# A COMPREHENSIVE REVIEW OF NEOLITHIC WATER CATCHMENT FACILITIES IN THE JAFR BASIN, SOUTHERN JORDAN: A PRELIMINARY REPORT OF THE JAFR BASIN PREHISTORIC PROJECT, PHASE 3, 2009

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## Introduction

The Jafr Basin Prehistoric Project was organized with a view to tracing the process of pastoral nomadization in southern Jordan on the basis of specific archaeological evidence. It was also an attempt to recover the totality of Neolithic studies by means of shedding light on the poorly understood dimension. However, a methodological issue confronted us at the very outset. In comparison with sedentary populations, pastoral nomads are in general smaller in group size, higher in mobility, simpler in material culture, and therefore much inferior in archaeological visibility. Now that their footprints themselves are difficult to specify, archaeological methods can hardly be applied. This is the reason why the process of pastoral nomadization is yet to be clearly defined. However, they often construct stone-built burial cairns, and not sporadically but in a compact mass. This much is visible enough in an archaeological sense. Given this, we ought to be able to catch a glimpse of their social dynamics through their unique burial practice. With such a methodological perspective, we have successively investigated a dozen prehistoric funerary sites in our research field or the northwestern part of the Jafr Basin.

The first phase of the project was conducted over the eight years from 1997 to 2004, the vast majority of which was devoted to a comprehensive excavation at the stratified funerary site of Qā' Abū Ṭulayḥa West (e.g. Fujii 2003). The excavation shed light on a unique burial practice of prehistoric pastoral nomads in the Jafr Basin for the first time. The final two seasons addressed complementary operations to fill up a few gaps interstratifying in the chronological sequence of the key site (e.g. Fujii 2005a, 2005b). The series of investigations enabled us to establish a tentative chronology of burial practice in the Jafr Basin from the Late Neolithic to the Early Bronze Age. The chronology provided a basic framework for understanding the process of the pastoral nomadization in the basin.

The second phase, taken place for the four years from 2005 to 2008, changed direction to retrace the origin of pastoral nomadism back to the PPNB (Pre-Pottery Neolithic B) period. A total of six excavation seasons at Wādī Abū Ṭulayḥa revealed that the Middle to Late PPNB Jafr Basin witnessed the beginning of short-range transhumance bringing along a limited number of domestic sheep and goats from a parent settlement probably to the west (Fujii 2006a, 2006b, 2007a, 2008a, 2008b, 2009a, 2009b; Hongo 2008). Quite unexpected was the fact that the PPNB agro-pastoral outpost was equipped with a well-organized water catchment system consisting of a large cistern, a basin-irrigation barrage, and two minor wadi barriers (Fujii 2007b, 2007c, 2010a). Available evidence suggests that the climatic deterioration toward the end of the PPNB caused the reduction in pondage at the cistern and the decline and/or instability in opportunistic agriculture within the flooded area of the basin-irrigation barrage. It seems that both of the crises led to the abandonment of the neighboring fixed outpost and a consequent shift to pastoral nomadism (Fujii 2010b). Given this, it follows that the water supply problem at the remote outpost holds another key to reading the process of pastoral nomadization in the basin.

The third phase of the Jafr Basin Prehistoric Project was designed to address this challenging issue (Fujii 2010c). Our research objective is to

shed new light on the process of pastoral nomadization from the viewpoint of water exploitation strategies in arid peripheries. We anticipate the four years from 2009 to 2012 for the research period. The first field season was conducted for about ten days from September 13 to 23, focusing on a comprehensive review of Neolithic water catchment facilities thus far known in the basin. The following is a brief summary of our preparatory work looking ahead to subsequent full-fledged investigations.

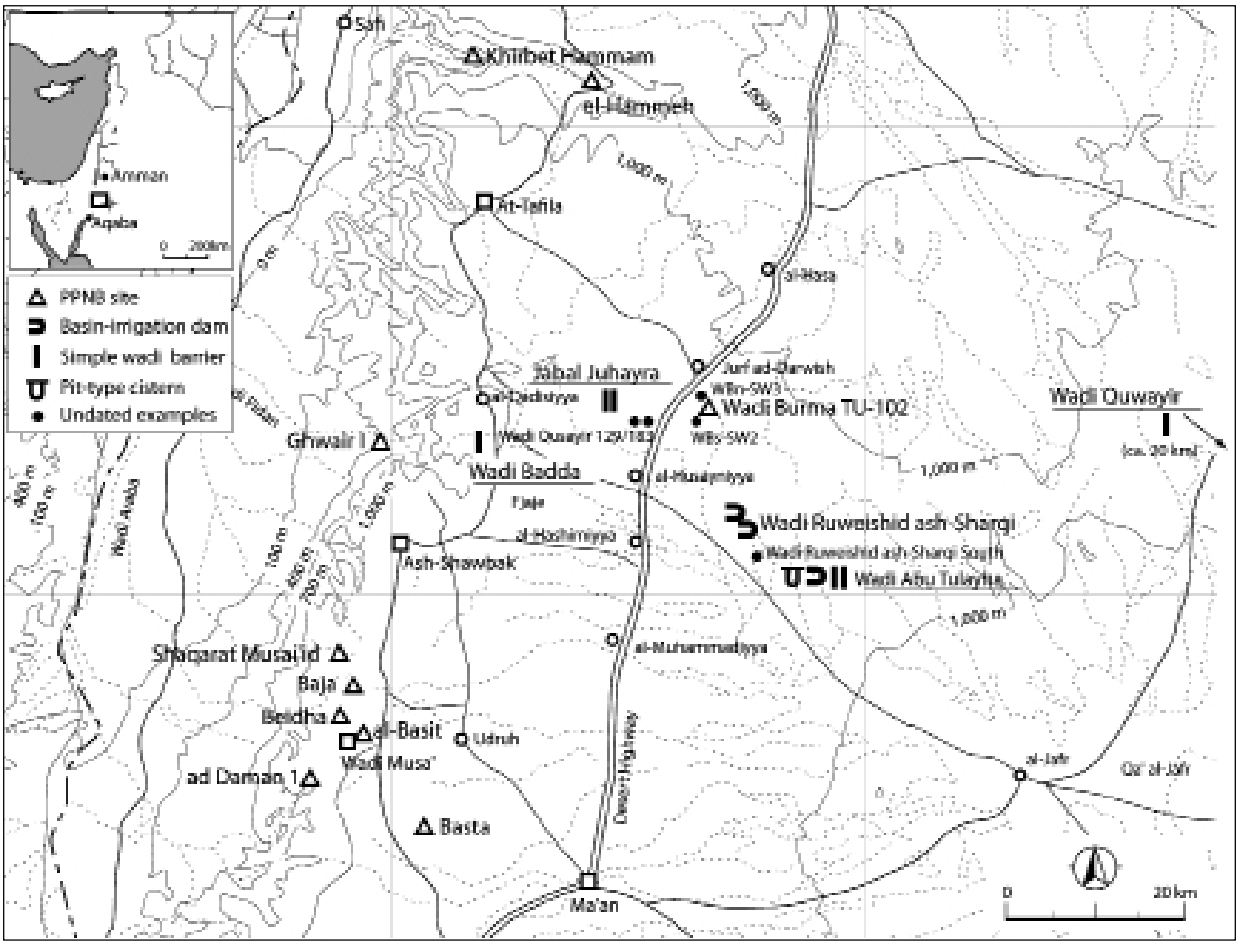
## Neolithic Water Catchment Facilities in the Jafr Basin

