



# Unbridled Development of Urban Space and its Implications for the Preservation of Landmarks

## The Morro da Queimada Archaeological Site, Ouro Preto, Brazil

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The process of expansion of urban centers in Brazil has been distinguished by the complete absence of planning. As a result, urban environments lead to land uses encroaching on, defacing and destroying landmarks. Attention is given to the Morro da Queimada Archaeological Site. This represents an important cultural heritage of the 1720 movement of secession during the gold rush. Several ruins of mining equipments such as houses, wells, shafts and galleries have been gradually destroyed. The process of the site's loss of distinct character has been monitored since 1950 using aerial photographs and cartography. Collected data indicate a conservative annual land-use change rate of about 1.5%. This rate points to the complete destruction of the site in 2008. This paper proposes the creation of the Morro da Queimada Historical Park, within the limits of the remaining set of ruins. © 2001 Published by Elsevier Science Ltd.

### Introduction

The lack of planning that characterizes urban centers in Latin America, especially related to the process of expansion, is one of the chronic problems that has affected various Brazilian cities to a lesser or greater extent. Owing to various factors, this process of unplanned settlement began in Brazil at the end of the 1950s, and evolved in different ways in different regions. This evolution is controlled by socio-economic and political factors. At the end of the 20th century, it came to be a challenge for public officials, and is in large part responsible for the urban chaos that can be seen in many Brazilian cities.

In a general sense, this process may be conveniently considered to be an anthropogenic disturbance because it causes a series of environmental prob-

lems such as pollution of the underground water table due to the complete absence of sewage systems and superficial waste exposures that pollute the surface waters.

According to the Brazilian Institute of Geography and Statistics, 53% of the total population lived in urban areas in 1970. This rate increased very quickly, reaching 81% in 2000. It is important to point out that annual population growth rate decreased, for the same period, from 3% in the 1970s to 1.6% in 2000. The data clearly indicate that the migration process is in the main responsible for the saturation of Brazilian cities. The new urban inhabitants are generally low-income and the migration process reflects a search for better living conditions.

In general, land-use planning was not enough to prepare the urban space to accommodate this new population. In many cities, this kind of planning simply did not exist. Additionally, successive economic crises have affected the country with impoverishment

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of a great number of Brazilian citizens. As a consequence, the worst results of this process are poor quality of life due to the "slummification" of neighborhoods without adequate infrastructure and appropriate public areas, and the exposure of inhabitants to natural hazards such as floods and landslides. The cruelty of this process may most clearly be seen in the extent to which Brazilian citizens are subjected to unsafe living conditions, which are systematically ignored by public officials.

The city of Ouro Preto, Latin America's most acclaimed landmark (Fig. 1) is an example of this process of unplanned settlement with its attendant problems. It is a city of 45,000 inhabitants in which this situation has been aggravated as a result of the extremely irregular topography that characterizes the entire urban area, the unfavorable geotectonic aspects of the bedrock and successive human interventions in the physiography of the area.

