TREATMENT PLAN FOR ARCHAEOLOGICAL MONITORING AT THE NORTHWEST FIRE/RESCUE DISTRICT NEW CENTRAL SERVICES CAMPUS, TOWN OF MARANA, ARIZONA

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HEG Project 10-072,

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INTRODUCTION

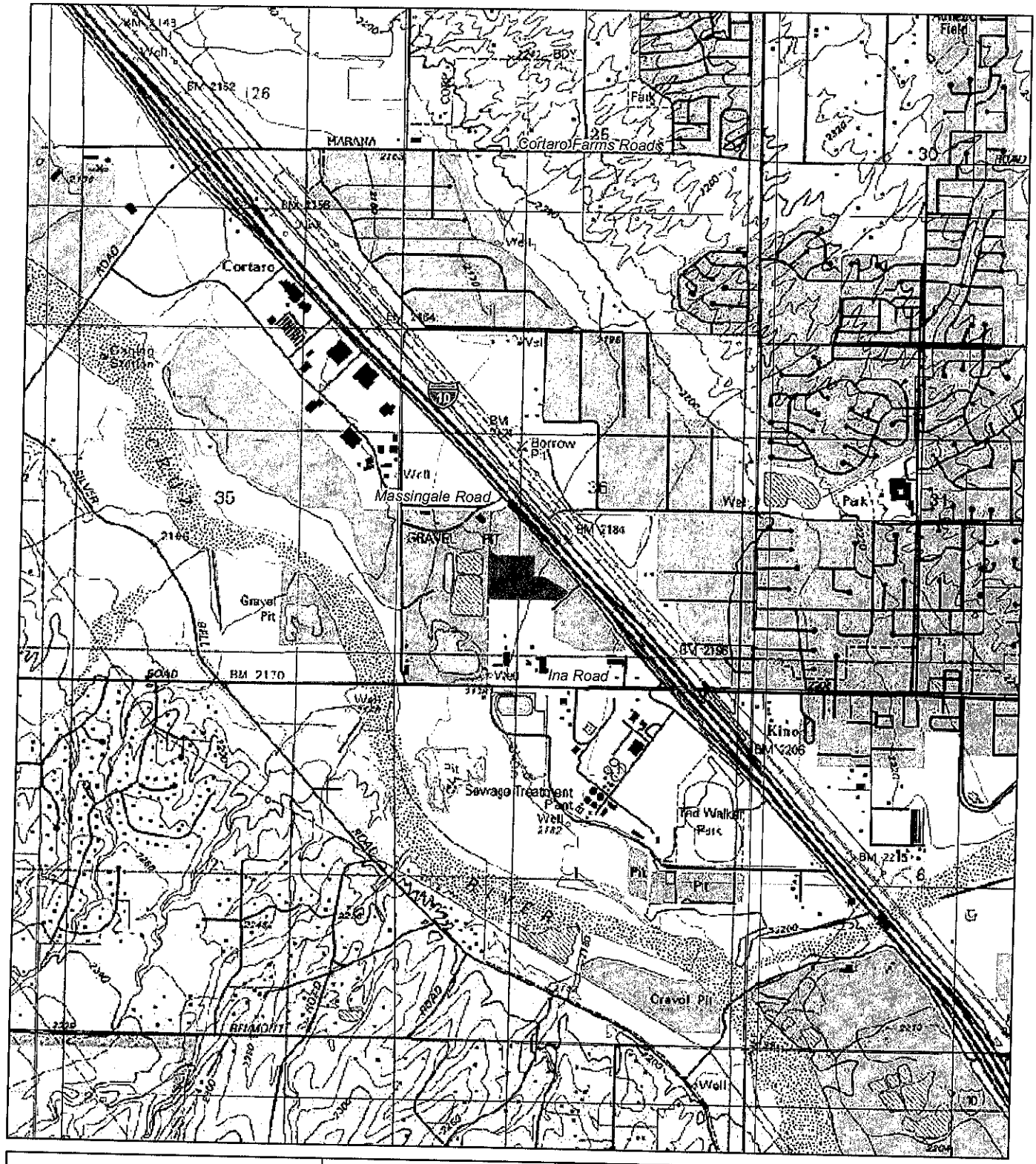
The Northwest Fire/Rescue District (NWFRD) intends to build a new facility, the Central Services Campus, at 7375 N. Star Commerce Way in the greater metropolitan Tucson area. Construction of a sewer line and a concrete vault measuring approximately 13 feet × 31 feet is expected to require excavation to depths of more than six feet. Harris Environmental Group (Harris Environmental) contracted with NWFRD to prepare a treatment plan for cultural resources within the area to be affected by proposed construction and to conduct archaeological monitoring during deep excavation. This plan will be submitted to the Town of Marana in support pursuant to Title 20 (Section E-2) of the Town's Land Use Code: "Protection of Cultural Resources."

The property to be monitored is located within the Town of Marana, Pima County, Arizona (Figure 1). The proposed facility is within the boundaries of the Costello-King site (AZ AA:12:503 [ASM])[1], a Preceramic period site dating to the San Pedro phase (1200–800 B.C.; (Mabry 2008) (Figure 2). Portions of the site have been excavated previously, discovering many nonarchitectural features, such as pits and fire pits; small, circular architectural features; and irrigation ditches that watered fields where maize and other crops were cultivated (Ezzo and Deaver 1998; Riggs et al. 2000). The site is adjacent to Las Capas (AA:12:111), another site with an intensive occupation spanning the Middle and Late Preceramic periods from about 2100 B.C. to 800 B.C. Portions of this site also were previously excavated (Mabry2008; Whittlesey et al. [eds.] 2007), uncovering literally thousands of features. This part of the Tucson Basin appears to have been occupied intensively, such that sites are nearly continuous along the Santa Cruz River.