Our previous investigations located a total of seven Neolithic or supposedly Neolithic water catchment facilities in and around the Jafr Basin: four at Wādī Abū Ṭulayḥa, two at Wādī ar-Ruwayshid ash-Sharqī, and one at Wādī Baddā (**Fig. 1**). In order to double-check our previous identification, we reexamined them by means of either trench excavation or surface cleaning. In addition, we newly confirmed three likely examples in the course of the retrospective survey.

*Wādī Abū Ṭulayḥa*

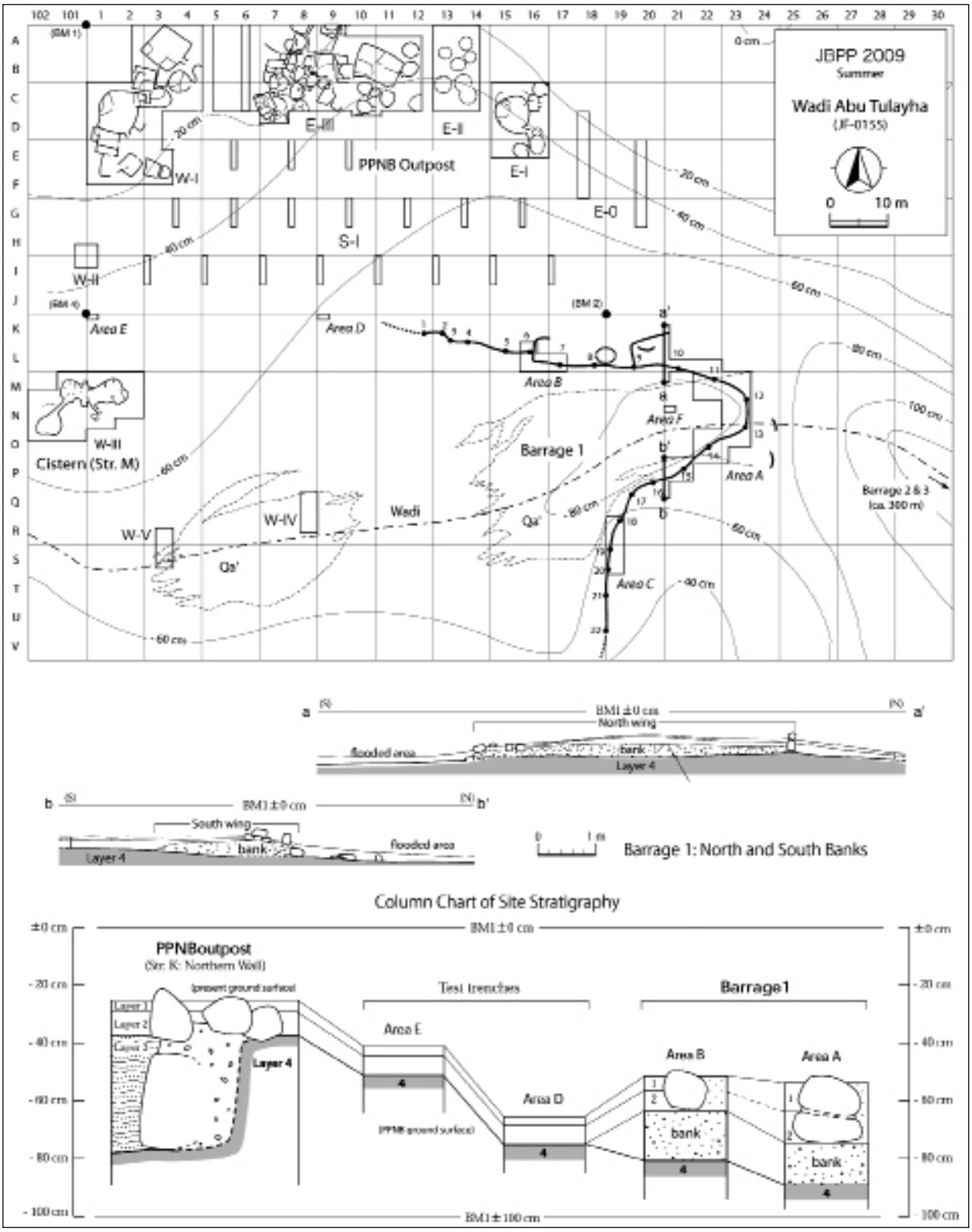
The site of Wādī Abū Ṭulayḥa is a small agro-pastoral outpost lying in the northwestern part of the basin, and is dated to the M-LPPNB period on the basis of a series of AMS dates and comparative studies of diagnostic artifacts. As mentioned above, the site contained one cistern and three barrages, all of which were intensively excavated and reported in some detail elsewhere (e.g. Fujii 2007b, 2009a).

