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Beas Landscape and Settlement Survey:
Harappan Sites at Dunyapur/Lodhran – Punjab, Pakistan

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Abstract: This article reports the results of field work conducted between 1996 and 2001 in the Punjab province of Pakistan. Our methodology was based on scraping surfaces to identify remnant features in a region recently levelled for establishment of homesteads, crop farming, and animal husbandry. The article includes unpublished maps, surface records, diagnostic finds, and radiocarbon dates based on core samples. The research captures a short period when Harappans moved to parts of this region and engaged in unique forms of water management techniques. Follow up analyses and satellite imagery provide evidence for site modification and heritage loss.

Keywords: Harappan, Beas, Dunyapur, Water Management

Studies of the Indus civilization have focussed on its major cities. Early excavations at Harappa and Mohenjo-daro revealed an aggregation of large populations and development of sophisticated infrastructures, while studies of rural settlements were neglected by scholars. These circumstances changed in the 1980s when three regional surveys focussed on rural settlements in the Punjab and Sindh. In Cholistan, Rafique Mughal launched a massive survey in 1974 (published in 1997) in which Harappan sites from the mid-fourth millennium to the Late Harappan were categorized in terms of hierarchies based on settlement size. A major breakthrough was the identification of site function broken down into industrial sites, camps, and settlements. Louis Flam's regional survey (1981) in Sindh focussed on the ecological differences among settlements. His results established that a broad range of locations from mountainous to coastal regions were integral to the social and economic development of the Indus civilization.

A subsequent exploration was conducted by a Survey of Archaeological Sites and Monuments in the Punjab, preliminary results of which were reported in Pakistan Archaeology 29:1-474 (Mughal *et al*. 1996). In 1995, Dr. Muhammad Rafique Mughal, then the Director General of Archaeology and Museums, introduced me to several Harappan sites on the Old Beas River to assess the feasibility of developing a more intensive programme of research than had been undertaken by the Punjab survey on Harappan settlements. This early visit and subsequent short field seasons that began in 1996 confirmed that the newly discovered settlements offered an opportunity to utilise the results of the survey on a selection of the Harappan sites as baseline data for more intensive investigations and a closer documentation of the cultural and natural stratigraphy of the Beas settlements.

Beas Landscape and Settlement Survey

The Beas Landscape and Settlement Survey was based on multi-scalar research involving Landsat imagery, field and GIS mapping, and an intensive sampling strategy complemented by pottery yard research on collections of diagnostic materials datable to Harappan periods. In addition, cores were bored into selected sites for further analyses of cultural and natural settlement histories. Thus, it documented a new area of research, filling gaps in our understanding of non-urban settlements, some of which were associated with the Beas River and their underground water systems. Our survey merged the data from the Punjab survey with a targetted and complementary testing strategy involving high-yield surface collection methods to integrate long-term developments from the onset of settlement to their abandonment. Off-site

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research continued in order to protect the heritage of the settlements and other evidence collected as part of the survey.

Our methodology was designed to collect as much evidence as possible without a full-scale excavation focussed on sites contemporary with the Early/Middle/and Late Harappan (Table 1). Methods included a field and GIS mapping and sampling programme, a geoarchaeological component, Landsat and Corona imagery. The ongoing, long-term excavations at Harappa enabled us to reconstruct a chronological sequence by comparing ceramic and small finds from our surface collections with identical objects found in stratigraphic contexts at Harappa.

In previous presentations of the results of our Beas surveys, we focussed on settlements positioned on the Bari doab, as the major source of water used for agricultural purposes. In our results from Dunyapur reported in this paper, we present evidence for small-scale communities situated at some distance from the Beas, dependent on underground water sources and relict meander channels that were associated with settlement shifts (Fig. 1). The figure documents the locations of eighteen sites. An additional site, Chak 22M, was associated with Harappan materials, but not previously identified as Harappan by the Punjab survey team.

Table 1 – Chronological Sequence based on the established chronology at Harappa

The Beas methodology included mapping contours and creating 5x5 metre (modified at selected sites to 10x10 metre) surface grids based on quadrats designed to provide maximum coverage for each site. The grid was the basis for collecting a random sample of surface finds. Clearance involved surface scraping, a method used to good effect in Mesopotamia by Postgate (1983), designed to recover usable information about site layout without excavation. We complemented his approach by including random sampling to achieve maximum coverage of material collections.

The complementary nature of the two components contributed to the survey's long-term objective to identify architectural features, activity areas, hydraulic structures, pathways, kilns, the remains of craft activities and other features (See online Harappa.com/beas/mapping project/slide3 for more details on our methods). Since the Dunyapur sites had undergone significant destruction, we modified our approach at selected sites to include field maps that recorded scraped surfaces and allowed for the identification of remnant features and samples of surface finds.

All weighed and counted objects remained in situ in the units from which they were collected, except for selections of ceramics recorded in our pottery database. Whole vessels, unique types, and small finds were accessioned and turned over to the Curator at the Harappa Museum. Small numbers of diagnostic materials not suitable for accession were retained in secure storage at Harappa.

Geoarchaeological sub-surface cores and trenches were implemented at select sites for collection of cultural and organic chronologies for C14 radiocarbon dating and reconstructing occupation and floodplain histories (see online Harappa.com/beas/mapping project/slide3 Table 2 for the full list of cultural and non-cultural dates).

Central to the success of the project was the systematic collection and survey strategy devised to establish comparable datasets with which to contextualize the rich mosaic of landscapes, site locations, occupational chronologies, and geomorphic histories of the region. As the research progressed at the Dunyapur chaks, we returned to sites over several year periods and noted changes which had occurred as the result of everyday human 'use' such as on roads and other pathways. Our results preserved moments in time, perhaps over hundreds of years, of landscape and settlement along the Old Beas.

Table 1. Chronology and periods based on Harappan excavations

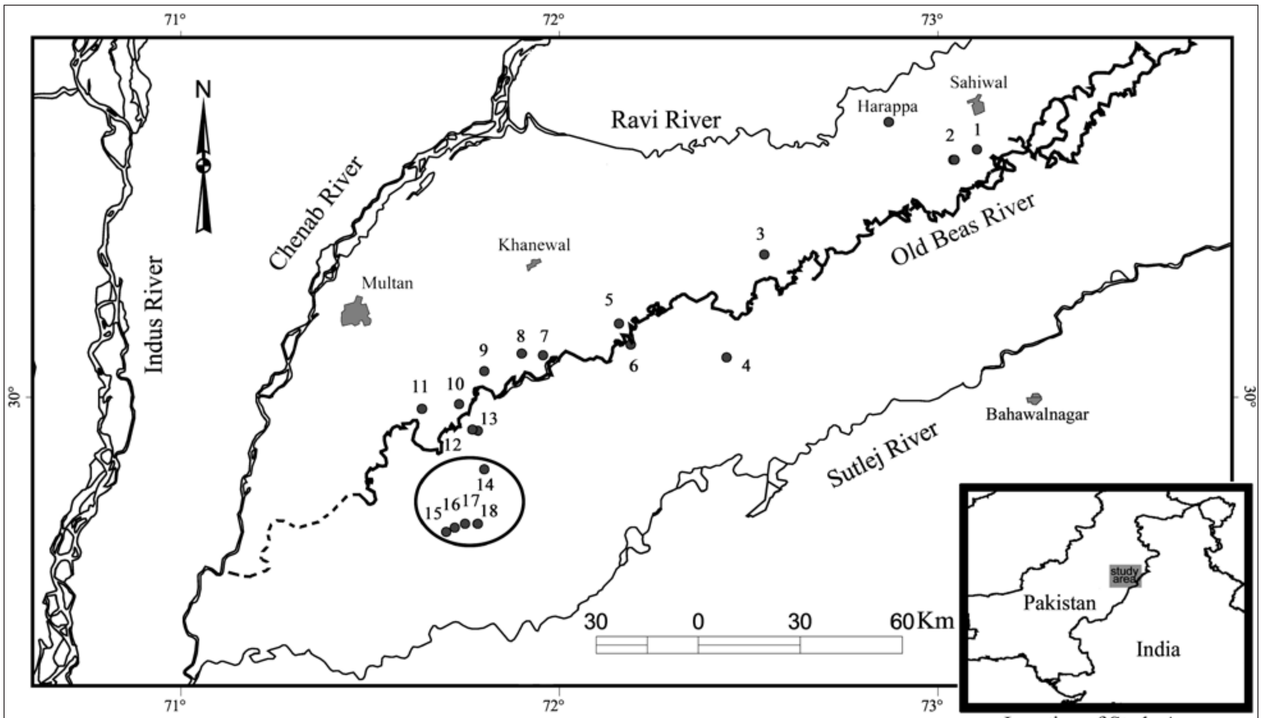
Period	Phase	Date
1	Ravi/Hakra	3700-ca. 2800 BCE
2	Kot Diji/Early Harappan	2800-ca. 2600 BCE
3A	Harappa A	2600-2450 BCE
3B	Harappa B	2450-2200 BCE
3	Harappa C	2200-1900 BCE
4	Harappa/Late Transitional	1900-ca.1800 BCE
5	Late Harappa	Ca. 1800 - <1300 BCE

Beas Settlement and Landscape Survey at Dunyapur

In 1991, Lodhran achieved the status of District and Dunyapur, Tehsil, which is situated on the Lodhran-Khanewal road at a distance of about 65 km. from Khanewal and 46 km. from Multan.

We approached the Dunyapur sites as we travelled north on the Dunyapur road in 1996. At that time, road construction was underway and large quantities of rock were strewn along the route brought in for road building purposes. Turning off the paved road, we travelled east through an extensive dune, 1.8-2.5m. high and a series of archaeological sites. Many changes were underway as settlers moved into the region to set up homesteads and engage in cultivation. A substantial portion of the region had been subjected to extensive ploughing, remodelling, and technical improvements in the form of tube wells.

The locations of the sites at Dunyapur were unusual. The dune field was located at the southern end of our survey area and distant from the Beas (see Fig. 1 map). They also differed from the upstream sites in our survey. Not only were they some distance from the main Beas, but several were also arranged in a cluster. One site, Mai Manoori Bhir was significantly larger than the settlement cluster and isolated from them. Five of the settlements (Chaks 18/19M, 21M, 22M, 27M) were closely positioned small communities. Chak 29M was at a crossroad of the main Dunyapur Road and the dirt path in the dune field.



Key to Archaeological Sites

1. Lahoma Lal Tibba
2. Chak Purbane Syal
3. Chak 90-12L
4. Kusamsar
5. Chak 76-15L
6. Tibba Bagh Thali
7. Vainiwal
8. Chak 140-10R
9. Chak 113-10R
10. Chak 123-10R
11. Chak 133-10R
12. Qutab Pur
13. Chak 160WB
14. Mai Manoori Bhir
15. Bhir Chak 29M
16. Tibba Chak 27M
17. Chak 21M
18. Chak 18-19M

Figure 1. The ancient Beas River and Harappan sites with Dunyapur Chaks circled.

Coordinates = all sites occupied in Early and Middle Harappan:

71 48’ 00”E, 29 50’ 00”N – Mai Manoori Bhir
71 43’ 20”E, 29 42’ 00”N – Chak 27M
71 47’ 00” E, 29 42’ 30”N – Chak 18/19M
71 45’ 00”E, 29 42’ 30 N – Chak 21M
71 40’ 00”E, 29 41’ 25”N – Chak 29M

A Large Settlement - Mai Manoori Bhir

We surveyed Mai Manoori mound on January 17, 1998 and again in 1999 on February 28 and April 19. No intact sections were visible on initial inspection as the mound had been totally modified by cultivation and settlement, apart from a shrine or tomb referred to as the Old Lady’s Tomb/Shrine. Visitors and local people believe that important beads associated with the tomb were ‘unique to this part of the world.’ Surface areas were pock marked where digging occurred in search of the beads.

We were informed by local people that the mound had been levelled approximately three years previously; and others claimed the site originally had been 32-55 ha. Even though this number seems exaggerated, the original mound clearly was much larger than the current remains suggest. The Punjab surveyors of the archaeological sites and monuments several years before our Beas research measured the site at 6.89 ha. while the Beas team defined its settlement size as 3.5 ha., based on the spoil piles and berms scattered throughout and upon its core area in 1998. Comprised of a sandy soil, the mound measured up to 3 metres high in some places, from which abundant pre-Harappan (Kot Diji or Hakra) sherd fragments were discovered, along with those of traditional Harappan styles from the Early and Mature Harappan periods.

