

## Irrigation Systems Around Umm Qays

### 1. Introduction: Survey Area and Aims

An archaeological pilot survey was carried out between 19 October and 1 November 2008 in the Liwā' Bani Kinānah region, located north-west of Irbid in northern Jordan<sup>1</sup>. This region is significant because of the Decapolis sites of Umm Qays and Abila, as well as other remains of the Hellenistic, Roman and Byzantine periods. The focus and starting point of the survey was the landscape north-east and north-west of Umm Qays. Some sites and areas further east were also included, in order to assess the connections of this more remote area with the main cities during the periods under consideration, as well as for reasons of heritage management.

Archaeological studies of Umm Qays have focussed on the town and some parts of the surrounding landscape, but northern and north-eastern parts of its envisaged territory and agricultural resource area have hardly received any attention. For this reason, a pilot survey focussed on irrigation was undertaken in the region north and north-east of Umm Qays, as well as some parts of the Liwā' Bani Kinānah district between the Yarmouk river and main road from Umm Qays to Irbid. Liwā' Bani Kinānah covers an area measuring approximately 25 by 16 km.

This project was undertaken with the support of the Department of Antiquities of Jordan (DoA), especially then Director-General the late Dr Fawwaz al-Khraysheh and departmental representative Mr Jihad Harun, and Yarmouk University (YU) at Irbid, especially Professor Zeidun al-Muheisen. We are most grateful to them for their interest and assistance<sup>2</sup>.

Owing to the water sources, agricultural soil and areas of grazing in the surrounding hilly landscape, we can assume that the study area was of significant value to its inhabitants. At the outset of this study, it was deemed important to develop a body of knowledge about (1) how the landscape was used and affected by communities practicing irrigation, (2) what kind of irrigation systems were feasible in the landscape, (3) what the influence of irrigation was on socio-economic aspects of society, (4) how the remains of ancient irrigation systems can be dated and (5) whether these remains can be associated with any historically known population group.

Some previous surveys have been undertaken in the region but, as far as is known, there has been no work on ancient irrigation works or channels. Some publications mention recent irrigation systems which were and are used by local people in areas where water sources are sufficient for this purpose (Schumacher 1888: 152; Glueck 1951: 133; al-Karaimeh forthcoming). Other studies mention an underground channel which was supposedly used to supply water to some of the Decapolis cities in the region (Hoffmann and Kerner 2002: 129-135; Döring 2007: 24-35).

Gottlieb Schumacher surveyed the area several times. His first survey of 1884 concentrated on the area north of the Yarmouk river (western Hauran and eastern Jaulan), while the area south of the river received little attention (Schumacher 1886). His second survey focussed on the Yarmouk river area, where the railway from Damascus to Haifa was to be constructed (Schumacher 1888). The third survey was of Abila, one of the Decapolis cities

<sup>1</sup> The province of Irbid contains five districts (Ar. *liwā'*), amongst them Liwā' Bani Kinānah.

<sup>2</sup> Special thanks are also due to the manager of the DoA Umm Qays office, Mr Salameh Fayad, as well as to Muwaffaq al-Bataineh

(survey and FIG. 2) and Yousef Zoobi (FIG. 11) from YU. We are also grateful to our locally employed team of Hassan and Salah al-Karaimeh and Mustafa Masarweh. Mr Tiziano Goossens of Archol at Leiden designed the finds card.

(Schumacher 1889). Finally, he surveyed northern 'Ajlūn<sup>3</sup>, including the Decapolis which he mapped, giving detailed descriptions of villages, ancient sites, wadis and other features in the region (Schumacher 1890).

Nelson Glueck surveyed the western area, including the eastern tributaries of the Jordan river, Wādī al-Yarmouk and Wādī al-'Arab between 1945 and 1949 (Glueck 1951: 125-184). He described ancient sites such as Tall Ḥilyah and Tall al-Ḥuṣūn (see *Section 3* below). Furthermore, he mentioned that the inhabitants of several villages in the area irrigated their fields from springs.

James Mellaart and Henri de Contenson surveyed the Yarmouk region in 1953. Their survey concentrated on the banks of the Yarmouk river, where a number of archaeological sites were threatened by planned irrigation schemes for the Jordan Valley. Sites mentioned include Tāll Jāmid, dated to Early Bronze I-II, and Tall Qurṣ. A number of flint-scatters were also identified (Mellaart 1962). De Contenson aimed to complete the previous survey by adding more sites and details about the material culture (De Contenson 1964).

Kerestes, Lundquist, Wood and Yassine put together a team that surveyed three areas where dams were due to be built in the Yarmouk, Zarqā' and Wādī al-'Arab valleys. They identified 31 sites in the Magarin reservoir area by the Yarmouk River, which yielded archaeological material dating from the Palaeolithic to Ottoman periods (Kerestes *et al.* 1978).