Our retrospective survey conducted a stratigraphic reexamination of Barrage 1 that was identified as a basin-irrigation dam in the spring field season of 2006. What we focused on was the structure of banks that fringed the flooded area of the barrage. In order to scrutinize the nature of the bank deposits, we newly opened two




*1. Neolithic water catchment facilities in the Jafr Basin.*

elongated test trenches across both wing walls (**Figs. 2, 3**). As a result, it turned out that the stone-built wall of the north wing was founded on an anthropogenic bank ca. 6m wide and up



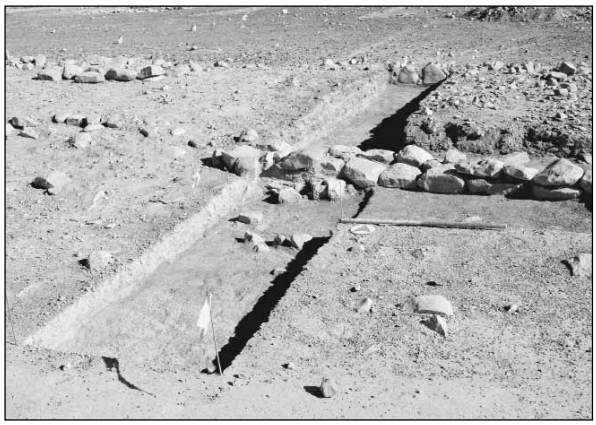

*2. Wādī Abū Ṭulayḥa: sections and elevations of Barrage 1.*

*3. Wādī Abū Ṭulayḥa: general view of Barrage 1 (looking N).*

to ca. 0.3m high (**Figs. 2, 4**). Interestingly, the bank contained no impermeable material such as clay; instead, it consisted only of reddish brown silty sand and a number of abraded flint pebbles. It is likely therefore that the bank was constructed by means of scraping together surface deposits of *ḥamād* of those days. (This is the reason why our previous reports defined it by error as the PPNB surface layer; Fujii 2006a: Fig. 2; 2006b: Fig. 2.) This means that it was originally permeable in structure and, therefore, allowed standing water to infiltrate into the surrounding terrain. Thus it follows that the barrage was not intended for long-term water storage from the very beginning of construction. These observations corroborated our previous view that it was used as a basin-irrigation dam. It can also be reasonably understood within this framework that the stone wall was poorly constructed with gaps being often left between any two adjacent stones. Presumably, the stone wall, especially its distal half, was placed on the permeable bank just for erosion control.

The south bank also proved to have the same structure (**Figs. 2, 5**). Here again, a permeable anthropogenic bank containing reddish brown silty sand and abraded flint pebbles was confirmed underneath a gappy stone wall. However, it was much more compact in dimensions than the northern counterpart, measuring ca. 2.5m wide and up to ca. 0.4m high. This is probably because it was constructed taking full advantage of a natural slope fringing the southern half of the flooded area.

The trench excavations corroborated anew our previous view that Barrage 1 was construct-



*4. Wādī Abū Ṭulayḥa: close-up view of the North Trench (looking NNW).*

*5. Wādī Abū Ṭulayḥa: close-up view of the South Trench (looking SW).*

ed for temporary basin-irrigation rather than long-term water storage. Collateral evidence for this functional identification comes from the fact that the neighboring outpost produced a certain amount of charred cereal and pulse seeds as well as numerous grinding implements (Nasu *et al.* 2008). Also suggestive is the coexistence of the large cistern specializing in reserving drinking water, which highlights the systematic use of water catchment facilities at the remote outpost.

The trench excavations also proved that the construction of Barrage 1 involved large-scale civil engineering works as well as laborious stone masonry works. Since both banks are ca. 1 square meters in cross-section and 40-50 meters in length, the total amount of earth used for their construction is estimated at 40-50 cubic meters or even more given the post-construction consolidation. Such an ambitious project cannot be done in spare time, supporting our view that the outpost was used, though on a seasonal basis, every year by a certain number of transhumants.

We also reexamined the cistern or Structure M, taking advantage of three illicit digging pits that were opened along the southern walls during our off-field season. As a result, it turned out that the masonry walls were backed with a more than 0.5m thick layer of clay mortar tempered with a large amount of limestone and flint rubble (**Fig. 6**). It is needless to say that the thickness of the clay-mortar layer coincided roughly with the planimetrical boundary line between the fill layer behind the walls and the PPNB surface layer. Thus it follows that the masonry walls were not only coated with fine-textured clay on their inner surface but also carefully waterproofed with rubble-tempered coarse clay on their rear side. This finding substantiated anew our functional identification. Incidentally, the rear coating also included flint flakes and a large amount of ash, both of which were probably brought from the neighboring outpost as tempering material of clay. This finding made the synchronism between the two structural entities more reliable. Several charcoal remains included in the ash, now under radiometric dating, would provide an exact construction date of the cistern.

*Wādī ar-Ruwayshid ash-Sharqī (North)*

Being located ca. 7km northwest of Wādī Abū Ṭulayḥa, this site occupies again a flat terrain along a side wadi flowing eastward. It was briefly investigated in the spring field season of 2006 together with the three barrages at Wādī Abū Ṭulayḥa (Fujii 2007b, 2007c). The investigation showed that the site consisted only of two basin-irrigation barrages, and that unlike Wādī Abū Ṭulayḥa, it was not accompanied with a neighboring outpost. These observations led us to a tentative conclusion that the two barrages served as an enclave field or pasture for transhumants who made a seasonal round trip between a parent settlement to the west and the outpost (i.e. Wādī Abū Ṭulayḥa) to the east.