In February 1999, members of the team prepared a rough Field Map (Fig. 2). The map is framed on its north by a modern irrigation channel, which continued on its east along a road that ran parallel to the channel. Central features of the site included the modern shrine, courtyard, and small mud-brick building located at the centre of the map marked by an TSX (later used as a marker in a GIS map). An additional mud brick building and flat bench are shown in the northeast. Numbers shown on high and low berms on the north, west, and south refer to field flags. A road cuts through the site at mid-point and includes two smaller paths trending northerly. Numbered features include mud brick walls, sherd scatters, and a possible platform. A sherd scatter comprised of craft activity related materials was identified between the extreme southern berm and the ‘blowout.’ Blowouts are sandy depressions found in sand dune ecosystems; this one records shrub regeneration.

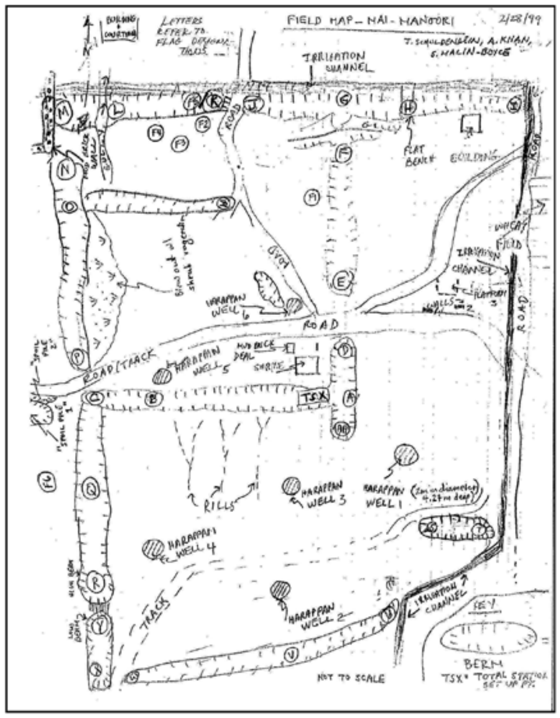


Figure 2. Field map of Mai Manoori Bhir

The most important technical feature at Mai Manoori is the Harappan style wells. Well number 1 was clearly visible on the surface and measured 2 metres in diameter. A photograph of this well shows wedge shaped baked brick using the traditional technology practised in Harappan well construction (Fig. 3). Remains of well 1 noted on the field map were measured to a depth 4.27metres. Like other Harappan wells discovered at Beas sites, attempts to draw potable water were unsuccessful, as it was salty and undrinkable. Five other wells were traced using surface clearance methods. Baked brick traces of well construction were found throughout the areas where wells were traced (Fig. 4). All told, six wells were discovered at Mai Manoori Bhir, including the exposed well, which was recorded and measured.

Figure 3. Well 1 at Mai Manoori Bhir

Figure 4. Scatters of baked bricks define five other wells.

On April 19, 1999, the Beas Survey team returned to the site one last time to finish collection and prepare a GIS map (Fig. 5). In view of the destroyed nature of the settlement, we did not use the gridded quadrat system but divided collection areas by two lot numbers, 2800 and 2801. Collection bags were labelled N, S, and E using the center of the mound as a reference point for these directions. All diagnostic sherds were picked up and recorded in our pottery yard database, and additional small finds were collected. In total, 124 diagnostics of traditional Harappan forms (based on identification by Beas team members who had worked in the Harappa pottery yard) were recorded. They included dish on stand, ledge shouldered jars, large and small jars, jar/pots, bowls/basins and dishes. Cooking

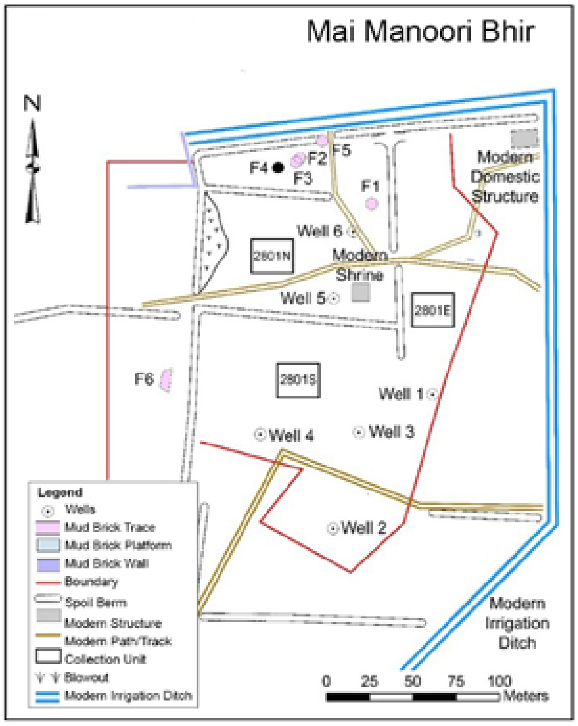


Figure 5. GIS map of Mai Manoori Bhir

pots and perforated jars also were present. All of the sherds were types known from number designations used at Harappa at the time.[1]

They included six Early Harappan and forty-seven Mature Harappan vessel Types. One sherd was decorated with a characteristic 'berry' motif typical of a transitional style found in Period 2/3 Harappan contexts (see online Harappa.com/ beas/mapping project/slide10 Figure 11 for an example of the type). We had planned to prepare illustrations for publication of the Mai Manoori Bhir finds in our next field season in 2001 but were unable to return to Harappa.

Twenty-three small finds were collected in February and April 1999 and bagged in lot 2800. The small finds included 1 shell bangle, bits of metal tools, a modern steatite bead found in the shrine, a few terracotta pieces including balls, and two figurines.

Sharri Clark studied the full range of figurines of the corpus at Harappa (Clark 2016). The figurine (Fig. 6) from Mai Manoori Bhir, H98/ BS 2800-5, falls within the evolution of figurine types from Period 2 to the end of period 3. In the evolutionary sequence presented on Figure 5.21,

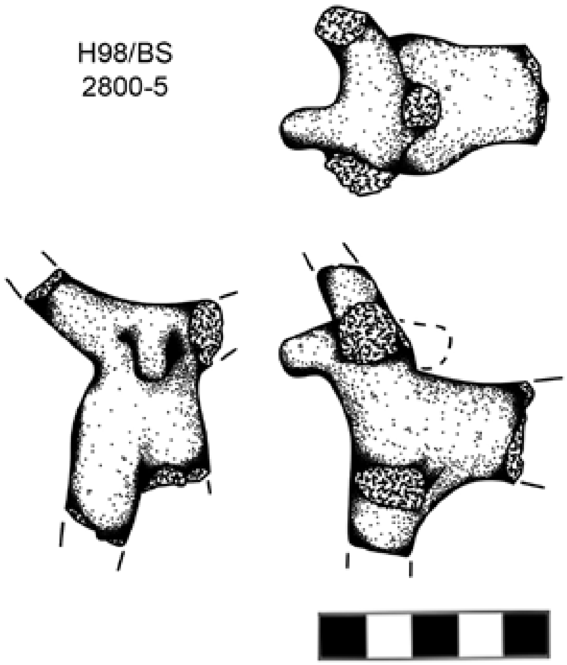


Figure 6. Zoomorphic Figurine at Mai Manoori Bhir

Clark (2016: 240), compares H98/BS 2800-5 to a type Z-ZBU-D-2 (early period 2 or early 3A/B. They have more rounded snouts and flattened humps and are undecorated (Clark 2016: 240, fig.5.21). This type is listed in Appendix F-960-961 (Clark 2016).

Heritage and Preservation

Mai Manoori Bhir, in spite of the destruction of major parts of the settlement as it existed during the Harappan periods, is one among many of the villages and towns the Beas Landscape and Settlement survey studied. Large or small they have enriched our understanding of the Indus civilization and regional and temporal settlement trends in the Punjab. They also have provided challenges to heritage and preservation issues. At a minimum, the broader public should be informed of the significance of these precious reminders of the past. In Multan, the Importance of heritage issues are of ongoing interest. In 1981, Mai Manoori Bhir emerged as a central feature of initiatives of the Multan Regional Development Plan, Archaeology & Cultural Heritage Sectoral Report and issued an appeal for protection of the site, acknowledging the significance of Mai Manoori Bhir and its Harappan remains. Recommended were preservation initiatives and measures to avoid continued damage from heavy machinery, among other interventions toward preserving and conserving archeological/Cultural Heritage in the region.

A Settlement Cluster – Chaks 18/19M, Chak 21M, Chak 22M, Chak 27M

Chak 27M was the best preserved of the small settlement cluster. Our research there began in 1998. The site surface had been newly plowed. A team member, Laura J. Miller, prepared a field map using the newly ploughed surface to trace buildings, production areas, and other significant features (Fig. 7A).

The LJM map records tractor spoils in bold outline and topographic divisions with dotted lines. Divisions of the site were formed based on two tractor spoils encircled by streets, gullies and nullahs, which bordered the large freshly ploughed area. On the LJM map, Feature A defined a low area of loose silts devoid of architectural features and low concentrations of sherds. Features B, E, F, H, and L traced two large and several smaller buildings during surface clearing. There were low concentrations of sherds associated with the building traces, none of which contained production debris. In distinction, to the west of Feature A, Feature A/B on the west, was covered by large areas of lithics and ceramics preserved on the surface along with two kilns and concentrations of overfired sherds and kiln debris (Figs. 8, 9).

South and East of the above features, Feature S is defined by several building traces separated by streets and concentrations of sherds, suggestive of a group of households. The third area, defined by tractor spoils showed scatters of materials which were not recorded.

In March 1999, we returned to Chak 27M to produce a GIS map (Fig. 7B). When 7A and 7B are viewed side-by-side the features on the GIS and LJM maps showed some shifting of building traces since 1998 but the basic topography was intact. This shift is most notable in the traces of the largest building identified in Feature F, which we assume was the result of foot traffic on the site since 1998. Changes could also reflect differences between hand-held compass and tape compared to the GIS technology. Some features shown on the LJM Field Map are not recorded on the GIS map.

Our principal goal in preparing a GIS map was for greater accuracy and implementing our standard methodology by dividing the site into quadrats and selecting a random sample for 100% coverage. The quadrats are numbered in a 3400 series through 3420 marked as collection units on the GIS map.

At Chak 27M, sherd fragments confirmed the site's occupation during Early and Mature Harappan periods (Fig. 7A/7B). Surface indicators on the original 1998 map were substantiated by the large collections of vitrified brick fragments and sherds (Figs. 8, 9). In contrast in the central building areas, there were large quantities of vessels of all sizes and virtually no productive debris in Feature A/B. In Feature H, there was an abundance of production debris, including overfired ceramics and shell. In distinction, in Features F, B, and S, the clusters of buildings lacked production debris, but were filled with a tremendous variety of ceramic types (Fig. 10). In lot 3420, which was cut by the modern path, ceramics consisted predominantly of eroded pottery and small finds. Finally, local school aged boys were fascinated by our work (they also liked listening to the soccer match between India and Pakistan on our car radio) and collected large quantities of beads, stone, steatite, and some lapis lazuli and carnelian which they turned over to us.