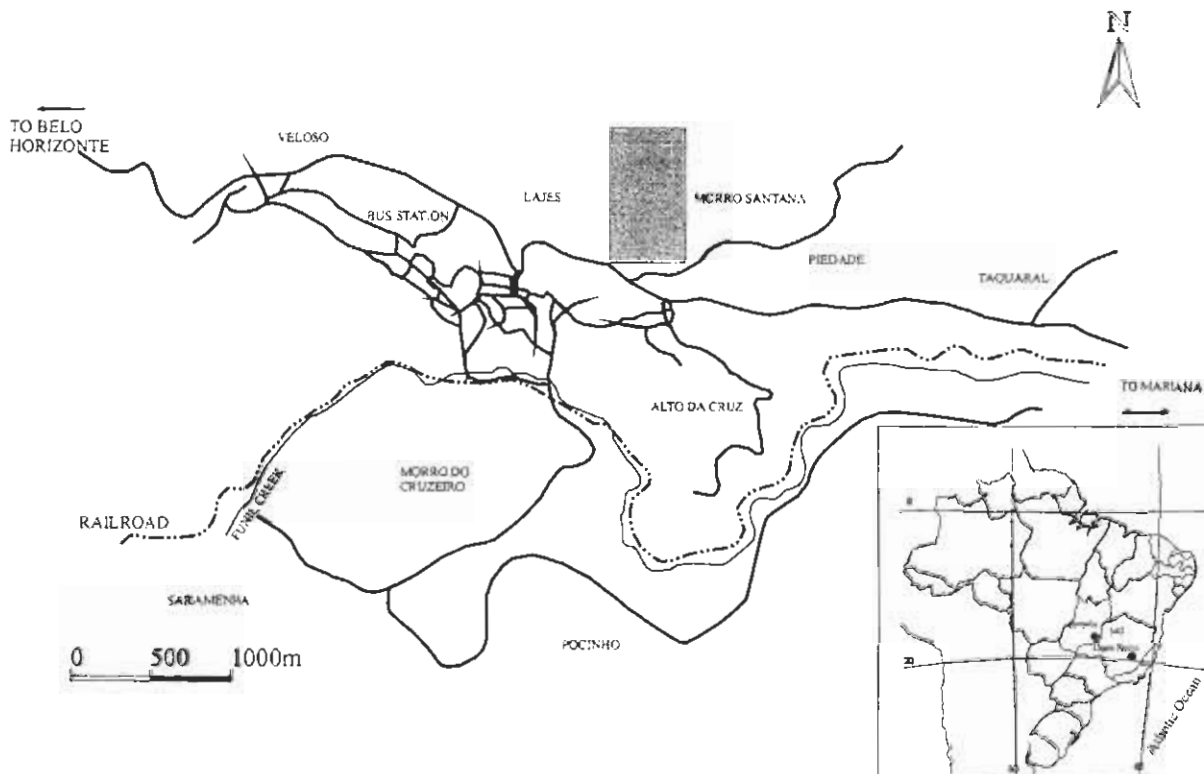
This paper will address an aspect occurring as a result of this process: the consequent defacement and ensuing destruction of landmarks and historical sites. Specifically, it will draw attention to the case of Morro da Queimada or Arraial de Ouro Podre. This area constitutes the original urban center that later became the Arraial de Vila Rica (presently called Ouro Preto). After a brief diagnosis of urban occupation in Ouro Preto, this paper will analyze the process that has been taking place in the aforementioned

area. The historical basis for the preservation of this area will also be offered as well as a proposal for the creation of a Historical Park that will preserve the existing archaeological material. In addition, it will serve to emphasize the importance of gold mining in the 18th century and the social turmoil of 1720, which has, in large part, remained ignored by Brazilian society.

### Diagnosis of the problem of urban settlement in Ouro Preto

The historical city of Ouro Preto has its origins in the discovery of gold at the end of the 17th century. The city achieved its apogee in political, economic and historical terms at the end of the 18th century. Gold mining was the basis of its economy during this period. The intense search for gold affected the entire region in which the city is located today, especially the Ouro Preto range, the northern portion of the present day urban area. According to the Fundação João Pinheiro (1975), the local population during the period was approximately 150,000, not counting slaves, who had as their principal function the mining of gold.

Gold was initially searched for in alluvial areas. Later on it was extracted from host rocks which in large measure underlie the area in which the city is now located. This can be confirmed by observing



**Figure 1** Ouro Preto urban zone. The Morro da Queimada site is indicated by the shaded rectangle

excavations that are found throughout the area. The mining process entailed the construction of underground openings and wells, which usually followed mineralized veins. The process also involved the extraction of gold from iron formations that existed in nearly the entire range, from Ouro Preto to Mariana. Consequently, in many areas located in the Ouro Preto range, gold mining activities substantially altered the landscape and the original hydrological regime. These activities destabilized the soil and accelerated the process of evolution of the slopes. The rearrangement of such a large volume of material, the diverting of natural drainage and the excavation of innumerable galleries and wells constituted the principal practices of the period.