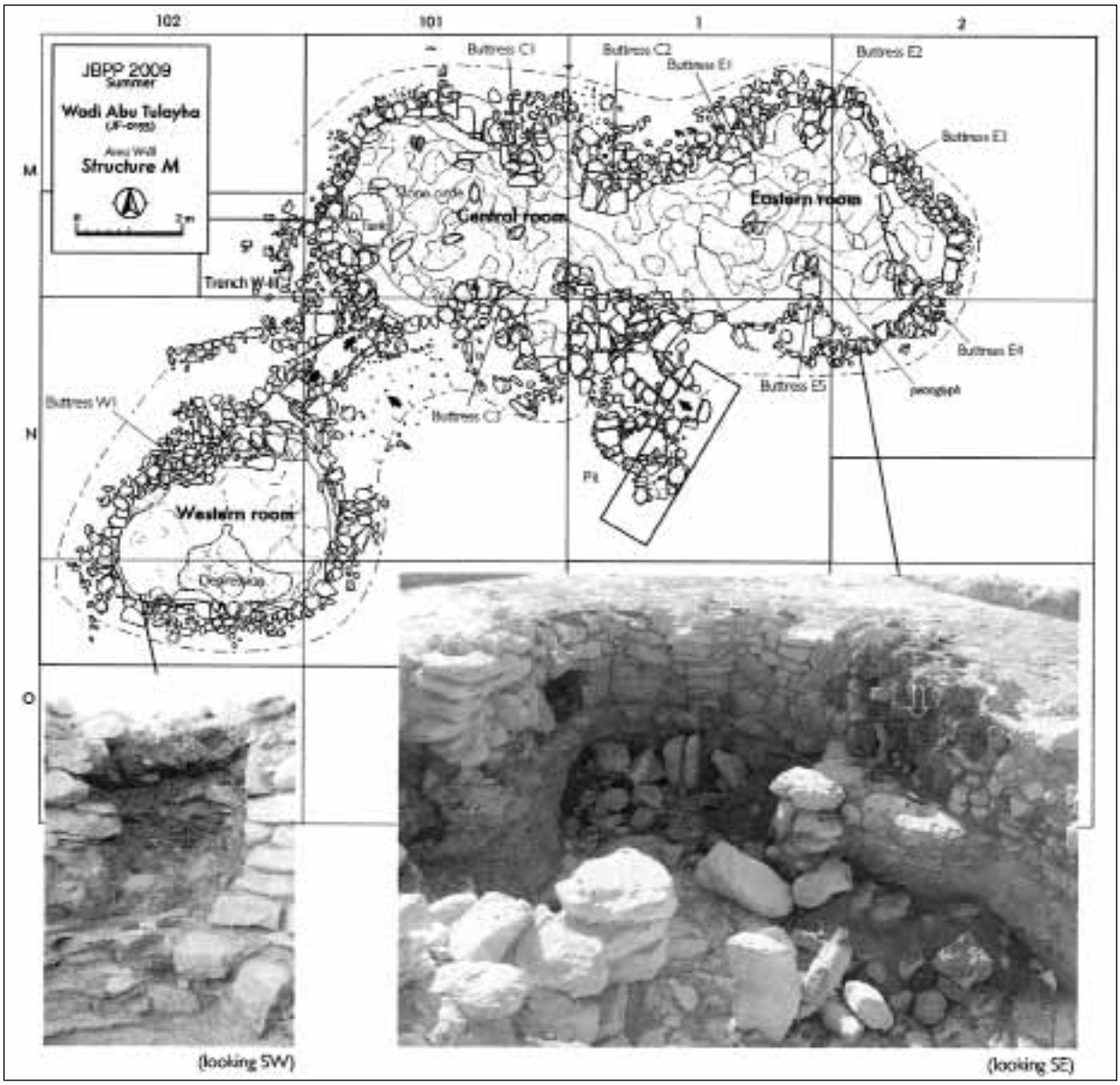
Our review started with a brief resurvey of the surrounding area, which revalidated that no settlement was incorporated into the site. So we turned to a stratigraphic reexamination of Barrage 2 and opened three 1m by 10m test trenches: two across both wings and the other across the converging point (**Figs. 7-8**). The investigation attested to a combination of permeable anthropogenic banks, ca. 6-7m wide and up to ca. 0.3-0.5m high, and poorly constructed stone walls, and our previous functional identification proved to be appropriate. The banks were constructed again taking full advantage of natural slopes bordering the flooded area of the side wadi (**Fig. 9**).

A bilaterally notched stone weight, a key to identifying Neolithic barrages in the Jafr Basin, was found around the north bank (**Fig. 10**). This was the second example found at the barrage and the first one was incorporated into the converging wall (Fujii 2007b, 2007c). Though out of the original context in this case, the repeated occurrence of such a diagnostic artifact has made our previous dating more reliable.

In addition to the main body of the barrage, we also sounded a few stone alignments dotted within the flooded area. This operation aimed to find out a pit-type cistern like Structure M at Wādī Abū Ṭulayḥa, but they proved to be simple windbreaks constructed probably in the recent past. The absence of a cistern makes sense, however, seeing that the site was devoid of a settlement.