Figurine 3401-103 from Chak 27M (Fig. 11) does not have an exact analogy. The torso and neck are preserved. The head is partially preserved (horns or ears are damaged and missing). The figurine compares to Z-ZBU-A-2

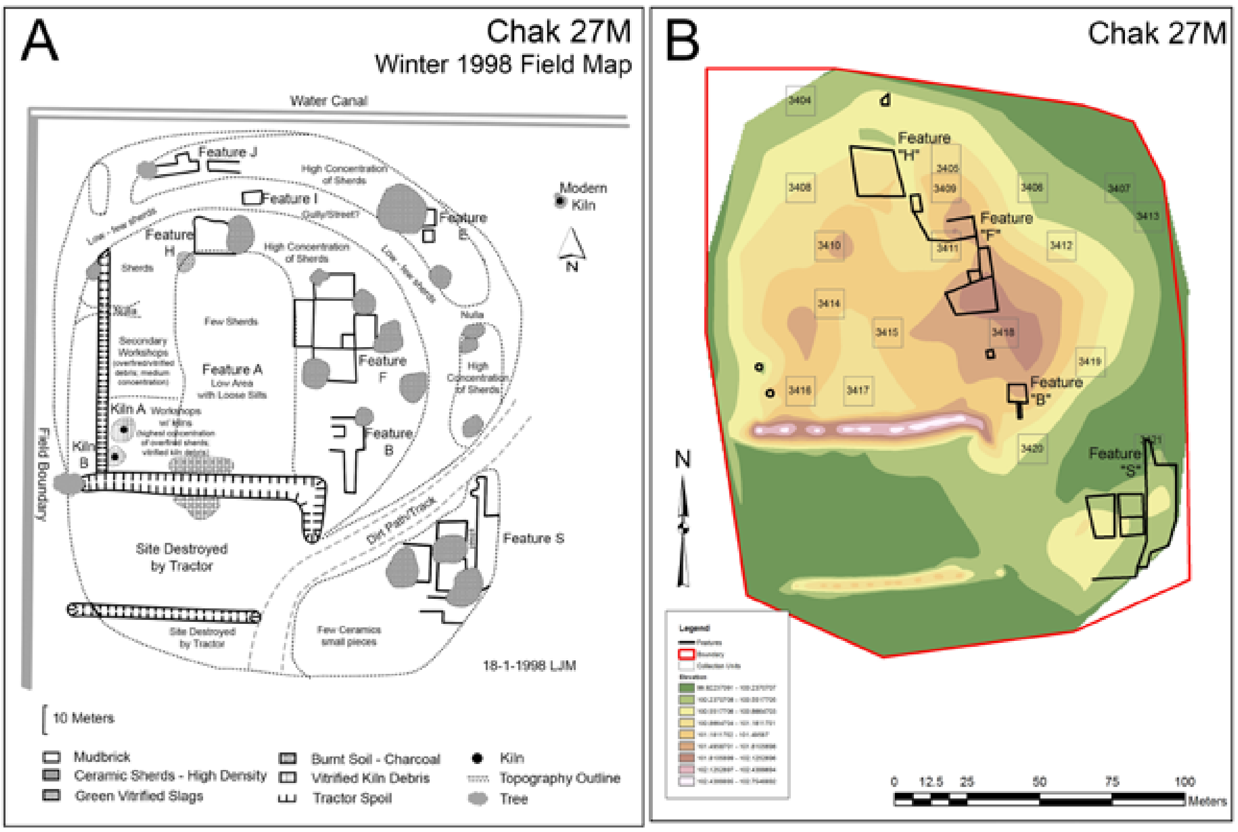


Figure 7. A & B - Field and GIS maps compared from Chak 27M

Figure 8. Lithics and ceramics surface scatter at Chak 27M

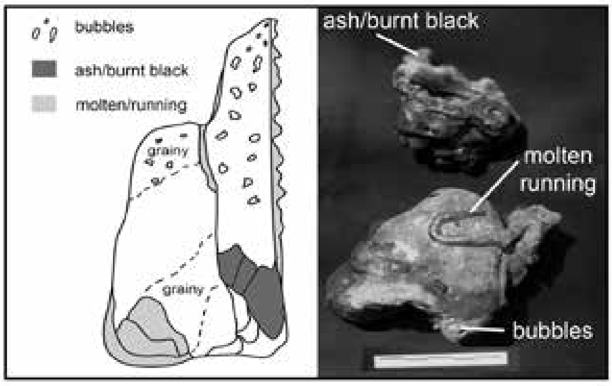


Figure 9. Examples of burnt brick from kilns at Chak 27M

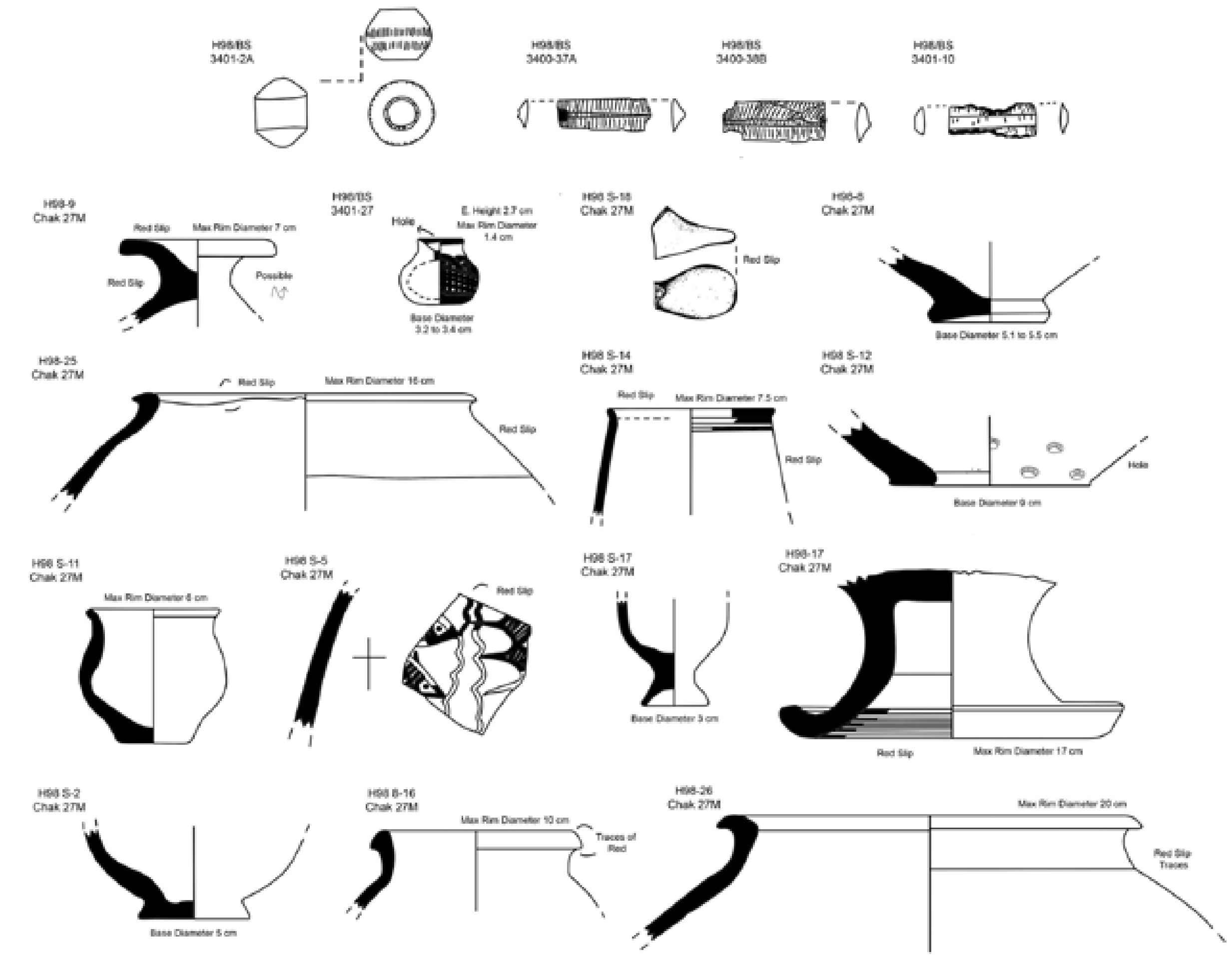


Figure 10. Ceramics at Chak 27M

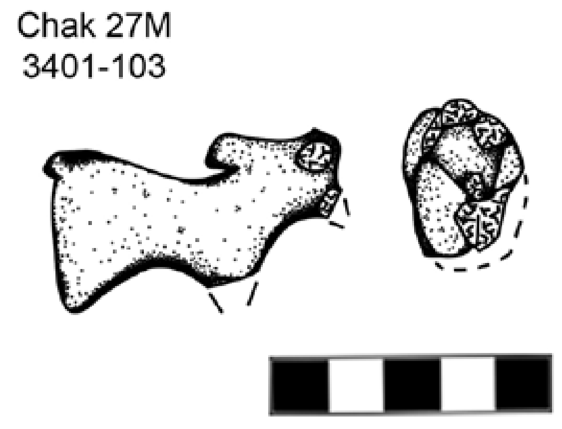


Figure 11. Zoomorphic Figurine at Chak 27M

(if shoulders and rumps are nearly the same height) and Z-ZBU-B3 (if rump projects above the shoulders). Faces are generally featureless 'with simple pointed or cylindrical snouts; short, upturned horns and humps that vary from tiny to somewhat disproportionately large' (Clark 2016: 240). Type Z-ZBU-A-2 is found in period 2-3 A/B contexts. Type Z-ZBU-B3 is found in period 3 A and B (Clark 2016: 241).

A core was dug near Feature B. (All Dunyapur Cores are discussed below under Dunyapur Cores.)

Chak 22M

This Harappan site was located approximately 500 metres from the south edge of Chak 27M and was totally destroyed. It was not identified as Harappan in the Punjab survey of archaeological sites and monuments. A local farmer brought us to an empty field and courtyard of a house. According to the farmer, in the past there were many other sites throughout the area, and he showed us the location of a portion of the original Chak 22 mound. When we questioned him about the absence of sherds, he stated that villagers collect them and grind them up to put in cement. Recovered pieces also are used to decorate patios. We observed nearby patios with attractive fragments of Harappan materials pressed like mosaic tiles into mud and straw plaster. The survey or archaeological sites and monuments measured Chak 22M at .46 ha.

We were unable to find the remaining sites to which the farmer referred, but the Dunyapur area emerged as a major locus of Harappan occupation when Mai Manoori Bhir, 18/19m, 21m, 27m, 29m, and now 22m are considered together.

Chak 21M

Chak 21M had been destroyed a month before we arrived but remained undisturbed during later visits. Using the standard methods applied to other Beas settlements and Chak 27M, we divided the site into 10 x 10 m quadrats (Fig. 12). These quadrats were designed for intensive artifact collection, our standard method to insure 100% distribution of activity and collection areas. All materials were weighed, counted, and recorded. Of the 10,000 sherds weighed, counted and recorded, diagnostics were turned over to the Harappa curator while others were stored at Harappa. The remaining were left on the site.

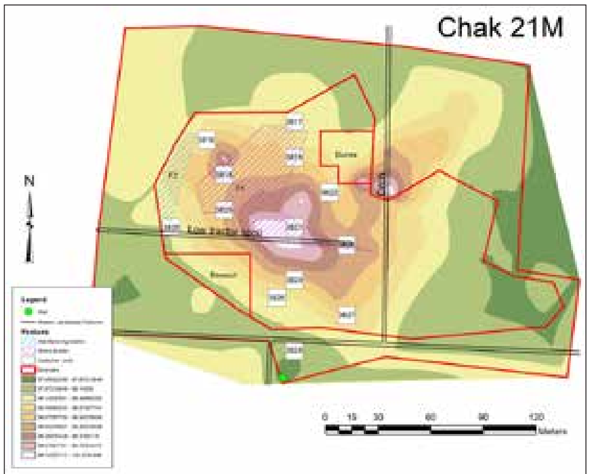


Figure 12. GIS map at Chak 21M

Traces of mudbrick walls were visible on the surface when scraped. On the north there were concentrations of sherds that ended at dune encroachment; on the west in Feature 2, there was production debris. On the east a modern ditch was bounded by dunes and sherd concentrations that extended out into a field over an area of a hectare. Also labelled on the map is a blowout, a depression or hollow formed by wind erosion on preexisting sand or stabilized due to dune vegetation.

Outside of the southern limit of the site, there was a well, the upper parts of which were produced from traditional Harappan wedge-shaped, baked brick. Local farmers pointed out the well to us and informed us that they were unsuccessful in their attempts to draw water.

Ceramic fragments (Figs. 13, 14) included Early Harappan red slipped jars, grey fragments of a dish and a bowl on a stand, while others were decorated with sandy parallel lines and jar/pots with red slip and painted horizontal lines; some had small, trimmed contiguous bases. Mature Harappan sherd fragments included a dish on stand, with red slip and a footed base. In quadrats labelled 3826 and 3824, there was evidence for production debris in the form of nodules, shell, and drips from melting. One Early Harappan flat-baked bangle (not shown) was present; sherd and nodule collections were Early or Mature Harappan.

A core was dug at Feature 1 on the GIS map. (All Dunyapur Cores are discussed below under Dunyapur Cores.)