These previous investigations indicate that additional cultural remains are likely to be present in the area where NWFRD plans to construct its new Central Services Campus. To comply with applicable regulations, including the Town of Marana's Land Development Code, Title 20, Protection of Cultural Resources, NWFRD is required to have a qualified professional archaeologist during ground-disturbing activities to ensure that subsurface cultural deposits, cultural features, and human remains and artifacts of cultural patrimony are not disturbed during construction.

This document presents Harris Environmental's treatment plan for the affected property. It includes a brief culture history and research questions that will guide additional archaeological investigations if such are required, a plan for conducting monitoring, and procedures to be followed should significant subsurface cultural remains be encountered during mechanical trenching or excavation and monitoring of these activities.

[1] All site numbers, unless otherwise noted, are in the format AZ __:__:__ (ASM). From this point in the document, the prefix AZ and the suffix ASM are dropped.



Northwest Fire and Rescue

T12S, R12E, Sec 36
Pima County, Arizona
USGS Quad: Jaynes

Heg Project # 10-072

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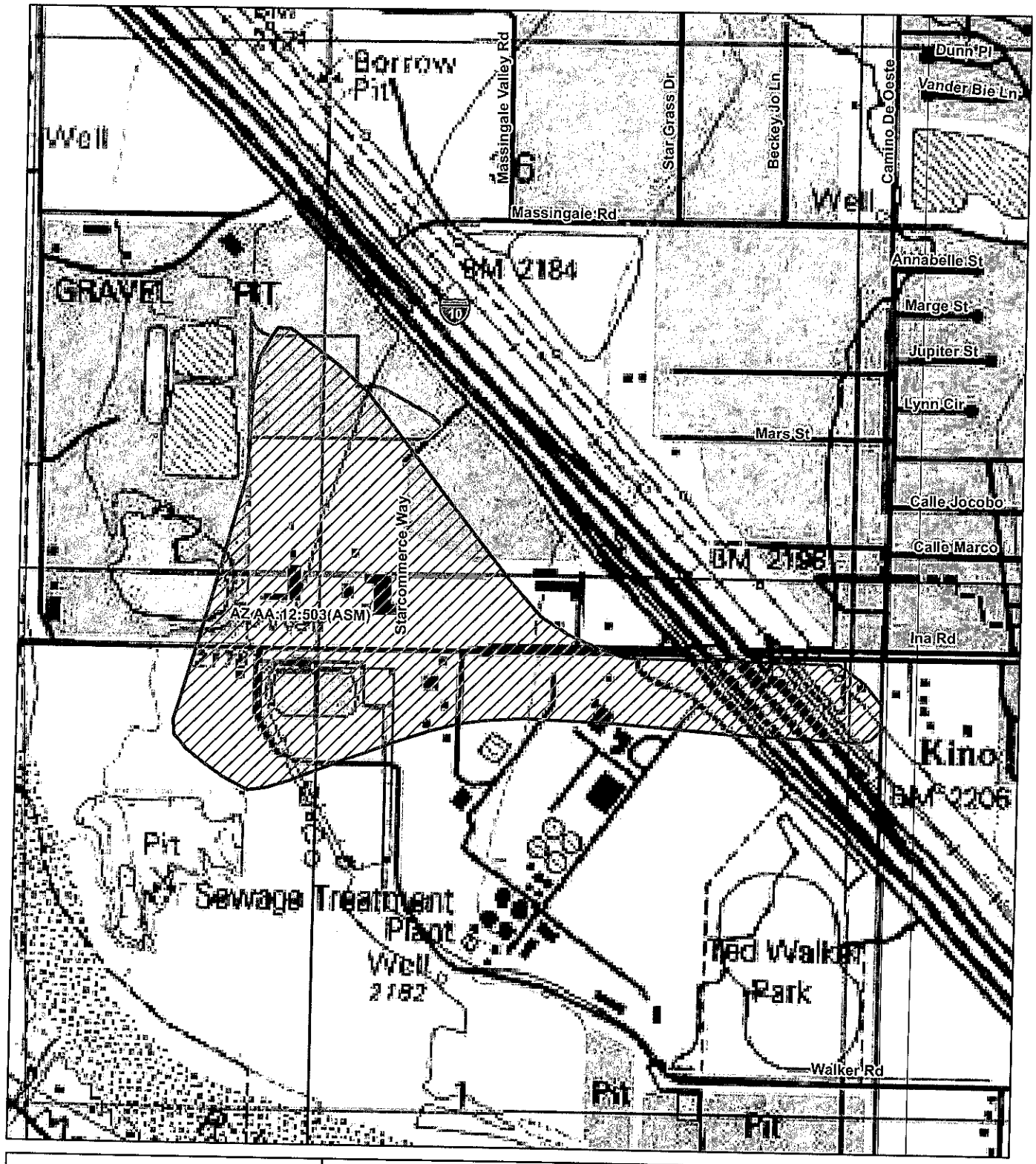
Figure 1. Project Area



Northwest Fire and Rescue

T12S, R12E, Sec 36
Pima County, Arizona
USGS Quad: Jaynes

Heg Project # 10-072

Project Area

Archaeological Site

N
W E
S

0 100 200 400
Meters

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Figure 2. Costello King Site, AA:12:503.

ENVIRONMENTAL SETTING, PREVIOUS RESEARCH, CULTURE HISTORY, AND RESEARCH QUESTIONS

The proposed Central Services Campus is located in the northwestern Tucson Basin, which is part of the Basin and Range physiographic province. As the name implies, the province is characterized by northwest-southeast–trending, block-faulted mountain ranges bounding deeply filled sedimentary basins, or grabens. To the east is the Santa Cruz River, a major tributary of the Gila River that once carried surface water through the Tucson Basin from Punta de Agua on the south to Point of the Mountain on the north. The Santa Cruz River and secondary streams which flow into it, such as the Cañada del Oro Wash and the Rillito River, provided abundant water for irrigation and floodwater farming. They also carried periodic floodwaters, some of great magnitude, with consequences for the residents of the area. Floods develop when winter storms bring too much moisture to be absorbed. In the late winter and early spring, warm rains may combine with snowmelt to create raging torrents.