*Wādī Baddā*

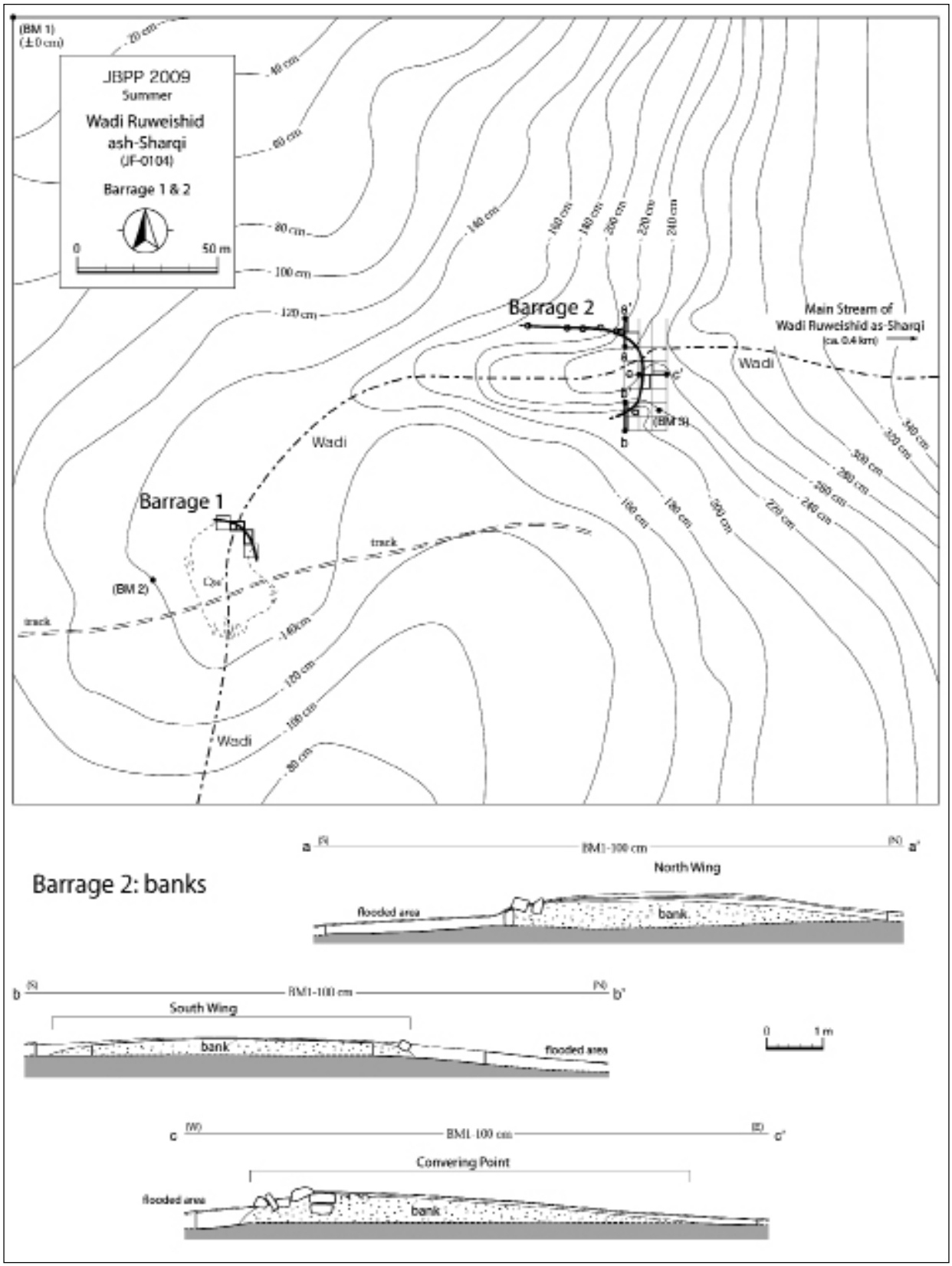
The site of Wādī Baddā is a small PPNB settlement lying immediately below the Fujayja escarpment that borders the western edge



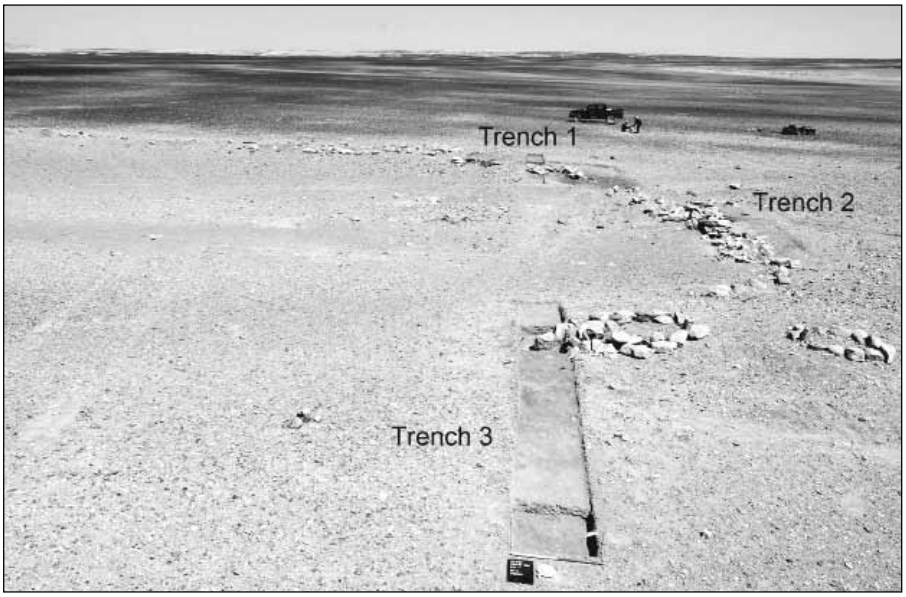

*6. Wādī Abū Ṭulayḥa: illicit digging pits along the southern wall of Cistern.*

of the Jafr drainage system. It is situated atop of a small limestone hill, overlooking a meandering wadi flowing down westward from the escarpment (**Figs. 11, 12**). The site was found by chance in our one-day excursion in the summer field season of 2007, when a remnant of a barrage-like robust wall was noticed below the settlement, at the north bank of the wadi (Fujii 2007d).

We revisited the site and briefly reexamined the wall remnant by means of surface cleaning. The reexamination proved that the feature was ca. 1.5m high and ca. 1m thick, being constructed with three to four rows and four to six courses of undressed limestone angular cobbles (**Fig. 13**). It is still unknown, however, how far it buries itself under the slope deposits. The construction materials, ca. 0.3-0.6m long, were piled up irregularly in either a horizontal or an upright position. On the other hand, foundation stones were placed in a horizontal position and still half-buried in fluvial deposits. This masonry wall was quite different in both dimensions and structure from normal wall alignments exposed at the settlement atop the hill, suggesting its unique function. In this connection, it should