Chak 18, 19 M

Chak 18M had recently been levelled and few remnants of past habitation remained. Most of

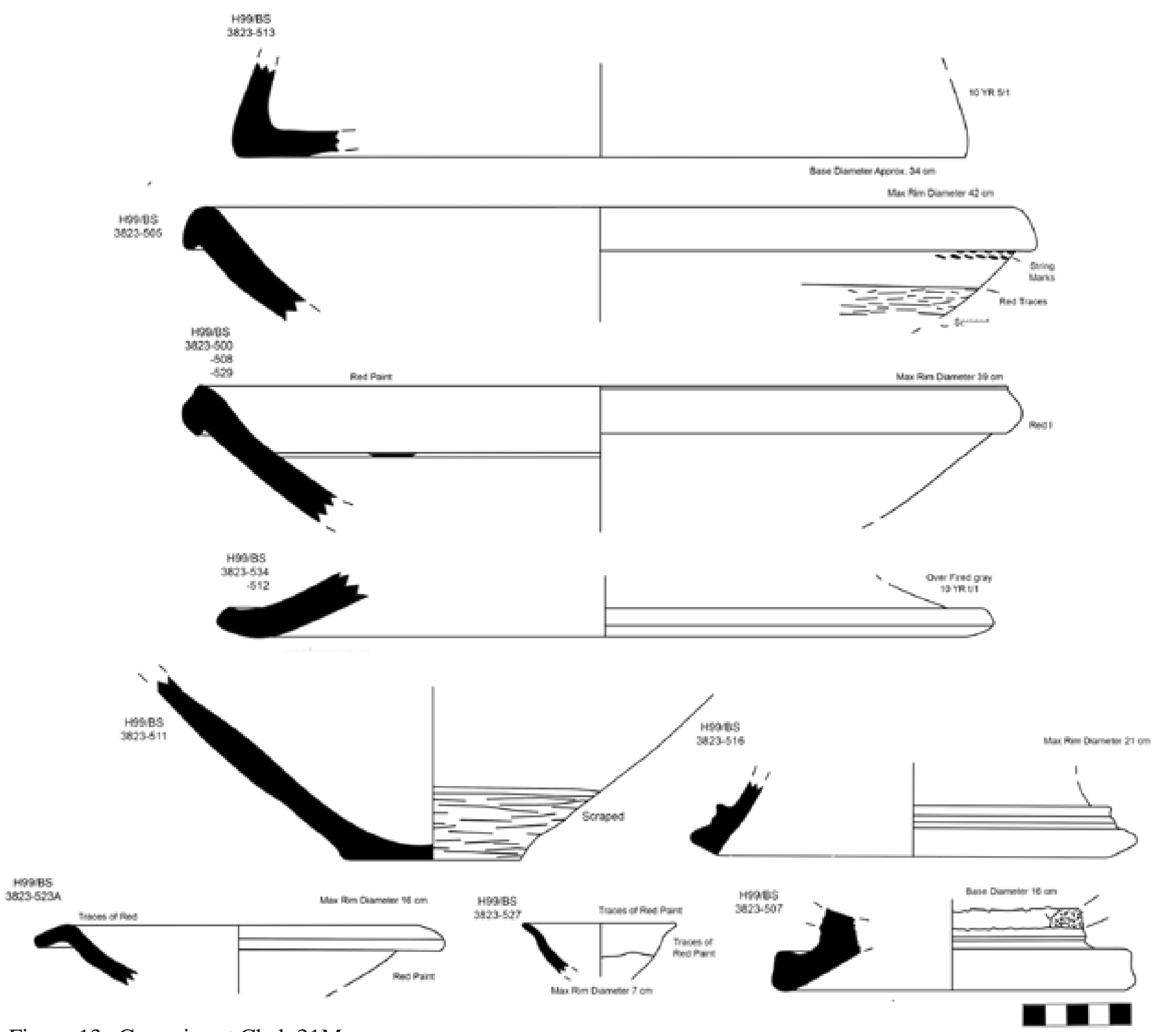


Figure 13. Ceramics at Chak 21M

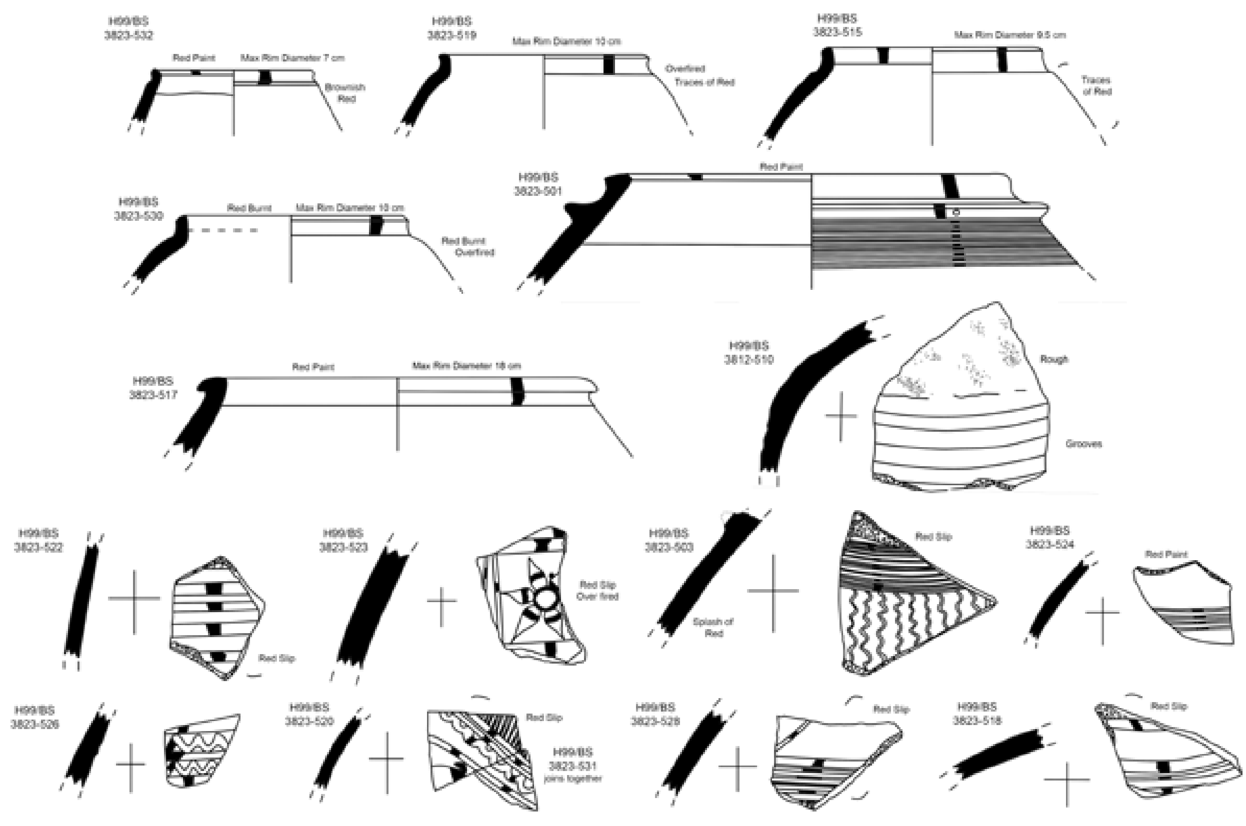


Figure 14. Ceramics at Chak 21M

its remains had been dumped into surrounding fields. Chak 19M was separated from Chak 18 M by an irrigated field (approximately 300 metres wide) to its south on a low mound that had been modified by attempts to cultivate the surrounding area as shown on the GIS map (Fig. 15). In view of the degree of destruction at the site, we did not employ our standard method of dividing the site into quadrats. After scraping large segments of the site, we defined several scatters of cultural materials, shown as Scatters A – D. On the northwest, Scatters D and C signify a ditch. The GIS map contains a color gradient showing elevation. Ceramic (Fig. 16) and other artifact remains at Chak 18/19 confirmed the site's occupation in the Early and Mature Harappan. In addition to concentrations of vitrified sherds, melted drips from firing and modern brick fragments, finely crafted pottery comprised of red slip, black paint, and sandy textures were identified as Early Harappan and Mature Harappan. There were no nodules, terracotta cakes, figurines, cart fragments, or steatite beads, which were found at other Beas sites.

A core is indicated in Scatter A (All Dunyapur Cores are discussed below under Dunyapur Cores.)

A site at a Crossroad - Chak 29M

Chak 29M is located on the Dunyapur paved road near its intersection with the unpaved path on which the above Chaks were located. We briefly stopped at Chak 29M in 1996 as we travelled north on the Dunyapur road. At that time, road construction was underway and large quantities of rock had been brought into the area for road building purposes. Small quantities of the rocks littered the site.

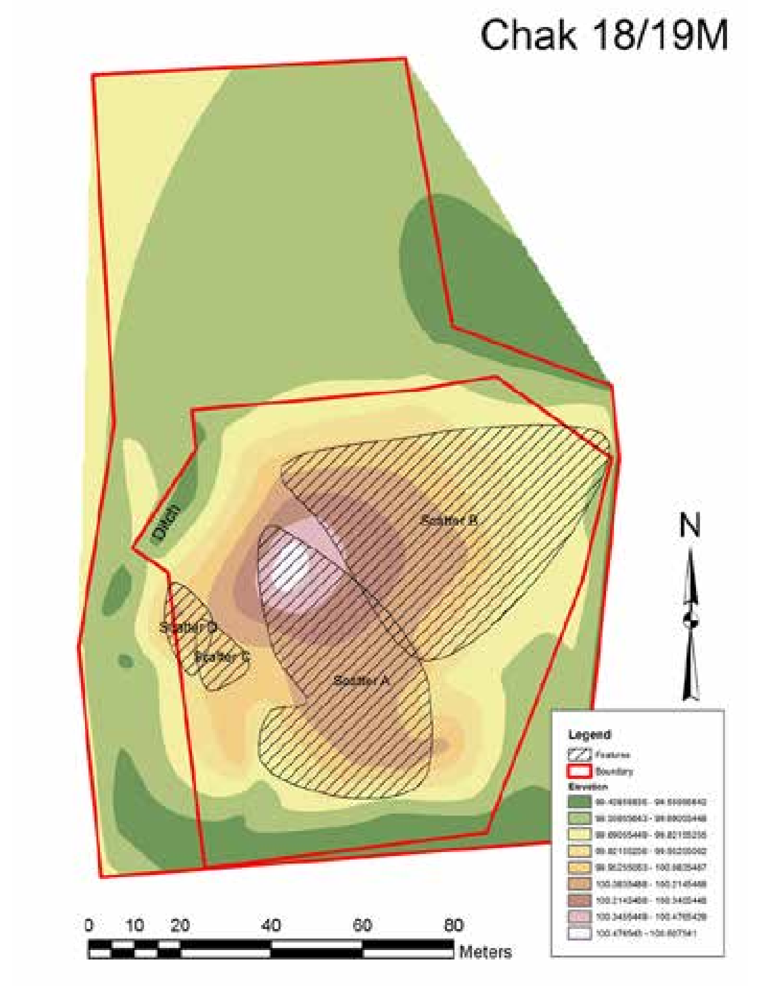


Figure 15. GIS map Chak 18/19M

We returned to the site in 1999 to prepare a GIS map (Fig. 17). The map records elevation gradients, modern ditches cutting across the site, a modern water-holding pond, residential compound, an abandoned structure, and surface scatters. Whether the well south of the GIS map was modern or Harappan is unknown. We surveyed the entire site in spite of its disorder concentrating on Scatters A and B and the collection units. The latter were divided into 10 x 10 m. quadrats, using the scraping/clearing method, identifying artefacts and counting and weighing sherds. Large quantities of ceramics and small finds of traditional types found in Early and Mature Harappan contexts were present.

Following the Harappan occupation, Chak 29M was not occupied, except for a small Medieval settlement. Follow-up satellite images showed continued activity involving some changes. The residential compound in the north and the abandoned structure disappeared. A new structure was identified where scatter A is shown on the 1999 GIS map. The area on the west side of the site had been levelled and cleared for agriculture and gardening. Chak 29M appears to have maintained its prime location at the intersection of the main Dunyapur road and the cultivated areas in what once was a dune field.