All studies in the Liwā' Banī Kinānah region, including the current one, have yet to provide a complete picture of the area because only small sections have been studied at a time. The region is archaeologically rich, making it attractive to researchers. Additionally, modern agriculture and village expansion have destroyed or threaten to destroy many ancient sites in the region. An investigation of the whole area is therefore urgently needed. This study therefore has two aims: (1) to carry out a detailed examination of irrigation activities around Umm Qays and (2) to assess the vulnerability of a number of sites further to the east, whether described by Glueck or not, that have extensive remains of the Hellenistic and Byzantine periods, with some focus on water management.

The current focus on irrigation systems came out of a small ethno-archaeological study of current irrigation in the Liwā' Banī Kinānah region (al-Karaimeh, *forth coming*). An archaeological pilot survey was needed to investigate systems supposed to have been used in the past. Such a survey would need to collect and record evidence from ancient activities that were related to past irrigation systems, water installations (e.g. reservoirs, cisterns, canals), agricultural land and settlements (insofar as they related to water management and cultivation). After the pilot survey, further surface exploration with the same aims and methods would be needed.

Pottery sherds and other artefacts were collected in and around areas where irrigation and water installations are located. In addition, off-site features and structures were also documented. The focus of the study is on the domestic landscape, with a view to interpreting the activities of societies that lived there in the past. The archaeological data are used to analyse the relationship between these societies and the landscape. Consequently, the irrigation systems and other agricultural installations are studied not only technologically, but also economically and socially with the aim of understanding society as a whole. The project therefore includes an anthropologically-oriented comparative analysis.

During the survey, data were collected from the remains of water installations and settlements of many periods. However, the chronological focus of this study extends from the Hellenistic to Byzantine periods, with a possible extension into Umayyad times.

## 2. Survey Methodology

Modern surveys of landscapes and ancient sites have used many methodologies (cf. Renfrew and Bahn 2008: 73-106; Banning 2002; Bintliff 1996, 2000a; Kaptijn 2009). However, this pilot survey had very specific aims: to search for irrigation channels, structures and features related to agriculture and water management, water installations and occupation sites (e.g. villa, hamlet, extensive sites) in the landscape beyond the city walls of Umm Qays. For this reason, sites with structures were selected for sampling, while sherd-scatters were not. Furthermore, at this stage, the survey did not aim to

<sup>3</sup> Arabic place-names transliterated according to the Annual of the Department of Antiquities of Jordan system, except those taken

from references.

sample the whole area of Liwā' Banī Kinānah, but was designed to investigate some areas in the hinterland of Umm Qays that could provide specific information related to the research objectives. Selection of sites for detailed examination was based on the previous ethno-archaeological study of the area and information from local people about ancient water channels, water installations and settlements in the region.

The geographical location of the archaeological remains has influenced the sampling strategy. Some of the structures or sites were located in flat areas, others on slopes and others on hill— and mountain-tops (*ca.* 350 m above sea level). The basic approach was to sample the surface of a site, within the area defined by its structures. Thus, for channels, the surface of the channels and immediate surroundings were surveyed, but not the fields between them (see *Channels* below). This sampling strategy was designed to collect pottery sherds that could provide information on the date, intensity of use and function of the sites. It was also necessary to try to distinguish between sherds associated with the site itself and those washed in from other locations, especially for sites located on hill-slopes. In practice, three methods were used for sherd collection, according to site-type: (1) channels, (2) sites of < 2000 m<sup>2</sup> with remains of dwellings or water installations and (3) extensive sites with remains of dwellings.

#### *Channels*

Recognisable narrow channels and their immediate surroundings (3 m width) were divided into plots on the basis of location and curves. Each plot was then divided into three parts for surface collection, each part being 1 m wide and 50 m long. Part 1 consisted of the channel surface itself, while Parts 2 and 3 were 1 m wide strips along the right (marked +) and left (marked −) banks of the channel respectively. Each channel plot had starting and finishing points, but owing to erosion it was often uncertain where the channels actually started and ended. Nevertheless, the 50 m lengths defined in the survey were clearly visible sections of ancient channels.

#### *Sites < 2000 m<sup>2</sup>*

A second method was used to sample sites of < 2000 m<sup>2</sup> with visible remains of dwellings or water installations. The site was divided into four plots

(A, B, C and D), on the basis of two lines crossing in the supposed centre of the site. This method was chosen because such sites tended to be both small and located close to the channels.

