir. https://iccm-mosaics.org/wp-content/uploads/2020/04/MEKNES-Proceedings.pdf#page=211

Lugari, Alessandro, and Patrizia Schievano. 2010. Messa in opera e monitoraggio di un sistema di copertura temporaneo: Pavimento del Tempio della Pace - Fori Imperiali Roma. In *Atti del XV Colloquio* *dell'Associazione Italiana per la Studio e la Conservazione del Mosaico, con il patrocinio del Ministero per i Beni e le Attività Culturali [Acts of the XV Colloquium of the Italian Association for the Study and Conservation of Mosaics]*, edited by Claudia Angelelli, 325–32. Rome: Edizioni Scripta Manent di Tipografia Mancini s.a.s.

Lysandrou, Vassiliki, and Eleftherios Charalambous. 2017. Reburial of mosaic pavements: An *in situ* conservation method. In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24–27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 319–24. Firenze: Edifir. https://iccm-mosaics.org/wp-content/uploads/2020/04/MEKNES-Proceedings.pdf#page=347

Nardi, Roberto, and Kristian Schneider. 2013. Site conservation during the rescue excavations. In *Excavations at Zeugma: Conducted by Oxford Archaeology*, edited by William Aylward, 55–70. Los Altos, CA: The Packard Humanities Institute. https://zeugma.packhum.org/pdfs/v1ch02.pdf

Neguer, Jacques. 2017. The Lod mosaic: Discovery and history of the intervention. In *The Conservation and Preservation of Mosaics: At What Cost?: Proceedings of the 12th ICCM Conference, Sardinia, October 27–31, 2014 [La conservation et la préservation des mosaïques: à quel coût?: actes de la 12e conférence de l'ICCM, Sardinie, 27–31 octobre 2014]*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed, and Roberto Nardi, 210–16. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9781606065334.pdf#page=229

Noei, Sina. 2022. Detailed documentation and in situ conservation according to mortar characterisation of opus sectile uncovered in the Saint Philip Church of Hierapolis (Pamukkale-Turkey). *Mediterranean Archaeology and Archaeometry* 22 (2): 123–37. https://www.maajournal.com/index.php/maa/article/view/712

Onnis, Carla. 2010. Protezione dei pavimenti musivi in fase di scavo. In *Atti del XV Colloquio dell'Associazione Italiana per la Studio e la Conservazione del Mosaico, con il patrocinio del Ministero per i Beni e le Attività Culturali [Acts of the XV Colloquium of the Italian Association for the Study and Conservation of Mosaics]*, edited by Claudia Angelelli, 253–56. Rome: Edizioni Scripta Manent di Tipografia Mancini s.a.s.

Papafotiou, M., E. Kanellou, and G. Economou. 2010. Alternative practices for vegetation management in archaeological sites: The case of Eleusis. In *II International Conference on Landscape and Urban Horticulture*, edited by G. Prosdocimi Gianquinto and A. Chiusoli, 879–83. ISHS Acta Horticulturae 881. Leuven: International Society for Horticultural Science (ISHS). https://doi.org/10.17660/ActaHortic.2010.881.148

Pomicetti, Antonella, and Maurizio Molinari. 2016. Claterna fra restauro e valorizzazione: nuove proposte per la "Casa del Fabbro" [Claterna between restoration and valorization: New proposals for the "Casa del Fabbro"]. In *Atti del XXI Colloquio dell'Associazione Italiana per la Studio e la Conservazione del Mosaico, con il patrocinio del Ministero per i Beni e le Attività Culturali (Reggio Emilia, 18–21 Marzo, 2015) [Acts of the XXI Colloquium of the Italian Association for the Study and Conservation of Mosaics, with the Sponsorship of the Ministry of Cultural Heritage and Activities and Tourism, (Reggio Emilia, 18–21 March, 2015)]*, edited by Claudia Angelelli, Daniela Massara, and Francesca Sposito, 80–85. Rome: Edizioni Scripta Manent di Tipografia Mancini s.a.s.

Rhouma-Ghmari, Hamida, and Mohedinne Chaouali. 2017. Bulla Regia: la conservation des mosaïques à quel coût? In *The Conservation and Preservation of Mosaics: At What Cost?: Proceedings of the 12th ICCM Conference, Sardinia, October 27–31, 2014 [La conservation et la préservation des mosaïques: à quel coût?: actes de la 12e conférence de l'ICCM, Sardinie, 27–31 octobre 2014]*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed, and Roberto Nardi, 40–47. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9781606065334.pdf#page=59

Roby, Thomas, Livia Alberti, and Aïcha Ben Abed. 2014. Costs and benefits of in situ mosaic conservation: An analysis of technician training and conservation work in Tunisia, 2001–2008. In *10a Conferenza del Comitato internazionale per la conservazione dei mosaici (ICCM): la conservazione: uno strumento di conoscenza [The 10th Conference of the International Committee for the Conservation of Mosaics (ICCM):*

Conservation: An Act of Discovery], edited by D. Michaelides, 284–95. Palermo: Regione siciliana, Assessorato dei beni culturali e della identità siciliana, Dipartimento beni culturali e della identità siciliana.

Roby, Thomas, Livia Alberti, and Aïcha Ben Abed. 2010. A preliminary assessment of mosaic reburials in Tunisia. In *Conservation and the Eastern Mediterranean: Contributions to the Istanbul Congress, 20–24 September 2010*, edited by Christina Rozeik, Ashok Roy, and David Saunders, 207–13. *Studies in Conservation*, 55 (suppl. 2). London: International Institute for Conservation of Historic and Artistic Works. https://doi.org/10.1179/sic.2010.55.Supplement-2.207

Roby, Thomas, Livia Alberti, Cristina Caldi, Ermanno Carbonara, Moheddine Chaouali, Leslie Friedman, and Hamida Rhouma. 2017. Mosaic conservation planning and implementation at the site of Bulla Regia, Tunisia. In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24–27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 327–31. Florence: Edifir. https://iccm-mosaics.org/wp-content/uploads/2020/04/MEKNES-Proceedings.pdf#page=73#page=355

Roby, Thomas, Livia Alberti, and Ermanno Carbonara. 2013. *Technician Training for the Maintenance of In Situ Mosaics*. Los Angeles: Getty Conservation Institute; Tunis: Institut national du patrimoine, Tunisia. http://hdl.handle.net/10020/gci_pubs/tech_training_english

Roby, Thomas, Leslie Friedman, Livia Alberti, Ermanno Carbonara, and Ascanio D'Andrea. 2024. *Bulla Regia Mosaic Conservation Project: A Model Field Project of the MOSAIKON Initiative*. Project Report. Los Angeles: Getty Conservation Institute; Tunis: Institut National du Patrimoine de Tunisie; New York: World Monuments Fund. https://hdl.handle.net/10020/gci_pubs_bulla_regia_mosaic