Chak 29M ceramics are illustrated on figures 18 and 19. Large quantities of ceramics with a tremendous amount of variety of Harappan types are from the Early and Mature Harappan. Much like the other Beas sites at Dunyapur, there were many large bowls and tall jars with large

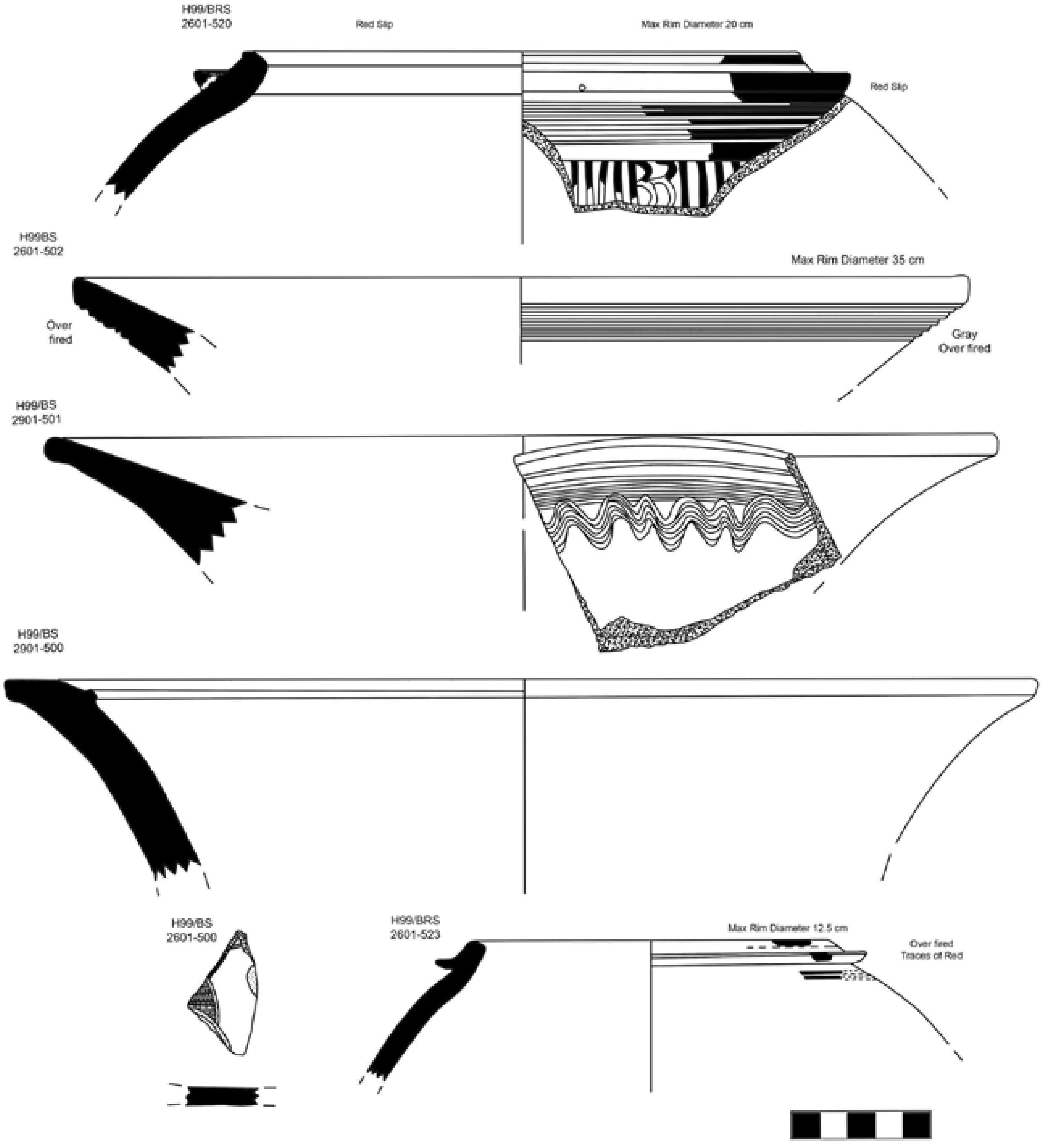


Figure 16. Ceramics at Chak 18/19M

maximum diameter width (506 for example). Both are obviously very useful for storage. On figure 18, 502 is part of a dish on stand. Similar types are illustrated on figure 19. Ledge shouldered and other large and small jars are illustrated along with string cut and contiguous bases; while 517 is unusual and may be an early Ravi/Hakra small vessel. The small fragment with the plus/or X 'sign' may be a potter's mark or other message. Object bearing number 520 is a base and body part of a perforated jar, a type found at most of the Dunyapur settlements. In our pottery yard database there are many entries for Chak 29M ceramics recorded as extremely large body sherds which are labeled as unidentifiable.

Sub-surface Cores in Dunyapur contexts

The integration of cultural (here noted as Early/ Mature/Late Harappan) and natural stratigraphy provide a window into the onset and post-date of settlement. As discussed earlier, a cultural and non-cultural list is available online at (Harappa.com/beas/mapping project/slide3 Table 2 for the full list of cultural and non-cultural dates). Here, below I provide a table of non-cultural dates 'Table 2 - Selected Radiocarbon dates from Dunyapur and other Beas sites,' and focus on three dates from Chak 19M, Chak 21M, and Chak 27M and one from Crossing 6, the oldest date.

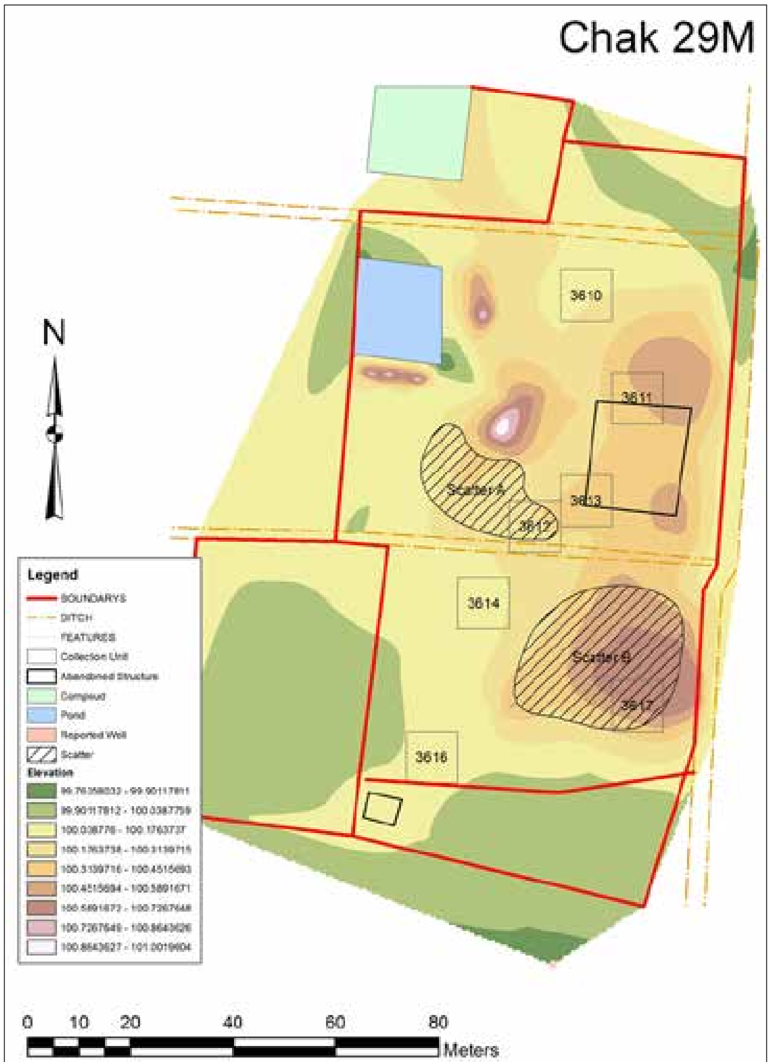


Figure 17. GIS Chak 29M

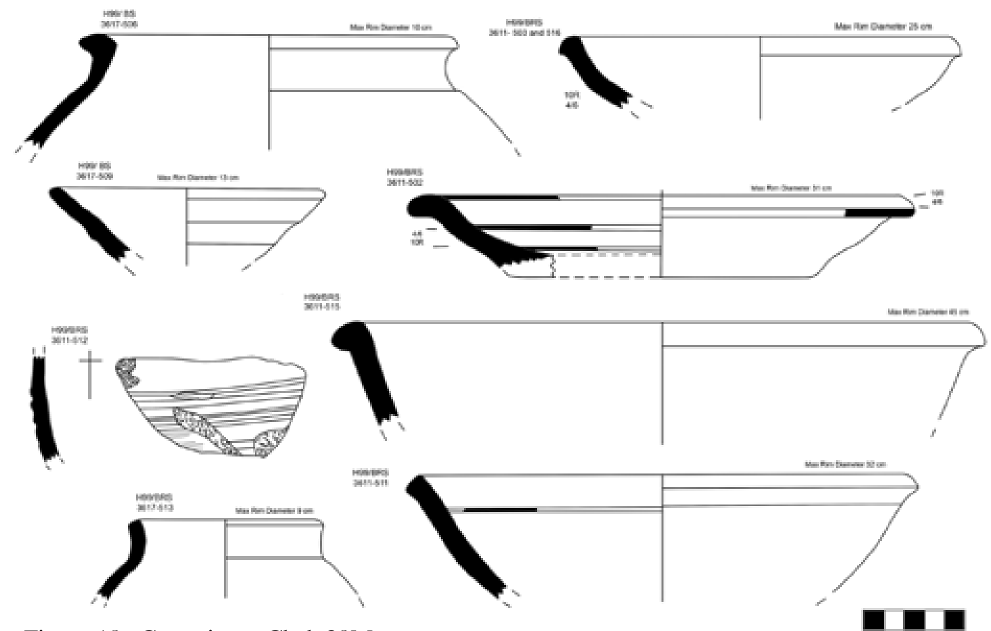


Figure 18. Ceramics at Chak 29M

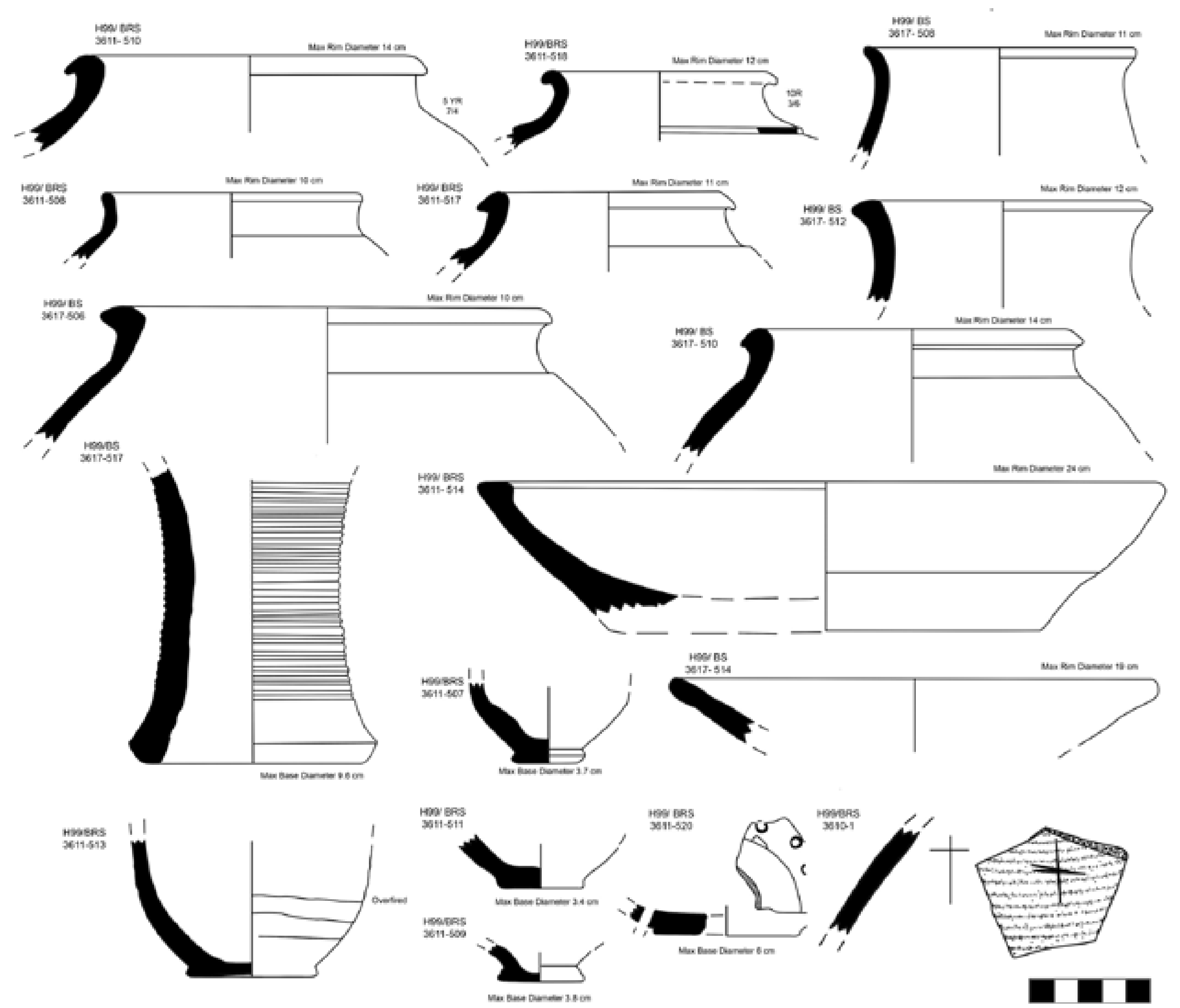


Figure 19. Ceramics at Chak 29M

Table 2 – Selected Radiocarbon dates from Dunyapur and other Beas sites

A standardized methodology for core data was used at larger and well-preserved sites but was modified for the southernmost extension of Harappan settlements described in this paper. Core data integrate the settlement histories of sites located near the levee slopes of the Old Beas with the changes in settlement distribution (away from the Beas) in the occupation of this region. The organic sediments are in natural and alluvial contexts and represent various contributions of degraded carbon-rich material in humic soils, recording hundreds of years of settlement.