Millennia of alluvial deposition along the Santa Cruz River created deep, fertile soils that were highly suited for agriculture with sufficient water. In general, these soils are thermic and semiarid (Hendricks 1985). Along the river is a Torrifluvents association, which Hendricks described as deep, moderately coarse to moderately fine-textured soils. Many of these soils are well-drained, sandy loams with good potential for floodwater and irrigation agriculture.

The climate of the Tucson Basin is semiarid, with a bimodal precipitation pattern consisting of summer and winter rains (Sellers and Hill 1974). Summer rains derive from the south and are typically short, intense afternoon thunderstorms that develop over the mountains and are highly localized. Nearly one-half the total precipitation for the entire year (an average 11.24 inches) falls during the monsoon months of July, August, and September. Winter rains result from frontal systems originating in the Pacific Ocean. These rains are gentler, longer, and typically are widely dispersed. April, May, and June are extremely dry months.

Summer temperatures are hot, and winter temperatures are relatively mild. July is the hottest month, and January is the coldest month. There is a 90 percent probability of a "freeze-free" period lasting at least 253 days (Western Regional Climate Center 2003). The great number of frost-free days resulted in a long growing season for ancient farmers, but it was balanced by the region's aridity.

The Tucson Basin is part of the Sonoran Desert, a desert of great biological diversity. The project area lies within the Arizona Upland division and the Sonoran Desertscrub biotic community (Brown and Lowe 1980). The river floodplain and the adjacent bajada slopes were primary resource areas. In ancient times, the Santa Cruz River corridor would have supported riparian vegetation, including cottonwood, willow, hackberry, and dense mesquite bosques, along with a wide variety of forbs and grasses. Where the water slowed to form marshy areas, cattail, sedge, and other water plants grew. The riparian corridor with its water and lush vegetation supported a wide range of mammal, reptile, and bird species that were hunted in ancient times (Fish and Gillespie 1987). On the bajadas grew diverse, economically useful plants, including saguaro, cholla cactus, prickly pear cactus, mesquite, palo verde, ironwood, and catclaw. Mule deer, cottontail

rabbits, jackrabbits, many small rodents, and in prehistory, possibly antelope, inhabited the desertscrub of the bajadas and adjacent floodplain.

Today, the project area has been affected by historical agriculture and modern urbanization. Many native tree and shrub species have been replaced by exotic tamarisk and landscaping plants; mesquite bosques have disappeared coincident with river channelization, groundwater pumping, and subsidence. Housing, roads, farming, and industrial facilities have affected wildlife habitats and land contours and have introduced nonlocal construction materials.

Previous Research

Many archaeological investigations have been carried out in the vicinity of the project area. Mabry (2008) identified 11 sites within what he labeled the Las Capas site complex, most of which is located on the west side of the Santa Cruz River and Interstate 10. The complex extends north and south of Ina Road. Mabry (2008:26) believed that four sites were related, based on their proximity, similar age, and similar cultural features: AA:12:111, Las Capas; AA:12:503, the Costello-King site; AA:12:100; and AA:12:130. Except for Costello-King, the sites are located south of Ina Road.

The Costello-King site was first recorded in 1986, according to Ezzo and Deaver (1998:3). It was described as a diffused scatter of flaked stone and ceramic artifacts covering 54,000 m^2. The following year, the Institute for American Research (now Desert Archaeology, Inc., [DAI]) conducted text excavations at Costello-King, discovering limited subsurface deposits and only one subsurface feature of unknown age. Statistical Research, Inc., (SRI) carried out data recovery and testing investigations in 1995 at a 14-acre portion of Costello-King called the Waste Management locus, which is located southwest of the current project area. The site was named after the clients for that project. The archaeologists identified 208 features, including extramural pits and thermal features, outdoor activity areas, water-conveyance features, and one architectural feature. Features originated from two different levels dating to the San Pedro phase (1300–800 B.C.) (Ezzo and Deaver 1998).

In 1998, Professional Archaeological Services and Technologies (PAST) surveyed the vicinity (Stephen 1998). The archaeologists found that the Costello-King site extended east and north of the area that SRI investigated. DAI also completed investigations related to a reclaimed water line on the south side of Ina Road. Identified features included water-conveyance features, extramural pits, a flexed inhumation, artifact concentrations, and two possible pit structures (Lindeman et al. 1998). This area was identified as part of the Costello-King site (Mabry 2008:28).

Beginning in 1998, DAI carried out test excavations and data recovery at Las Capas for the Arizona Department of Transportation (ADOT). At about the same time, SWCA Environmental Consultants (SWCA) conducted data recovery at another part of Las Capas called the Treatment Plant locus (Whittlesey et al. [eds.] 2007). In 2002 and 2003, SWCA conducted testing and data recovery at another part of Las Capas labeled the Warehouse locus (Whittlesey et al. [eds.] 2007). The DAI and SWCA investigations yielded thousands of features, including many pit structures as well as water-conveyance features, wells, human and animal burials, and much more. Most recently, DAI returned to Las Capas in 2009 to discover field and ditch systems (Herr 2009).

Also in 1998, SRI conducted another phase of testing at the site for Palm Harbor Homes (Ezzo 1998). The most important discovery was the deliberate burial of a large dog whose head had

been severed from its body (Ezzo and Stiner 2000). The dog was found to differ from the typical small dog of the Preceramic–Early Formative eras, and ^{13}C from bone collagen indicated a diet high in C_4 plants, likely maize. Regardless if the dog consumed maize in the form of refuse or human feces, this is additional evidence that maize represented a significant part of the Late Preceramic period diet.

In the same year, SRI carried out investigation at a portion of Costello-King called the Ina-Trico locus (Riggs 1998; Riggs et al. 2000). The area, which is located east of and adjacent to the Waste Management locus, consisted of two parcels of land on the north side of Ina Road. Twenty-seven features were identified in the test trenches and were found at two levels, as at the Waste Management locus. A possible irrigation ditch proved to be a natural channel. Identified features included pits, activity surfaces, and thermal features. No artifacts were collected, and no radiocarbon samples were submitted for dating. Maize pollen and agricultural-weed pollen and the charred remains of saguaro and grass seeds were identified in the pollen and flotation samples. Because the maize pollen was collected from nonfeature contexts, this part of the site apparently was as an agricultural field.