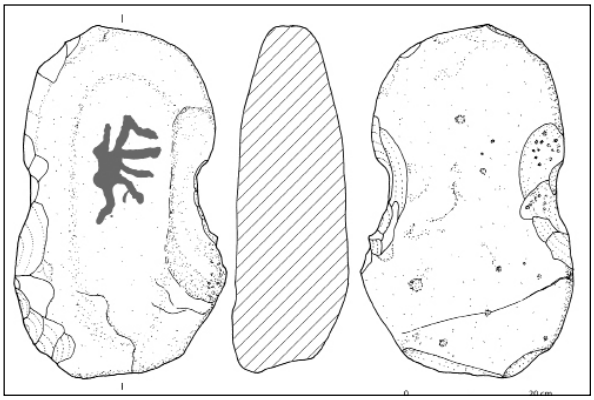



*7. Wādī ar-Ruwayshid ash-Sharqī: sections of Barrage 2.*




*8. Wādī ar-Ruwayshid ash-Sharqī: general view of Barrage 2 (looking N).*

*9. Wādī ar-Ruwayshid ash-Sharqī: close-up view of Trench 1 (looking NW).*



*10. Wādī ar-Ruwayshid ash-Sharqī: bilaterally notched stone weight.*


*11. Wādī Baddā: general view of the site (looking N).*

*12. Wādī Baddā: general view of the wadi (looking SE).*

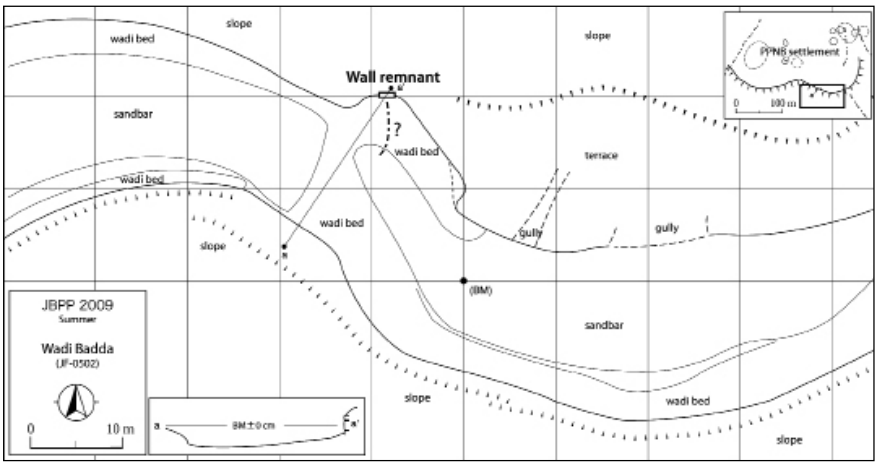
*13. Wādī Baddā: close-up view of the wall remnant (looking N).*

also be added that clay-like mortar was confirmed between construction materials. There is little doubt that the feature represents a remnant of a small reservoir dam.

The question is its date. Since no direct clue was found in our previous survey, we produced a topographical map around the feature in an effort to explore its archaeological background (**Fig. 14**). The map illustrated that the basement level of the wall remnant accorded roughly with the northern dry wadi bed, and that the latter was ca. 1m higher in elevation than the present wadi bed to the south. There is no doubt that the reservoir dam was constructed against the earlier stream. It is also worth reminding that the wall buries itself into the slope sediments to a certain extent. There is an increasing possibility that it dates back to the same period as the neighboring PPNB settlement. This is even more so because the settlement is isolated in the ravine and essentially a single-period site, although the final conclusion must await a full-fledged investigation scheduled in the near future.

*Jabal Juhayra*

The site of Jabal Juhayra is a small PPNB settlement lying ca. 10km southwest of Jurf ad-Darāwīsh, a traditional village along the Hejaz Railway. It is located in a small-scale ravine on

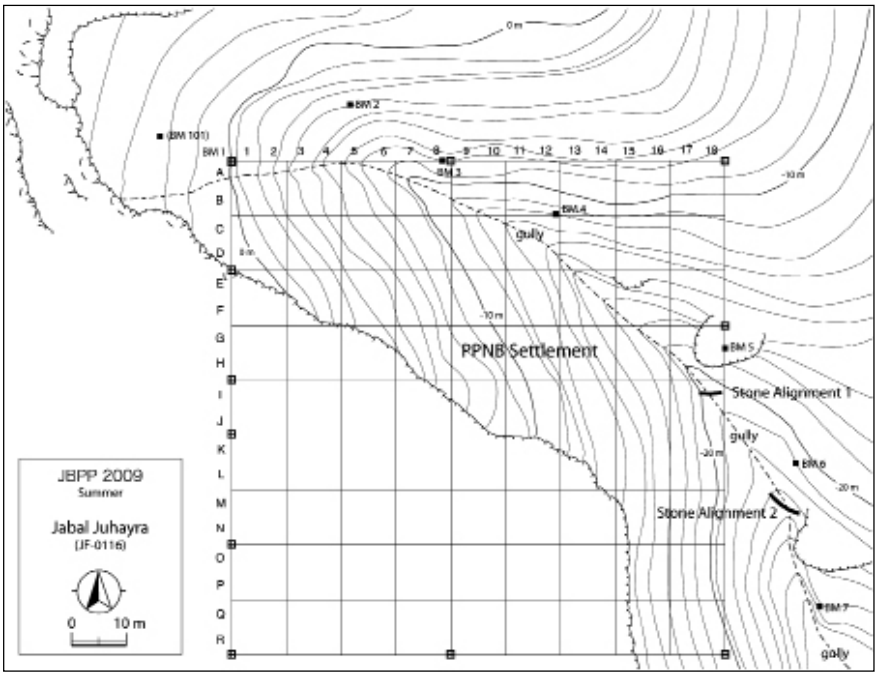



*14. Wādī Baddā: topographical map around the wall remnant.*

the southeastern flank of an isolated volcanic hill of the same name, overlooking a small gully flowing below the settlement (**Fig. 15**). The site was found for the first time during our 2001-2002 winter season survey and briefly reported elsewhere (Fujii 2002; Fujii and Abe 2008).

No clear evidence for water catchment facilities was found in the previous survey, but this survey confirmed for the first time two likely stone alignments in the middle and lower courses of the gully (**Figs. 16-17**). Both of them were small in dimensions, measuring ca. 2-3m long, ca. 0.3-0.7m thick, and ca. 0.2-0.3m in exposed height. They were constructed with a single row and course of undressed limestone cobbles, but

*16. Jabal Juhayra: close-up view of Stone Alignment 1 (looking NE).*




*15. Jabal Juhayra: site plan and the location of the two stone alignments.*

*17. Jabal Juhayra: close-up view of Stone Alignment 2 (looking NW).*

our brief sounding suggested that another course of stones underlay the exposed stone alignment. There is little doubt that they were used as small water storage facilities. Both of them do not always correspond to the direction of the present stream of the gully, but this might be due to minor change in channel.