After the gold had been exhausted, economic and political decline set in, the population had declined, and, as result, these areas had been abandoned, human intervention ceased, and a certain balance was achieved. Thus, the process of evolution of slopes came to be influenced only by natural agents. Although these alterations in the area had accelerated this evolution, it may be assumed that the evolution of slopes in the Ouro Preto range did not have a direct anthropic contribution at least until the beginning of the 1970s. Nonetheless, there remain throughout the range various structures of earlier mining. At that time, the mining processes were rudimentary and did not take into account any technical planning, including geological and engineering concerns. Horizontal and inclined galleries were opened to reach the mineralized veins without any topographic control, thus forming real labyrinths, trying to follow the ore body. Shafts were excavated without care for safety, just being enough for just one person to get in. One of the main problems of mining at that time concerned water. Water was important to separate gold from the ore. Mining on the tops of hills was then subject to water supply. One of the mechanisms developed to store water was the building of small dams known as *mundeo*. The *mundeo* was a small circular or square reservoir, up to 10 m in diameter and 3–4 m deep, made up of rock blocks, joined together by means of sand and mortar. The *mundeos* were built in isolation or in series downhill. In its front wall, there is a narrow chink closed by a wood table that allows a controlled flow of water. Despite the lack of geological knowledge to support a technical mining operation, a series of sub-horizontal channels (about 1–3% declivity) were dug along the hills at different topographic levels and up to 4 km in lateral extension in order to provide water to fill the *mundeos*.

The ruins, galleries, wells, channels, *mundeos* and excavations are of inestimable archaeological, historical and cultural value and may highlight the history of mining in Portuguese America during the 17th century. This heritage — neither surveyed nor studied — remains unknown, despite its cultural and scientific value. Additionally, the ruins present a great potential for the tourism industry. One set of ruins can be seen

in present-day neighborhoods such as Veloso, Piedade, Alto da Cruz and Morro da Queimada. The latter neighborhood contains a large number of ruins and structures that represent a rich and controversial period in Brazilian history.

Beginning in the 1970s the problems of unplanned development that occurred to varying degrees as a result of growing urbanization in many parts of Brazil also affected Ouro Preto. The recent land use, therefore, is a second-generation process that interferes with the balance that the scarps had achieved and generates various risk factors. The unplanned settlement also poses problems for the city's heritage. Most of the city's heritage and geological landmarks have been destroyed or altered by new construction and are nearly impossible to recover or restore. The lack of public policies regulating the use of urban areas allowed most low-income individuals to use those former mining areas, which, in turn, created an impact on several historical sites.

There have been attempts to plan land-use in Ouro Preto during the past 25 years. The first one was worked out by Fundação João Pinheiro in 1975 but this plan gave attention just to the historical downtown, focusing on the architectural heritage and ways to improve civil and religious structural preservation. In 1982, with an agreement of the City Hall, the Federal University of Ouro Preto and The National Secretary of Cultural Heritage, a Geotechnical Map of the urban area was produced at scale 1:2000. This map was the most important document to provide a land-use policy in the city, but not all its suggestions and regulations could be applied due to the lack of a legal basis to their applications.

The second attempt undertaken by the City Hall in 1989. Unfortunately, due to political problems, this plan could not be concluded either (Sobreira, 1992a). In 1996, a new plan was developed by the City Hall, which encompassed a broader view of the problem, taking into account the encroaching process along the hills around the city. This plan also proposed an urban zoning based on physiographic, urban and architectural aspects. However, just like the others, most suggestions and policies were not applied due the lack of a legal basis.

### **Morro da Queimada historical background**

The ruins of Morro da Queimada are vestiges of a large mining center from the 18th century. It was first known as Morro do Ouro Podre. Later it came to be called Morro do Paschoal da Silva, as a reference to the area's most affluent landowner. The present name Morro da Queimada (Burned Hill) is a reference to an episode in which D. Pedro Miguel de Almeida Portugal, the Count of Assumar - the Governor of the provinces of São Paulo and Minas Gerais beginning in 1717 — ordered that the area should be set on fire as a punishment for the members of the movement of secession of 1720, most of whom lived there

(Vasconcellos, 1904; Veiga, 1897). The leaders of the rebellion were mostly affluent Portuguese nationals who opposed the crown colonial policies in Minas Gerais and the ways in which the Count of Assumar administered the province. The leader of the movement was Paschoal da Silva Guimarães, one of the richest local miners, the owner of the majority of businesses related to trade, and owner of a large number of slaves.

This historical episode, known as the Vila Rica sedition, highlights the Morro da Queimada's role as one of the oldest historical sites in Ouro Preto. It also emphasizes its importance as a point of reference for future studies in the history and archaeology of 18th century mining.