Roby, Thomas, Leslie Friedman, Moheddine Chaouali, Hamida Rhouma-Ghmari, Livia Alberti, and Ermanno Carbonara. 2020. The conservation plan for mosaics at Bulla Regia: A component of the MOSAIKON model field project. In *What Comes to Mind When You Hear Mosaic?: Conserving Mosaics from Ancient to Modern: The 13th Conference of the International Committee for the Conservation of Mosaics, Barcelona 15–20 October 2017*, edited by Roberto Nardi and Montserrat Pugès i Dorca, 337–48. Firenze: Edifir. https://iccm-mosaics.org/wp-content/uploads/2022/03/ICCM_BarcelonaActs-2.pdf#page=389

Romagnoli, Francesca Gaia. 2023. Il restauro del mosaico con colombi. In *San Miceli: un insediamento rurale paleocristiano nella Sicilia Occidentale*, edited by Élisabeth Lesnes and Randall W. Younker, 363–69. Roma: "L'Erma" di Bretschneider.

Russell, Miles, Dave Stewart, Paul Cheetham, and Harry Manley. 2022. Artistic Lysons? New work on the 'lost' mosaics of Frampton Roman villa, Dorset. *Mosaic: The Bulletin of the Association for the Study and Preservation of Roman Mosaics* 49: 19–31. https://eprints.bournemouth.ac.uk/38358/

Şahin, Derya, and Y. Selçuk Şener. 2015. The Basilica mosaic on Asar Island at Myndos. *Journal of Mosaic Research* 8: 141–66. https://doi.org/10.26658/jmr.306319

Şener, Y. Selçuk. 2008. Türkiye'de arkeolojik alanlarda mozaiklerin korunma(ma)sı: karar, yöntem ve uygulama açısından bir İnceleme [Conservation (non-conservation) of the mosaics of archeological sites in Turkey: An analysis regarding decision, method, and practice]. In *IV. Uluslararasi Türkiye Mozaik Korpusu Sempozyum Bildirileri "Geçmisten Günümüze Mozaik Köprüsü": 6–10 Haziran/June 2007 Gaziantep [The Proceedings of IV. International Mosaic Corpus of Türkiye "The Mosaic Bridge from Past to Present"]*, edited by Mustafa Sahin, 191–95. Uludag Üniversitesi Mozaik Arastirmalari Merkezi Yayinlari Serisi. 1, Sempozyum bildirileri 2. Bursa: Uludag University Press.

Şener, Yaşar Selçuk, Bekir Eskici, and Hande Kökten. 2014. Restoration of the mosaics in the Byzantine monastery complex in Torba (Bodrum, Muğla, Turkey). In *10a Conferenza del Comitato internazionale per la conservazione dei mosaici (ICCM): la conservazione: uno strumento di conoscenza [The 10th Conference of the International Committee for the Conservation of Mosaics (ICCM): Conservation: An Act of Discovery]*, edited by D. Michaelides, 496–508. Palermo: Regione siciliana, Assessorato dei beni culturali e della identità siciliana, Dipartimento beni culturali e della identità siciliana.

Stewart, John. 2014. Mosaics: Conservation and preservation. In *Encyclopedia of Global Archaeology*, edited by Claire Smith, 5044–50. New York, NY: Springer New York. https://doi.org/10.1007/978-1-4419-0465-2_95

Stewart, John. 2016. The conservation of mosaics on archaeological sites. In *Conservation of Cultural Heritage in the Arab Region: Issues in the Conservation and Management of Heritage Sites*, edited by Zaki Aslan, 90–96. Rome: International Centre for the Study of the Preservation and the Restoration of Cultural Property. https://www.iccrom.org/sites/default/files/2017-12/selected_readings_1_en.pdf#page=89

Theodorakeas, Panagiotis, and Maria Koui. 2010. Conservation procedures for the reburial of mosaic pavements: A review of materials and techniques. In *Monument Damage Hazards & Rehabilitation Technologies: Proceedings of the 8th International Symposium on the Conservation of Monuments in the Mediterranean Basin, Patras, Greece, May 31–June 2, 2010*, edited by Maria Koui. Athens: National Technical University of Athens. http://library.tee.gr/digital/m2616/m2616_theodorakeas1.pdf

Tülek, Füsun. 2008. An evaluation of the preservation of reburied mosaics in Cilicia. In *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29–December 3, 2005 [Leçons retenues: les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques: actes de la 9e conférence de l'ICCM, Hammamet, Tunisie, 29 novembre–3 décembre 2005]*, edited by Aïcha Ben Abed, Martha Demas, and Thomas Roby, 393–96. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9780892369201.pdf#page=414

Uğuryol, Mehmet. 2013. The conservation of the mosaic of the "House of the Ionic Capitals" in Hierapolis (Pamukkale, Turkey). *Journal of Cultural Heritage* 14 (3, Suppl.): e125–e132. https://doi.org/10.1016/j.culher.2012.12.006

Wootton, William T., Alaa El-Habashi, John D. Stewart, and Hafed Walda. 2015. Conserving and managing mosaics in Libya (CaMMiL): The final project review. *Libyan Studies* 46: 103–13. https://doi.org/10.1017/lis.2015.2

Yeşİl, Şehrigül. 2021. Reburial of mosaics: Field experiment comparing six different systems based on the results of monitoring station in Perge. *Journal of Mosaic Research* 14: 363–87. https://doi.org/10.26658/jmr.1014580

Yeşİl-Erdek, Şehrigül. 2020. Experimental comparison of six methods of *in situ* mosaic reburial. In *What Comes to Mind When You Hear Mosaic? Conserving Mosaics from Ancient to Modern: The 13th Conference of the International Committee for the Conservation of Mosaics, Barcelona 15–20 October 2017*, edited by Roberto Nardi and Montserrat Pugès i Dorca, 755–60. Firenze: Edifir. https://iccm-mosaics.org/wp-content/uploads/2022/03/ICCM_BarcelonaActs-2.pdf#page=807

Zizola, Chiara. 2008. The legacy of Nora, Sardinia: A project for the conservation, restoration, and maintenance of mosaics. In *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29-December 3, 2005 [Leçons retenues: les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques: actes de la 9e conférence de l'ICCM, Hammamet, Tunisie, 29 novembre–3 décembre 2005]*, edited by Aïcha Ben Abed, Martha Demas, and Thomas Roby, 165–73. Los Angeles: Getty Conservation Institute. https://www.getty.edu/publications/resources/virtuallibrary/9780892369201.pdf#page=186

PART II

Training and Planning Documents

Introduction to the Training and Planning Documents

The following documents, referred to in the Introduction, are tools to facilitate the entire process of reburial, from the decision-making and planning stages to the implementation, inspection, and maintenance of a reburial. They are products of both MOSAIKON training courses for site managers and of field work by conservators and conservation technicians in Tunisia from 2010 to 2022. Although the intended users of the documents are not always the same, the documents are included together in this publication because they are complementary.

