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# PREHISTORIC GILA RIVER CANALS OF THE SAFFORD BASIN, SOUTHEASTERN ARIZONA: AN INITIAL CONSIDERATION

James A. Neely and Everett J. Murphy

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James A. Neely, Department of Anthropology (C3200), University of Texas, Austin, Texas 78712 (neelyja@utexas.edu).

Everett J. Murphy, 262 W. Dankworth Lake Rd., Safford, Arizona. 85546. (murph@aznex.net).

## Abstract

Archaeological survey, a few archaeological excavations, and historical information have provided important substantive and circumstantial evidence that Gila River water was extensively tapped by canals for domestic uses and agricultural irrigation during prehistoric times in the Safford Basin. Several of the historic canals currently in use are believed to be refurbishments of prehistoric canal channels, or that they are later excavations that closely follow prehistoric canal alignments. Each of these seven canals is briefly described and the evidence for their possible prehistoric origins is considered. Current evidence points to the earliest canals as being constructed by the San Simon Mogollon occupants of the basin at a time perhaps as early as ca. 190 B.C., although it is likely that subsequent inhabitants of the basin may well have enlarged the canals and extended the networks through an incremental process. While many of the findings are tentative, this study represents an initial effort that will hopefully aid future research.

## Introduction

To sustain subsistence requirements for food, fiber, and other products, the prehistoric inhabitants of the Safford Basin used agriculture (Clark 2004; Neely 2008a) to achieve a necessary crop yield through manipulations of plants and their physical environment (Bye and Shuster 1984:127). They were able to achieve their goal of sufficient crop production by using several environmental sub-zones, or microenvironments (Coe and Flannery 1964), and by manually modifying the landscape to receive additional sources of moisture as well as better retain and more efficiently distribute the moisture that was naturally available. Archaeological survey of the Safford Basin has provided evidence of a three-part prehistoric agricultural strategy (Neely 2008a). These are: (1) widespread dry-farming/runoff fields receiving moisture only from rainfall and snowfall; (2) fields in the foothills of the Pinaleño Mountains irrigated by canal systems taking water from springs and runoff from rainfall and snowmelt; and (3) fields on the floodplain irrigated by canal systems taking water from the Gila River.

It is highly probable that a great deal of effort was expended in the selection and modification of plants to achieve required crop yields. Unfortunately, as has been previously discussed more fully (Neely 2008a), at this time we do not have the evidence to do more than make a few general statements regarding this aspect of the overall agricultural diversification strategy (e.g., Diehl 2004; Neely 2008a; Neely and Doolittle 2004; Smith 2004). For the present, the reconstruction of agricultural strategies must depend most heavily on relic water management infrastructure and agricultural fields as well as archaeological sites and artifacts. Although other water sources were present and utilized (Doolittle and Neely 2004; Neely 2001b, 2005a, 2008a), it is proposed that the well-planned excavation of several canals taking water from the Gila River supported a large portion of the basin's prehistoric crop production, and guaranteed its yearly availability.

The objectives of the present study are fourfold: (1) to investigate the evidence for the presence of prehistoric Gila River-source canals in the Safford Basin; (2) to evaluate the

evidence for the prehistoric origins of certain historic Gila River canals; (3) to examine the data concerning when those canals were originally excavated and used; and (4) to consider the possibilities of who — which prehistoric group(s) or "culture(s)" — planned, excavated, and used those canals. We have found this to be a difficult set of goals to achieve by means of a study largely based on archaeological survey. This paper should be regarded as an initial consideration of these subjects. The findings should be considered tentative; undoubtedly they will be modified and refined as additional archaeological and historical work is accomplished. Some aspects of this paper are of a speculative or hypothetical nature, and some readers will be dismayed by this and think our effort to be a waste of time. But, if logical, well founded, and clearly labeled, such hypotheses are warranted when conclusive data are absent. Hopefully this study will serve as a starting point to guide future research, if for no other reason than to prove us wrong.

Specifically, this paper focuses on the canals with their heads or offtakes in the eastern portion of the Safford Basin, from just northeast of the small community of San José to just west of the town of Thatcher (Figure 17). It is an expanded version of a section of a more encompassing article discussing the Prehistoric Agricultural Strategies of the Safford Basin (Neely 2008a) recently submitted for publication. It also incorporates new information gleaned from additional fieldwork and research that augments our studies on agricultural systems conducted over the last several months. While a clear picture of the prehistoric fields and canal systems associated with the Gila River will probably never be achieved, several lines of evidence have permitted an initial consideration. As noted, the information utilized was largely obtained by survey, although a few small excavations have provided important and substantive data. Historical studies have also significantly contributed to this paper.

With the information at hand, it appears that the Safford Basin was second in the American Southwest only to the Phoenix Basin in the intensity and extent of river-based canal use and the size of the related area of agriculturally utilized land in prehistoric times (Doolittle 2008; Neely 2008a). The surface evidence of prehistoric Gila River-based canals is rapidly diminishing while the sub-surface evidence is elusive and difficult to obtain, making prehistoric Gila River canal use one of the most difficult subjects in the study of agricultural development in the Safford Basin. This is due largely to the destruction and concealment of the canals and related fields by intensive historic/modern farming practices and the growth of communities paralleling the river. Paradoxically, in a few cases modern farming and public works have aided our study of ancient agriculture with excavations that disclosed prehistoric remains.

Archaeological evidence for the proposed prehistoric floodplain fields and canals is tantalizing, but lacking in quantity. A few excavations (Botsford and Kinkade 1993; Clark 2004, 2006; Huckleberry 2005; Lascaux and Huckleberry 2006) have provided important, but limited, information. When compared with the tangible evidence obtained primarily through survey in other parts of the Safford Basin (e.g., Doolittle and Neely 2004; Neely 2001a, 2005a, 2008a; Rinker 1998), the evidence for Gila River canals and related fields is sparse. However, the excavated evidence, when combined with

settlement pattern data and historic information is sufficient to tentatively reconstruct the routes of some of the prehistoric canals. This reconstruction, augmented by Doolittle's (2008) study of the floodplain fields of the basin, presents a developing picture of Gila River floodplain agriculture.

The majority of the historic information (Colvin 1997, 1998; Colvin and Cook 2006; Fewkes 1898, 1904; Ramenofsky 1984; Southworth 1919) indicates canal-irrigated cultivation of the Gila River floodplain was being conducted mostly by Hispanic agriculturalists by 1870-1871. However, Spanish explorers may have known the area by the eighteenth century. Considering the 1757 arrival of the priest Bartolomé Sanchez in the Cliff, New Mexico Upper Gila River area, some 100 kilometers east of the Safford Basin (Ackerly 1997; Doolittle 2000:387; Sanchez 1856), it seems quite possible that Hispanic agriculturalists occupied the Safford Basin earlier than 1870. A letter written by R. Louis Michelena (1990), indicating that Hispanic occupants of the Safford Basin were excavating canals as early as 1853, supports this possibility. This letter, and its importance, will be discussed below. Interestingly, like the early Hispanic and European agriculturalists in the Safford Basin, Padre Sanchez noted the presence of prehistoric agricultural irrigation canals in the Upper Gila River region (Ackerly 1997:354; Doolittle 2000:387; Sanchez 1856).

It is proposed that prehistoric canals were present on both sides of the Gila River in the Safford Basin (Figure 1). The names of the canals used herein have been adopted from historic studies (Colvin 1997, 1998; Colvin and Cook 2006; Ramenofsky 1984), early archaeological studies (Fewkes 1898, 1904), and the U.S.G. S. 7.5-minute topographic maps of this area. A few of the historic canals in the Safford Basin are herein proposed to be refurbishments of prehistoric canals or closely follow the paths of prehistoric antecedents. For the time being, we must assume that the remaining canals are of historic origin.

## Prehistoric Canals South of the Gila River

As of 2006, evidence supports the presence of at least five prehistoric canals irrigating fields on the south side of the river. From east to west, they are historically named the Old San José - Fourness Canal, the San José - Highline Canal, the Montezuma Canal, the Union Canal, and the Sunflower Canal (Figures 17, 18).

### The Old San José - Fourness Canal

Named the "Old San José Canal" by Babb (1901:Figure 201) and the " Fourness Canal" by Southworth (1919:163), this is the easternmost of the canals that may have had a prehistoric origin. The early historic, and possible prehistoric, head of this canal, as explained by Southworth (1919:163), served both the San José Canal and the Fourness Canal prior to 1891, when the canals were separated and the head of the San José Canal was moved a short distance down-river.

Today, all that is apparently preserved of this canal is a small segment of its channel visible approximately 1.8 kilometers south-`southwest of the present head of the San José Canal, as close as 50 meters to its east, and immediately east of the present paved Buena Vista road (see point "A" on Figure 18). This canal courses just above the toe of a high terrace (Figure 19), is higher than the San José Canal at this point, and in places has a conspicuous channel and well-defined outer (western) berm (Figure 20). It is about 1.5 m wide at its present floor level, and is about 50 cm deep, making it substantially smaller than the present channel of the San José Canal (discussed below). The flow in this canal would have been augmented by runoff from the high terrace immediately to the east. This canal was traced northward to a prominent “nose” of the high terrace but it is uncertain, due to road construction and alluviation, whether this canal followed the contours around the nose of the terrace or if it coursed outward and northeastward. Because of the topography, it is clear that this canal did not branch from the San José Canal but had its head at the Gila River further upstream. Neither the earliest detailed map (Arizona State Water Commissioner 1920) nor the earliest aerial photos (U. S. Department of the Interior 1935:A20 04009 273-8) we have found of this area revealed any clear indications of the upper portion or head of this canal, although it is conceivable that the channel may have followed the well-considered northeastward route we have projected on Figure 18.