Culture History

This section considers the culture history of the Tucson Basin, focusing on the Preceramic (Archaic) period. Because the Costello-King site dates to the San Pedro phase of that period, we address earlier and later eras in Tucson Basin culture history only briefly and do not consider the Protohistoric or Historic periods.

The Paleoindian Period (9500–8000 B.C.)

The earliest known human occupation of southern Arizona was during the Paleoindian period (9500–8000 B.C.). Archaeological remains characterizing that time were left by small groups of hunter-gatherers who hunted now-extinct large game, such as mammoths and bison. Many excavated Paleoindian sites represent the killing and butchering of these animals; residential camp sites are rare. Artifact assemblages include distinctive "fluted" projectile points, which were hafted to handheld spears, along with other tools used for skinning animals and cutting meat and bone.

Although extensive research has been carried out at Paleoindian sites in southeastern Arizona, no substantial evidence of Paleoindian occupation has been discovered in the Tucson Basin. The lack of Paleoindian sites in the middle Santa Cruz River valley may be because it was unattractive to Clovis hunters, because they visited the area only sporadically, or most likely, because natural geomorphological processes have buried or destroyed these sites (Haynes and Huckell 1986; Huckell 1984; Waters 1986).

The Early and Middle Preceramic Periods (8000–2000 B.C.)

The time between the Paleoindian period and the appearance of pottery-container technology around A.D. 200 is typically labeled the Archaic period, although recently, archaeologists have begun to refer to the latest portion of this era as the Early Agricultural–Late Archaic period (for example, Mabry 2008). As discussed by Whittlesey et al. [eds.] (2007), this terminology is confusing and somewhat misleading, as people continued to rely heavily on gathering wild-plant foods and hunting, although they had begun to farm. Whittlesey et al. [eds.] (2007) suggested that the overall label

should be changed to "Preceramic," and the Early Agricultural–Late Archaic period should be called the Late Preceramic period.

At the end of the Pleistocene, climatic changes perhaps in conjunction with human hunting behavior led to the extinction of large animals and necessitated a shift from an economy largely based on hunting large game to one based on collecting a broad spectrum of wild-plant foods and hunting small game. Dates for the beginning of the Early Preceramic period are somewhat ambiguous, but this time probably began around 8000 B.C.

The Early Preceramic period, previously known as the Early Archaic period, is poorly known in the Tucson Basin (Huckell 1984:137), probably as a consequence of the ephemeral character of early sites as well as low population density. Tapering-stemmed points, such as the Lake Mohave, Jay, and Silver Lake types, characterize assemblages from this period. Few radiocarbon or stratigraphically dated remains have been documented. The archaeological sites of this time are equivalent to the Sulphur Spring stage of the Cochise culture first identified in the Sulphur Spring Valley (Sayles 1983; Sayles and Antevs 1941; Waters 1986).

The Middle Preceramic period, also known as the Middle Archaic period, is better represented in the Tucson Basin. It is equivalent to the Chiricahua stage of the Cochise culture (Sayles and Antevs 1941). Assemblages are marked by the presence of Chiricahua, San Jose/Pinto, and, in the latest stages, Cortaro-style (Roth and Huckell 1992) projectile points; slab metates, basin metates, mortars, and pestles characterize grinding equipment. Socioeconomic adaptation at this time in southern Arizona appears to have been based on the exploitation of a wide range of plants and animals in complementary environmental zones.

Important sites dating to this time include Los Pozos (AA:12:91) and Las Capas along the Santa Cruz River. Deeply buried evidence of episodic occupation, including thermally affected features, pits, and oxidized surfaces, was found at both sites. Artifacts included Cortaro projectile points, hand stones, manos, grinding slabs, and flaked, tabular tools. Some of these artifacts were cached. Small charred seeds and mesquite beans reflected on-site processing of wild plants. Importantly, maize (*Zea mays*) was found in the Middle Preceramic deposits at both sites. The radiocarbon date of 4050 ± 50 B.P. (CAMS-34923; $\delta^{13}C = -10.0‰$) at Los Posos was considered somewhat unreliable (Gregory 1999:118), but a date of 3670 ± 40 B.P. (Beta-148409; $\delta^{13}C = -10.6‰$) from Las Capas is solid evidence of early maize (Whittlesey et al. [eds.] 2007). No architectural features or water-control features were found at Las Capas or Los Posos, meaning that maize must have been farmed by rainfall, "pot irrigation," water-table farming, or more probably, by overbank flooding.

The Late Preceramic Period (2000 B.C.–A.D. 200)

Huckell (1995) defined the earliest phase of the period, dating from about 2000 to 1300 B.C., but did not give it a label. Whittlesey et al. [eds.] (2007) suggested it be called the Silverbell interval to avoid the awkward use of the phrase "earliest, unnamed interval of

the Early Agricultural period." Evidence for early maize dating between 1700 to 1300 B.C. has been found at the Sweetwater locus of Los Pozos (Gregory 1999; Stevens 1999) and at Las Capas (Mabry 2008; Whittlesey et al. [eds.] 2007).

The San Pedro phase (1300–800 B.C.) is equivalent to the San Pedro stage of the Cochise culture first defined by Sayles and Antevs (1941). This period witnessed changes in artifact assemblages, cultural features, and archaeobotanical remains, signifying changes in settlement and subsistence patterns. Important sites include Costello-King, the Milagro site (BB:10:46) in the eastern Tucson Basin (Huckell et al. 1995), Las Capas, and sites in the Cienega Creek valley (Huckell 1995). Other sites include the Valley Farms site (AA:12:736) (Wellman 2000), the Home Depot site (AA:12:352) (Doak 1999), the Wetlands site (AA:12:90) (Freeman 1998), Solar Well (AA:12:105) (Mabry 1990), the Dairy site (AA:12:285) (Fish et al. 1992), and the Cortaro Road site (AA:12:232) (Slawson et al. 1986), indicating a great increase in population size and density during the San Pedro phase.