Table 2 orders radiocarbon dates from organic sediments according to the location of the archaeological sites along a downstream axis following the course of the drainage to the confluence of the Beas with the Indus trunk channel. Upstream (U), middle (M), and downstream (L) segments reflect general principles of drainage as measures for explaining the sequence of geological events; typically, downstream (alluvial) sedimentation is thicker and more recent than upstream. The organic sediments are utilized to construct floodplain histories. As the table shows, at Harappa and Lahoma Lal Tibba, in the upper segment of the Beas, the organic dates pre-date the earliest occupations in the Early Harappan. The oldest date is from Crossing 6, downstream from Harappa. It represents a terminal Pleistocene terrace along the Beas; it is currently 3-4m. above the floodplain and yielded organic materials indicative of an ancient pond or swamp. The determination of 15,720 +/- 70BP is consistent with higher Pleistocene-aged terraces of the river that have been documented upstream and provide the first dated evidence of a major interval of Beas valley downcutting.

The ages listed for these organic sediments on Table 2 spread from the Pleistocene through the Middle Holocene when the Beas and the Ravi were relatively stable channels. Cultural deposits from mounds spanned the third millennium BCE implying that stabilized stream flow and low levels of geomorphic activity were contemporaneous with successful Harappan age adaptation to the flood basins of Old Beas and Ravi floodplain and terrace environments recorded at Crossing 6.

The three cores from Chak 19M (Fig. 20), Chak 21M (Fig. 21) and Chak 27M (Fig. 22) are dated sediments, which pre-date Harappan settlement. The 7380 +/- 40 B.P. date at Chak 19M marks a transition from traces of cultural materials to natural stratigraphy comprised of silty fine sand. Chak 21M, 9500 +/- 60 B.P., also below cultural materials, is marked by silts and clays coarsening to sands with depth in the Holocene Alluvium. The Pleistocene date of 12,110 +/- 40 B.P. from Chak 27M is well below cultural sediments transitioning from fine sandy silts to organic rich clay.

Table 2. Chronology of Dunyapur Cores

Non-cultural Dates	C14 Age	Context	Segment
Lahoma Lal Tibba	6900 +/- 40 B.P.	Holocene Alluvium	Upper – E/M/??
Lahoma Lal Tibba	5970 +/- 40 B.P.	Holocene Alluvium	Upper – E/M
Lahoma Lal Tibba	13,050 +/- 60 B.P.	Pleistocene Alluvium	Upper – E/M
Harappa	11,270 +/- 40 B.P.	Pleistocene Alluvium	Upper – E/M/L
Harappa	13,090 +/- 40 B.P.	Pleistocene Alluvium	Upper – E/M/L
Crossing 6	15,720 +/- 70 B.P.	Pleistocene Terrace	Middle
Chak76-15L	7120 +/- 100 B.P.	Holocene Alluvium	Middle
Chak 160 WB	5970 +/- 40 B.P.	Holocene Alluvium	Lower – E/M
Chak 19M	7,380 +/- 40 B.P.	Holocene Alluvium	Lower E/M
Chak 21M	9500 +/- 60 B.P.	Holocene Alluvium	Lower E/M?
Chak 27M	12,110 +/- 40 B.P.	Pleistocene Alluvium	Lower E/M
Chak 133-10R	11,150 +/- 50 B.P.	Pleistocene Alluvium	Lower E/M?
Mai Manoori Bhir	N/A	N/A	Lower E/M