We then traced this canal to the west-southwest some 900 meters, to a point at which the well-defined channel turns southeastward to enter a large drainage bisecting the terrace (Figure 18). Unfortunately, we could not trace it further because it was on posted private land. Aerial photos (U. S. Department of the Interior 1935:A20 04009 273-8) verify that the canal did turn southeastward into the drainage arroyo, but we could not determine if the canal was directed into the arroyo to irrigate the alluvial fan at its mouth, or if it crossed the fan and continued southward. In the 900 meters we traced this canal it was seen to descend (from north to south) approximately 3.0 meters. This drop, although not measured from the original floor of the canal, suggests a gentle grade of about 0.3 percent.

Babb (1901:341, Figure 201) briefly mentions this small canal as functioning in 1899, and Southworth (1919:163) and Colvin (1997, 1998) discuss it in only slightly greater detail, but we have failed to find further mention of it in any other historic studies or documents. While we have no tangible proof, it is entirely possible that this feature represents a prehistoric canal that may have seen historic refurbishment. We base this hypothesis on the proximity of two or three prehistoric habitation sites (i.e., AZ CC:2:16 and AZ CC:2:4 [ASM]), and perhaps AZ CC:2:3 (ASM), all with estimated overlapping times of occupation (Neuzil 2005; Arizona State Museum Site Survey files) on the south side of the Gila River, and probably two contemporaneously occupied sites AZ CC:2:8, and 2:5 (ASM) on the north side of the river. This is admittedly one of the most circumstantial of the historic canals we propose to have possibly been a rejuvenated prehistoric canal or to have a possible prehistoric counterpart. It illustrates the pattern of having habitation sites with contemporaneous or overlapping occupations situated along its channel, but lacks some of the other supporting evidence we have found with other canals in the basin.

**The San José - Highline Canal**

The next canal down-river, the San José Canal (Figures 17 and 18), is one of the canals mentioned in historic studies noting the refurbishment of prehistoric canals by the early Hispanic occupants of the Safford Basin (Colvin 1997, 1998; Ramenofsky 1984). J. Walter Fewkes, the first professional archaeologist to excavate in the Safford Basin, noted the presence of this canal, an abundance of abandoned prehistoric canals, and that: "... sections of the modern ditches follow the course of the ancient waterways" (Fewkes 1898:613). Fewkes (1904:178) specifically states that "an old settler" in Solomonville told him that the "modern" San José ditch follows, in part, the course of an ancient canal.

Our survey indicates that most of the present channel of this canal probably closely approximates its original course, but we were not able to locate the earlier head of this canal that Southworth (1919:163) states was a sort distance up-stream until 1891. The prehistoric existence of this canal is supported by four observations: (1) the presence of remnants of old, apparently prehistoric, segments of the canal, (2) the presence of remnants of apparently prehistoric offtakes from the canal, (3) the occurrence of archaeological sites with overlapping occupations paralleling the course of the canal, and (4) historic information that this canal was ancient and had been refurbished by 19th century Hispanic and Anglo agriculturalists.

As with other canals to be discussed, the dimensions (i.e., width, depth, and length) of the prehistoric counterpart of the San José Canal are not known. Although Fewkes (1904:175) comments on the apparently large size of the prehistoric irrigation ditches in the Safford Basin, Southworth (1919:162) notes that the Brown Canal (i.e., the Michelena - Tidwell Canal - discussed below) was only three feet wide until 1883. Today, the San José Canal is quite large (Figures 17, 18, 21), and it is feasible that its present day dimensions approximate those of the prehistoric canal as well. The scale of a canal system reflects the value (i.e., real and perceived need) placed on it by its agriculturally based users, and examples may be seen in the large-scale works found through archaeology. The large Hohokam canals of the Phoenix Basin (Abbott et al. 2006; Doolittle 2000:347-409; Hunt et al. 2005) are prime examples. Crown (1984, 1987:Figures 2, 3; also see Doolittle 2000:390-392) reports equally large prehistoric canals located near Florence, Arizona that head about 145-airline kilometers west-northwest of the city of Safford. One of those canals, also on the south bank of the Gila River, evidently once serviced the area of the Casa Grande Ruin. The mind boggles at the amount of time and effort expended, in some cases for apparently little return, on some of the massive prehistoric water management features and systems in Mexico (e.g., the canals/aqueducts on the Cerro Tetzcotzingo and Cerro Purificación in the Texcoco area [Doolittle 1990:127-135] or the Purron Dam in southern Puebla [Neely 2005b; Neely et al. 2005; Woodbury and Neely 1972]).

Our 2006 survey provided two scenarios for the relationship of the San José Canal and the Highline Canal. The first of these is that the San José Canal terminated in fields at a point about 950 meters to the northeast of the Highline Canal (see point "A" on Figure 17), and that its connection with the Highline Canal represents a historic extension.

Babb's (1901:341:Figure 231) map apparently supports this scenario by showing the 1898 course of the San José Canal ending near Solomonville. However, Babb's map is of a very small scale and displays a number of apparent discrepancies in canal routes and names. The apparent route of the Highline Canal, which Babb terms the "Enterprise Canal", is shown as "under Construction." In addition, from this source there is no way to determine if the Highline Canal was to follow the relict channel of a prehistoric canal.

The second scenario is that the present connection of the San José Canal and the Highline Canal existed in prehistoric times, making the total length of this canal (i.e., the combined San José Canal and the Highline Canal) approximately 25 kilometers. At this time, we propose that the second scenario is not only feasible but also quite likely.

*The Relationship of the San José Canal with the Highline Canal.*

The two most likely objections that may be raised to our proposal for the prehistoric existence of the combined San José Canal - Highline Canal, and its feasibility in general, are: (1) the overall length of the combined canal, and (2) the north-south oriented natural drainages (e.g., the San Simon River) that would have stood in the way of making this one long canal.

The first of these two objections is easily countered. The approximate 25-kilometer length of the San José - Highline Canal is less than the over 30 kilometer long prehistoric canal reported by Crown (1984, 1987; also see Doolittle 2000:390-392) that serviced the Casa Grande Ruin area. Longer canals are also found in other locations in the Hohokam area (Abbott et al. 2006; Doolittle 2000:347-409). The San José - Highline Canal functions well today, so there is no real reason why it could not have functioned prehistorically.

Perhaps the major objection that may be raised to our proposal is that the postulated ancient canal would have had to be constructed to cross north-south trending drainages, including the San Simon River channel, in order to function. While today this canal crosses north-south drainages by means of siphons, such crossings may be seen as considerable barriers for prehistoric engineers. As a result, ancient counterparts of the historic canals have been generally dismissed as technologically impossible or impracticable in prehistoric times.

Evidence for the engineering knowledge and technological capability to overcome this problem has been archaeologically documented in the Safford Basin and elsewhere in the American Southwest. The discovery of the prehistoric raised aqueduct south of the city of Safford in Marijilda Canyon (Neely 2007a, 2007b; Neely and Crary 1998) indicates that crossing such drainages was not an insurmountable obstacle for the prehistoric agriculturalists. By having the knowledge to construct this aqueduct, it is entirely reasonable that the prehistoric agriculturalists could have constructed a similar structure to span large drainages. This structure probably took the form of a canoa (cañoa - cf. Doolittle 2000:Figure 10.4), such as that seen spanning a wide drainage today in the vicinity of Las Trampas, New Mexico (Figures 22 and 23).

The Mullen Wash aqueduct, located in the Verde Basin of Arizona, provides an additional excellent example that reinforces the probable use of aqueducts in the form of canoas. Mindeleff (1896) first recorded the limestone canal of which the Mullen Wash aqueduct was a part. It was better documented and more thoroughly studied later by Midvale (1946). Doolittle (2000:377, Fig. 10.13) observes that the break in the Mullen Wash aqueduct, where it crosses the active channel of Mullen Wash, was probably spanned by "... split and hollowed logs ..." (Doolittle 2000:Fig. 10.4; Van West and Altschul 1997:346, Plate 9.4).

At the present juncture of the San José Canal with the Highline Canal, the San Simon River channel ranges from around 19 to 26 meters across, depending on the place on the constantly changing banks one takes a measurement. It is currently about 3 to 3.5 meters from ground level to the bed of the river (measured when dry). However, Gary Huckleberry (personal communication 2006) has informed us that the current depth and width of this entrenchment occurred after about 1900, and that the San Simon channel was previously less wide and deep (Olmstead 1919). To span the river the prehistoric agriculturalists could have constructed an aqueduct constructed of several large trees that had been cut in half longitudinally with U-shaped channels cut into them (Figure 23). Several such large logs, laid side-by-side and overlapping end-to-end, and supported by a framework of vertical logs imbedded in the river bottom and banks (see Figures 22 and 23), could easily have spanned the width of the San Simon River and connect4ed the ancient segments of the large San José and Highline Canals. Near the small village of San Juan del Maguey, in the state of Jalisco in Highland Central Mexico, Neely (personal observation 1970) has also seen a similar task accomplished with large agave leaves. In this case, many large agave leaves had been overlapped side-by-side and end-to-end, and sewn together with agave fiber, to span a wide drainage. This very strong and flexible conduit was supported on a framework of logs.