The site management documents begin with those that contextualize reburial among other potential site conservation interventions (Document 1) and provide a decision-making framework for it (Document 2). This is followed by a document that outlines the overall reburial process, from information gathering to planning through to implementation and then monitoring and maintenance (Document 3).

To facilitate the decision making and information gathering about each mosaic, two survey forms have been developed. One is more general in scope and is intended more for site managers (Document 4), while the other is more detailed and was developed for practitioners—both conservators and conservation technicians—to prioritize which mosaics to conserve first, and also to help quantify and program the interventions and estimate the time needed (Document 5). Document 5 was created as an Excel file to facilitate making calculations using the gathered survey data.

These forms are followed by an introduction to principles of and materials for reburial (Document 6), a core training material for site managers that complements the previously published PowerPoint lesson developed for technicians, along with a chapter in the technician training handbook (https://www.getty.edu/conservation/publications_resources/teaching/pdf/mosaics_conservation/mosaics_reburial_july2021.pdf;www.getty.edu/conservation/publications_resources/pdf_publications/tech_training.html).

The principles document is followed by two reburial planning forms, one developed for site managers (Document 7) and the other for practitioners in the context of the Bulla Regia Mosaic Conservation Field Project (Document 8). Document 8 was created as an Excel file to facilitate making calculations using the gathered data.

These forms are followed by guidance documents for field testing of reburial materials, both fills and separation membranes (Document 9) and general recommendations about the reburial of mosaics re-laid in situ on reinforced concrete (Document 10).

Finally, this compilation ends with a recording and evaluation form developed to assist with the process of documenting and assessing a reburial intervention over time, both its condition and effectiveness in protecting a mosaic (Document 11), especially when no previous documentation is available. For the technical terminology of mosaic conditions and interventions, see the GCI-INP MOSAIKON technician training handbook and illustrated glossary (www.getty.edu/conservation/publications_resources/pdf_publications/techtraining.html).

Document 1: Site Conservation Intervention Options

Document 2: Reburial Decision-Making

Document 3: Reburial Process

Document 4: Mosaic Preliminary Survey Form

Document 5: Mosaic Rapid Survey Form (Bulla Regia Project)

https://iccm-mosaics.org/wp-content/uploads/2020/04/MEKNES-Proceedings.pdf#page=355

https://www.getty.edu/conservation/publications_resources/pdf_publications/pdf/bulla-regia-mosaic-conservation-project.pdf#page=47

Document 6: Basic Principles and Materials for Reburial

Document 7: Reburial Planning Form

Document 8: Reburial Planning Form (Bulla Regia Project)

https://www.getty.edu/conservation/publications_resources/pdf_publications/pdf/bulla-regia-mosaic-conservation-project.pdf#page=153

https://www.getty.edu/conservation/publications_resources/pdf_publications/pdf/bulla-regia-mosaic-conservation-project.pdf#page=156

Document 9: Evaluation of Materials for Reburial of Mosaics

Document 10: Guidance on Reburial of Mosaics on Reinforced Concrete

Document 11: Reburial Inspection Form

https://doi.org/10.1179/sic.2010.55.Supplement-2.207

Document 1: Site Conservation Intervention Options

PREVENTIVE MEASURES	REMEDIAL MEASURES			PRESENTATION/ INTERPRETATION
	MINIMAL INTERVENTION	MEDIUM INTERVENTION	MAXIMUM INTERVENTION	
Maintenance (e.g., vegetation control)	Surface cleaning	Deep cleaning	Disassembly and reinstatement	Restoration
Drainage	Desalination	Removal of modern repairs	Installation of structural reinforcement—ties	Anastylosis
Stabilization of natural slopes	Pointing joints/ gap filling	Filling/replacement of masonry	Lifting and relaying (mosaics)	Reconstruction
Control of coastal erosion	Stabilization of edges (renders, mosaics)	Grouting		
Signage/ restriction of access	Sacrificial renders	Fixing with metal armatures		
Reburial	Capping of wall heads	Surface stabilization		
Storage (architectural fragments, lifted mosaics)	Rebedding original stone or brick			Cover building/ shelter
	Support of masonry (temporary or permanent)			

INCREASING LEVEL OF INTERVENTION (RISK TO AUTHENTICITY) ⟶
INCREASING COST OF INTERVENTION ⟶
INCREASING COST OF LONG-TERM MAINTENANCE ⟶

Preventive measures: Creation of an environment which reduces the rate of deterioration of the materials of archaeological remains (to preserve maximum material authenticity)	**Remedial measures**: Stabilization of degraded materials of archaeological remains by means of the addition of new materials (which results in some loss of material authenticity)

Document 2: Reburial Decision-Making

DECISION-MAKING FOR CONSERVATION INTERVENTIONS

REBURIAL

step 1 PREPARATION: Collecting Information

1.1 Establish Baseline Information

What is known about the site? Where are the gaps in research? What is the history of interventions at the site (excavation, conservation, and use)?

step 2 ASSESSMENT: Investigating and Evaluating

2.1 Analyze the Resource and Its Context

- **2.1.1 Significance, Values, Benefits, and Stakeholders**
- **2.1.2 Conditions, Threats, and Risks**
- **2.1.3 Management Context**

step 3 RESPONSE: Making a Decision

3.1 Determine the Appropriate Conservation Option

In response to the assessment, what is the best way to preserve the values of the site?

3.2 Develop a Strategy

How will the conservation intervention be implemented to meet the stakeholder, technical, and management needs resulting from the assessments?

If reburial is chosen, the following considerations should be addressed:

3.2.1 Stakeholder Considerations

Compensation strategies

- Documentation and publication
- Research needs
- Display/exhibition

Communication and consultation strategies

- Popular and scholarly press
- Networking, lecturing
- Advisory group

3.2.2 Technical Conservation Considerations

- Research and testing needs
- Remains to be protected
- Depth of fill
- Duration of reburial
- Bulk fill materials
- Horizon markers
- Specialized fills
- Erosion control and drainage
- Vegetation control
- Post-reburial use
- Long-term monitoring

3.2.3 Management Considerations

- Costs
- Expertise required
- Post-reburial maintenance needs
- Security
- Legal implications
- Documenting location and method

MONITOR AND MAINTAIN

Document 3: Reburial Process

1. Assessment of significance, conditions, threats, and risks
2. Deciding what and how long to rebury
3. Metric survey (baseline documentation)
4. Detailed condition survey
5. Interventions before reburial
   A. Vegetation removal
   B. Stabilization of pavements and walls
   C. Drainage
   D. Slope stabilization
6. Reburial design
   A. Fill materials
   B. Separation membrane materials (if needed)
   C. Fill containment materials
7. Materials testing
8. Materials delivery methods
9. Reburial process
   A. Intervention procedure
   B. Pavement protection measures
10. Documentation of the reburial
11. Monitoring and maintenance

Document 4: Mosaic Preliminary Survey Form

The Mosaic Preliminary Survey Form is intended to be used to survey a large number of mosaics (e.g., an entire site/region) for the first time. It can be adapted for other forms of pavement (e.g., *opus sectile*). Condition, significance, and exposure/risk data can be entered into a database and GIS format, which can then be developed into a prioritized program of conservation treatments across sites and regions.