The San Pedro phase was characterized by relatively small habitation structures with a few interior bell-shaped storage pits, numerous extramural storage and processing pits, abundant flaked stone artifacts (including San Pedro and Empire projectile points), simple shell jewelry, clay objects, seed-milling equipment, flexed inhumation of the deceased, and maize cultivation. Excavations at Las Capas (Mabry 2008; Whittlesey et al. [eds.] 2007) provided a wealth of new information on the San Pedro phase. As early as 1300 B.C., the residents were cultivating maize, building irrigation ditches, constructing pit structures, and using large, bell-shaped storage pits in extramural and intramural contexts. Fired-ceramic artifacts included figurines, beads, pipes, cornucopia-shaped objects, and sherds from small, baseball-shaped bowls. Pit structures were arranged in loosely defined clusters lacking formalized structure. Irrigation ditches initially were used opportunistically to capture floodwater and later were used more systematically (Mabry 2008). Although these innovations reflect a more sedentary way of life than that practiced by earlier peoples (Doyel 1984; Eddy and Cooley 1983:46–47; Huckell 1990:351), these settlements were not occupied permanently, and some mobility continued to characterize a lifeway that remained focused on wild-plant foods.

The succeeding Early and Late Cienega phases (800 B.C.–A.D. 200) witnessed further changes. The pit structures were small and informal; they lacked hearths and contained many large storage pits, suggesting they may have served as specialized storage facilities. At the same time, the number of extramural storage facilities was greatly reduced (Mabry 1998; Huckell 1990, 1995; Gregory 2001a, 2001b). Corner-notched Cienega points replaced the earlier San Pedro and Empire points, and ground stone and shell inventories became more elaborate. Large structures may have been used for communal ritual functions.

The Early Ceramic Period (A.D. 200–650)

The Early Ceramic period marked the transition between the Late Preceramic period and the subsequent Hohokam Pioneer period. Sometime around A.D. 200, perhaps as much as two centuries earlier, true ceramic containers appeared in the Tucson Basin. This period

is divided in two phases: the Agua Caliente and Tortolita phases. This was a transitional time, marked by the introduction of new patterns and the persistence of some older patterns. The Agua Caliente phase was characterized by plain, brown ware ceramics containing sand inclusions and made by coil and scrape construction. The vessel shapes were primarily seed jars and occasionally bowls (Deaver and Ciolek-Torrello 1995; Whittlesey 1998).

The appearance of ceramic containers coincided with greater residential stability, increased reliance on cultigens, and greater architectural formality. There was a significant change in storage technology. Ceramic vessels were used for storage, rather than the large storage pits of the earlier Preceramic period (Ciolek-Torrello 1998). True pit houses characterized the Agua Caliente phase, some of which were "bean" shaped. Large communal houses similar to those of the Mogollon heartland (Anyon and LeBlanc 1980) were present. This formalization in architecture suggests greater residential stability.

The introduction of red-slipped ware marked the beginning of the Tortolita phase around A.D. 400. New vessel shapes, such as the flared-rim jar and flared-rim bowl (the latter thought to be a hallmark of later Hohokam ceramic technology) were introduced. In addition to the locally made Tortolita Red pottery, Vahki Red and Vahki Plain ceramics from the Gila-Salt Basin and San Francisco Red representing the Mogollon are commonly found at Tortolita phase sites in the Tucson Basin. Houses in pits made their appearance, and they eventually became the most common architectural style (Wallace and Lindeman 2003:Table 4.1). Large communal houses continued to be used. Large dart points and ground stone tools focused on basin metates and hand stones were similar to those of the Preceramic period (Ciolek-Torrello 1998).

By the end of the Early Ceramic period around A.D. 650, sufficient cultural differentiation was present to warrant treating the material culture of groups that inhabited southern Arizona as separate cultural entities. Some basic patterns persisted into the Hohokam sequence, however, and others continued in the Mogollon cultural tradition (Ciolek-Torrello 1995; Whittlesey 1995).

The Hohokam (A.D. 650–1450)

By around A.D. 650, the archaeological culture we recognize as the Hohokam of the Tucson and Gila-Salt Basins had appeared. The Hohokam sequence is composed of four periods: Pioneer (A.D. 650–750), Colonial (A.D. 750–950), Sedentary (A.D. 950–1150), and Classic (A.D. 1150–1450). In the Tucson Basin, the Pioneer period includes the Estrella-Sweetwater and Snaketown phases (duplicating the phases of the Gila-Salt Basin sequence). The Colonial period encompasses the Cañada del Oro phase, equivalent to the Gila Butte phase of the Phoenix area, and the Rillito phase, equal to the Santa Cruz phase. The Sedentary period has a single phase, the Rincon phase, which has been divided into Early, Middle, and Late subphases and is equivalent to the Sacaton phase of the Phoenix area. The Classic period incorporates the Tanque Verde phase (Soho phase equivalent) and Tucson phase (Civano phase equivalent). Little evidence of the latest

Hohokam phase of the Gila-Salt Basin, the Polvorón phase, has been found to date in the Tucson Basin.

The pre-Classic Hohokam culture of the Tucson Basin was distinguished by distinctive ceramic technology, including the use of crushed metamorphic rock temper, life forms on painted pottery, and paddle and anvil finishing; house-in-pit architecture; formal site structure, including courtyard groups with communal work areas, trash mounds, and associated cemeteries; and the ball-court–cremation ceremonial complex.

Little evidence of Pioneer period occupation has been found in the Tucson Basin, with the exception of Hawk's Nest in the Avra Valley (Czaplicki and Ravesloot 1989). Ceramics displayed grooved and incised decoration; initially, painted designs were and simple and geometric, but later Pioneer period pottery had complex, hachured decoration. Evidence for simple water-conveyance features at the Dairy site (Deaver 1996) and elsewhere demonstrated the persistence of maize farming and agricultural technology from the Preceramic period.