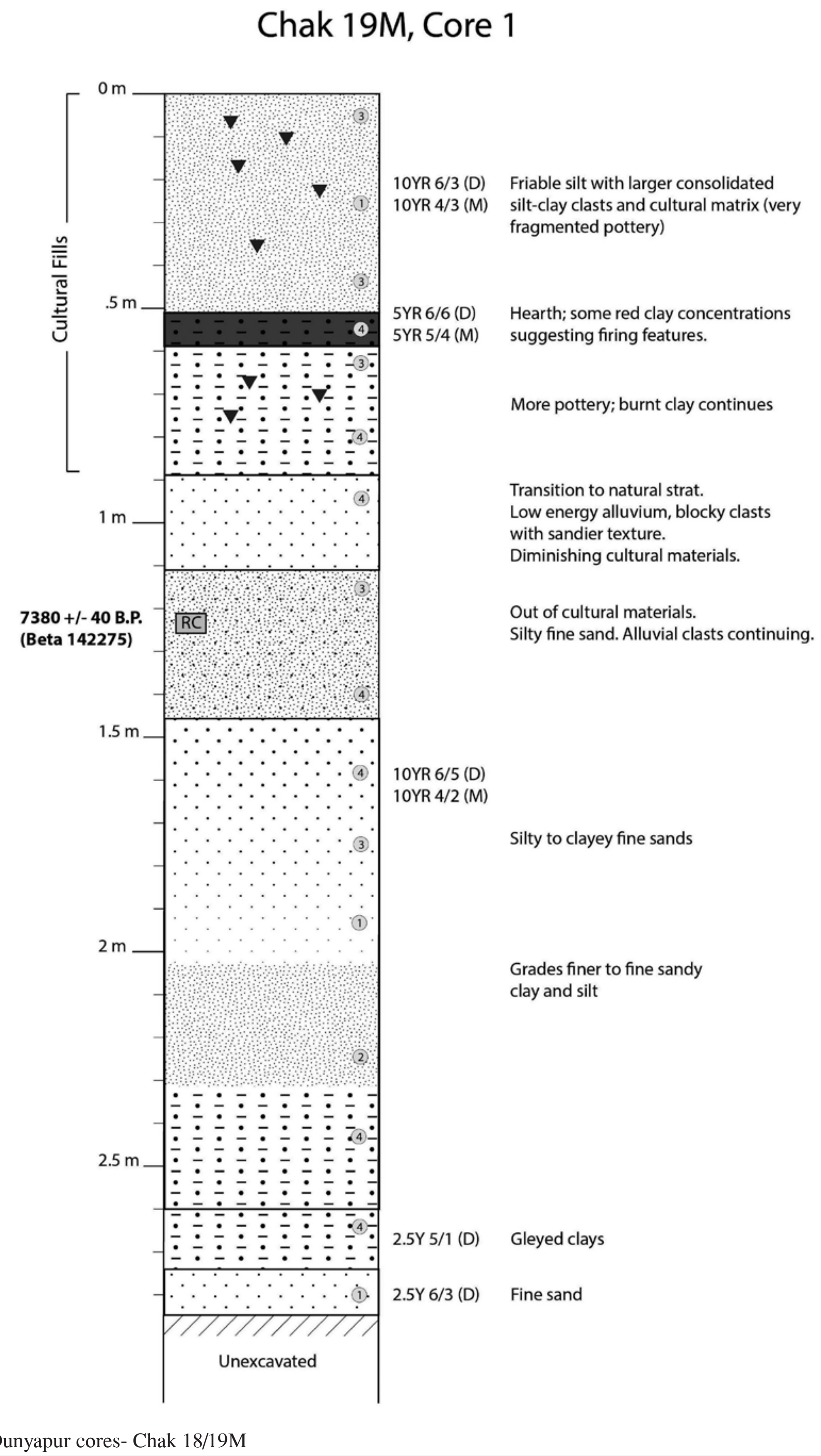


Figure 20. Dunyapur cores- Chak 18/19M

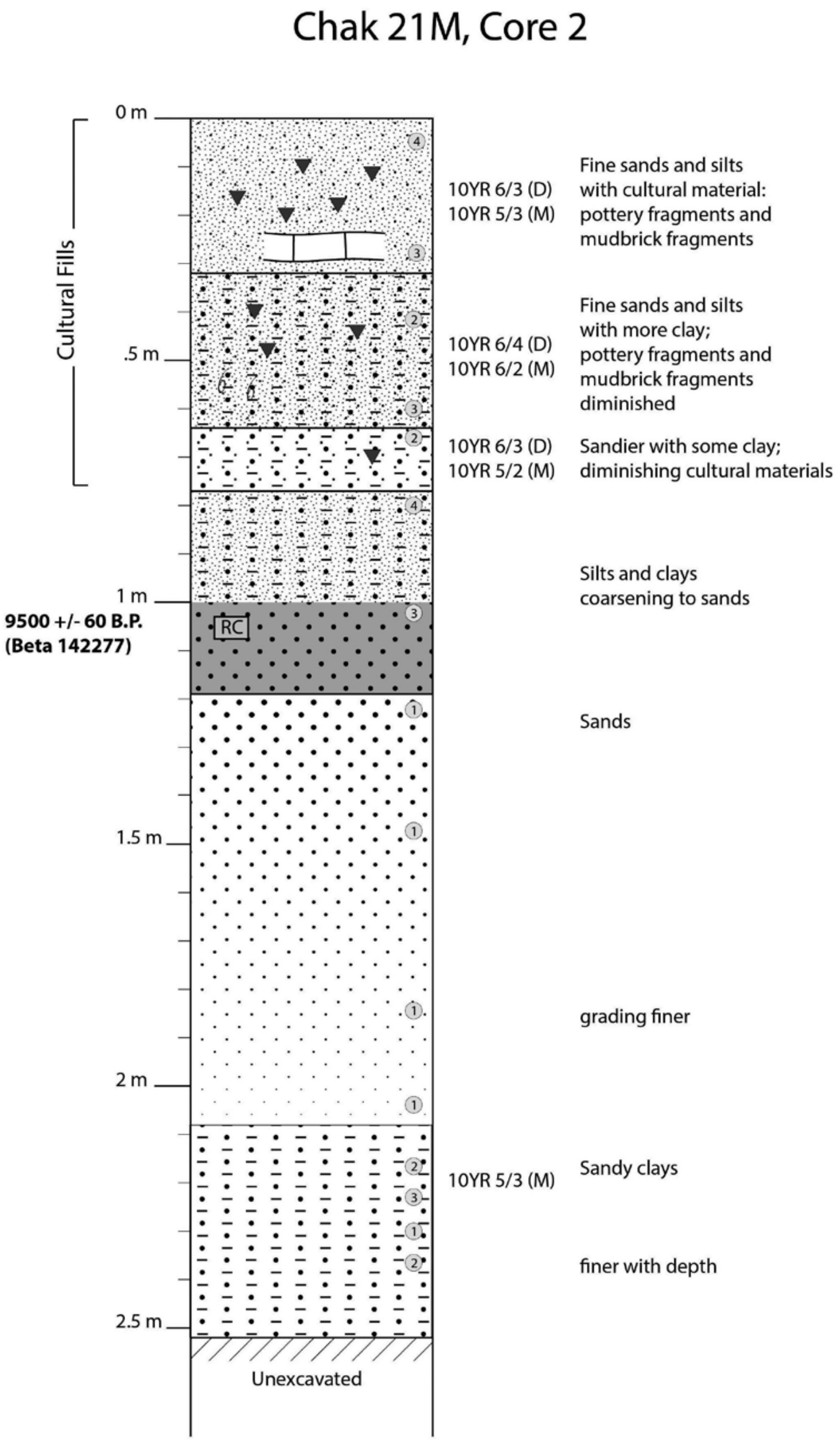


Figure 21. Dunyapur cores- Chak 21M

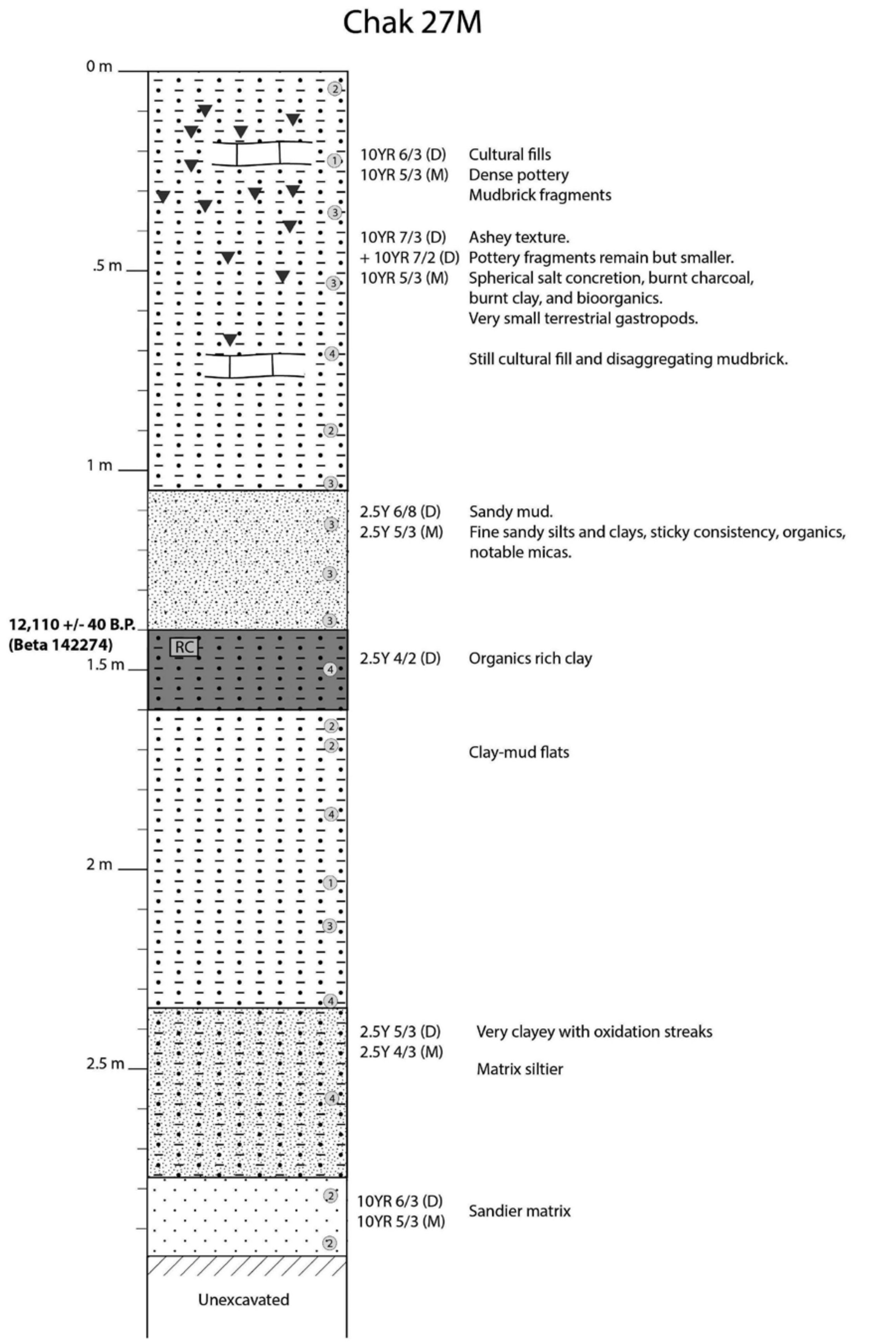


Figure 22. Dunyapur cores- Chak 27M

The Significance of the Dunyapur Chaks

The Dunyapur Chaks not only shared some traits or traditions with other settlements in our survey, but also were unique. Based on the evidence from ceramics and small finds discovered at the Dunyapur settlements, newcomers to the area were in touch with Harappans beyond the region in which they settled and brought experiences and ideas with them to Dunyapur. They showed a clear interest in water and engaged in practical applications of underground sources. Viewed from the perspective known from Mohenjo-daro, the principal vantage points from which underground technologies were known was for potable drinking water, sanitation and urban maintenance. Michael Jansen titles the results of his research at Mohenjo-daro, *City of Wells and Drains Devoted to an Ethos of Water Splendour* (Jansen 1993). At Mohenjo-daro the wells were either assigned to a single household or shared by two or three. Small and large jars (some almost one metre tall and one metre at their maximum body diameter filled with water were located at convenient points along streets for maintenance and other uses (Wright and Garret 2018).

We have not found any evidence for sanitation drains at Dunyapur or elsewhere at Beas settlements, but the presence of numerous wells at Mai Manoori Bhir and several other Beas sites, raise questions about whether the wells were used for more than a water supply for drinking and other household needs. At Dunyapur the Harappans constructed their wells with wedge-shaped, baked bricks. Remnants of wells found at Mai Manoori Bhir and other sites attest to the building materials and technology used in well construction. Along with the large ceramic jars in many different sizes and forms, they served as more than adequate containers for water storage. But aside from a healthy source of drinking water and other everyday uses, could they have served other purposes?

The wells at Mohenjo-daro stand tall after many years of rebuilding. Hidden within their stratigraphy is a wealth of information about the technology, changes in building techniques, and use over successive generations to which not much thought has been given. An exception is Heather Miller's suggestion that the characteristic rope marks at the top of wells at Mohenjo-daro (Miller 2006: 110-12) may have been used to lift water from wells. Although there is no evidence for shaduf, Miller suggested that some form of lift irrigation from wells could have been used for watering trees, gardens, select plants, and possibly small field crops. Elsewhere, the results of recently published documents from third and second millennia BCE Egypt published by Moreno Garcia (2022) provides examples for the use of wells for the watering of specialized and lucrative crops such as date palms in Pharaonic Egypt in the absence of *shaduf*. While distinctions were made between cisterns, basins, and wells, the texts appear not to describe the specifics of how water was drawn from the wells. However, some second half of the third millennium BCE scenes in tombs 'show farmers carrying pottery jars suspended on wooden yokes to irrigate small square-shaped beds' (Moreno-Garcia 2022: 330). The *shaduf* technology was not invented until many years later in Egypt in the New Kingdom period (Moreno-Garcia 2022: 334).

These examples suggest that the use of wells for small or larger plots of land for watering specific crops may have provided a sustainable solution to the shortage of water at Dunyapur. As Miller suggests, however, the use of lift irrigation from wells would have required cooperation among members of the community and been labor-intensive. In Egypt, wells for water provisioning of plants were for many a private endeavour, given the use of the term 'private water' in distinction to 'water of Pharoah' (2022: 342). As noted, relying on lift irrigation from wells would have been labour intensive requiring a cooperative/collective labor force. The ceramic containers (large jars, pots, bowls and basins) discovered at Harappan sites in Dunyapur would readily accommodate water storage facilities for lift irrigation.

Harappan Canals at Dunyapur?

Waterscapes are a term or concept used to refer to the 'interface between land and water from the vantage point of humans' (Hauser 2021: 17). The Beas River flowed between the Ravi/Chenab and Sutlej, providing a natural resource for settlements during the Harappan periods. Many Beas sites were positioned on elevated landforms at the margins of doabs, capturing Beas waters at optimal times for agriculture and husbandry over several hundred years during the Early and Mature Harappan period. The use of this access to water for cultivation would have been a reliable source and one relatively free of siltation, waterlogging, and salinization.

The Dunyapur Chaks, as noted, were located some distance from the Beas. Lift irrigation for the cultivation of select plants using wells and storage containers, though useful, limited cultivation practices. Delving into the archaeological literature, the Beas team explored the landscape for additional sources of water that could be tapped or stored. Management of water includes various damming technologies observed by Walter Fairservis (1971) and Sir Aurel Stein in Baluchistan (1929); niche constructions or tapping overbank deposits (Wilkinson 2015); and channeling water from runnels into reservoirs at Dholavira are well known (Bisht 2015). We did not find these or any other evidence for water technologies in place at Dunyapur during the third millennium BCE.[2]

In 2013, given the absence of the above examples, Carrie Hritz and I carried out a small research project, using declassified CORONA imagery. (CORONA images are routinely used by archaeologists; they are declassified photographs taken of land use between 1960 and 1972 by the U.S. Government). By mapping a few key-remains of the river system in detail, the results of our early study suggested that the dynamics of the Beas River, its tributaries, and settlement pattern shifts might be related to water availability as the main and secondary channels of the Chenab and Beas shifted (for additional details, see Harappa.com/Beas/mapping-project, slide 13). The remains of the channel systems in this area demonstrate the complicated stratigraphy of the ancient landscape features in the Punjab province.

Figure 23 is based on CORONA imagery. The large black circles are Beas sites; the dashed line, the ancient Beas and the dark flowing lines, the relict meander scars visible in three locations. One relict meander shows a channel that runs parallel to the Beas and was contemporary with Chak 90-12L (see Fig. 1 for the location of Chak 90-12L), a site that was occupied in the Early and Mature Harappan. The channel has been correlated with geological maps, thus providing preliminary ground truthing without groundwork. In a second location, the map shows lateral shifts near the Chenab. And finally, a third shift is visible near the Dunyapur region.

In 2022, this early research was followed up by a rigorous review of the relict meander channels near Dunyapur (Casana and Wright 2023). The new research used the Beas database by employing historical CORONA, multispectral Landsat imagery and modern high-resolution satellite imagery 'to prospect' for various land use features including 'canals, field systems, river channels, or roadways'. These several lines of evidence from CORONA images collected in 1972 and various processing 'tools' to verify their findings involved analyses of 14 ground control points and elevation models with which to identify river courses and canals. The results of these analyses revealed a linear feature that measured 60 to 130 m wide following a path that touches upon Chak 18/19M, Chak 21M, Chak 27M, and Chak 29M (likely to have crossed Chak 22M) and firmly dated to the Early and Mature Harappan, based on our ceramic and small find collections.

Figure 24 provides a closeup of one portion of the 'linear feature detected on CORONA imagery (at the top), revealing numerous smaller linear features that are interpreted as canal offtakes or other irrigation features adjacent to the main canal (bottom)' (Casana and Wright 2023: 303). The remains of a canal are shown by imagery comprised of darker sediments that surround the desert plain. Numerous smaller linear features are interpreted as offtakes shown adjacent to the main canal. The linear quality of the sedimentary feature is suggestive of an anthropogenic channel that differs from the snake-like meander patterns followed by the Sutlej and the Ravi rivers. Figure 25 reconstructs the course of the relict canal identified in the Dunyapur dune field. The canal system originates and ends in either the modern Sutlej River channel or the ancient Beas. Dots indicate the locations of the Harappan sites recorded by the Beas survey.