#### *Extensive Sites*

Extensive sites were divided into three areas (A, B and C) on the basis of site geography. Each area was further sub-divided into three plots (1, 2 and 3). This method was used, firstly, because such sites extend over large areas and, secondly, because site areas are typically variable in terms of slope and other characteristics. Some sites have been affected by recent human activity, such as looting or cultivation, including terracing for olive tree cultivation. In practice, the best way to sample these sites was to define each terrace as a plot.

### **3. Locations Surveyed (FIG. 1)**

#### *A. Around Umm Qays*

The landscape north and north-east of Umm Qays is remarkable for its complex of ancient remains. The region is divided into three areas (see FIG. 1): *Area 1* is the focus of the survey. It is situated immediately north-north-east of the town of Umm Qays, high on the wide ridge that drops down to the north; it is characterised by graves, cemeteries, reservoirs, channels and building structures.

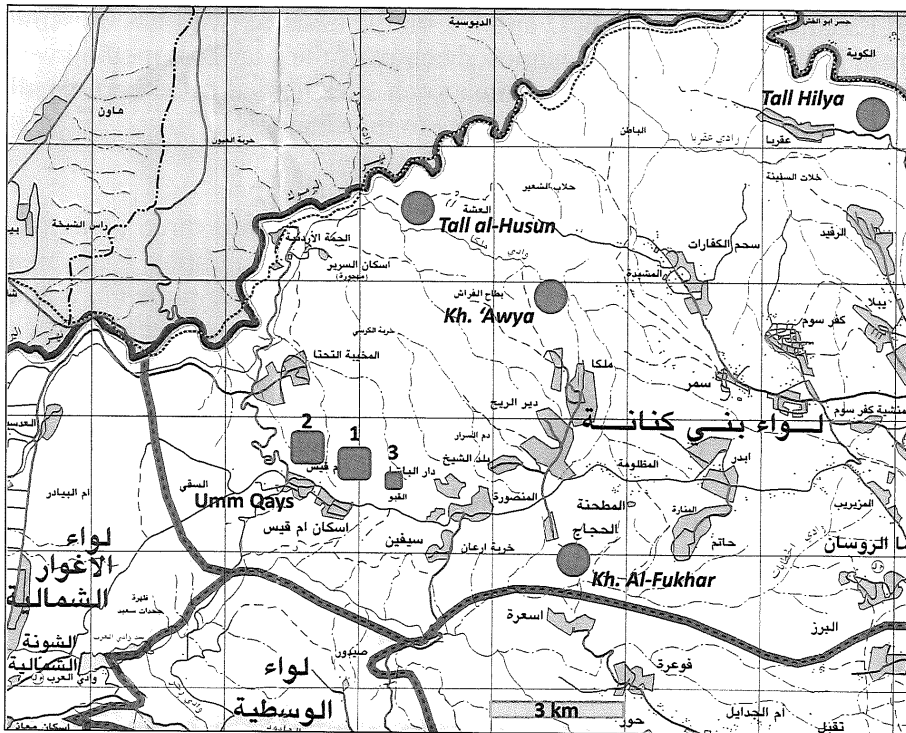
*Area 2* lies directly to the west of Area 1. It extends over mountain slopes and two wadis. It has channels, small caves and a built structure which may have been a reservoir, as well as a feature located slightly further down the valley.

*Area 3* lies approximately 3 km east of Area 1, about 1 km north of the road from Umm Qays to Irbid at the village of al-Qabū. It contains part of an underground tunnel, channel and reservoir.

#### Area 1

The discovery of a number of channels immediately raised questions such as: How many channels are left in the area? Where does each channel begin and end? Which is the main channel and which are the branches? A total of four main channels and a number of tributaries were traced and followed (FIG. 2). The channels were divided into plots as described above. In this way it was possible to collect all artefacts from the channel surface and immediate surroundings.

Channel 1 runs above Channel 2 (see FIG. 3)



1. Liwā' Banī Kinānah with surveyed sites (modified from 2006 Royal Jordanian Geographic Centre map).

from south-west to south-east. The start and end points are not yet defined because of erosion and sedimentation. The first section starts at 272.42 m asl, with the last part being at 271.60 m asl. A huge cistern or well is located almost 30 m below the last part of Channel 1 before it disappears.