### **The destruction of the historical site of Morro da Queimada (1950–1998)**

Similar to other places with ruins and remains of enormous historical and cultural value in the Ouro Preto, the Morro da Queimada site has been gradually destroyed. The Morro da Queimada's ruins are scattered in a 250,000-m<sup>2</sup> area that has not been deeply affected by mining activity. According to preliminary research, this area potentially has rich archaeological material that is essential for the reconstruction of the mining history in the region. However, large parts of the original area of Morro da Queimada were used and many of its ruins were destroyed in the process of preparing the terrain for new construction. Areas that had been previously "recomposed" were also utilized as either foundations or parts of new houses, and the rocks that were part of the ruins were "recycled" as construction material. In the majority of the cases this sort of human intervention has permanently damaged the area's heritage and historical sites. Nonetheless, this process is advancing towards yet other structures, and, judging by the present-day situation, very soon houses will take over the whole area.

Establishing the original boundaries or limits of the Morro da Queimada site is a difficult task. A countless series of walls, houses and ruins, as well as galleries and shafts, are scattered along the Ouro Preto range between the present urban nucleus and the Passagem de Mariana village. It is not known whether the whole set of ruins is of about the same age as the original Morro da Queimada site, or if some of them had been built later. Most of them are, however, con-

temporaneous with the main period of mining activity in the 18th century.

A concentration of ruins still exists in the upper part of the Morro da Queimada site. The cartography of those ruins has revealed vestiges of houses, walls and mining equipment (Figs. 2 and 3). The ruins are north of 15th August Street (Fig. 4), covering an area of about 250,000 m<sup>2</sup>. The area is limited to the north by the top of the Ouro Preto range and to east and west by scarps that were created from the mining excavations. The only place where a similar set of ruins can be found is at the Passagem de Mariana village. Dwellers tell about the removal of blocks of canga, a ferruginous lithified surficial rock, from the ruins to be used in the building of new houses during the 1960s and 70s. This process can still be seen in the use of ruins as bases for new houses or parts of ruins in new buildings (Figs. 3a and b).

The study presented here was based on comparative analyses of aerial photographs and other available cartographic bases from different periods. The following cartographic bases have been used: 1950 aerial photographs (flight by Cruzeiro do Sul, scale 1:25,000), 1969 aerial photographs (flight by Cruzeiro do Sul, scale 1:10,000), 1986 aerial photographs (flight by Esteio, scale 1:30,000) and 1986 orthophotos (flight by Esteio, scale 1:10,000).

The aerial photograph analysis involved the interpretation of a pair of photos with stereoscopy with ocular 3x. The methodology applied consists of a definition of the area used for each span of time measured and its proportion to the total area considered. The measurement is done carefully, taking into account the relation between the distance of fixed and unchangeable points and the settlement front. Distances are measured with the help of a stereo micrometer and later compared to pairs of different dates. By linking the points that define the settlement front, a polygonal that represents the land-use area in given period is obtained. Although some distortion exists due to the conical projection of the aerial photographs, measured and calculated values can be taken as acceptable due to the scope of the analysis and also due to the speed of the transformations.

Observations are complemented by a topographic survey carried on in 1998 in order to evaluate the actual condition of those ruins. The topographic survey was carried out by plane-table mapping with electronic alidade E-RK at a scale of 1:1000. Results of

Table 1

Monitoring interval	Total used area (sq m)	Use %	Time interval (y)	Annual land use rate %	Total land use rate %
1950-69	10,800	4,3%	19	0,22	0,22
1969-86	65,700	26,3%	17	1,3	0,70
1986-97	175,000	68,2%	11	3,8	1,45
total	250,000	-	47	-	-

(a)



(b)



**Figure 2** Aspects of the ruins of the Morro da Queimada site. The ruins are mainly composed of "canga", a lithified surficial rock formed of detrital fragments cemented by goethite. One may find ruins of houses, walls, *mundeos*, channels and other mining equipment