By A.D. 800, the beginning of the Rillito phase, population began to increase rapidly (Doelle and Wallace 1991). Many large settlements with ball courts were the centers of larger communities that included farmsteads, field houses, and plant-procurement locales. These include Los Morteros (AA:12:57) (Wallace 1995), Dakota Wash (AA:16:49) (Craig 1988), the Hodges Ruin (AA:12:18) (Kelly et al. 1978; Layhe 1986), and Waterworld (AA:16:94) (Czaplicki and Ravesloot 1989). The Tucson Basin ceramic tradition burgeoned, with red-on-brown pottery that differed from the Gila-Salt Basin red-on-buff pottery in paste but paralleled it in design and vessel shapes.

The Sedentary period was a time of considerable change in the Tucson Basin. There was substantial growth in the number of small to moderate-sized settlements, and settlement expanded into all parts of the Tucson Basin (Elson 1986). Ball courts ceased to be used. There was increased use of agave, which was cultivated in large rock-pile fields. Ceramic manufacturing flourished, with the appearance of white-slipped and red-slipped pottery, black-painted pottery, and by the late Middle Rincon phase, Rincon Polychrome pottery (Deaver 1989). The increase in farmsites during the Sedentary period has been attributed to salubrious climatic conditions (Van West and Altschul 1994).

Beginning in the late Rincon phase, sweeping changes took place. During the Classic period, many existing settlements were abandoned, and new settlements were established in previously unoccupied areas (Fish et al. 1992). New architectural construction was used, including adobe-walled pit structures and aboveground structures of adobe and stone masonry, some of which were enclosed by adobe and stone compound walls (Kelly et al. 1978; Slaughter and Roberts 1996). Earthen platform mounds became the focal point of communal activities. Inhumation burial was added to the mortuary complex; at some sites, cremation persisted along with inhumation, although at other sites, inhumation replaced cremation. A wider variety of cultivars and wild-plant resources was exploited than previously. Agave use intensified (Wallace 1995:806–810), and artiodactyls were hunted much more frequently.

Ceramics changed along with other lifeways, with shifts in painted designs, vessel shapes, and the use of smudging. Corrugated pottery and Mogollon-style brown ware and red ware evidently were locally made in the eastern Tucson Basin. In the Tucson phase, a wide variety of locally made and nonlocal polychrome wares appeared, including Roosevelt Red Ware, Maverick Mountain Polychrome, Tucson Polychrome, and White Mountain Red Ware.

Another phenomenon of the Classic period was the appearance of terraced, hillside sites, usually located on outcrops of volcanic rock. These *cerros de trincheras* often have rectangular enclosures or compounds, masonry rooms, linear alignments, and *corrales*, or subrectangular enclosures, which often are located on the summits. *Cerros de trincheras* are distributed throughout northern Sonora and the Papaguería. Perhaps the best-known examples are Cerro Prieto northwest of Tucson (Downum and Madsen 1993) and the Linda Vista trincheras site near the northern end of the Tucson Mountains (Downum 1993).

The Classic period was a time of demographic shifts, likely prompted by drought. Evidence of population relocation from northern and central Arizona has been documented in the San Pedro River valley and possibly the eastern Tucson Basin (e.g., Clark 2001; Di Peso 1958; Slaughter and Roberts 1996; Woodson 1999). Some archaeologists view the changes in the Classic period material culture, site structure, and settlement patterns as resulting from sociopolitical and economic reorganization prompted by the influx of new people to the region.

During the Tucson phase, population aggregation took place in the southern Tucson Basin, the northern Altar Valley around the Coyote Mountains, and at University Indian Ruin (Doelle and Wallace 1991:Figure 7.26). The area around the Picacho Mountains also contained substantial communities with platform-mound sites (Ciolek-Torrello and Wilcox 1988; Henderson and Martynec 1993). Other areas were characterized by smaller settlements. By A.D. 1400, most settlements in the Tucson Basin were abandoned. Archaeologists lack good information about the causes of abandonment, which may have included severe flooding with consequences for farming systems. Similarly, the time between the abandonment of prehistoric settlements and the appearance of the historical O'odham peoples of southern Arizona is poorly known.

Research Issues

Research issues pertinent to investigations at the NWFRD parcel of the Costello-King site include subsistence and food-processing technology, farming technology, and settlement patterns. These are discussed briefly.

Subsistence and Food-Processing Technology

During the Early and Middle Preceramic periods, local populations made their living by foraging and hunting small and large game. This necessitated considerable mobility, as people followed the ripening of various wild-plant resources and traveled from uplands to lowlands on hunting expeditions. Sometime around 2000 B.C., maize was introduced, and the subsistence base was altered irrevocably. The dependence on wild plants and the associated processing technology along with the characteristics of early maize allowed it to be incorporated into the diet without substantial changes in technology. Wild plants and game continued to be used, however, and it

was not until centuries later than populations in southern Arizona became more or less dependent upon maize and other cultivated plants. Even then, wild resources such as cactus and mesquite continued to be important.

Previous research has determined that maize was relatively common at Costello-King, in the form of pollen and carbonized cupules, cob fragments, and kernels. Economically useful wild-plant resources included cactus, *Chenopodium* seeds, grasses, and *Typha* (Davis 1998; Holloway 1998). Analysis of animal bone indicated that large game such as mule deer and white-tailed deer was important, although rabbits and other small animals also were procured (Ezzo and Deaver 1998). Technology used to process plant foods and game remained much like that of earlier, Middle Preceramic assemblages, despite the presence of maize. Metates were the slab or basin type; pestles indicate possible processing of foods such as mesquite or acorns (Knoblock 1998). The lack of trough metates and ceramic containers, the presence of more cob fragments and cupules than kernels, and the frequency of thermal features at Costello-King all imply that maize was primarily consumed as whole, green ears and was roasted. Little grinding of maize kernels took place, although maize pollen has been recovered from grinding tools (Whittlesey 1998; Whittlesey et al. 2007).