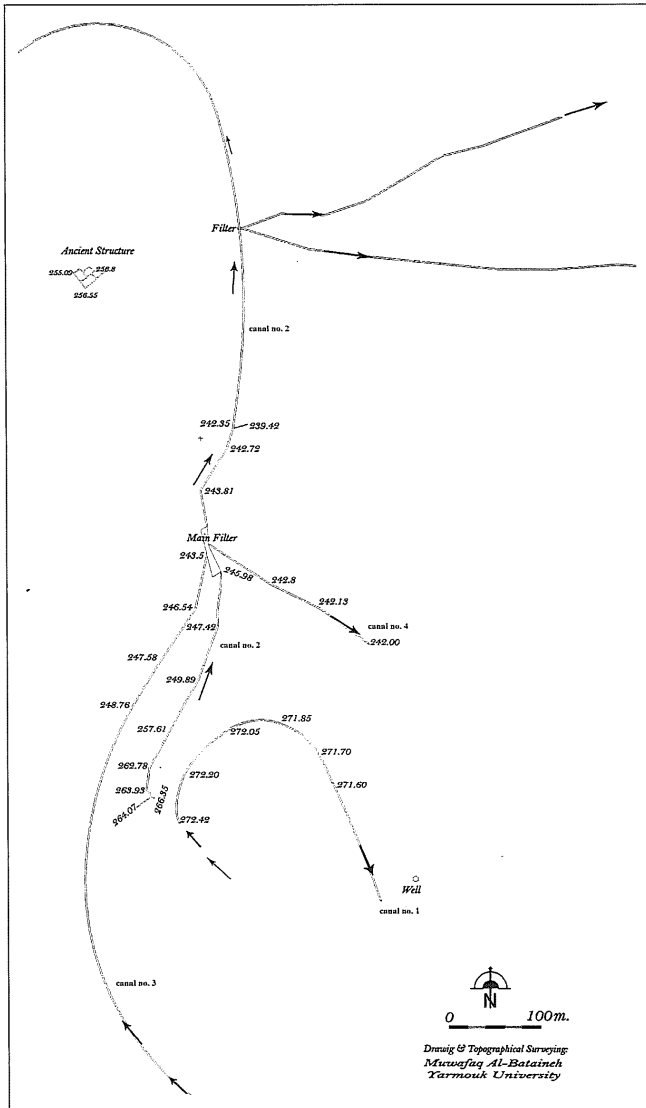
The remains of Channel 2 start on the south-west side of the area. The original starting point could not be defined because of erosion. After some meters the channel splits into two at a t-junction. The longest section runs from the south at 266.35 m asl with a curve to the east. The channel's width ranges from 38 cm in the south to 30 cm in the east at the junction. Branch D splits from Channel 2 and runs from east to west. Its width is 34 cm at the junction, but after just a meter it is 30 cm, at an elevation of 264.07 m asl. It is very difficult to follow the channel to the west owing to erosion.

Channel 2 splits into three further branches (A, B and C). Branch A runs from the main channel at 239.42 m asl from south to north. At its north end, Branch A turns east and then disappears owing to erosion of the bedrock. Branch B runs from Channel 2 to the wadi, where local people cultivate fields to this day. Branch C runs also from the main channel in a northerly direction, but then turns east towards where the fields are located; it does not reach them because of erosion. The bend in the channel from north to east is because of the

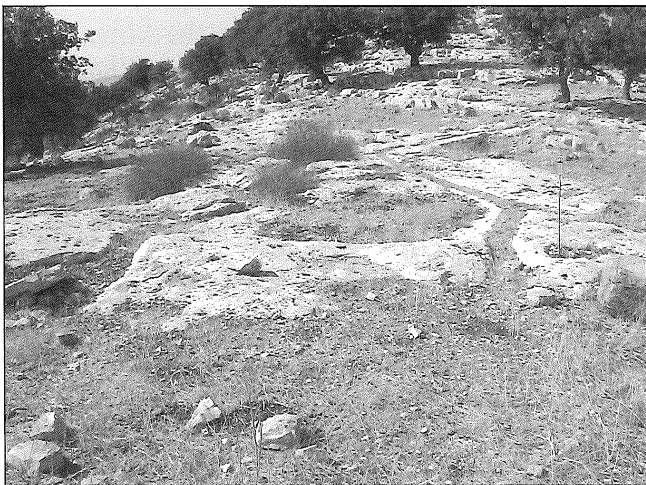
presence of a cliff to the north. Cultivation is carried out in the immediate vicinity. The functions of the channel branches are not yet clear and need more investigation. There are several possibilities, including irrigation of the fields below, supplying water to cisterns or simply drainage.

In the middle of the site is a central junction ('main filter') where the channels meet and split (see FIG. 2). It lies at 243.5 m asl. This junction may originally have had an associated reservoir, but it is not defined because of sedimentation. Channel 2 enters the central junction and continues to the north where it splits into the three branches described above. Channel 3 ends at the central junction, also coming in from the south. It runs below Channel 2 at 248.76 m asl. Further south it runs through Area 2, where it joins another channel. Channel 3 has two outlets, one in Area 1 and the other in Area 2. In the former the channel is 36 cm wide and the outlet 22 cm wide and 22 cm long (see FIG. 4). In the latter the channel is 41 cm wide and the outlet 9 cm wide and 30 cm long. Channel 4 starts at the central junction and runs south-east. The end of the channel has not been defined because of erosion and sedimentation, but its last section is at 242.00 m asl.