Notes

Mosaic: General Characteristics

Significance
This rating is based on the nature of decoration, its relative importance on the site, and the mosaic's integrity and authenticity.

Mosaic: Observed Phenomena

Surface/Structural Deterioration
Deterioration is simplified into general categories. It uses standard terminology (Illustrated Glossary, Getty Conservation Institute 2003, 2013). Assessment of deterioration is by means of a graded scale to quantify the surface area affected and the severity of the phenomena. Combining these two parameters provides a rapid and simple means to classify the approximate condition caused by each phenomenon (e.g., a rating of **4C** is the most serious condition, **1A** is the least serious, **0** is not applicable).

Mosaic Condition
This rating is a relative scale that combines previous assessments of specific conditions (in the data field immediately prior) into one rating. It takes into consideration the fact that some deterioration phenomena are more serious than others (e.g., rooted vegetation is more hazardous than the presence of micro-organisms).

Present Exposure and General Access Conditions
These categories define threats that influence the "risk environment" of a mosaic.

Risk Assessment
"Exposure and access conditions" is a relative rating of the combined factors identified in the data field immediately preceding. "Evaluation of risk" is a relative rating that considers general pavement condition with respect to its degree of environmental and visitation exposure and identified threats.

Priority for Intervention
This rating considers the previous assessments of significance, condition, identification of threats, and degree of exposure and risk as a basis for determining the relative priority for conservation intervention.

Immediate/Short-Term Recommended Actions/Interventions
These are, for example:

- detailed condition survey
- reburial (limited mosaic stabilization before, followed by limited maintenance)
- exposure (complete stabilization and presentation, followed by frequent maintenance)
- improved drainage

MOSAIC PRELIMINARY SURVEY FORM				
Site:		**Building:**	**Room:**	**Mosaic ID:**
MOSAIC: GENERAL CHARACTERISTICS				
Dimensions (approx.)		Width:	Length:	Area (m^2):
Materials	Surface	☐ Stone	☐ Ceramic	☐ Glass
	Support	☐ Lime mortar	☐ Cement mortar	☐ Iron reinforcement
Location		☐ Pavement	☐ Wall	☐ Vault
Integrity		☐ Original support	☐ Lifted and re-laid	☐ Detached mosaic
Decoration		☐ Plain	☐ Geometric	☐ Figurative
SIGNIFICANCE		Scale 1–5: 1 High / 5 Low		Rating:
MOSAIC: OBSERVED PHENOMENA				
Accessibility		☐ Fully	☐ Partly	☐ Not accessible

Extent refers to **the percentage of surface area** affected by the phenomena:
Rate the extent by circling the appropriate number: **0 None, 1 (< 10%), 2 (10–30%), 3 (30–50%), 4 (>50%)**

Severity refers to the **degree** to which the phenomenon impacts the physical integrity of the pavement:
Rate the severity by circling the appropriate letter: **A low, B moderate, C high**

SURFACE DETERIORATION			*NOTES*
Deteriorated tesserae	Extent	0 1 2 3 4	
	Severity	A B C	
Deteriorated mortar between tesserae	Extent	0 1 2 3 4	
	Severity	A B C	
Detached tesserae	Extent	0 1 2 3 4	
	Severity	A B C	
Efflorescence	Extent	0 1 2 3 4	
	Severity	A B C	
Vegetation	Extent	0 1 2 3 4	
	Severity	A B C	
Micro-organisms	Extent	0 1 2 3 4	
	Severity	A B C	

STRUCTURAL DETERIORATION			*NOTES*
Cracks	Extent	0 1 2 3 4	
	Severity	A B C	
Bulges	Extent	0 1 2 3 4	
	Severity	A B C	
Depressions	Extent	0 1 2 3 4	
	Severity	A B C	
Tessellatum lacunae	Extent	0 1 2 3 4	
	Severity	A B C	

Detachment between layers (voids)	Extent 0 1 2 3 4	
	Severity A B C	
DETERIORATION OF INTERVENTIONS		***NOTES***
Deteriorated lacunae fills or edging repairs	Extent 0 1 2 3 4	
	Severity A B C	
Cracking/corrosion of metal reinforcement	Extent 0 1 2 3 4	
	Severity A B C	
Other:	Extent 0 1 2 3 4	
	Severity A B C	

MOSAIC CONDITION

Evaluate all of the information above to provide an assessment of general condition.

Critical deterioration	**1**	**2**	**3**	**4**	**5**	**Good condition**

PRESENT EXPOSURE AND GENERAL ACCESS CONDITIONS

☐ In open air	☐ Under open shelter	☐ Under removable cover	☐ Barrier
☐ Walked on	☐ Under enclosed shelter	☐ Reburied	☐ Other

RISK ASSESSMENT

Exposure and access conditions	☐ High	☐ Medium	☐ Low
Other (specify)			

Evaluation of Risk: Evaluate condition with respect to all apparent current and potential risks and rate the level of risk from highest to lowest.

High risk	**1**	**2**	**3**	**4**	**5**	**Low risk**

PRIORITY FOR INTERVENTION

High	**1**	**2**	**3**	**4**	**5**	**Low**

IMMEDIATE/SHORT-TERM RECOMMENDED ACTIONS/INTERVENTIONS

SUPPLEMENTARY INFORMATION

Photo image numbers:		
Other attachments (e.g., sketch plans). Identify:		
Survey completed by:		Date:

Document 5: Mosaic Rapid Survey Form (Bulla Regia Project)

Rapid Survey Form | **Site:** | **Date:** | **Part 1**

Mosaic Conservation Planning for Archaeological Sites | **Building:** | **Recorded by:**

	IDENTIFICATION								CONDITION									INTERVENTION						NOTES
									Micro-organisms		Critical tessellatum		Critical structural areas						Complete stabilization for exposure Work Days			Stabilization for reburial Work Days		
																				1		70%	30%	
Mosaic ID	Room/Space (m^2)	Mosaic (m^2)	Lacunae (m^2)	Mosaic in room (%)	Mosaic typology	Lacunae type	Reinforced concrete	Type of exposure	m^2	%	m^2	%	m^2	%	TOTAL critical areas (m^2)	TOTAL critical areas (%)	OVERALL CONDITION RATING (1-5)	Work days per m^2	Tessellatum stabilization	Micro-organism removal	TOTAL work days	Long-term	Short-term	
TOTAL																								
AVERAGE																								