While indisputable proof of the course and proposed extension of the San José Canal to include the Highline Canal is not now available; there is enough evidence present to at least propose it as a credible possibility. See the Observations section, below, for additional discussion on this matter.

*The Buena Vista Segment of the San José - Highline Canal.*

About 2.7 kilometers southwest of the present head of the San José Canal is located the Curtis Ranch, on which the large Buena Vista (Curtis) site (AZ CC:2:3 [ASM] - Fewkes 1898, 1904; Mills and Mills 1978) is situated. The ranch and site are located to the west of the present channel of the San José Canal (Figures 17 and 18). With permission from the landowner, Mr. Brooks Curtis, we investigated the remnants of the prehistoric canal that followed the perimeter of the peninsular-like terrace upon which the Buena Vista site was constructed. Unfortunately, much of this canal has been bulldozed inward toward the center of the terrace. This was done within about the last 15 years to increase the area of the modern fields located primarily to the north and west of the terrace. However, we were able to find a well-defined segment of the canal below a historic dwelling situated a short distance east of the "nose" of the terrace. About three meters below and

approximately 15 meters to the north of this dwelling, this canal segment was concealed in dense brush. The channel was situated about half way up the terrace face. The upper portion of the terrace appears to have been cut back to form a ledge into which the canal was excavated. The present 60 cm deep channel is about 3.5 meters wide at its bottom. Its outer (north) berm was clearly visible and the berm's interior face suggested a canal with nearly vertical sides.

J. W. Fewkes was apparently the first to record the canal channel at the perimeter of the terrace on which the Buena Vista site is situated. In viewing Fewkes' (1898:Plate XVI; 1904:Plate LXVI) map of the Buena Vista site (see Figure 41), we noticed that it shows a canal, flowing from a more northwesterly route than that presently taken by the San José Canal, met the "nose" of the terrace and then followed its western edge toward the south. This is inconsistent with our findings that the canal followed the entire perimeter of the terrace, and is also inconsistent with the situation as illustrated by an early map (Arizona State Water Commissioner 1920) and slightly later aerial photos (U. S. Department of the Interior 1935:A20 04009 273-8). These findings brought to mind two questions: (1) was the segment of the canal we describe above a segment of the prehistoric primary canal; and (2) did the Curtis family, who purchased the land in 1903 (Brooks Curtis, personal communication 2006) or people from the community of San José move the northern segment of the San José Canal to its present location after Fewkes' map was made? We had no definite solution for this inconsistency; however, we envisioned two possible explanatory scenarios. The first was that the original primary canal was situated further to the west than the San José Canal is presently located, and sometime after 1897 and before 1920 the northern segment of the canal was relocated (Figure 18). The second scenario, and probably the less likely, was that the cartographer mapping the site for Fewkes in 1897 may have erred by showing a still extant secondary canal (now named the Fourness Canal [Colvin 1998:21-22; Neely, personal observation 2006]) flowing into the terrace canal at this point as the primary source canal. If the latter scenario was the case, the cartographer apparently compounded this error when he failed to illustrate the eastern half of the true primary canal (i.e., the prehistoric counterpart of the San José Canal) that followed the approximate 180-degree arc of the terrace edge (Figure 18).

Babb's (1901:Figure 201) map of 1899 lacks the detail and scale to contribute. However, the 1920 map noted above designates the large bend of the canal that passed around the Buena Vista site's terrace as the “Old San José Canal”, and that it was “abandoned.” If the northern segment of the original prehistoric primary canal was relocated after 1897, perhaps due to its destruction during the disastrous floods of 1905- 1906 and/or 1914 (Talley ca. 1970:6, 9), it is possible that the eastern portion of the Buena Vista Canal seen on the 1920 map and 1935 aerial photos was part of that San José Canal realignment. In the early stages of our survey, we thought that the Buena Vista Canal might have been a secondary canal branching from the San José Canal at about the present location of a modern canal offtake that irrigates the fields to the west and southwest of the Buena Vista Site. However, in 2006, Mr. Brooks Curtis revealed that the canal that had bordered the Buena Vista site was not a secondary branch, but was once part of the primary San José Canal. Mr. Brooks recalled that his grandfather, father, and several other men used a “power shovel” to excavate a more direct channel for the San Jose Canal in the early

1900s, and thereby cut off the large bend that bordered the Buena Vista site terrace (Figure 18). Therefore, as best we can determine at this time, the original course of the San José Canal was correctly shown by Fewkes' map. Then, sometime after 1897 but before 1920, the northern part of the canal's course was moved eastward and the channel was cut around the north side of the Buena Vista site terrace. Sometime later, but before 1920, the bend in the canal then present around the Buena Vista site terrace was cut off to straighten the channel. Obviously, written records of these matters would do much in reconstructing the history of the San José Canal. Unfortunately, such records have not been found, and the historic information available does not contribute to the solution of the many problems seen or the questions raised (see the "Observations" section, below).

The ruins of an adobe house (Figure 24) were found about 60 meters west-northwest of the point where the proposed post-1897 realignment of the San José Canal turned westward to go around the Curtis ranch and the Buena Vista site. We learned that a Señor Sixto Molina homesteaded the property on which this adobe house is situated in 1896 (Graham County Records Office, Homestead Index, Homestead Book No. 1, Page 157). As we traced the course of the San José Canal southward, we found many adobe house ruins located on both sides of the San José Canal between this point and the community of Solomon. Although we have not as yet attempted to research these structures, the locations of these ruins suggests that the present course of the San José Canal from this point southward has not changed since agriculturalists of the late 1800s and early 1900s, like their prehistoric counterparts, used the San José Canal and constructed their homes near its channel. The presence of a now defunct "hot" spring situated immediately east of the adobe house (Brooks Curtis, personal communication 2006) may explain the placement of this house. However, to further complicate the question of the realignment of the San José canal, its location might also be used to suggest that the San José Canal was in its present location prior to the drawing of Fewkes' map. A white obelisk-shaped marble monument, erected in 1942, located immediately west of the adobe house (see Figure 24) commemorates the birth and death of four children from the Molina family. Assuming the children were buried at this location, the dates on the monument would indicate that the first child to die was buried here in 1899. This suggests, but by no means proves, that the adobe house was constructed here between 1896 and 1899.

Offtakes/Branchings from, the San José - Highline Canal.

A possible prehistoric offtake or branching from the canal that passes around the Buena Vista site was found that courses directly west toward an area of presently cultivated fields. From this point the larger canal continues its course of about 10 degrees E of S, to complete its loop around the Buena Vista site. At this location, the larger canal was about 1.5 meters in depth, approximately four meters wide at ground level, and about 1.5 meters wide at its present floor. The smaller canal was about 1.5 meters deep, some two meters wide at ground level, and about one meter wide at its present floor.

The indistinct remnants of several very old, possibly prehistoric, offtakes were also found branching northwestward from what is now the Highline Canal. These secondary canals were about two meters wide at ground level and approximately 50 cm in depth. This

segment of the Highline Canal courses just above the toe of a steep-faced high terrace (the T3 terrace - Figure 18; Huckleberry 2005:Figure 3.2) that supports dense riparian vegetation. The area to the north of this canal is heavily cultivated today, as it probably was in prehistory.

*Sites Probably Associated with the Ancient Predecessor of the San José - Highline Canal.*

From east to west, the five to eight habitation sites (Figure 17) probably associated with the San José Canal are: the Yuma Wash site (AZ CC:2:16 [ASM] - Brown 1973); AZ CC:2:4 ([ASM] - Arizona State Museum survey files); the Buena Vista (Curtis) site (AZ CC:2:3 [ASM] - Brown 1973; Fewkes 1898, 1904; Mills and Mills 1978; Tuohy 1960); the San José site (Fewkes 1898:614, 1904:173); and Epley's Ruin (AZ CC:2:64 [ASM] - Fewkes 1898, 1904; Lascaux and Huckleberry 2006; Lascaux and Montgomery 2005). Sites AZ CC:2:2 [ASM] and AZ CC:2:69 (ASM) may well have been associated with the Highline segment of the San José Canal. In addition, the unnamed and unrecorded site that is now largely covered by apartments and a small shopping center on the rise of land located between South 17$^{th}$ and South 20$^{th}$ Avenues, and other sites in its vicinity, may also have been associated. Most of these sites are documented in the reports cited above, the Archaeological Site Survey files of the Arizona State Museum, as well as by Neely (2005a, 2007a); and Neuzil (2005). As indicated by the reports of Bandelier (1892) and Fewkes (1898,1904), they represent the few sites that have, at least in part, escaped historic cultivation and urban construction. Fewke's (1898:610-616, 1904:170-175) observations on the large number of site remains present in the Solomonville and San José areas in the late 1800s are particularly insightful when considering prehistoric site and population densities and related subsistence requirements.