The remains of a monumental structure, perhaps a small fortress, constructed of limestone blocks are situated in the northern part of the area. The



2. The four channels with branches and the monumental structure (drawing Muwaffaq al-Bataineh).



3. Section of Channel 2 (photo Sufyan al-Karaimeh).



4. An outlet of Channel 3 (photo Sufyan al-Karaimeh).

structure lies opposite the channels and above the last part of Channel 2 with its three branches. It lies at 256.55 m asl. A number of rooms can be identified; one measures 6 x 6 m and has a cave underneath. Some small-scale looting has taken place and the structure has evidently been used by the Jordanian Army in the recent past. The site was sampled by dividing it into four plots (A, B, C and D) as described above.

### Area 2

The remains of structures and channels are located in the Khillit al-Hāj Hasan area of Umm Qays. The site is located in the northern part of the village below the road to al-Hammih and is to the west of Area 1.

The beginning of the channel in the south-west has not yet been defined because of sedimentation and erosion. The channel runs south-east and joins Channel 3 in Area 1. It was divided into two parts (A and B); sherds were collected from both sections.

The ruined structures sit on elevated ground at the edge of a wadi about 300 m north of the channel (FIG. 5). The structures themselves are unclear; some walls with plaster are visible from looters' pits, so one possibility is that they were used as reservoirs. Building stone is scattered around the area; pits and other signs of looting are widespread. The site was sampled by dividing it into four plots (A, B, C and D) as described above.

Further north, in the wadi about 400 m from the site, an installation was cut into bedrock. This may have been used as a reservoir in view of its shape and the presence of plaster. The structure has been damaged by erosion and looters.

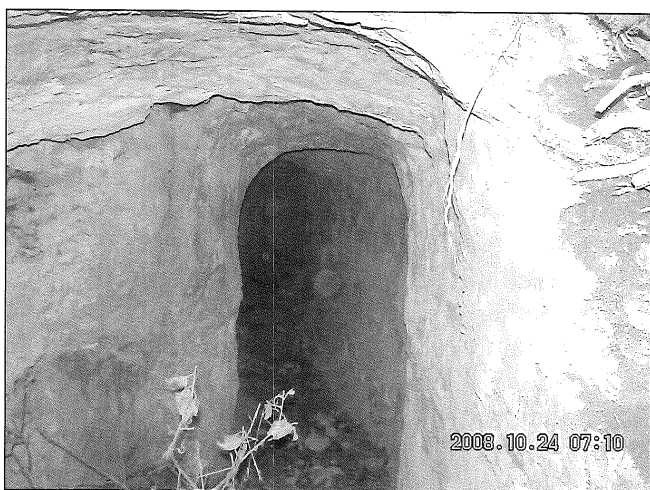




5. Built structures (reservoirs) in Area 2 (photo Sufyan al-Karaimeh).

#### Area 3 al-Qabū

The al-Qabū region is about 3 km east of Umm Qays and 1 km north of the road from Umm Qays to Irbid. A previously unknown section of the famous tunnel (Hoffmann and Kerner 2002: 129-135) was discovered there (FIG. 6). This section runs east -



6. Newly discovered length of the underground tunnel in al-Qabū region (photo Sufyan al-Karaimeh).

west and was traced for *ca* 200 m. The western part of the tunnel turns gradually to the south and ends with an opening facing west, overlooking an open area. The opening is approximately 2 m high and 1.5 m wide. At several places along its length, the tunnel has shafts in the ceiling and some plaster can still be seen on the tunnel walls. Next to the tunnel, a rock-cut channel runs from east to west. Furthermore, the remains of a reservoir were found nearby, mostly covered by soil although the top stones of its southern wall are clearly visible. Unfortunately, no sherds were found around or inside the tunnel, so dating has to be based on other data.

#### *B. Sites East and North-East of Umm Qays*

##### Tall Hilyah

The site of Tall Hilyah (Glueck 1951: 131) is located in Wādī Hilyah between ar-Rafid and 'Aqrabā on the road leading to the village of 'Aqrabā; it lies within the village lands of ar-Rafid. The site is located between the Yarmouk river to the north and 'Aqrabā to the south-west, at an elevation of approximately 350 m asl. The northern part of the site consists of a steep slope dropping down to the Yarmouk river; the southern part is less steep.