One important question is whether cultivation of maize was relatively common across southern Arizona during the San Pedro phase, or if it was practiced only along rivers or secondary watercourses. No evidence of maize or other cultigens was found at the Coffee Camp site in the Santa Cruz Flats, for example, although this site was used rather intensively(Halbirt et. al. 1993).

Questions we can ask include:

- What wild-plant resources were used? Are the ubiquities of these resources greater or lesser than that of maize?
- What animals were hunted, and how were they processed?
- Are cultigens other than maize present?
- Does the distribution of economically useful plants, cultigens, and animal bone across the investigated portion of the site tell us how these resources may have been processed? In what contexts are these resources found?
- What does ground stone and flaked stone technology tell us about plant and game processing?
- In the absence of ceramic containers, how was maize stored?

Farming Technology

In light of the discovery of early maize, it is not surprising that previous research has demonstrated the presence of water-control features at Costello-King (Ezzo and Deaver 1998) and Las Capas (Mabry 2008; Whittlesey et al. [eds.] 2007). Maize has relatively high water requirements, meaning it must be cultivated with supplemental water from one or more sources. The irrigation ditches found at Costello-King were oriented perpendicular to the Santa Cruz River and flowed away from it. Although relatively shallow, these features had parabolic cross sections and evidently carried water from the river to fields located outside the study area (Ezzo and Deaver 1998).

Similar ditches were found at Las Capas, although wells that might have been used for pot irrigation also were present (Whittlesey et al. [eds.] 2007). Initially, the ditches were used in an expedient manner to capture flow, but later, they were used more systematically (Mabry 2008). Elsewhere, water-conveyance features dating to the Pioneer period at the Dairy site appear to have been used to convey water collected from alluvial fans (Deaver 1996). Cienegas also may have been used as a source of irrigation water. It is evident that different kinds of water-control technology were used in the Tucson Basin. Although fields have been identified at Las Capas (Herr 2009), none have been discovered at Costello-King. The presence of maize pollen in nonfeature contexts and pollen of agricultural weeds, such as *Boerhaavia* and *Sphaeralcea* (Davis 1998; Ezzo and Deaver 1998), indicates that fields must have been located nearby, as maize pollen is heavy and is not distributed far from the plant.

Questions we can ask regarding this topic include:

- Can the water-conveyance features previously discovered at Costello-King be identified in the current study area?
- What kinds of features are represented (that is, are they primary or secondary branch canals)?
- Are any other kinds of water-control features, such as wells, present?
- Can we identify field areas through the presence of digging-stick holes, berms to contain water, pollen from cultigens, or other data?
- Is there any evidence that water control changed over time?

Settlement Patterns

Several questions relate to the settlement patterns of Late Preceramic period inhabitants of the Tucson Basin. The first concerns the degree of mobility these people practiced. The discovery of maize, irrigation ditches, and relatively large settlements with architecture has led many archaeologists to consider that the residents were sedentary village farmers. Several other lines of evidence, including stratigraphic and geologic evidence for periodic flooding (Nials 2008a, 2008b; Whittlesey et al. [eds.] 2007), cached artifacts in pits, remodeled pit structures, and reused storage and thermal facilities, indicate not only considerable mobility but also relatively short-term occupation.

The second question concerns the overall settlement pattern of Late Preceramic period people. Residential settlements may have been focused on two different areas, one centering on the floodplains and a second on the bajadas (Roth 1989). Both zones had permanent water sources and a constellation of diverse resources. By contrast, there may have been a single settlement system in which the people shifted seasonally from uplands to lowlands.

Third, we are interested in knowing the nature of the relationships among the various locales in the larger Las Capas complex. Did the floodplain and associated terraces represent a single settlement system where activities and types of features were similar

among all the locales? Or were different activities concentrated in different parts of the floodplain zone—farming in certain areas, residential activities in another? Questions we can ask include:

- Do features in the study area replicate those found in other portions of Costello-King or at Las Capas, or do they represent functionally different activity areas?
- What evidence can be marshaled for residential and logistical mobility?
- Do comparative data indicate that Costello-King and other floodplain sites were similar to sites located in bajada settings, or were they different?
- Is there evidence for temporally distinct occupations at Costello-King? Did activities change over time or remain the same?

MONITORING AND DISCOVERY PLAN

In this section, we present a plan outlining archaeological monitoring methods and recommended procedures for discovery situations. Included are recommendations for worker education, site protection, monitoring procedures, and how unanticipated discoveries should be handled. At present, there is no way to predict whether subsurface finds will be discovered in the study area. A plan to treat unanticipated discoveries is necessary to ensure that NWFRD remains in compliance with applicable regulations.

Worker Education Program and Site Protection

Prior to beginning construction, all personnel on site should receive brief basic training: what the archaeological monitor will do, what the likely cultural finds might be, and procedures that will be required in the event of an unanticipated discovery.

The archaeological monitor should meet with construction supervisory personnel to discuss the procedures that will be used. The archaeological monitor will provide a brief handout that will list and explain the types of cultural materials in the area and the steps to take in the event of an unanticipated discovery. This should also be posted in a public place near the construction site. In addition, all work crew and supervisory personnel should be informed that collecting prehistoric or historic artifacts and destroying archaeological sites and features are criminal offenses.

Archaeological Monitoring

The primary duty of the archaeological monitor is to observe all ground-disturbing construction activities each day that ground disturbance takes place at a depth of 6 feet or below. In the event that buried cultural deposits are exposed (a discovery is made) or inadvertent impacts to surface features take place, the monitor will follow procedures outlined in the discovery plan presented below. At the archaeological monitor's discretion, he or she may collect artifacts within the construction area for analysis and curation.