**The Montezuma Canal**

The Montezuma Canal is believed to represent the next prehistoric canal to occur down-stream on the south side of the Gila River (Figures 17 and 18). Historic information (Colvin 1998; Fewkes 1898:613) attests to this canal’s prehistoric origins. Fewkes (1904:178) specifically states that "an old settler" in Solomonville (name changed to "Solomon" around 1900) told him that the "modern" Montezuma ditch follows, in part, the course of an ancient canal. In addition, like the Union and Sunflower Canals (below), this canal has nearby archaeological evidence that supports its attribution as a refurbished prehistoric canal and/or closely follows the course of a prehistoric antecedent. Its very name, "Montezuma", suggests its prehistoric origin, as demonstrated elsewhere (e.g., Aztec, Montezuma Well, etc.) where historic groups have applied such names to ancient features. Recent excavations, at the northeastern edge of Solomon (Solomonville) (see "B" on Figures 17 and 18) by Tierra Right-of-Way Services, Inc., found segments of three prehistoric canals and one historic canal with east-west orientations near the functioning Montezuma Canal (Huckleberry 2005; Lascaux and Huckleberry 2006). The earliest of the prehistoric canals has been radiocarbon dated to cal. 190 B.C - A.D. 10, making it the earliest dated canal in the Safford Basin and one of the earliest dated canals in the American Southwest. As noted in the "Observations", below, these dates augment

the growing suite of dates from southern Arizona that indicate great antiquity for canal irrigation in the American Southwest.

Near the northeast edge of Solomon, the current Montezuma Canal turns due south and courses about 1.35 kilometers to where it branches from the San José Canal. However, the general topography of the area, as well as east-west orientations of the prehistoric canals found by Annick Lascaux and Gary Huckleberry (2006) near the northeast edge of the Epley's Ruin (AZ CC:2:64 [ASM]) and the Solomonville community, seem to indicate that the head of the original Montezuma Canal was to the northeast. Unfortunately, our survey was unable to find any evidence of an offtake from the river, nor of the 2.5 to 3 kilometers of the upper portion of this canal that presumably led to the presently visible remnant of the canal. Our thoughts were that the original head or offtake of the Montezuma Canal from the Gila River was probably located about 1.3 kilometers north-northwest of the small historic community of San José, and approximately 6.5 kilometers down stream from the head of the San José Canal (see Figures 17 and 18; Colvin and Cook 2006:11).

During our attempt to trace the upper portion of the Montezuma Canal by pedestrian survey, the only relatively undisturbed area in the vicinity was directly north of the Lascaux and Huckleberry excavations. In this area we did not find any evidence of a canal, but we did find the remains of a ruined adobe building in a dense stand of mesquite trees. This ruined adobe was reminiscent of other similar structures found to parallel the San José Canal, and was thought to support the theory that the head of the Montezuma Canal lay to the northeast. The 1920 map (Arizona State Water Commissioner 1920), found at the Gila Valley Irrigation District Office in Safford, resolved our quandary regarding the location of the probable original head of the Montezuma Canal. That map clearly shows the offtake of the Montezuma Canal was located very near where we had predicted it should be (Figures 17 and 18). The map also shows the route of the canal channel to where it joined the now existing portion of the Montezuma Canal, about 450 meters west- northwest of the Lascaux and Huckleberry excavations (see point "B" on Figures 17 and 18). Relative to the channel of the Montezuma Canal shown on the 1920 map, we now see that the ruined adobe noted above was situated just south of that primary channel, and thus maintained the pattern of early adobe ruins found paralleling the San José Canal. As the early aerial photos (U. S. Department of the Interior 1935:A20 04009 273-8) do not show the head or this portion of the Montezuma Canal, it is evident that its offtake was changed to branch from the San José Canal sometime between 1920 and 1935.

Considering the orientations and relatively small size of the Epley's Ruin prehistoric canals, Huckleberry (2005) comments that it is likely that the smallest of the three canals was a tertiary (lateral or field) canal, while the two others were secondary (distribution) canals and were probably branchings from an as yet to be determined primary canal. As noted above, the 1920 map shows the presently missing portion of the Montezuma Canal to course north of the Lascaux and Huckleberry excavations. Thus, due to the location of the Montezuma Canal, and because the topography slopes toward the river (north), it is unlikely that the canals found by Lascaux and Huckleberry were branches from its

prehistoric counterpart. The exact location for the offtake for the Epley's Ruin canals remains, for now, unknown. However, it is conceivable that the prehistoric canal segments found by Lascaux and Huckleberry may have branched from the prehistoric counterpart of the San José Canal a short distance southwest of the San José site. From Fewkes' (1898:612-613, 1904:178-179) observations, the evidence for prehistoric canal irrigation was abundant and clearly defined in the area between San José and Solomonville in 1897. It is a shame that it is not so today.

We were unable to investigate the Montezuma Canal immediately west of the Lascaux and Huckleberry excavations due to heavy historic disturbances and constructions. However, the topography suggests that the present course of this canal west of Solomon probably closely parallels its original course. Today the canal terminates in an open field area at a distance of about seven kilometers west of the Lascaux and Huckleberry excavations, however, the 1920 map indicates that the Montezuma Canal extended further westward into the city of Safford (Figure 18) to a point about halfway between the San José – Highline Canal and the Union Canal and about 500 meters south of the postulated southern limits of the Methodist Church Site (AZ CC:2:15 [ASM]), discussed below. Babb's (1901:Figure 201) map suggests that in 1899 the Montezuma Canal extended to just southwest of Thatcher (Figure 18).

*Sites Probably Associated with the Ancient Predecessor of the Montezuma Canal.*

The habitation sites probably associated with the predecessor of the Montezuma Canal are (from east to west): the San José site (Fewkes 1898: 614, 1904:173); Epley's Ruin (AZ CC:2:64 [ASM] - Fewkes 1898, 1904; Lascaux and Huckleberry 2006; Lascaux and Montgomery 2005); AZ CC:2:2 (ASM); probably the Methodist Church site (AZ CC:2:15 [ASM] – Brown 1973; Crary 1997); and other sites now destroyed or buried.

**The Union Canal**

The Union Canal appears to be the current counterpart of a fourth prehistoric canal located a bit further down-river on the south side of the Gila River (Figures 17 and 18). The 1985 USGS 7.5-minute Topographic Safford Quadrangle map and our survey indicate that this canal receives waters from a modern "aqueduct" (i.e., a buried pipeline) branching from the Highline Canal, and possibly from pumped wells. We found that east of South Barney Lane (where the canal appears to turn south) surface indications of the Union Canal have been obliterated by agricultural landform modifications and intensive cultivation.

An earlier head, perhaps the original head, of this canal took water from the Gila River at a point in the approximate center of Section 18, Township 7 South, Range 27 East (Figures 17 and 18), approximately four and a half to five kilometers east of where the "aqueduct" is shown to join the surface channel (1985 USGS 7.5- minute topographic Safford Quadrangle). The location of this offtake is documented by interviews (e.g., Frank Quinn [a local Safford historian], personal communication 1997), and from older maps (e.g., Bureau of Land Management [BLM] 1973). The 1920 map noted above also

indicates the head of the Union Canal to be located at nearly the exact point shown in Figures 17 and 18, and by Colvin and Cook (2006:11). Attesting to the rapid human modifications affecting canal channels, the aerial photos (U. S. Department of the Interior 1935:A20 04009 273-8) indicate the channel was straightened just west of the offtake sometime between 1920 and 1935 (see "5" on Figure 18). As was accomplished for the San José Canal at the location of the Buena Vista site, this straightening cut off a large bend in the channel of the Union Canal. To the west, the course of the historic canal, from just northeast of site AZ CC:2:2 (ASM) (Figures 17 and 18) to where it enters the current community of Thatcher, appears to be in about the same location as may be projected for its prehistoric predecessor. This observation is based on three factors. (1) Although we could not walk the course of the canal through much of the heart of Safford and Thatcher, the topography of the landscape into which the canal was excavated presents few alternatives in its route. (2) The presence of archaeologically documented remnants of prehistoric canals found nearby the present functioning canal. (3) Archaeological sites paralleling the course of the canal.

Two complexes of canals have been archaeologically documented just north of the present channel of the Union Canal (see point "C" on Figures 17 and 18). It must be noted that these canals were apparently located at or near the north-central edge of the Methodist Church site (AZ CC:2:15 [ASM]).

The northernmost complex of canals (Figure 25) was found to contain three small prehistoric canal segments associated with prehistoric architecture. This complex of canals was found as a result of professional test excavations anticipating the construction of the present Bureau of Land Management (BLM) office building in Safford (Botsford and Kinkade 1993). The site was named the BLM site and designated AZ CC:2:64 (BLM), although it probably is part of the Methodist Church Site (AZ CC:2:15 [ASM]). The site and canals were dated to ca. A.D. 850 - 1200 by means of associated ceramics samples.