Most of the upper part of the mountain has remains of buildings and other structures. Owing to the layout of the site, it was sampled (as described above) by dividing the site into three areas (A, B and C) and each area into three plots (1, 2 and 3). Area A is located on the hill-top, Area B beneath Area A to the east and Area C yet further to the east. There are structures in Areas A and B but none in Area C, which is characterised by exposed bed-rock. On the south-east side of Area B are some caves which were recently used by the Army. There are two water wells on the site, one on the north-west side of Area A and the other on the south side of Area B. The latter has a reservoir and a channel which runs down to a field (FIG. 7).

Local people own the land of Tall Hilyah. Looting has occurred, but despite this the site is still in quite good condition; it has been used as an Army base in the recent past.

##### Khirbat al-Fukhkhār

Khirbat al-Fukhkhār lies within the territory of Malkā village in al-Ḥujjāj district, and is situated *ca* 7 km east of Umm Qays on the road between Malkā and As'arah at an elevation of approximate-



7. Cistern with reservoir and channel at Tall Hilyah (photo Sufyan al-Karaimeh).

ly 350 m asl. The name al-Fukhkhār derives from the pottery sherds that litter the site. The land is owned by local people and has been used for olive cultivation for the past ten years. A new road divides the site into two areas (A and B). Area A is located on the west side of the As‘arah road, with Area B on the east side. For sampling, Area A was divided into two plots (1 and 2); each plot was subdivided into two using the + and - signs. Area B was divided into five plots. Area A has some caves, but has been damaged by looting and cultivation; there are no archaeological structures in this part of the site. FIG. 8 depicts a looter’s pit, showing the thickness of the sherd layers. Area B still has some buildings and cisterns, but has unfortunately been almost completely destroyed in order to create new terraces for olive cultivation. There are however



8. Looters’ pit showing thickness of the sherd layers at Khirbat al-Fukhkhār (photo Sufyan al-Karaimeh).

still some structural remains on the slope between Plots 3 and 4.

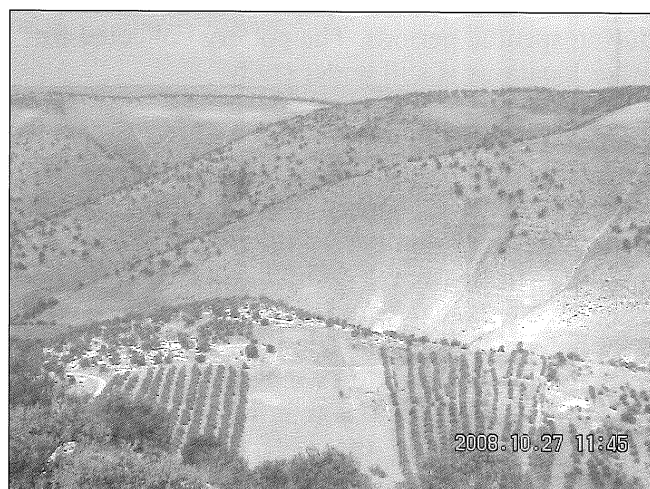
#### Khirbat ‘Āwya

Khirbat ‘Āwya is located north of the village Malkā, in whose lands it is located and through which it can be accessed. The site is situated high above the wadi bottom, in flat fields approximately 213 m asl. It has been damaged by looting and olive cultivation (FIG. 9). There are the remains of some monumental structures spread over two areas (A and B). The structure in Area A has been demolished, but the original stones are scattered over the surrounding area. There are also some remains of mosaic-flooding in the centre of Area A, as well as a cave.

Area B is east of Area A. This part of the site has likewise been damaged by olive cultivation and many limestone blocks have been re-used in recent construction; there are also signs of looting. Some archaeological structures remain and artefacts were collected from both areas.

#### Tall al-Huṣun

Tall al-Huṣun (Glueck 1951: 137) is located on the south bank of the Yarmouk river, east of al-Mukhayba and west of Saḥam, to which it belongs. This large site covers the upper part of a mountain approximately 273 m asl (FIG. 10). A road has divided the site into two parts. Part A is a small area with some structures, which was sub-divided into three plots (1, 2 and 3) for the survey, during which sherds were collected. Area B has more complex structures and covers much of the hill; there are inner walls, outer walls and parallel walls, as well