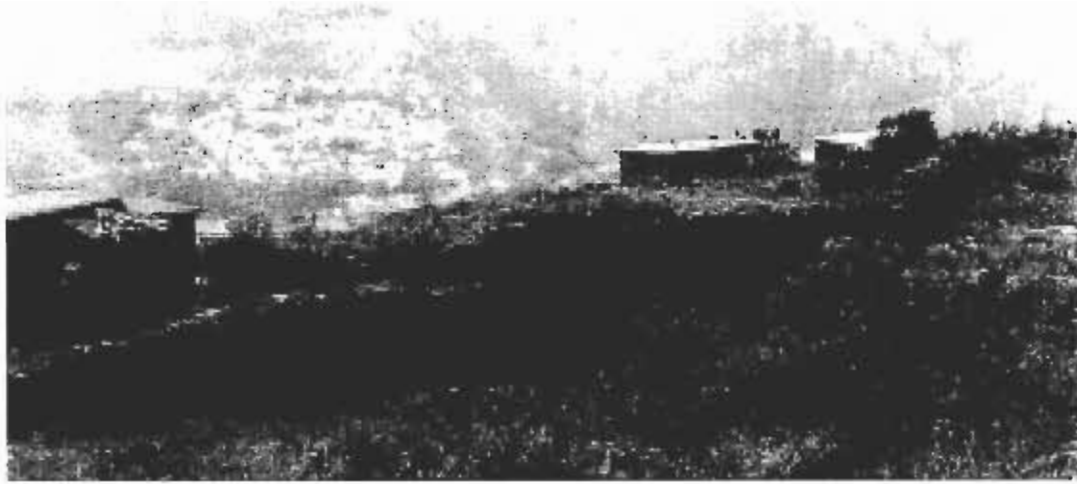
the plane-table mapping were plotted on the same basis of the aerial photographic survey.

All cartographic data were digitized to produce an integrated map with a uniform scale. By comparing

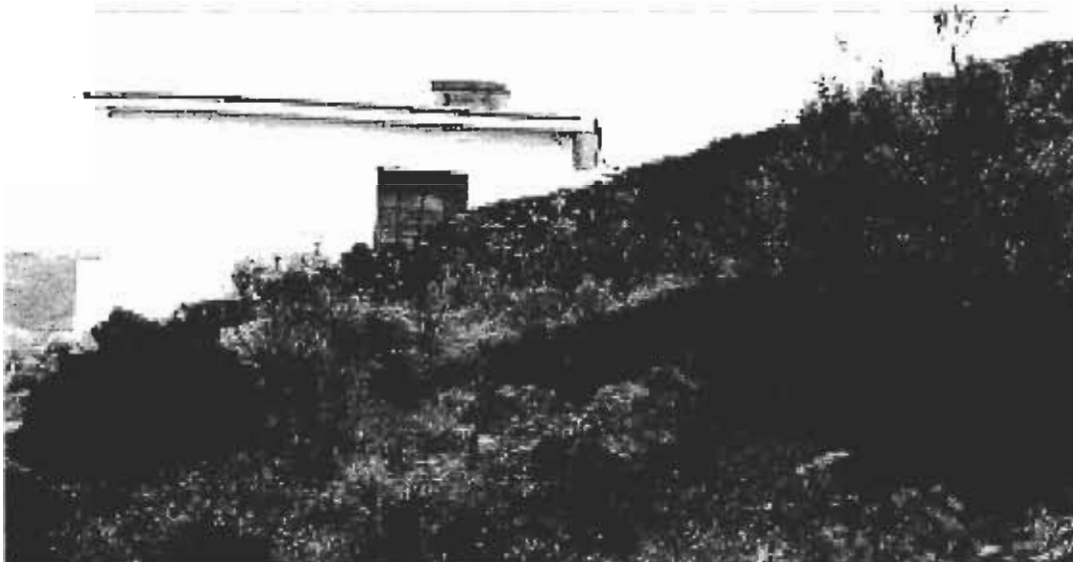
results obtained from different times it was possible to get a diagnosis of the evolutionary process of the area and an analysis of the annual land-use rates.