The southernmost of these two complexes of canals (Figure 26), also in association with prehistoric architecture, was fortuitously found to the south about a year later. The owner and developer of the property excavated this site. Fortunately, Gay Kinkade (BLM Archaeologist), Everett Murphy (Arizona Archaeological Site Steward), and Joseph Crary witnessed this excavation and were able to briefly study the findings. The canal recorded by Crary (1997) was just north of and generally paralleled the present channel of the Union Canal. Crary was able to note that the route of this relatively large prehistoric channel had been modified several times (Figure 26), possibly due to a "fine-tuning" of the channel grade for more efficient flow, or to repair washouts.

Following the Union Canal through Safford and Thatcher was quite difficult as it passes through developed neighborhoods, but we were able to see it in enough places to get a good idea of its topographic surroundings. Lack of time prevented us from tracing this canal more than about a kilometer west of Thatcher, just past where the Highline Canal presently joins the Union Canal.

*Sites Probably Associated with the Ancient Predecessor of the Union Canal.*

The proposed ancient predecessor of the Union Canal apparently had as many as seven habitation sites in association. These sites (from east to west) are: Epley's Ruin (AZ CC:2:64 [ASM]); AZ CC:2:2 (ASM); the Methodist Church site (AZ CC:2:15 [ASM] – Brown 1973; Crary 1997); the BLM site (AZ CC:2:64 [BLM] - Botsford and Kinkade 1993); sites AZ CC:2:290 (ASM), and AZ CC:2:291 ([ASM] - Clark 2004); and the Daley site (AZ CC:2:235 [ASM] - Clark 2004; Lee et al. 1981). It is conceivable that the small occupation exposed at AZ CC:2:289 ([ASM] - Hall and Clark 2004: 23-41) was also using this canal. A large artifact scatter (AZ CC:2:236 [ASM] - Clark 2004) also may have been associated. Other sites (e.g., the "Safeway site"), for which I have been unable to obtain information, were also probably associated.

**The Sunflower Canal**

The Sunflower Canal is proposed as the fifth canal on the south side of the Gila River that may have had a prehistoric counterpart. The 1985 Safford, Arizona Quadrangle of the U.S.G.S. 7.5-minute Topographic map series indicates that the Sunflower Canal has its present head or offtake at a well and is surrounded by fields. Our survey found this canal to have an unlined dirt channel about 1.5 m wide at its floor and one meter deep, but could not locate its head at the Gila River. However, an interview with Frank Quinn (personal communication 1997) and the 1920 map (Arizona State Water Commissioner 1920) permit the placement of the historical, and possible prehistoric, offtake from the river just southwest of, and across the river from, site AZ CC:2:10 (ASM) (see Figures 17 and 18). We were able to follow the course of the Sunflower Canal towards Thatcher, but we lacked the time to trace it to its termination.

In 2000, archaeological testing by Desert Archaeology, Inc. discovered prehistoric canal segments and associated habitation sites north of U.S. Highway 70, between the communities of Safford and Thatcher (Clark 2004; Nials et al. 2004). The excavations disclosed segments of two ancient canals (AZ CC:2:296 and 297 [ASM]) that generally parallel the Sunflower Canal and are only a short distance to its north (see point "D" on Figures 17 and 18). The dimensions of the prehistoric canals (Nials et al. 2004) are not quite as great as the larger canals found at Epley's Ruin, however, they are larger than the Sunflower Canal is today. These prehistoric canals have been radiocarbon dated at A.D. 1-300 and A.D. 900 - 1400. Early historic canals also found during the excavations indicate a long, continuous history of canal irrigation.

*Sites Probably Associated with the Ancient Predecessor of the Sunflower Canal.*

Four or five habitation sites were probably associated with the ancient counterpart of the Sunflower Canal: AZ CC:2:10 (ASM); sites AZ CC:2:290 (ASM); and AZ CC:2:291 ([ASM] - Clark 2004), and probably the Daley Site (AZ CC:2:235 [ASM] - Clark 2004; Lee et al. 1981). While site AZ CC:2:289 (ASM) is only listed as an "agricultural activity" site (Clark et al. 2004:Table 1.1), the occupants of its two pit structures (Hall and Clark 2004: 23-41) may well have utilized this canal.

## Prehistoric Canals North of the Gila River

Our survey on the north side of the Gila River has just begun, and therefore is largely incomplete. To date, the Michelena - Tidwell and Graham Canals are the only canals on the north side of the Gila River we believe to have evidence of possible prehistoric counterparts (Figure 17). Our evidence consists of historical information and the proximity of a number of prehistoric sites, and is more circumstantial than that for the canals on the south side of the Gila River.

### The Michelena - Tidwell Canal

The canal presently known as the Tidwell Canal is located on the north side of the Gila River, north of the community of San José (Figure 17 - Colvin 1997, 1998; Colvin and Cook 2006:11). This canal was first known as the Michelena Canal, and perhaps also included the Brown, Mejia, and Sanchez Canals in its history. A letter written by R. Louis Michelena (1990) indicates that his uncle's father and grandfather, Manuel and Trinidad Michelena, excavated the Michelena Canal around 1853. Assuming the 1853 date is correct, this makes this the earliest historic canal known for the Safford Basin. Because the Michelena Canal is officially registered as having been constructed in either 1874 (Colvin 1998:25) or 1885 (Michelena 1990), this letter also illustrates the early practice of first excavating a canal, and then officially registering it several years later; a situation also noted regarding the Fourness Canal by Colvin (1998:21). Because of the documented practice of the early Hispanic farmers refurbishing prehistoric canals for use, and the proximity of archaeological sites to this canal, we believe it is likely that this canal may have had a prehistoric counterpart.

Because of a number of refurbishments, that may well have also lengthened the canal, the head or offtake of this canal from the Gila River is difficult to place. The original head of this canal may have been across the river from that of the Old San José - Fourness Canal.

*Sites Probably Associated with the Ancient Predecessor of the Tidwell Canal.*

The four habitations sites (from east to west) that may have been associated with the proposed ancient canal are: the Earven Flat Site (AZ CC:2:8 [ASM]); AZ CC:2:5 ([ASM] - Ahlstrom 1997; Brown 1973; Tuohy 1960); AZ CC:2:6 (ASM); the Buena Vista (Curtis) site (AZ CC:2:3 [ASM] - Brown 1973; Fewkes 1898, 1904; Mills and Mills 1978; Tuohy 1960); and AZ CC:2:9 (ASM). The Sanchez agricultural sites (Seymour et al. 1997) may also have been associated.

### The Graham Canal

To the west of the Tidwell Canal, the second canal on the north side of the Gila River we believe may have had a prehistoric counterpart is the Graham Canal. Part of the circumstantial evidence is historic information dealing with the town of “Smithville” (now named Pima), and recorded in Mormon Church records in the “St. Joseph Stake History, Pima Ward” and “St. Joseph Stake History, Eden Ward” (Williams 1937:23).

According to Williams (1937:23), the document states that the Mormons: “ ... had enlarged fifteen to twenty miles of the old ditches (the old ditches were widened from three to four feet to, in many cases, eight to ten feet and deepened proportionally).” A second historic document (Talley 1970:7) states that "... an old channel ..." was used in the process of realigning and constructing a new diversion for the Graham Canal after the disastrous flood during the winter of 1905-1906. While the "old ditches" and "old channel" mentioned in these documents could refer to earlier historic channels, they could equally well refer to prehistoric canals. There are also a number of prehistoric sites located along the course of the Graham Canal.

*Sites Probably Associated with the Ancient Predecessor of the Graham Canal.*

At least four habitation sites that may be associated are (from east to west): AZ CC:2:10 (ASM); the Peterson Wash Site (AZ CC:2:31 [BLM] - Taylor 1983); the Peck Wash Site (Neely and Doolittle 2004:131-132); and AZ CC:1:3 ([ASM] - Neuzil 2005). Although primarily focused on agave cultivation, the Safford Grid site (AZ CC:1:2 [ASM] - Doolittle and Neely 2004; Neely and Doolittle 2006) also has small habitation components that may have been associated. Off the map (Figure 17) to the west (see Neely 2007a:Figure 1) there are five more habitation sites that may well have been in association, these are: AZ CC:1:5 (ASM); AZ CC:1:6 (ASM); the Eden site (AZ CC:1:4 [ASM] - Tuohy 1960); AZ CC:1:7 (ASM); and the Owens-Colvin site (AZ CC:1:19 [ASM] - Neily et al. 1993; Rule 1993).

## Observations

A number of observations have resulted from our study of the canals in the eastern half of the Safford Basin. These observations are pertinent to provide perspective and better understanding of the prehistoric Gila River canals and related phenomena.

1) The re-excavation of ancient canals, and/or the positioning of historic canals over or adjacent to the channels of ancient canals, in the Safford Basin should not be considered unusual or isolated events. A growing body of evidence suggests that the refurbishment and reuse of prehistoric canals was rather commonplace (Doolittle 2000:368-369). Such refurbishments have been documented for the prehistoric canals of the Middle Gila Valley (Haury 1976:122-123; M. Kyle Woodson, personal communication 2006), the Phoenix Basin (Masse 1981; Purcell 2007; Rogers 1976), and throughout the world (e.g., Peru [Gelles 1996]; Sri Lanka [Stanbury 1996]; Sonora, Mexico [Doolittle 1988]; Puebla, Mexico [Neely 2001b, 2005b; Neely and Rincon Mautner 2004; Woodbury and Neely 1972]).