9. General view of Khirbat ‘Āwya from the south (photo Sufyan al-Karaimeh).



10. General view of Tall al-Huşun (photo Sufyan al-Karameh).

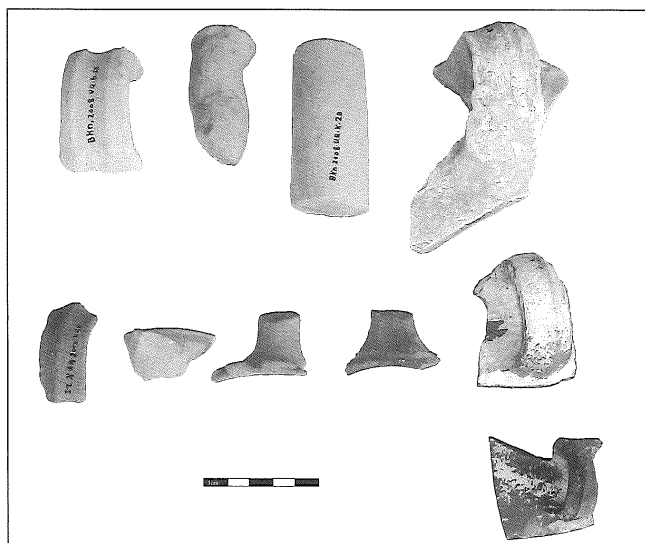
as evidence for monumental structures, seemingly belonging to a large urban settlement. The original large building stones are scattered over the area. There is an underground tunnel or cistern with openings in the top and side, and a small associated channel. There is also evidence for small-scale looting. It is not yet known who owns the site.

#### 4. Preliminary Analysis of Pottery from Around Umm Qays

A total of 1,059 sherds were collected during the pilot survey. However, to date only those from the areas immediately north and north-east of Umm Qays have been processed. These sherds were accorded priority because they were recovered from the channels, structures and water installations. They therefore needed to be dated in order to establish whether or not these features could have been associated with the population of Umm Qays during specific periods. The pottery collected from other locations is still under study.

##### *Chronology and Typology*

In total, 669 pottery sherds were collected from channels, building structures and water installations. The total number of diagnostic sherds was 137: 100 from Area 1 and 37 from Area 2 (FIG. 11). A Hellenistic to Islamic ceramic type-series does not yet exist for the Umm Qays region. Therefore, the sherds collected were compared with pottery from nearby regions (e.g. Magness 1993). On typological grounds, the material dated from the Hellenistic to Early Islamic periods, with most sherds being Roman. Although these sherds came from the channels, associated settlement sites had



11. Pottery from the Umm Qays region (photo Yousef al-Zoubi).

the same material, including quite a high proportion of Roman red-slipped table ware; some settlements also had Iron II material.

##### *Pottery Distribution and Density*

The distribution and density of the collected pottery sherds varied from location to location. Not all channel-plots yielded the same quantity of sherds. For example, just a single sherd was collected from one Channel 2 plot, while another Channel 2 plot yielded 56. Similarly, more than 60 sherds were collected from a Channel 3 plot in Area 2. This variation may be the result of post-depositional processes, such as erosion.

All the channels are rock-cut and the surrounding areas are bedrock. In the case of channels on slopes, sherds may of course have been washed in. Some of these sherds were quite eroded, indicating secondary deposition. A clear example is a Channel 2 plot which runs alongside the monumental structure (see above) in the northern part of Area 1. There, although 67 sherds were collected, the majority clearly originated from the monumental structure.

#### 5. Analysis and Interpretation

##### *Description and Dimensions of Channels*

It was somewhat surprising to find channels in this area, threading all over the landscape in a complex manner, not least because they couldn't be seen on aerial photographs. During the survey, at least



four major channels with branches and outlets were identified. All channels that have been traced to date are rock-cut. The base is flat, with a slope that would have permitted water to flow gently through the channel. The sides are straight; in some cases the height of the channel sides varies, while in others both sides are the same height. In most cases, the channels are covered with sediment, but occasionally they are exposed because of an absence of soil in the surrounding area.

The average width of a channel is between 20 cm and 50 cm, with a minimum of depth of 12 cm. At some junctions the channels widen, e.g. at the t-junction of Channel 2. This is 38 cm wide at the top and 30 cm wide at the bottom; the channel it joins is 34 cm wide.

#### *Layout and Construction*

The method of cutting the rock to construct the channels was remarkable, with cut-marks remaining clearly visible. These marks show the direction of cutting and pick-axe impressions in the channel surfaces. They also indicate the direction in which the channels were constructed; it is clear that channels were constructed from top to bottom, i.e. the higher channels were constructed before the lower ones.

The start and end points of the channels could not be identified because of sedimentation and erosion. Water sources were likewise not identified during the survey. Water may have come from cisterns, a spring or the underground water system that supplied Umm Qays. It will be crucial to identify the source in due course, because this will enable the system to be dated through association with structures, building material and ceramics at the source. It may also enable examination of water distribution and irrigation rights in the region.