Rapid Survey Form **Site:** **Date:** **Part 2**

Mosaic Conservation Planning for Archaeological Sites **Building:** **Recorded by:**

	CONDITION		SIGNIFICANCE						EXPOSURE					PRIORITY		NOTES
Evaluation Scale	1–5		1–5	1–5	1–5	1–5	1–5		1–5	1–5	1–5	1–5		6–150	0–100	
Weighting		4						2					1			
Mosaic ID	OVERALL CONDITION RATING	WEIGHTED OVERALL CONDITION	Archaeological-Iconographic Value	Technical-Artistic Value	Integrity	Authenticity	OVERALL SIGNIFICANCE RATING	WEIGHTED OVERALL SIGNIFICANCE	Environment	Visitation	Structural Collapse	OVERALL EXPOSURE RATING	WEIGHTED OVERALL EXPOSURE	SYNTHESIS WEIGHTED RATINGS	OVERALL PRIORITY RATING	
BUILDING AVERAGE																

Document 6: Basic Principles and Materials for Reburial

	OBJECTIVES	HOW?	FOR HOW LONG? (DURATION)			CONSIDERATIONS
			SHORT TERM	MEDIUM TERM	LONG TERM	
1	Create stable moisture regime: avoid rapid wet/dry cycles	Depth of fill material	15–30 cm	30–50 cm	50–150 cm+	General guide only (more is better)
		Permeability of fill material	✓	✓	✓	Soil or sand (see materials table below)
2	Prevent salt damage; allow free water movement: permeability and continuity of capillarity between buried feature and fill	Choose/test fill material for capillarity	✓	✓	✓	Soil or sand (see materials table below)
		Compaction of fill	✓	✓	✓	Good contact between fill and feature
		Avoid impermeable membranes in fill above the buried feature	✓	✓	✓	
3	Create suitable chemical environment	Use fill compatible with buried feature	✓	✓	✓	Soil or sand (see materials table below); avoid fill with different chemical composition (see materials table below)
4	Discourage vegetation growth	Depth of fill material	15–30 cm	30–50 cm	50–150 cm +	General guide only (more is better)
		Remove roots/ vegetal matter from fill material	✓	✓	✓	See materials table below
		Suitable geotextile* as second line of defense		✓	✓	Not in contact with buried feature
		Hard surface landscaping	✓	✓	✓	Gravel (see materials table below)
		Regular maintenance above/around reburied site	✓	✓	✓	Include vegetation-free buffer zone around reburied feature

	OBJECTIVES	HOW?	FOR HOW LONG? (DURATION)			CONSIDERATIONS
			SHORT TERM	MEDIUM TERM	LONG TERM	
5	Create thermal stability (especially where winter frost occurs)	Depth of fill material	15–30 cm	30–50 cm	50–150 cm+	General guide only (more is better); Short term needs additional insulation
6	Facilitate reexcavation (especially for short-term or seasonal reburial)	Aid removal of fill material	✓			Strong separation membrane; geotextiles* (see materials table below)
		Documentation	✓	✓	✓	With good archiving for future access
		Insertion of horizon markers	✓	✓	✓	A noncontextual object or a thin layer of distinctive fill material (e.g., a layer of sand) or a permeable and durable separation membrane (e.g., plastic netting)

- In order to design a reburial cover that provides efficient protection, every archaeological feature to be reburied should be subject to a condition survey, an identification of threats, and a risk assessment.
- Monitoring and maintenance are needed for all durations of reburial: short-, medium-, and long-term.

Materials for Reburial

FUNCTION	PURPOSE	DESIGN	MATERIALS	NOTES
Fill material	Provide thermal protection	Adequate depth of materials	Soil	Sieved where in contact with buried feature; remove roots and other vegetal matter; suitable pH and chemical composition
			Sand	Free of salts and iron
	Provide stable moisture regime	Adequate depth of materials	Soil	Remove roots and other vegetal matter; suitable pH and chemical composition
			Sand	Free of salts and iron

FUNCTION	PURPOSE	DESIGN	MATERIALS	NOTES
	Provide good permeability and capillarity		Soil	Sieved where in contact with buried feature
			Sand	Appropriate grain size distribution
	Provide chemical compatibility with materials to be reburied	pH similar to that of reburied feature, or neutral	Soil	This may need to be brought from another site
			Sand	Free of salts and iron
	Discourage vegetation	Adequate depth of materials	Soil	Remove roots and other vegetal matter
			Sand	Free of salts and iron
			Gravel	For landscaping of surface; needs renewal when contaminated with soil that can promote vegetation
Separation membranes	Prevent mixing of fill layers Discourage vegetation growth		Geotextile*	With required properties. Need good soil hydrostatic pressure (e.g., at least 50 cm of fill cover) with geotextiles
			Other synthetic fabrics	
			Plastic netting	
	Keep feature clean from fill Facilitate reexcavation		Geotextile*	With required properties. Need good soil hydrostatic pressure (e.g., at least 50 cm of fill cover) with geotextiles
			Other synthetic fabrics	
	Horizon marker (is membrane needed?)		Non-contextual object; layer of distinctive fill material; Plastic netting	Open weave with good water permeability if a membrane is used

*Geotextiles: properties can vary significantly and may or may not respond to reburial requirements, so they need to be chosen carefully if they are to be used. Nonwoven geotextiles are preferable to woven ones (greater water permeability), and their thickness (gm/m^2) needs to be considered as well. It is advisable to select geotextiles with manufacturers' data sheets that describe their characteristics. Otherwise, care should be taken with synthetic fabrics with unspecified properties (e.g., those that are inexpensive and locally available) as their use could have negative consequences. Samples of these should be tested in the field before purchase and use (see Document 9: Evaluation of Materials for Reburial of Mosaics).