Again, the question is their date. We produced a topographic map as a supplementary approach, but no useful clues to the issue were obtained. Thus an in-depth discussion must await a full-fledged investigation in the near future, but the two observations referred to above (i.e. the buried condition and the minor discrepancy with the present channel) seem to hint at a relatively early date for the two features.

*Wādī al-Quwayr*

Unlike the four sites described above, this site is located outside our original research area, in the northeastern part of the Jafr Basin. It was found for the first time by two American scholars and reported as a PPNB flint scatter (Quintero and Wilke 1998). Both of them revisited the site (or J-17 in their site registration code) in the summer of 2009, when they noticed that several masonry walls as well as numerous artifacts were exposed by an illicit excavation (Wilke personal communications). The reason why we visited the site in the course of the retrospective survey is that they sounded out the author about the feasibility of a rescue excavation.

The site was situated at the edge of a flat-topped plateau encompassing the northeastern part of the basin. The distribution range of flint artifacts suggested the site size of ca. 0.1 ha, the norm of PPNB desert sites in southern Levant. The illicit excavation exposed several semi-subterranean masonry structures, which appeared to be aligned roughly in the east-to-west direction. The east-to-west orientation is common to PPNB outposts in Transjordanian Plateau. They were round or oval in general plan, measuring ca. 3-5m in diameter and up to ca. 1m in floor depth. The masonry walls were relatively superior in construction quality, being carefully built with up to several courses of undressed or partly dressed limestone cobbles (**Fig. 18**). The coexistence of a large structure and several smaller features reminded us of a combination of a key structure and attached components at Wādī Abū Ṭulayḥa (e.g. Fujii 2007a: Fig. 5). The same was also true with small finds, which included petroglyphs, flint basin-querns, and diagonally truncated stone bars, to say nothing of a large number of PPNB flint artifacts. There is little doubt that the site represents a PPNB outpost like Wādī Abū Ṭulayḥa. All of the finds were left intact for our future investigation.

In addition to the structural remains, a small stone alignment, ca. 2m long and ca. 0.2-0.3m in exposed height, was found in the lower course of a small gully that runs southward beside the outpost (**Fig. 19**). It was a single stone-row wide and single stone-course high, but our brief sounding suggested that another course of stones underlay the wall. Seeing that limestone bedrock layers were exposed throughout the gully bed, it was probably used as a wadi barrier to store seasonal runoff water. However, nothing can be said about its date, except that it may possibly have belonged to the neighboring PPNB outpost. Our rescue excavation scheduled in the

*18. Wādī al-Quwayr: general view of the site (looking E).*

*19. Wādī al-Quwayr: close-up view of Stone Alignment 1 (looking NW).*

2010 summer field season would hopefully provide a reliable clue to the key issue.

**Other Examples**

In addition to the Neolithic or supposedly Neolithic water catchment facilities described above, the survey also dealt with five isolated examples difficult to date. Four of them were known examples, but the other (i.e. Wādī ar-Ruwayshid ash-Sharqī South) was a new finding in the course of the survey.

*Wādī ar-Ruwayshid ash-Sharqī (South)*

This site is located on a wadi bed ca. 5km downstream of the PPNB barrage site of Wādī ar-Ruwayshid ash-Sharqī mentioned above. Though heavily shredded and half-buried by seasonal muddy streams, an intermittent stone alignment ca. 10m in preserved length was newly found (**Fig. 20**). It was slightly incurved toward the lower course, suggesting the use as a water catchment facility. It is most unlikely, however, that it functioned as an impounding dam, since it occupied a flat, permeable terrain in the middle of the extensive wadi bed. Rather, the use as a basin-irrigation barrage would be more likely in view of the location and the simple structure. Seeing that it is not accompanied with a neighboring outpost, it may represent an enclave field or an isolated pasture like the two barrages at Wādī ar-Ruwayshid ash-Sharqī. No reliable clue to the dating was found, although a protruded reinforcement wall attached to the central part of the stone alignment reminded us of similar devices at Wādī Abū Ṭulayḥa and Wādī ar-Ruwayshid ash-Sharqī.

*20. Wādī ar-Ruwayshid ash-Sharqī South: general view of the stone alignment (looking NW).*

*Wādī Burma South SW2*

Wādī Burma is among major tributaries of Wādī al-Ḥasā, flowing northward through a hilly terrain that forms the northwestern watershed of the Jafr drainage system. Our research area includes its uppermost reaches, where several dozens archaeological features were located in the course of our comprehensive investigations in 2003 and 2004. The site of Wādī Burma South SW2 (or WBs-SW2 in our site registration code) is among those and was partly excavated in the summer field season of 2003 (Fujii 2004). The investigation confirmed a pair of stone-built walls that stretched along an upper river terrace over ca. 400m and converged at their southern extremities (**Fig. 21**). It was originally defined as a kite site or a drive-hunting facility, but redefined later as a water catchment facility for lifting up seasonal runoff water to the surrounding flood plain ca. 1-2m higher in elevation (Fujii 2005a).

Here again, the question is its date. Although the previous investigation collected a small number of artifacts around the converging point, they were stray objects swept away from the upper course and, therefore, useless for dating. Unfortunately, the situation still remains unchanged. The retrospective survey revalidated our previous functional identification, but no clue to dating was obtained except that the location on the upper river terrace is suggestive of a relatively early date for the unique feature.

*Wādī Burma North SW3*

This site is located on an upper river terrace ca. 1.3km downstream or NNE of Wādī Burma

*21. Wādī Burma South SW2: general view of the site (looking SW).*

South SW2 and consists only of a remnant of a curvilinear stone alignment opening upstream (**Fig. 22**). It was tentatively registered as a kit site again in the 2004 summer field season, but left intact due to the poor state of preservation. The feature was a simple structure single stone-row wide and a single stone-course high, and often left a gap between any two adjacent construction materials. In light of these observations and the reassessment at Wādī Burma South SW2, there is little doubt that the feature can also be defined as a basin-irrigation barrage rather than a drive-hunting facility. No datable artifacts were found, but the remarkable elevation gap between the feature and the present wadi bed suggests the possibility that it dates back to remote antiquity.