A 36-year period of monitoring of the area coupled

(a)



(b)



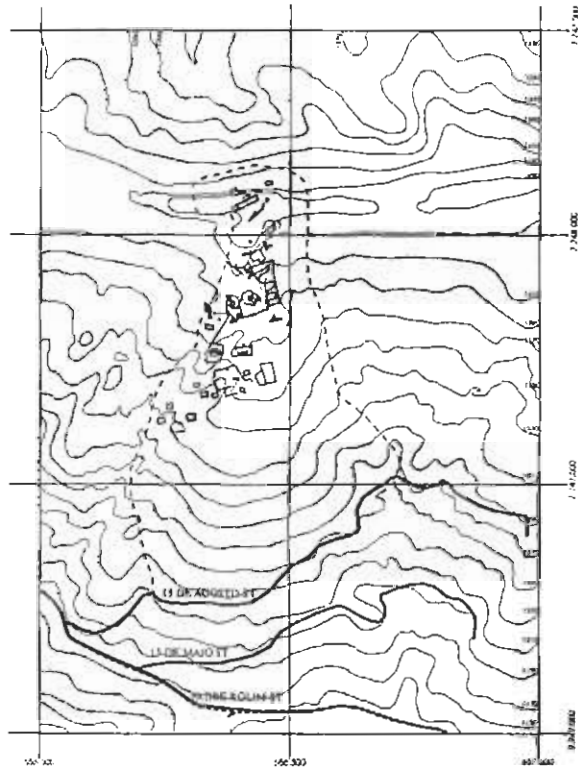
**Figure 3** Photographs of recent use of the Morro da Queimada site. Recent land-use is achieved by the removal of ruin fragments for new buildings and also by new buildings in the middle of the site

with the 1998 topographic survey, provided an analysis of the area for 47 years. By determining land-use rates for periods of 19, 17 and 11 years, a median rate for the five decades was obtained. Fig. 5 and Table 1 represent the land-use evolution and calculated land-use rates.

Looking at the 1950s photos, one can see the absence of land use north of August 15th Street. Land was, however, partially used to the south of this street with low-density land use concentrated especially

north of Conselheiro Quintiliano Street. All the area which is now the Morro da Queimada, Morro Santana and Piedade and part of the Alto da Cruz neighborhoods was preserved from recent human interference. Ruins could be found in every natural relief, especially where the Morro Santana neighborhood is now.

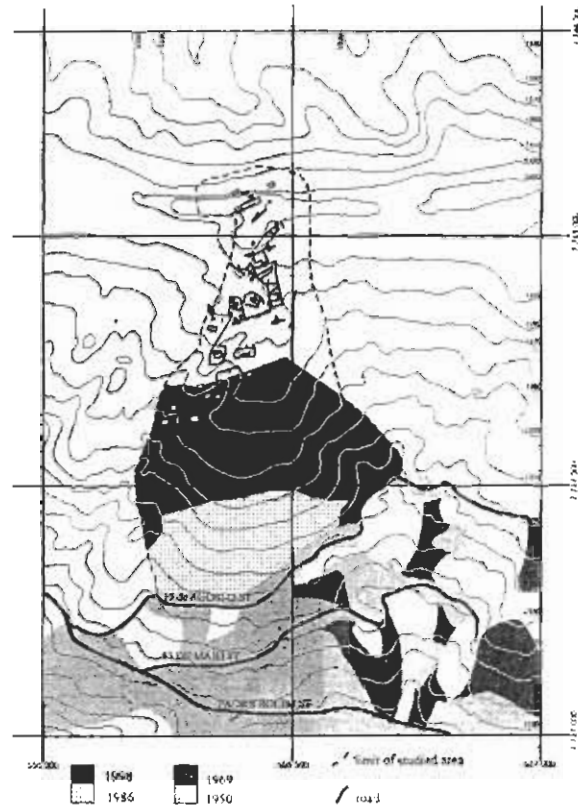
In 1969, the situation had clearly changed. The northern part of August 15th Street was beginning to be used, whereas on the southward side of that street,



**Figure 4** The ruins of the Morro da Queimada site in detail. The area delimited by August 15th Street and the dotted line encloses the remaining set of ruins (north). The southern portion of the site has been completely used (see Fig. 5). Contours in meters

the area was completely used. Most of the houses were small with low-quality building materials. Land use at that time reached 4.3% of the total area (approximately 10,000 m<sup>2</sup>). For the analyzed period (1950–1969), the land-use rate was thus 0.22%. Regarding the Morro Santana neighborhood, the vicinity of the main street (August 15th Street) was partially used and a great part of the ruins had been destroyed. The Piedade neighborhood did not exist at that time. The end of the 60s marks a more pronounced period of settlement, which also was not accompanied by urban planning.