#### *Social Aspects and Economy*

The system of water management as a whole is not yet clear. However, it seems likely that effort was expended and invested in the construction of channels in order to domesticate the landscape. The channels were well-designed and well-executed on hill slopes by engineers. It is clear that construction of the channels, controlling the flow, keeping them clear and irrigating the surrounding fields was the work of more than one person. The channels are spread over a large area that would have required a substantial investment of labour.

#### *Monumental Structure*

The monumental structure on the hill-top opposite the channels to the north was strategically positioned. It overlooks all the channels and fields, and has an excellent view north where other agricultural fields, the Yarmouk river and Tall al-Ḥuṣūn are located. It also has good views to the north-west and east of Umm Qays, although the city itself cannot be seen. The function of this monumental structure has not yet been determined. It may have been directly associated with the channels and agricultural fields in the surrounding region, or it could alternatively have been a fortification to protect the northern territory of Umm Qays.

#### *Discussion: The Current Challenge*

It is hard to date the construction and use of the channels and water installations. On the basis of the pottery, it may be assumed that the system dates to some time between the Hellenistic and Early Islamic periods. It can also be assumed that the newly discovered section of the underground tunnel and the channel and reservoir in the al-Qabū region were used for irrigation, and that the underground tunnel was the main water source for that system. If this was indeed the case, it would seem that the system dates to Hellenistic, Roman and / or Byzantine periods (Hoffmann and Kerner 2002: 129-135). Another chronological indicator is the turning of a branch of Channel 2 from north to east because of erosion of the northern edge. The channel clearly post-dates this erosion, which unfortunately remains undated. Cracks in the bedrock are yet another potential chronological indicator. They seem to have been caused by earthquakes which damaged the channels and in some cases rendered them useless. The well-known earthquakes of the 7th and 8th centuries AD (Weber 1990: 11) may have been responsible, but it should also be borne in mind that tree growth in channels may also have caused damage, especially in areas where sediments had accumulated.

As has been noted, the water source which supplied the channels has not yet been identified; there are no springs in the area today. At the current stage of research, it is hard to speculate about the kind of role these channels may have played in supporting the economy of Umm Qays. They may have supported the main settlement, Gadara, by facilitating food production for local consumption or exchange. Indeed, following the discovery of these channels,

water installations, reservoirs and the underground tunnel in this particular landscape, the question arises as to why they were constructed in the first place. Possible reasons could include (1) changes in rainfall which required additional water control and / or management, (2) a need to increase agricultural production because of population growth or (3) simply to benefit from surplus water by using it for agriculture and thereby giving the landscape a new perspective.

## 6. Conclusion

During the survey, three different methods of sampling were used, reflecting the different geographic locations of the archaeological remains. Sherds were collected from channels, specific features or water installations and from extensive sites, as well as from sites which have been damaged by agricultural development.

The survey has yielded promising results. Areas where channels used to run and the remains of structures and water installations were discovered. Rock-cut channels were found in the landscape and could be traced over long distances. Furthermore, it was established that the channels divide into branches with junctions and outlets that could have supplied water to terraces for irrigation. Sites associated with agricultural fields were apparently closely linked to water management systems, in locations such as the confluences of steep wadis, water sources or even major accumulations of cultivable soil to which water was guided. Other newly discovered sites with substantial remains of dressed stone architecture – especially those on hill-tops, e.g. Tall Hilyah – had their own water systems. These were presumably associated less with irrigation than with water collection and storage for other purposes.

The pottery samples collected by the survey date from the Hellenistic to Early Islamic periods, with the Roman period being best represented. Associated settlement sites yielded the same material, including quite a high proportion of Roman red-slipped table ware; a number of settlements had Iron II material as well.

The pilot survey demonstrated that the channels are on the whole well preserved and traceable, but have in some places been destroyed by erosion or earthquake. It is probable that the region was intensively used for water collection and distribution for agricultural purposes, including areas that have

little or no soil cover today.

Construction of the channels, water installations, reservoirs and tunnels in the area beyond the city walls of Umm Qays demonstrates that the fertile soils of the hill slopes and wadis were cultivated by means of irrigation. It appears that all fields to the north were used for agriculture, to judge by the presence of channels and water installations in the area.

Investment in the landscape and cultivation of each and every spot with fertile soil seems to have regarded as a necessity. This may have been because of population growth, climate change which made cultivation without irrigation impossible, or even investment for pleasure and profit. Further study will be necessary to understand why these investments in the domestication of the landscape were made. What was the relationship between the settlements and use of channels and water installations for irrigation or other purposes? Until when did people work the land, and where were the borders of settlements and cities?

The region's archaeological remains are currently threatened by construction and agricultural development. If its full archaeological potential is to be realised, further work examining the profound effect the landscape has had on its past inhabitants is urgently required.

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