The seven canals postulated to represent prehistoric features in the Safford Basin have apparent prehistoric counterparts in other areas in what is now southern Arizona. For example, the canals found in the Middle Gila Region in the vicinity of the Casa Grande ruin by Crown (1984, 1987) were excavated in similar topographic locations, and in similar relationships with sites and fields, as those occurring in the Safford Basin. Although farther removed, the pattern of prehistoric sites vis-à-vis canals is also

generally similar to that in the Phoenix area (e.g., Abbott et al. 2006:Figure 1; Howard 2006; Howard and Huckleberry 1991; Hunt et al. 2005:Figure 3).

2) The early radiocarbon dates recovered from the prehistoric canals of the Safford Basin are not unusual considering the much earlier dates being recovered from agricultural sites and canals in the Tucson Basin (Mabry 2007; Theil and Mabry 2006).

3) In reviewing the locations of the sites and canals being considered in this paper, two interesting things may be seen. First, each of the large major sites is bounded on two sides by water sources (Figure 18): Epley's Ruin by the Montezuma Canal and the San José Canal; AZ CC:2:2 (ASM) by the Union Canal and the Montezuma Canal; the Methodist Church Site by the Union Canal and both the Montezuma Canal and the San José - Highline Canal; the large unrecorded site south of the Highline Canal by that canal and several springs; and possibly the Buena Vista site by the Gila River and the San José Canal. Second, the canals have been engineered to maximize the available irrigable lands by conveying water from their offtakes on the T1a floodplain terrace and channeling it up onto the T1b terrace (Figure 18). Thus, apparently each of the canals was designed to supply water to segments of the terraces that could not be supplied by the other canals, either because the fields lay up-slope or because there was not sufficient water to irrigate all of the field area lying between a higher canal and the river.

4) The San Jose - Highline Canal is extremely well engineered. It follows a course that keeps it at the highest point a prehistoric canal probably could have been excavated in the southeastern part of the Safford Basin. This provides irrigation water to the highest irrigable area to its west and north and, thereby, maximized the use of the southern Gila River floodplain. This engineering design is apparently quite similar to that used in the construction of the canal that supplied water to the area of the Casa Grande Ruin (Crown 1987:Figures 2, 3; also see Doolittle 2000:390-392). The proposed prehistoric San Jose - Highline Canal is, therefore, in keeping with the prehistoric engineering skills demonstrated outside of the Safford Basin.

In addition, considering the choice placement of the San José - Highline Canal at the toe of the T3 terrace, it would not perhaps be surprising to find an earlier similar long canal following the toe of the T1b terrace, which is generally located just north of and follows the present route (from east to west) of the lower San José Road and U.S. Highway 70 (Figure 18). The placement of a canal in the latter location would conform to the upper limits of irrigable floodplain fields proposed by Doolittle (2008). While there is no direct evidence to support this hypothesis, it is a scenario that future researchers should keep in mind.

5) Because we are uncertain of the original dimensions of the prehistoric primary canals at any time during their periods of function and the systemic relationship of the canal segments exposed through excavation, we have demurred from categorizing the excavated examples as being primary, secondary, or tertiary in nature. Some 145-airline kilometers to the west-northwest of the city of Safford, in the vicinity of Florence, Arizona, are the closest recorded remnants of major prehistoric canals coming from the

Gila River outside of the Safford Basin. Crown (1987:150-151; also see Doolittle 2000:390-392) reports the presence of a single large prehistoric primary canal on the north as well as the south bank of the Gila River. The north canal is said to have a discernable length of 11 km and a width of 12 meters, while the south canal was measured at 32 km in length and has a width of four to seven meters. Both of these canals were as long and as wide as many of the larger historic Gila River canals found presently in the Safford Basin. With these comparative data, supported by size comparisons with canals in the Phoenix Basin (Abbott et al. 2006:285; Doolittle 2000:396-408: Howard 2006), the large size of the San José Canal, and its inclusion of what is now termed the Highline Canal, is reasonable for a large Southwestern prehistoric primary canal. Thus, the size of the San José - Highline Canal rather closely approximates Crown's canals for at least one stage in their functioning existence. In this light, the tentative categorizations of "secondary" and "tertiary" (Huckleberry [2005] and Nials et al. [2004]) for the excavated prehistoric canal segments may well be correct. However, the large canals in the Casa Grande - Florence area may only represent the later occupations (ca. A.D. 1150-1450), which could well affect the interpretations of the Safford Basin prehistoric canals. For example, the relatively large size of the Epley's Ruin Feature #6 canal (Huckleberry 2005) and its early date (190 B.C. - A.D. 10) may indicate one of two things, pending further investigations. It could represent an early primary canal, rather than a secondary canal as it has been attributed. Or, Feature #6 was, in fact, a segment of a secondary canal; which indicates that at least one of the early canals of the Safford Basin was quite large. Here we are faced with two interrelated dilemmas: lack of broad excavation exposure and a single very early radiocarbon date, neither of which lends itself to very secure interpretations. Very much as Doolittle (2000:408) has noted for the Phoenix Basin, and we have observed in the realignments of historic canal channels, the canal systems and the irrigated landscapes of the Safford Basin should be considered as dynamic and ever changing (Huckleberry 2005). In certain times and situations smaller canal systems would have been suitable, while in others larger systems would have been more appropriate and necessary. An interesting comparison may be made between discoveries in the Safford Basin and Hunt's (1994) findings in the Cuicatlán area of highland central Mexico. Hunt's examination of the Río Grande provides striking similarities with the Gila River. Yet, there is no evidence that the Río Grande of the Cuicatlan Valley had been used for canal irrigation in prehistoric times. In a very thorough examination of the data, Hunt (1994) concludes that the probable explanation for this lack of canal irrigation was the fact that the prehistoric agriculturalists had no need for such technology. However, Hunt (personal communication 2006) observed that the lack of such evidence is not evidence that the river was not used. Obviously, the prehistoric agriculturalists of the Safford area deemed canal irrigation from the Gila River very necessary in spite of the constant threat of crop destruction and canal washouts by climatic vagaries affecting the river (Neely 2004).

6) We have recorded a broad band-like area of springs with an eastern edge beginning about five kilometers west of the juncture of the San José Canal with the Highline Canal. These springs occur in a general south- southwest–north-northeast alignment from the foothills of the Pinaleño Mountains to the scarp of the T3 terrace above the river floodplain. This alignment of springs is approximately five kilometers in width, and

probably indicates the presence of a geologic fault. The overflow from these springs drains northward into the Highline Canal. The archaeological sites located in this area were most likely situated to take advantage of these springs. The northernmost of these sites (e.g., AZ CC:2:69 [ASM] and the unrecorded site now covered by a subdivision of Safford) may also have been associated with the Highline Canal and the fields to the north that it serviced. As the general topography slopes from the Pinaleño Mountains towards the Gila River, runoff from rainfall and snowfall would have also augmented the canal flow.

7) Unlike what has been found with the dry-farming (Doolittle and Neely 2004; Neely 2001a, 2008a; Neely and Doolittle 2006) and foothill (bajada) irrigation (Neely 2001a, 2005a, 2008a, b) systems of the Safford Basin, the fields associated with the Gila River canals remain poorly known. This is due to the great modifications of the Gila River floodplain landscape by intensive historic cultivation (which includes ongoing mechanical land-leveling) and the urban expansion of Safford and other communities paralleling the Gila River since the late 1800s.

Our findings correspond with and are reinforced by Doolittle's (2008) reconstruction of the potential agricultural area of the Gila River floodplain. Additionally, the possibility that the San José - Highline Canal may have serviced sites and fields at higher elevations (i.e., on the T1b level of the Gila River floodplain [Figure 18 - Huckleberry 2005:Figure 3.2]) would, perhaps for the later periods of agricultural activity, have substantially increased Doolittle's (2008) area estimates of lands that were available for irrigation by Gila River-based canals. Doolittle has estimated that as much as 7,000 hectares (17,290 acres) of the floodplain were available for irrigated cultivation along both sides of the Gila River in prehistoric times, but as yet we have found nothing visible on the ground surface to indicate their presence. Nor did the limited excavations of Botsford and Kinkade (1993), Clark (2004, 2006), and Lascaux and Huckleberry (2006 - also see Huckleberry 2005) find evidence of the floodplain fields. In sum, we have no information as to their nature, shape or size, because the entire Gila River floodplain is currently being used as agricultural fields, or is beneath urban development. However, there are four sources to which we may refer to obtain some very limited ideas as to the prehistoric fields associated with the Gila River canals.

First, we may glean some idea as to single field shapes and sizes from the well-defined irrigated fields found in Lefthand Canyon (Neely 2005a, 2008a). The apparent fallacy in using the foothill (bajada) systems as a model is the limited water supply and smaller canals present. This would suggest that only the largest fields in the foothill systems possibly approached the sizes of the Gila River floodplain fields. In Lefthand Canyon the largest irrigated fields were found to be rectangular in shape and range from about 6,000 $m^2$ to 14,300 $m^2$ in area (Neely 2005a, 2008a).