Document 7: Reburial Planning Form

REBURIAL PLANNING FORM				
SITE:		**MOSAIC ID:** / /		
BUILDING:	**ROOM:**			
	DESCRIPTION			
Feature(s) to be reburied				
Objectives of reburial			Duration	
Dimensions of area			m^2	
METRIC SURVEY	Surface area	Time/days	Labor/cost	
Photography				
Drawing				
ASSESSMENTS	Surface area	Time/days	Labor/cost	
Significance				
Condition				
Threats and risks				
INTERVENTIONS BEFORE REBURIAL	Surface area	Time/days	Labor/cost	Materials/cost
Vegetation removal				
Walls				
Pavements				
Stabilization				
Pavements				
Grouting				
Filling interstices				
Infilling lacunae				
Edging repairs				
Resetting tesserae				
Walls				
Capping wall heads				
Repointing				
Drainage				
Internal				
Perimeter				
Slope stabilization				

Surface net/membrane				
Vegetation				
Other				
REBURIAL DESIGN	**Volume/ surface area required**	**Materials Source**	**Labor/cost**	**Materials/cost**
Separation membranes				
Fill materials				
Containment materials (borders)				
Entire stratigraphy				
MATERIALS TESTING	**Objective**	**Test(s)**	**Labor/cost**	
Separation membranes				
Fill materials				
MATERIALS DELIVERY	**Method**	**Time**	**Labor/cost**	
To site				
To site storage				
To reburial site				
REBURIAL PROCESS	**Method**	**Time**	**Labor/cost**	
Containment (borders)				
Reburial procedure				
Pavement protection				
DOCUMENTATION	**Method**	**Time**	**Labor/cost**	
Before reburial				
Reburial				
MAINTENANCE	**Method**	**Time**	**Labor/cost**	**Frequency**
Vegetation removal				
Addition of fill				
Drainage clearance				
Slope stabilization				

MONITORING	Method	Time	Labor/cost	Frequency
Vegetation growth				
Loss of fill cover				
Drainage blockage				
Slope erosion				

SKETCH PLAN/SECTIONS (WITH DIMENSIONS)	
Prepared by:	Date:

Document 8: Reburial Planning Form (Bulla Regia Project)

BUILDING NAME: **DATE:** **FORM: PART 1**

[Data from GIS and Rapid Survey Form (RSF)]						MOSAICS TO BE PRESENTED								MOSAICS TO BE REBURIED																
Room ID	m^2			From RSF ÷ 2			Lacunae Treatment Type			Lacunae Treatm. W/D 1 Techn. + 2 Workers									Reburial Materials			Barriers m					After Short-term Reburial			
	Room	Tessellatum	Lacunae	Tessellatum Stabilization W/D 2 Technicians	Micro-organism Removal W/D 2 Technicians	Tess. Stab.+ Microorg. Removal W/D 2 Technicians	m^2 Infilling	m^2 Gravel	m^2 Other	W/D Infilling	W/D Gravel	W/D for Drainage or Other	Lacunae Treatment TOTAL W/D 1 Technician + 2 Workers	L-T= Long-term S-T= Short-term		Tess. Stab. for Reburial W/D 2 Technicians	Lacuna Treatm. for Reb. W/D 2 Technicians	Reburial area m^2	Sand m^3	Gravel m^3	Geotextile m^2	Wooden planks	Cement mortar	Stone blocks	Reburial W/D 1 Techn. + 2 Workers	Barrier construction W/D 1 Techn. + 2 Workers	Long-term reburial	Presentation	Other	Notes
										0.7	0.25			L-T →		70%	0.20		0.2	0.1	25%				0.16					
														S-T →		30%			0.1	0.05					0.08					
														L-T	☐												☐	☐	☐	
														S-T	☐															
														L-T	☐												☐	☐	☐	
														S-T	☐															
														L-T	☐												☐	☐	☐	
														S-T	☐															
														L-T	☐												☐	☐	☐	
														S-T	☐															
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														L-T	☐												☐	☐	☐	
														S-T	☐															
TOTALS														TOTALS													☐	☐	☐	

BUILDING NAME: **DATE:** **FORM: SUMMARY**

SUMMARY			REBURIAL MATERIALS						WORK DAYS			
Conservation work in the building		Quantity in the building	Sand m^3	Gravel m^3	Geotext m^2	Wooden Planks m	Cement Mortar m	Stone Blocks m	Team 2 Technicians	Team 1 Technician +2 Workers	Team 2 Workers	Team 4 Workers
Mosaics to be presented: (from Form Part 1)	Tessellatum stabilization of in situ mosaics + In-situ stabilization of mosaics on concrete panels											
	Lacuna treatment											
Mosaics to be reburied: (from Form Part 1)	Tessellatum stabilization and lacuna treatment											
	Reburial and barrier construction											
Other types of pavements: (from Form Part 2)	Cocciopesto											
	Stone slab pavement											
	Preparatory layers											
	No pavement											
	Drainage or Other											
	Barrier construction and reburial											
Other types of remains: (from Form Part 3)	Walls											
	Stairs											
	Light wells											
	Columns or bases in situ											
	Stone elements											
	Plasters											
	Other											
	TOTAL material for reburials											
	Teams' Work Days											

TOTAL Work Days/1 Technician	
TOTAL Work Days/1 Worker	

Document 9: Evaluation of Materials for Reburial of Mosaics

Reburial is a protective conservation measure practiced frequently on archaeological sites to reduce the environmental fluctuations (primarily wetting/drying and heating/cooling) that cause deterioration of ancient remains. It is advocated as a more sustainable and economically feasible approach to site conservation, compared to the construction of a shelter for example, because of its potential for creating a more stable environment at a much lower cost. However, to keep transportation costs low, it is often carried out using materials readily at hand near the site without considering their characteristics and properties.

Reburial is only effective if the stratigraphy is properly designed using suitable materials. It is recommended that materials are tested in advance of specification, purchase, and placement, particularly for medium- and long-term reburials, to ensure that they do not create a reburial environment that contributes to the deterioration of the site remains. The performance criteria listed subsequently are for the protection of inorganic ancient materials such as stone, ceramic, and mortar. Organic materials require very different reburial environments, and they are not treated here.

Described in this document are simple field methods of evaluating the properties of potential reburial materials to confirm their suitability and compatibility for use to protect inorganic porous building materials commonly found on archaeological sites. The most important property of materials used in reburial is their capacity to allow liquid water transport so that moisture can move freely from the ground through the architectural feature and the reburial stratigraphy and vice versa, thus avoiding, or at least reducing, localized salt crystallization within (or at the interface of) reburied materials due to the possible presence of soluble species dissolved in ground water.

Soil and sand are common fill materials used for reburial, but their water transport properties can vary considerably depending on their grain size distribution and other characteristics (e.g. clay content). Separation membranes such as plastic netting and synthetic woven and nonwoven fabrics, including geotextiles (specialist products designed for geotechnical applications), are often included in reburial stratigraphies. These may be used to prevent mixing of different fill materials, but they may cause unintended negative consequences for the reburied remains if not selected carefully. For long-term reburial, they may not be needed. As geotextiles are made from hydrocarbons, their manufacture incurs an environmental cost from oil extraction, and consequently it should be an ethical obligation to exclude them when not necessary. There is also the practical issue of an unnecessary expense of purchasing such a specialized material that is often imported.