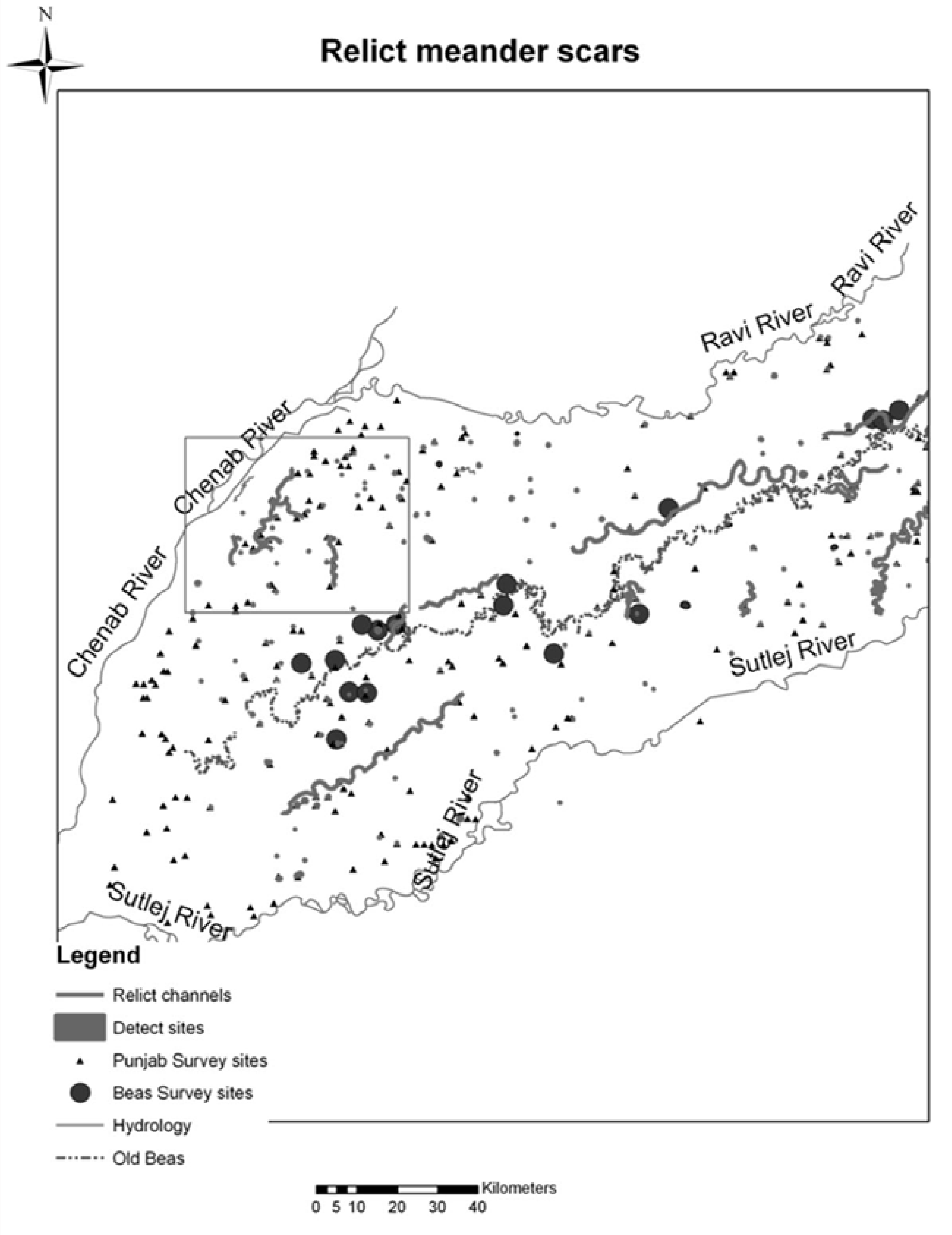


Figure 23. CORONA map showing relict meanders 2013

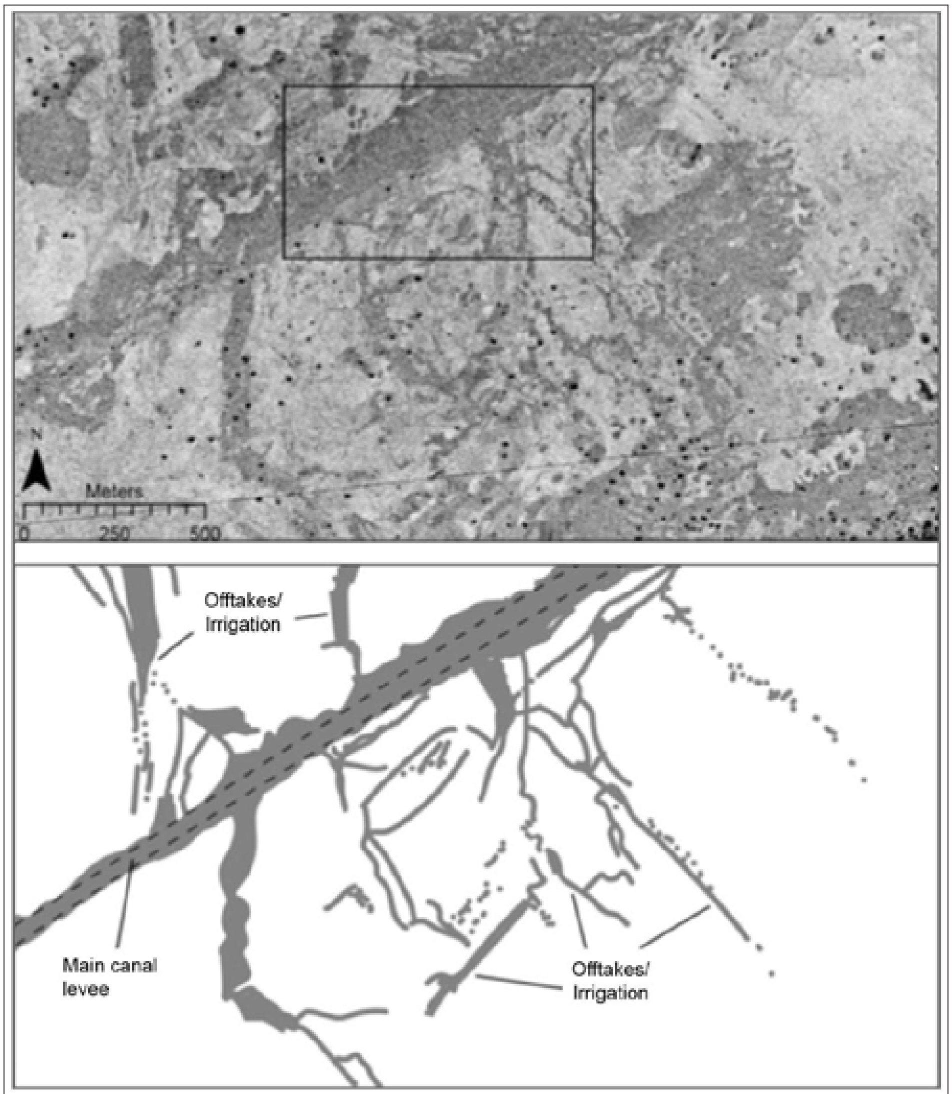


Figure 24. CORONA imagery showing linear features 2023

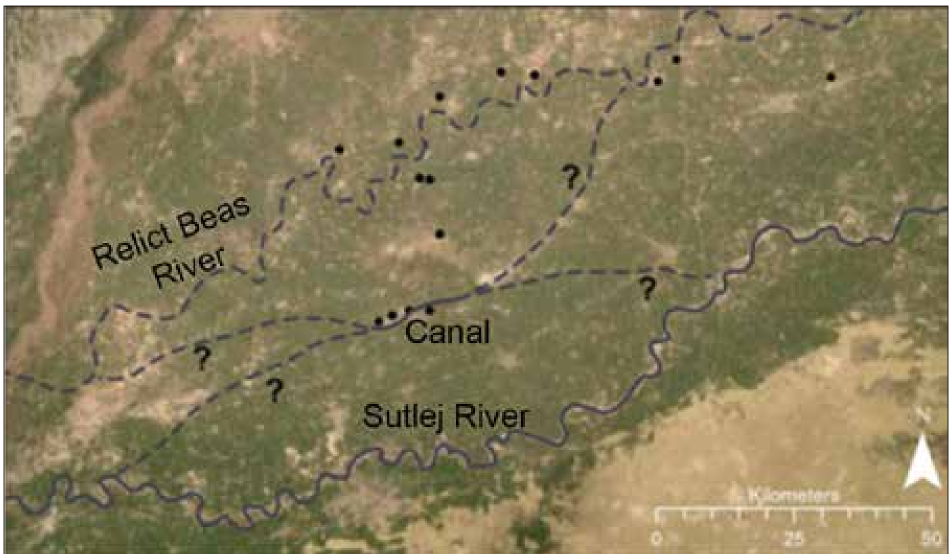


Figure 25. Reconstruction of the relict canal and Beas Survey sites 2023

Discussion

The ingenuity with which the Harappans at Dunyapur approached life in a remote location adds to the history of settlements in rural/ hinterland areas. A cluster of settlers in small-scale communities explored a new habitat and met the challenge of the region's hydraulic limitations. We do not know whether the Harappans at Dunyapur ventured into this region as part of an expansion undertaken by an Indus 'state' or was based on the initiative of members of collective/cooperative communities, possibly kin related. Their strong background in engineering technologies has expanded our understanding of rural settlements in the Harappan world. They are unique when compared to settlements at other Beas sites which we studied.

Expanding that picture to include Indus-related archaeological evidence known from surveys outside of the Beas demonstrates that the exploration of challenging environments took different forms. In Cholistan, Mughal (1997) documented diverse populations engaged in a variety of specialties living in large and small settlements in the shadow of a constantly shifting hydrology. Cameron Petrie (2019) noted that excavations in northwest India have shown discontinuous individual settlements and later reoccupation as Mughal had found in Cholistan. People living on the landscapes of both areas coped with braided river systems[3]. The Indus and the Beas tributary appear more stable than river systems in Cholistan and northwest India. In Sindh settlements at Gaj Nai were small - less than 5 ha—and maintained water systems based on a stream channel where the influent flow of spring water provided a perennial supply of water (Flam 2013: 101ff). Gabarbunds, long known to assist in the provision of water from intermittent stream channels, were also part of their water management strategy. And at small sites, less than 1-5 ha., at Dubi, Rohri, Veesar Valley, and Kandharki, Qasid Mallah (2008) described workshops arranged in clusters of settlements involved in a variety of crafts and located near small backwater lakes which may have been an 'old river bed' (Shar 1996).

A significant amount of time has passed in which to forego the theories of Karl Wittfogel (1957) who believed that political control of water management systems required despotic rule. Our studies at Dunyapur and at other Harappan villages have documented a variety of inventive water management strategies managed by Indus local farmers. Many textbooks continue to cite Wittfogel's hypothesis despite the archaeological evidence. It's time to set aside irrigation as a concept linked to powerful institutions (Wright 2018) and restore its meaning simply as the practice of supplying land with water so that crops and plants will grow which were undertaken under conditions Wittfogel may not have imagined.

Conclusion

The Dunyapur Harappans lived in four or five small settlements and perhaps at one larger at Mai Manoori Bhir. They engaged in innovative approaches to maintaining access to water in order to provide adequate resources for cultivation and domestic life. Our methods made it possible to record spatial arrangements, availability of materials, and access to water, an essential human need. Apart from Mai Manoori Bhir, people lived in settlements of less than 5 ha., including small fields. Activities at sites varied little but at some there was evidence for the production of ceramics and lithics. A few items such as figurines, beads, and an occasional bracelet could be considered luxury items. Beads produced from stone, steatite, lapis lazuli and carnelian clearly reflect at least limited outside contact. The building identified at Chak 27M stands out as separated from the work-related activities at the settlement. Ceramics associated with the building lacked production debris, suggesting it may have been a meeting place or even a household. Ceramics we collected complemented domestic and water-related needs and provided a strong chronological component to the research. There were two basic ceramic forms comprised of jars and bowls in various sizes and a limited number of items such as perforated jars and dish or bowls on stands. The perforated jars suggest the processing of milk products and dishes on stands, a traditional (perhaps a luxury), serving item. Like the beads, they indicate a degree of contact with a world outside of Dunyapur. The prevalence of large containers comprised of jars and basins were essential to our interpretation of lift irrigation and the construction of canals drawn from relict meanders. Both technologies required sustained and cooperative working groups suggestive of kinship-related groups.

Acknowledgments

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Notes

1. A baseline publication from which the typology at Harappa was established is Dales and Kenoyer (1986). Jenkins 1993 publication is an early update on the evolving pottery database. For a review of the pottery types and criteria used in establishing a type, see H.J. Miller (2018), a review of the relevance of shape, form, and productive technologies developing each type.
2. In a newly published paper Madella and Lancelotti (2022) take an archaeobotanical perspective on water supply and water management. Their paper includes archaeological and modern examples of water harvesting in the Harappan era and today, efforts that are making important impacts on major field crops and others. These examples are also suggestive of strategies people in the ancient Indus may have applied. Several articles in the same publication, *Irrigation in Early States. New Directions*, edited by Stephanie Rost (2022) focus on wells in the central Sahara: Sherry, Mattingly and Wilson write on balance wells (shaduf) and animal-operated wells. Scurlock writes about wells in Mesopotamia used in palm groves and vegetable gardens. Elsewhere, the use of wells in modern cities, like in Mumbai's riverine hinterlands have saved the day in times of drought (Anand 2017).
3. For a review of landscape archaeology in northwest India, see Adam Green and Cameron Petrie, Landscapes of Urbanization and De-Urbanization: A Large-Scale Approach to Investigating the Indus Civilization's Settlement Distributions in Northwest India. *Journal of Field Archaeology* 43(4): 284-99; published online.

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