The archaeological monitor will complete a daily log that includes the amount of time spent at the site, the names of the construction supervisor and monitoring personnel, and a narrative of the day's activities. The log should provide pertinent information to assess

unanticipated cultural finds (for example, the context and appropriate observations on sediment, depth, and so on). Any discoveries or inadvertent damage to cultural resources will be noted, and any procedures taken to deal with them will be recorded. The type of find will be recorded to the finest level possible (for example, Hohokam plain ware sherd, tin can).

Discovery Plan

A discovery includes cultural resources such as buried artifacts, features, or human remains. Examples include prehistoric stone, ceramic, shell, and bone artifacts; Historic glass, metal, and ceramic artifacts; nonhuman bone; and human bone. Examples of features include, but are not limited to, soil discolorations, deposits of ash or charcoal, pits, thermal pits (distinguished by ash, charcoal, burned areas, or fire-altered rock), architectural remains, and human burials and associated artifacts. These may be prehistoric or historical in age. Cultural materials that are younger than 50 years old do not qualify as discoveries.

In the event of a discovery during construction or inadvertent damage to subsurface features, the following steps should be taken.

- All construction activity in the immediate vicinity of a discovery will cease. As soon as possible, all other ground activity within 100 feet (30.5 m) of the discovery also will stop.
- The archaeological monitor will verify the discovery. During verification and evaluation of the discovery, the monitor will have the authority to probe with a trowel and shovel scrape as necessary to verify the discovery and determine if it constitutes a feature (e.g., does the discovery represent a human burial or nonhuman bone?).
- If the archaeological monitor determines that the find is an isolated artifact or nonhuman bone that is either out of context or lacking association with other artifacts or features, is less than 50 years old, or is noncultural in nature, construction may resume. Human bone is treated differently (see below).
- If the find qualifies as a discovery—that is, an artifact in situ with associated materials, human bone, a feature, or a significant isolated find—it will be reported immediately to all concerned parties. These include the Harris Environmental principal investigator, the Arizona State Museum (if human bone or associated grave goods are found), the Town of Marana, and the NWFRD.
- If the find qualifies as a discovery, sufficient data should be collected to evaluate its significance. No extensive excavation should be undertaken, but the feature should be documented to the extent possible in order to evaluate its significance or document damage. If a section has been cut through the feature, for example, it should be profiled to determine stratigraphy and composition of fill. Any artifacts eroding from the face of the profile should be plotted on the profile and collected for subsequent analysis and curation. The type of feature (pit, thermal pit, structure) and its dimensions should be recorded. Photographs should be taken, and the discovery should be recorded on appropriate forms to the extent possible. The provenience of the discovery should be plotted on the profile and the site map using a Global Positioning System (GPS) device, and the association of the discovery with the construction unit should be noted.

- Samples may be taken as the archaeological monitor deems appropriate (for example, flotation from organic deposits, organic materials for chronometric dating, pollen samples, etc.).
- The Harris Environmental archaeologist may remove the cultural materials using applicable professional guidelines and scientific methods.
- If the find is extensive or deemed important (for example, a buried pit house), consultation with the Environmental Engineering Division of the Town of Marana and the State Historic Preservation Office may be undertaken. The integrity of the discovery will be assessed, and the research potential will be evaluated within the context of the research design presented here. As necessary, a testing or data-recovery plan may be devised to treat the find. Data recovery will address research issues while expediting the resumption of construction activities. If the discovery is determined to be a significant cultural resource, then an area of at least 20 feet (6.10 m) surrounding the discovery should be fenced to protect it. Unanticipated cultural resources exposed during construction may require data-recovery investigations as discussed above before construction can resume.

If a discovery has been determined to be significant by the concerned agencies (in consultation with SHPO, if appropriate) the following issues must be discussed:

- Confirmation of the nature and scope of treatment to be completed prior to issuance of a written notice to proceed;
- Determination of a schedule for the completion of archaeological work;
- Determination of the nature and scope of any protective measures required once construction resumes; and
- Determination of the nature and scope of any postconstruction treatment that may be required.

Discoveries of Human Remains and Associated Artifacts

Any discovery of isolated human bone, articulated human remains, or grave goods constitutes a special case that is treated differently from nonhuman finds. Prior to beginning fieldwork, Harris Environmental will obtain a project-specific burial memorandum of agreement (BMOA) from ASM. In accord with existing guidelines and tribal consultation, this document will specify how the remains or artifacts will be recorded and analyzed if these materials are discovered and their post-fieldwork disposition. In the event that human remains or associated artifacts are discovered, the following steps will be taken:

- When the archaeological monitor has determined that the remains are human, all activity within 100 feet (30.5 m) in all directions will cease.
- ASM will be notified immediately, and the requirements of the BMOA will be followed.
- The find will be covered and fenced for protection. The area will be kept undisturbed and will not be left unattended over the weekend. The remains will be recorded and excavated as specified in the BMOA. All remains will be treated with dignity and respect and will not be shown to the public or reported in the media.

- Disposition of the remains will be determined as per the BMOA. If necessary, the remains may be kept at a secure off-site location so that construction may proceed.

Reporting and Curation

Upon conclusion of construction and completion of archaeological monitoring, a report will be prepared that summarizes monitoring procedures and results. The report will be submitted to all agencies involved in the project and will contain, at a minimum, the following:

- A description of the archaeological-monitoring activities and results;
- Photographs, forms, and other documentation, including any data collection undertaken toward verifying a discovery;
- Artifact identifications and descriptions, if any collections are made; and
- Detailed site maps depicting site boundaries, construction areas, existing buildings or infrastructure, and the location of any unanticipated discoveries or artifacts.

Upon completion of any testing or data recovery undertaken as a result of a discovery, updated site forms will be completed and submitted to the ASM as necessary. All cultural materials, other than human remains and grave goods, recovered during archaeological monitoring or as a result of discovery will be curated at ASM. Disposition of human remains and associated artifacts, if any, will be made according to the BMOA.

Changes to Project Design

No modifications to project design that would affect the study area should be undertaken without consultation and coordination with the Town of Marana, Harris Environmental, and ASM.

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