Second, as in other regions (e.g., the Tehuacan Valley of Puebla, Mexico [Neely 2005b] and the Near East [Wilkinson 2003]), it is reasonable to presume the ancient cultivators of the Safford Basin Gila River floodplain were required to modify, develop, and manage the landscape to effectively utilize canal irrigation. In many regions these prehistoric

modifications of the landscape to accommodate canal-irrigated agriculture were maintained and continued into the historic period. If this is extrapolated to the Safford Basin, then we may assume that the historic Gila River floodplain fields are in some respects similar to those used in prehistoric times. While this may be true to some degree, we suspect that it is so only in the grossest terms (see Doolittle 2006).

Third, Bandelier presents a color drawing of a canal segment from a location to the west of Safford near Fort Thomas (Burrus 1969:83, 196). As may be seen in Figure 27, Bandelier has provided information as to the dimensions of this canal segment and the distances between branching canals. The distance between branching canals presumably provides one dimension of a single field. The fact that the branching canals leave the main canal at nearly a right angle suggests that at least some fields were quadralinear in shape; information that is verified by findings in Lefthand Canyon (Neely 2005a). Furthermore, the representation of some of the smaller canals with nearly right-angle bends in their channels shortly after branching from the larger canal suggests a manner by which water flow was probably slowed in the channels. With the data at hand, the Bandelier drawing indicates that the fields were probably rectangular in shape, but the great variation in the field dimensions is perplexing; the smaller dimension overlaps with one dimension of some of the Lefthand Canyon fields, but the larger dimension greatly exceeds the maximum dimension of the largest of the Lefthand Canyon irrigated fields. However, this illustration also generates other questions. For example, is the larger canal shown a primary or a secondary (distribution) canal? Did this canal carry waters from the Gila River, or is it part of a spring-fed foothill (bajada) system? While this canal may have been a segment of the same canal reported by Bandelier (1892:410; also see Hough 1907:38 and Neely 1998a) as: "About eight miles east of Fort Thomas ...", and descending "... from the base of the foot-hills of Mount Graham ...", its size exceeds that of the foothill canals. The orientation Bandelier gives does not correspond well with canals coming from either the foothills of the Pinaleño Mountains or from the Gila River. The final, and perhaps currently the best, resource we may draw from to obtain information that would possibly assist us in obtaining shape and size information about the Safford Basin floodplain fields is from outside the basin. This resource, although it too is extremely sparse, pertains to the fields paralleling the canal systems in the Phoenix Basin (Howard 2006; Howard, personal communication 2007). Howard has determined that some of the Phoenix Basin canal irrigated fields in Canal System #1 ranged from around 1.8 to 5.0 acres (7,285 to 20,235 $m^2$), a good match for the available data on early Akimel O'odham (Pima) field size (Russell 1908:87-88). It is interesting to note that this range of field areas is quite similar to that noted above for the Safford Basin's largest foothill irrigated fields. Howard also determined that in some areas of the Phoenix Basin there were from 15 to 40 fields serviced by the secondary (distribution) canals, again a rather good match for many of the ethnohistoric areas under irrigation discussed in the literature.

An additional pertinent observation is that: before the excavation of these prehistoric canals and the cultivation of the fields, the ancient agriculturalists probably had to expend a good deal of time and effort in removing the dense mesquite *bosques* that characterized the floodplain (Doolittle 2006:182-184; Ramenofsky 1984:50-57). While this clearing

provided the land necessary for agricultural intensification, it also destabilized the river regime and increased the probability of geomorphic change that undoubtedly resulted in "floodplain stripping" and the washing out of canal headworks (Doolittle 2006:182-184). On the other hand, the cleared areas would have received alluvium carried by the waters of the canals. This would have added rich, rejuvenating sediments to the cultivated areas as well as replenishing the to deposits lost to "floodplain stripping", and possibly acted as a stabilizing factor (Doolittle 2006:190-191).

8) The proximity of the proposed prehistoric canals to prehistoric occupation sites (Figures 17 and 18), and the fact that some of these canals actually passed through sites, strongly indicates that the canals served as domestic water sources as well as for agricultural irrigation. This is particularly evident for the large Buena Vista (Curtis) site (AZ CC:2:3 [ASM]), Epley's Ruin (AZ CC:2:64 [ASM]), AZ CC:2:2 (ASM), and the Methodist Church site (AZ CC:2:15 [ASM]). Although evidence of its existence is now difficult to find, the Methodist Church Site, in the center of the present city of Safford and about two kilometers south of the Gila River, was evidently one of the largest sites in the Safford Basin. This site is conservatively estimated as once covering an area of about 735,000 $m^2$ (73.5 hectares). The present course of the Union Canal apparently passes through, or immediately north of, this site. Fewkes (1898:610-616, 1904:170-175) also mentions the presence of an abundance of prehistoric canals and a multitude of mounds between the Buena Vista site and Solomon. He relates that his 1897 visit to the Safford basin found most of these sites already highly disturbed by agriculturalists. He also notes that interviews with residents indicated that these sites were still well preserved just 20 years earlier (i.e., 1877). The practice of using canals to supply domestic water is also indicated by the relative locations of sites and canals in the Middle Gila (Crown 1987:Figure 2; Haury 1976) and Phoenix (Abbott et al. 2006:Figure 1; Hunt et al. 2005:Figure 3) areas.

9) The placement of settlements in proximity to fields and water management infrastructure in all of the environmental sub-zones within the basin (Neely 2008a) facilitated the planting, tending, and harvesting of crops and maintenance of water management systems. In addition, it placed habitation in varied natural and human-developed ecotones (Clements 1904; Laurance et al. 2001; Odum 1983), making available greater numbers and varieties of wild plants and animals to supplement the diet and for other uses. For example, the prehistoric inhabitants of the Safford Basin very probably utilized the dense mesquite forests on the floodplain of the Gila River for wood and mesquite pods (ground for food).

Gila River canals, as well as canals having other water sources, very likely generated a human-made riparian microenvironment along their courses. Such riparian zones would have provided a ready supply of edible and useful plants, and would have been a haven for animals. While historic construction and especially cultivation have negatively affected the presence of this microenvironmental zone along most portions of the Safford canals, there are sections of the canal routes that are characterized by heavy vegetation with multiple species of arboreal and non-arboreal plants present. This phenomenon is clearly evident with the lower portion of the San José - Highline Canal where it courses

along the toe of the high T3 terrace (Figure 18). Although not mentioned previously (i.e., Neely 2005a), the smaller prehistoric canals distinguishing Lefthand and Marijilda Canyons are also set apart by a relict riparian micro- environment paralleling their courses. When Neely mapped the canals in Lefthand Canyon, the alignments of mesquite trees and vegetation were used as a guide in tracing the poorly defined segments of the canals. This riparian phenomenon has also been observed elsewhere in Arizona (e.g., Purcell 2007; David Purcell, personal communication 2007) and along the “fossilized” canals in the Tehuacan Valley of southern Puebla, Mexico (Caran and Neely 2006; Neely 2001b, 2005b).

10) It appears that the terrace on which the Buena Vista site is located may have been partially altered to convey water from rainfall and snowmelt outward from the site over its perimeter to the canal and fields below. Such site and landscape modifications to harvest water have been recognized for archaeological sites in the Maya region (Scarborough 1993, 1994; Scarborough and Gallopin 1991; Scarborough et al. 1995) and in southern highland Mexico (Neely 1972, 2005b), and may have been more widely practiced in the American Southwest than has been perceived.

## Temporal and Ethnic Placement of the Safford Basin Gila River Canals

Our search for written primary historical documents relating to the very early Gila River fields and canals was only moderately successful. Our earliest written resources were the reports of Babbs (1901), Fewkes (1898, 1904), and Southworth (1919). The files of the Gila River Irrigation District began in 1920, when the agency was founded. In a recent telephone conversation with Verna Rae Colvin (personal communication 2006), the recognized expert on the historic canals of the Safford Basin, we learned that she had found no earlier primary written sources. Her information evidently largely stems from interviews with elderly residents of the Safford area, from interviews with and articles by Ryder Ridgway, a long time Safford resident and historian, and from the files of the Gila River Irrigation District. It was primarily through interviews with her grandfather that Elizabeth Ramenofsky obtained the majority of her historical information regarding the fields and canals in the Safford area (Ann F. Ramenofsky, personal communication 2006), although she too evidently referred to Ryder Ridgway for information (Elizabeth Ramenofsky Collection, MSS #117, Arizona Historical Foundation).

The temporal and ethnic attributions for the historical Safford Basin Gila River canals have been documented. Colvin (1998) states that, in 1872, the Hispanic Mejia, Monte, and Montoya families excavated the Montezuma Canal, the first officially registered historic canal in the Safford area. In 1874, Francisco Monte and other Hispanic families registered the San José Canal. Eleven other canals were excavated between 1874 and 1895 (Colvin 1998:21-28), most by men with non-Hispanic surnames, many of whom were members of the Church of Jesus Christ of Latter Day Saints (the Mormon Church). As noted above, the historic information may not be as accurate as it is assumed it to be. We suspect that sometimes there is an interchangeable use of the words "excavated" and "registered." As noted for the Michelena - Tidwell and Fourness Canals discussed above, the unexplained gaps in time between when canals were "excavated" and then later

officially "registered" is misleading. Unfortunately, most of the possible incongruities occur in relation to the earliest historic information, apparently due to the lack of clearly written documentation.