Separation membranes are sometimes included as an archaeological horizon marker to alert future archaeologists reexcavating the site of past excavation. They are not strictly needed, if previous excavation records are deposited in a secure archive. Archaeologists should also be able to distinguish the difference between an unexcavated site and one that has been reburied, through the nature of its stratigraphy, or by using a material during reburial that is not a membrane (e.g., non-contextual object or layer of sand) to provide evidence of encountering an unexcavated or previously reburied level.

In new excavations, reburial should be considered at the outset, in readiness for the potential discovery and management of important features. This means that soil from the excavation should be retained, on site, for reuse as a fill material. In this case, it should be covered with a tarpaulin to prevent contamination with vegetal material.

Materials chosen for reburial need to fulfill the following general requirements to enhance the compatibility with the archaeological materials on site, as outlined more fully in Document 6: Basic Principles and Materials for Reburial.

- Fill materials should
  - Promote liquid water transport (**Test 1)**
  - Not provide additional sources of soluble salts (**Test 2)**
  - Not provide additional sources of free metal ions
  - Ensure chemical stability by having a pH that is compatible with the pH of materials to be reburied, or a pH close to neutral (**Test 3)**
- Separation membranes should
  - Promote good water vapor transmission (some manufacturers provide this on their data sheets; nonwoven, needle-punched geotextiles should be most permeable) (**Test 4**)
  - Act as an effective physical barrier against the finest grain sizes of the fill materials placed above it (**Test 5**)

Field Tests for Preliminary Evaluation of Reburial Materials

TEST 1: CAPILLARY WATER TRANSPORT OF FILL MATERIALS

Objective: Determine the capacity of a material to transport water by capillarity and maintain moisture stability

Note: High clay content of a fill material will enhance the capacity to absorb water but not to transport it.

Materials and equipment

- Samples of materials of interest: 400 ml
- Measuring beaker: 600 ml
- Tap water: 100 ml

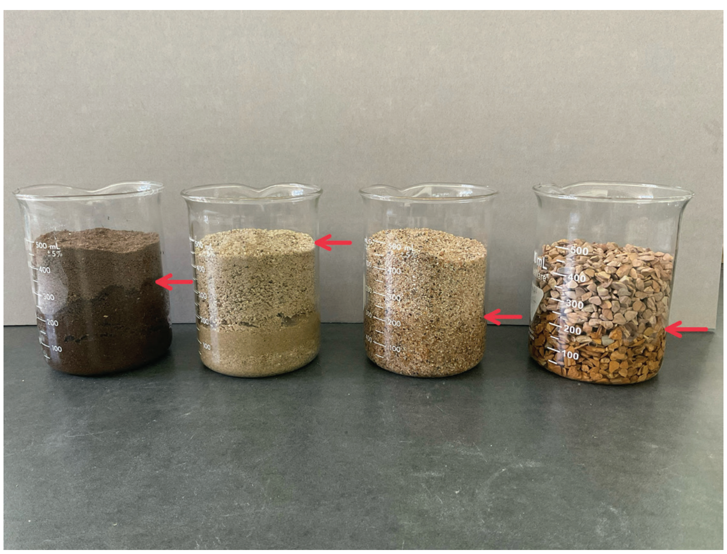
Procedure (repeat for each sample of fill material)

1 Pour tap water into the beaker.
2 Add the sample of fill material.
3 Leave for 1 hour.
4 Record the capillary height of water for each sample.

Evaluation

The preferred fill material is indicated by the sample in which the maximum height is attained by capillary rise of water.

The least preferred fill material is indicated by the sample with lowest height attained by water and by possible ponding of water at the bottom of the beaker.



TEST 1 *Example of different heights of capillary rise in soil, well-graded sand, large-grade sand, gravel. The well-graded sand shows best results for capillary water transport.*

TEST 2: SALT CONTENT OF FILL MATERIALS

Objective: Determine relative salt concentrations

Note: A conductivity meter requires calibration; salt indicator strips only determine their presence and so are not useful for comparing salt content between materials

Materials and equipment

- Portable conductivity meter
- Measuring beaker: 400 ml
- Samples of fill materials of interest: 100 ml
- Deionized or distilled water: 200 ml

Procedure (repeat for each sample of fill material)

1. Place fill material into beaker and add deionized or distilled water. Stir for 30 seconds and let it sit for 15 minutes.
2. Pour liquid into a clean cup through a fine mesh sieve.
3. Stir liquid again and test water with conductivity meter as instructed by the manufacturer.
4. Record results for each sample.

Evaluation

Materials with a conductivity measurement over 2 mS/cm may result in damage to reburied features over time.

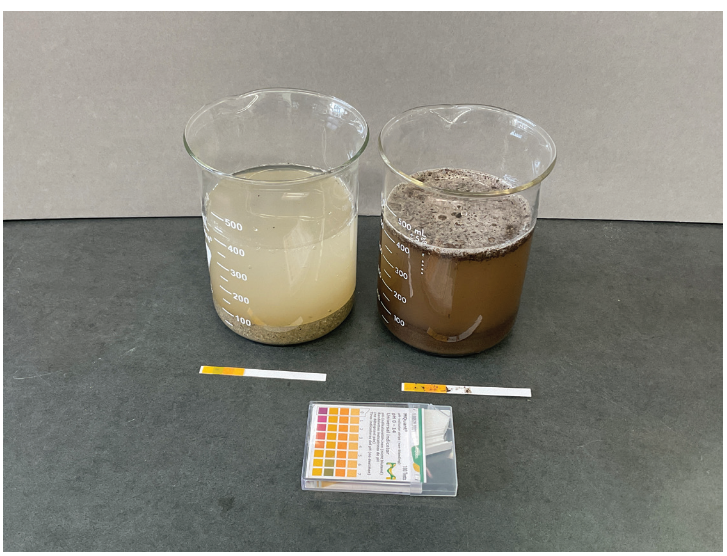
For normal soil/agricultural use, 0–2 mS/cm is considered salt free; 2–8 mS/cm slightly saline; 8–15 mS/cm moderately saline; >15 mS/cm strongly saline

Electrical conductivity is usually expressed as millisiemens per centimeter (mS/cm) or microsiemens per centimeter (μS/cm)

1mS/cm is equal to 1000 μS/cm

TEST 2 *Measurement of conductivity of filtered liquid from a soil sample*

TEST 3: pH OF FILL MATERIALS
Objective: Determine if the fill material is compatible with the pH of materials to be reburied, or a pH close to neutral Note: pH strips are preferred as a pH meter requires calibration
Materials and equipment
• pH indicator strips • Measuring beaker: 600 ml • Samples of fill materials of interest: 100 ml • Deionized or distilled water: 400 ml
Procedure (repeat for each sample of fill material)
1 Place fill material in beaker and add deionized or distilled water. Stir and leave to settle overnight or until suspended particles settle. 2 Test water with pH paper strip following the instructions of the manufacturer. 3 Record results for each sample.
Evaluation
Materials with a very different pH are to be avoided as these may result in damage to reburied features over time. pH of ancient building materials: • Limestone, lime mortar, and plaster: pH 7.5–10 • Brick: pH 9–10 • Gypsum: pH 7 • Sandstone: pH 3.5+ If pH compatible fill materials are not available, one with a neutral pH should be used.