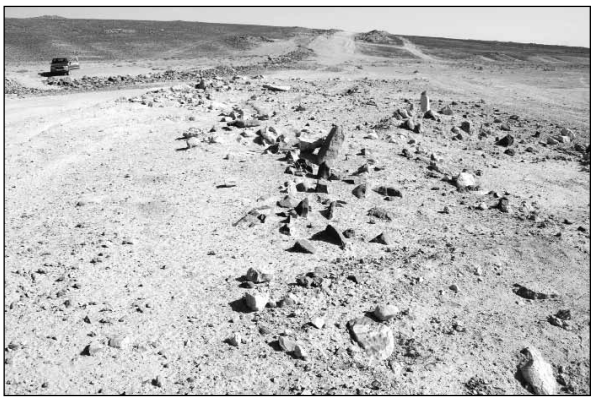
*22. Wādī Burma North SW3: general view of the stone alignment (looking NW).*

*Wadi al-Quṣayr 183*

This site lies on an upper river terrace in the lower course of Wādī al-Quṣayr, a side wadi of Wādī Burma. Our limited excavation, conducted in the 2004 summer field season, revealed a freestanding stone-built wall ca. 28m long and ca. 1.5-3.0m wide (Fujii 2005a). It occupied a flat, permeable terrain beside a small playa, suggesting the use as a small-scale basin-irrigation barrage. However, no clear evidence for dating was available. The retrospective survey of this field season did not provided any new information except that it was partly buried by a civil engineering work for laying a pipeline underground (**Fig. 23**).

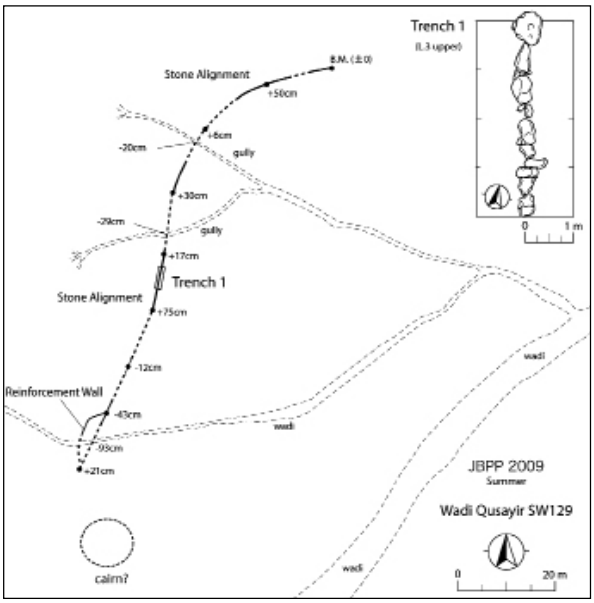
*Wadi al-Quṣayr 129*

The site of Wādī al-Quṣayr 129 is located on



*23. Wādī al-Quṣayr 183: general view of the wall alignment (looking N).*

a gently undulating hilly terrain ca. 700m upstream of Wādī al-Quṣayr 183. Our previous investigation, conducted again in the 2004 summer field season, confirmed an intermittent stone-built wall ca. 100m in total length. It was slightly protruded against the slopes and, therefore, tentatively identified as a simple wadi barrier for splaying seasonal runoff water to its surrounding terrain (Fujii 2005a). Our reexamination newly confirmed a remnant of a small reinforcement wall at the southern extremity (**Figs. 24, 25**). Such a device is common to Jafr Neolithic water catchment facilities (Fujii 2007b, 2007c), but we have to maintain a cautious stance on the dating of the isolated example.




*24. Wādī al-Quṣayr 129: the wall alignment and its surrounding topography.*

*25. Wādī al-Quṣayr 129: general view of the wall alignment (looking NNE).*

**Summary**

The comprehensive review revalidated that the Jafr Basin contained a variety of water catchment facilities. As previously discussed (Fujii 2007b, 2007c, 2010a), six of them — four at Wādī Abū Ṭulayḥa and two at Wādī ar-Ruwayshid ash-Sharqī — can be dated to the PPNB period with considerable certainty. In addition, the barrage-like wall remnant at Wādī Baddā and the two stone alignments at Jabal Juhayra may possibly also be included in the PPNB devices. The existence of at least six (or nine when including the second-ranking candidates) water catchment facilities highlights the essential role of water for the survival in the Neolithic Jafr Basin.

Two things merit attention, however. First, there is a remarkable difference in variety of water catchment facilities between the central area of the basin and its peripheral parts. While the central, more arid area contained at least three basin-irrigation barrages as well as other minor facilities, the western hilly terrain nearer to sedentary farming communities focuses only on the small wad barriers aside from a few undated examples. This unexpected picture, though possibly overemphasized by the difference in preservation conditions between the two areas, suggests that the initial transhumance was first established through transplanting a mixed economy common to the mother settlement area into arid peripheries. A good example is Wādī Abū Ṭulayḥa, where a line of evidence attested to a multi-facetted subsistence strategy consisting of basin-irrigation agriculture (sustained by Barrage 1), small-scale transhumance, and hunting of wildlife (Fujii 2009a, 2010a). It is important to note that the construction of full-fledged water exploitation facilities including basin-irrigation barrages first enabled early transhumants to penetrate into the Neolithic Jafr Basin.

We should also note that datable water catchment facilities in the prehistoric Jafr Basin focus exclusively on the PPNB period, and that no clear evidence for later examples has thus far been confirmed. This is possibly because while the PPNB transhumance was based on standard water use installations, full-fledged pastoral nomads in the subsequent periods substituted minor devices and/or natural ponds for them. Given this, pastoral nomadization in the Jafr Ba-

sin may be defined as a process of departure or liberation from fixed outposts sustained by full-fledged water catchment facilities, as suggested at Wādī Abū Ṭulayḥa (Fujii 2010b).

The retrospective survey proved that our working hypothesis mentioned at the beginning is worth testing in a broader context. It is now evident that the water supply problem at remote agro-pastoral outposts holds a key to reading the process of pastoral nomadization in the Jafr Basin. The next field season is to embark on a full-scale investigation of a few water catchment facilities newly found in the survey.

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