1986 aerial photographs and orthophotos indicate consolidated urban use around August 15th street. Used area represented 26.3% of the total area (less than 70,000 m<sup>2</sup>). For the time span (1969–1986) the annual land-use rate is 1.3% and 0.7% using as a base the time span 1950–1986. The set of ruins had not, however, been affected by any human interference, excepting the interference situated along the August 15th Street. The Morro Santana neighborhood settlement had, at this time, been completed with only a few vestiges of ruins. The Piedade neighborhood had also been established. Several problems related to slope stability along the Ouro Preto range were



**Figure 5** The evolution of the Morro da Queimada land use since 1950. A conservative estimate of the annual land use rate (1.5%) of ruins of the Morro da Queimada site indicates that it will be completely destroyed before 2008

already known, and some of them had been analyzed in detail at this time (Carvalho, 1982; Sobreira, 1990; Sobreira *et al.*, 1990).

The 1998 topographic survey and present field observations indicate that 68.2% of the total area is presently used (1,750,000 m<sup>2</sup>). This results in a land-use rate of 3.8% a year (1986–1999) or 1.45% a year (1950–1999). A significant part of the set of ruins has been completely destroyed, with the population density decreasing towards the north. The degree of human intervention is such that the possibility of urban rehabilitation seems unreasonable (Fig. 6). The Morro do Santana and Piedade neighborhoods are consolidated, and the lack of planning and effective public action have led to geological risks as the common process within these areas (Sobreira, 1992b; Fonseca and Sobreira, 1997; Sobreira and Fonseca, 1998).

Taking into account the whole observation period (1950–1999), the annual land-use rate is about 1.5%. This value, however, is not a representative one because, as has been clearly demonstrated, the annual rates accelerate with time. Simply taking the present rates and assuming them to be constant in the short term, the whole area will be totally used in 10 years.



(a)



(b)



**Figure 6** The visual effect of encroaching process. By comparing photographs from 1990 (photo A) and 1998 (photo B), it is possible to measure the speed of unplanned land-use. Take the highest point on both photographs for reference. At the top of both photos is the remnant set of ruins

Although this model may change, the fact is that land use has reached the main set of ruins at the Morro da Queimada neighborhood, and each intervention represents damage to the cultural heritage of the city.

### Conclusions and recommendations

Field and aerial photographic surveys indicate a clear process of "slummification" within neighborhoods of Ouro Preto City. Most of these areas are former mining areas and contain vestiges of ruins of the gold rush in Brazil in the 18th century. In the Morro Santana neighborhood, only a small set of ruins remains undamaged at the Morro da Queimada site. Projection of the annual land-use rates and the lack of public policies regulating the use of urban areas point to the complete destruction of the ruins at Morro da Queimada before 2008. Experience indicates that there is no reason to expect significant change of the official public posture that would include a more rational policy

or urban planning. Therefore, it is absolutely necessary to take steps to stop the land use process of the Morro da Queimada. The only effective way to avoid the ensuing destruction of the site is to delimit a *non-edificandi* area that would include the small remnant of the set of ruins. This area may conveniently be defined according to the following UTM coordinates (central meridian 23°), indicated in Table 2.

The remnant area represents just a small part of the big "Arraial do Ouro Podre" and should be transformed into the "Historical Park of the Morro da Queimada". By creating this park, it would be possible to rehabilitate the historical site, which would include the partial reconstruction of the 1700 gold era. This park would certainly be included in the Minas Gerais state historical routes. Additionally, it can be transformed into a historical and archeological study center in which information and exhibits about the 18th century gold rush and contemporaneous social movements can be made available. Owing to the social and econ-



Table 2

Station	Utm1	Utm2
1	665585	7747750
2	665570	7747835
3	665550	7747900
4	665525	7748120
5	665435	7748145
6	665312	7748110
7	665325	7748050
8	665387	7748040
9	665355	7747875
10	665325	7747825
11	655320	7747760
12	655255	7747725
13	655387	7747750

omic crisis now existing in Brazil, the only way to make this park become a reality is through the synergy between public and private efforts in the building of a self-sustaining project.

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