TEST 3 *Measurement of pH of fill materials: well-graded sand and soil*

TEST 4: WATER PERMEABILITY OF SEPARATION MEMBRANES
Objective: Determine the relative liquid water permeability of membranes Note: Many membranes will not allow water to pass until saturated, so membranes should be thoroughly pre-wetted prior to testing.
Materials and equipment
• Samples of fill materials of interest for reburial (to be placed above the separation membrane in the designed stratigraphy) • Samples of separation membranes of interest • Manufacturer data sheets for each membrane sample if available • Sieve of large mesh size over a tray or other receptacle • Tap water • Measuring beakers
Procedure (repeat for each sample of fill material)
1 Immerse the separation membrane sample in water and squeeze out excess. 2 Place the separation membrane in a sieve above a tray. 3 Spread the fill material (e.g., 200 ml) over the membrane and gently compact the material well. 4 Pour tap water (e.g., 100 ml) slowly over the fill and wait one hour. 5 Measure the water collected by volume, in a beaker.
Evaluation
The membrane that allows the most liquid water to pass through is potentially of greater benefit.

TEST 4 *Water permeability test, evaluating a lightweight synthetic separation membrane, showing water and sand particles that have passed through the membrane.*

TEST 5: FILTRATION CAPACITY OF SEPARATION MEMBRANES
Objective: Determine the capacity of a membrane to prevent fill materials from mixing with a different fill material below Note: Many membranes will not allow water to pass until saturated so membranes should be thoroughly pre-wetted prior to wet testing
Materials and equipment
• Samples of fill materials of interest for reburial (to be placed above the separation membrane in the designed stratigraphy) • Samples of separation membranes of interest • Manufacturer data sheets for each membrane sample if available • Sieve of large mesh size over a tray or other receptacle • Tap water • Measuring beakers
Procedure—dry (repeat for each potential fill material for each membrane)
1 Place the separation membrane in a sieve above a tray. 2 Spread the fill material over the membrane and gently press to encourage fill material to pass through the membrane. 3 Measure by volume the material that passes through the membrane.
Procedure—wet (repeat for each potential fill material for each membrane) (Can be carried out concurrently with Test 4)
1 Immerse the separation membrane sample in water and squeeze out excess. 2 Place the separation membrane in a sieve above a tray. 3 Spread the fill material (e.g., 200 ml) over the membrane and gently press to encourage fill material to pass the membrane. 4 Pour tap water (e.g., 100 ml) slowly over the fill and wait one hour. 5 Collect material that passes and separate with filter paper and dry the fill solids. 6 Measure the fill material collected by volume in a beaker.
Evaluation
The membrane that allows less fill material to pass is potentially of greater benefit.

TEST 5 (DRY) *Filtration test, showing the finest particles that have passed through the membrane (approx. 3x volume than that of wet test).*

Document 10: Guidance on Reburial of Mosaics on Reinforced Concrete

Reinforced concrete consists of a cementitious mortar and aggregate containing steel rods ("re-bar"), usually in a grid pattern, with the intention of increasing the tensile strength of the concrete for general building construction. This technique was commonly adopted in the past for the relaying of detached mosaic pavements for presentation. Unfortunately, in many cases this has caused damage to the mosaic panels over time. This is due to the ingress of moisture into the concrete, causing corrosion of the rebar. It results in cracking of the concrete and the tessellatum attached to it.

If such a mosaic panel is reburied, the presence of moisture and oxygen in the fill material will likely accelerate corrosion of the rebar.

Therefore, it is important to determine if rebars are present in relaid mosaic panels. If they are not already visible, simple metal detectors can be used to determine whether they are present. If so, additional treatments are needed prior to reburial.

Removal of concrete backing and relaying of the mosaics on a lime mortar bedding is the preferred long-term solution. However, this is a costly and complicated process requiring the transport of the mosaics to a conservation laboratory. Alternatively, there are in situ maintenance options that may allow for the safe reburial of mosaics on reinforced concrete.

If the corroded rebar is exposed, its surface can be treated by removing the corrosion products as much as possible and applying a protective coating, such as a commercial rust convertor/inhibitor, to help slow down the corrosion process.

If the metal corrosion is advanced and the surrounding mortar has fractured, a more intensive treatment to locally remove the corroded rebar may be necessary. The tessellatum is opened up in the area of damage, with the aid of gauze facing and adhesive to hold the tessellatum together. The exposed and corroded rebar are then removed with hand tools. Once the corroded rebars are completely removed from the panel and the tessellatum is reset in place in a new cementitious bedding mortar, the mosaic panel can be more safely reburied for the medium to long term.

In some cases, the structural damage to the mosaic support panel is so severe that it requires the removal and replacement of the reinforced bedding in order to preserve the tessellatum. In this case, the mosaic backing will need to be replaced by new lime mortar foundations.

Reburied mosaics on reinforced cement should ideally be specifically inspected for signs of rebar corrosion damage as part of the site's monitoring and maintenance program. If renewed corrosion and deterioration is observed, then the decision should be made to locally remove the rebar or to remove the entire reinforced concrete backing and replace it with new lime mortar foundations.

Document 11: Reburial Inspection Form

DATA FORM—REBURIAL ASSESSMENT	
	MOSAIC ID: / /

With this form, there should be a context photograph and a building plan indicating the location of the room and the reburied area.

SITE:			
BUILDING:		ROOM:	

☐ Mosaic on original bedding	☐ Lifted and re-laid mosaic
Date of mosaic excavation:	
Dates of mosaic conservation interventions:	
Date of mosaic reburial:	
Reburial surface area:	
Reburial carried out by:	
Type and frequency of maintenance:	
Location of inspection area:	
Size of inspection area:	

REBURIAL DESCRIPTION *(fill materials with their thickness and separation membranes in order from the top to the mosaic)*

Method of reburial containment:		
☐ fill material		
☐ separation membrane		
☐ fill material		
☐ separation membrane		
mosaic level		Reburial total thickness:

REBURIAL CONDITION

☐ Presence of vegetation	☐ Loss of fill materials
☐ Evidence of animal activity	☐ Deterioration of the separation membranes
☐ Evidence of vandalism	☐ Deterioration of the reburial containment method
☐ Presence of moisture inside the fill material	Presence of moisture: ☐ under separation membranes ☐ over separation membranes
☐ Presence of moisture in the separation membranes	

Observations on the Reburial and Possible Damage to the Mosaic due to the Reburial

General observations: Observations on the inspection area:

Information sources:	

Prepared by:		**Date:**	

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