Other historic information indicates that at least some of the Safford Basin canals were originally excavated much earlier than their officially recorded historic dates. Colvin claims prehistoric origin for some of the Safford Basin canals. She relates that both the Montezuma and San José Canals had been historically excavated: “... following the canal system that had been built by the Hohokams” (Colvin 1998:6), and that they: “... followed an old irrigation system that was used by pre-historic Indians” (Colvin 1998:20-21). The prehistoric origin of these canals is also supported by Fewkes (1898:613, 1904:178) and Ramenofsky (1984:42); who writes that in 1876 her Grandfather, Isadore E. Solomon, one of the first non-Hispanics to enter the Safford Basin and the founder of the town of Solomonville, found Hispanic farmers using “ancient” canals that they had re-excavated to irrigate their crops. Having provided credible archaeological and historical probability for the prehistoric origins of the Gila River canals discussed herein, we now consider by whom and when these prehistoric canals were excavated.

A review of the more recent literature (e.g., Botsford and Kinkade 1993; Clark 2004, 2006; Crary 1997; Doolittle and Neely 2004; Huckleberry 2005; Neely 2001a, 2005a, 2008a; Lascaux and Huckleberry 2006; Lascaux and Montgomery 2005; Neuzil 2005, 2006a, b; Purcell 2006; Rinker 1998; Seymour et al. 1997; Woodson 1995, 1999, 2006), involving both recent survey and excavation, quickly reveals that ceramics that have been attributed to five prehistoric “cultural” or “ethnic” groups have been found in the Safford Basin. While artifacts from earlier inhabitants are present, the San Simon Mogollon (Sayles 1945) was the first group to produce culturally distinctive ceramics in the Safford Basin (but see Di Peso 1956, 1979; Whittlesey 1995). However, four other Southwestern prehistoric "cultures" or "ethnic groups" are later represented by ceramics in the Safford Basin. In the apparent order of their appearance, ceramics attributed to the Hohokam, Mimbres Mogollon, Anasazi, and Salado are represented. In light of the little we know about Safford Basin archaeology, and the large number of sites that have substantial quantities of ceramic types attributed several of the "cultural" or "ethnic" groups noted above, we have wondered if what we are seeing is a reflection of heavy ceramic trade rather than the incursion of several multiethnic groups. This question appears to have been resolved in the article by Purcell and Clark (this volume), who report ethnically diverse contemporaneous occupations at two sites in the Safford Basin. Considering the findings of Purcell and Clark, many details must be investigated: what were their numbers, what were their roles in the socio-political schema of the basin, as well as what economic and socio-political relationships they had with the San Simon Mogollon and among themselves? Were they traders that subsequently formed sedentary enclaves (e.g., Clark 2001; Neely 1974; Neuzil 2005), or did they come for other reasons? There is recent evidence from the Goat Hill site (AZ CC:1:28 [ASM] - Woodson 1995, 1999, 2006), and possibly other sites in the Safford Basin (Neuzil 2005, 2006a, b), that Anasazi groups from northeastern Arizona, evidently passing through the Point of Pines region of east-central Arizona, came to the Safford Basin and established residency during the period of ca. A.D. 1275-1325. Climatic change and related economic and socio-political

problems are suggested as the most likely reasons for this migration. It is not unreasonable to consider these as among the causes for other prehistoric groups to visit and perhaps settle in the Safford Basin. Now that such incursions with residency have been documented, the Safford Basin presents a unique opportunity for a longitudinal study of several prehistoric "ethnic" groups with overlapping periods of coeval residence. To place these occupations of the Safford Basin in a temporal framework, the cited literature notes that the same ceramic types also serve as chronological markers indicating an occupation time span beginning perhaps as early as ca. A.D. 200 and lasting until about 1450. Even earlier and more conclusive dates for the occupation of the Safford Basin, and for the early construction and use of sophisticated water management and irrigation technology, come from radiocarbon samples collected from Gila River canal contexts. The excavations of Desert Archaeology (Clark 2004, 2006; Nials et al. 2004) disclosed two canals dating between A.D. 1 and A.D. 300. The Epley's Ruin excavations (Huckleberry 2005; Lascaux and Huckleberry 2006; Lascaux and Montgomery 2005) revealed an even earlier canal, radiocarbon dated at between 190 B.C. and A.D. 10.

## Summary and Conclusions

The Safford Basin has not received the archaeological attention that has been given other areas of the American Southwest. However, over about the last dozen years several projects have been conducted, and this largely ignored area is finally being recognized for its importance and potential. Most of this work has been survey, and excavation is sorely needed to verify the models generated and to provide the details that are not available through survey. Due to the foregoing, most of the following conclusions must be regarded as only initial considerations.

The archaeological and historical evidence strongly suggests that several of the historical canals taking water from the Gila River were either prehistoric canal refurbishments and/or closely follow the routes of prehistoric canals. Similar evidence from other regions of the American Southwest and elsewhere in the world support this practice, and therefore increase the feasibility of this having occurred in the Safford Basin. Although the recent excavations in the basin (e.g., Clark 2004; Lascaux and Montgomery 2005; Purcell 2006; Rinker 1998, and Woodson 1999) have provided some information as to the cultural continuity and change in the basin, we are still woefully ignorant. Ideally, large-scale excavations in floodplain contexts are needed to augment the existing small sample of sites and canals. Additional radiocarbon dates are also needed to more securely date features as well as to clarify their contexts and to discover their sequence of construction and lengths of operation. During this process it seems likely that we would also learn a great deal more about the fields these canals serviced.

The discovery of Gila River-supplied canals with very early radiocarbon dates during the excavations directed by Clark (2004, 2006) and Lascaux and Huckleberry (2006; Huckleberry 2005), especially those at Epley's Ruin (Lascaux and Huckleberry 2006; Lascaux and Montgomery 2005) which were in association with Mogollon household refuse, ceramics, architecture, and other features, suggest that the San Simon Mogollon

planned, excavated, and used the first Gila River canals in the Safford Basin. The span of prehistoric canal use evidently extends from perhaps as early as 190 B.C., but at least from ca. A.D. 10 to A.D. 1450. However, the evidence is very limited and sorely needs augmentation.

That the Mogollon may have been the initial canal builders in the basin may be considered unusual due to the relative sparseness of canal construction in the Mogollon heartland of west-central New Mexico and east-central Arizona, and the relatively small scale of those that have been recorded (e.g., Damp et al. 2002; Neely 1995). Be that as it may, the sparseness and small scale may well be due to as yet unperceived cultural factors, as well as the environmental conditions and the near absence of major streams in those regions. It seems unlikely that we will ever be able to determine if the early canals in the Safford Basin were a result of independent invention or emulation. It is entirely possible that the early canals in the Tucson or Phoenix Basins may have provided the prototypes for the Safford Basin canals. However, it is perhaps more appropriate and productive to attribute canal technology development to environmental conditions (i.e., availabilities and limitations) as well as local group necessities rather than resulting from direct contact with or influence from any specific "cultural" or "ethnic" group.

While the San Simon Mogollon appear to have been the originators of Gila River canal engineering in the Safford Basin, subsequent canal network modifications and expansions were likely influenced by later inhabitants; be they the descendants of the San Simon Mogollon or other groups that subsequently occupied the basin. It is feasible that the Hohokam may have had a role in canal enlargement and network expansion, but, if they did, how much of a role they had and how much other occupants of the basin contributed is unknown at this time. As suggested by the historic efforts to refurbish the prehistoric canals and subsequently enlarge the canals and expand the canal network, we think it appropriate to model the continuing prehistoric enlargements and expansions as an incremental process (Doolittle 1984).

Our perspective on canal engineering, as well as other aspects of water management, should be viewed in the same manner as Doolittle and Mabry (2006) have modeled the development of agriculture in the American Southwest. In the following quote, the replacement of the words “maize” with “water management technology” and “evolutionary” with “developmental”, would modify it to appropriately fit our thoughts on water management development, including floodplain irrigation.

> “Rather than thinking in simple, specific, single-process, single-event terms, our thinking about the early history of maize in the greater Southwest should be framed in the context of complex, diverse, and evolutionary processes over an extended period of time.” (Doolittle and Mabry 2006:118).

Survey has shown that substantial numbers of fields and other agricultural infrastructure are present in the three major environmental zones of the Safford Basin (Neely 2004, 2008a). It has been proposed that such diversification of agriculture most likely reflects a strategy to reduce the risks resulting from the highly variable and unpredictable

water/moisture resources (Neely 2004). Survey also suggests that the scale and number of field areas and water management infrastructure increase through time. As with the use of multiple environmental zones, the increasing construction of labor-intensive water management systems probably represents an adaptive risk reducing strategy. Complimenting and augmenting these strategies was the broadly distributed placement of habitation sites, which facilitated access to agricultural fields and water management systems as well as to an increased variety of naturally occurring plants and animals. It is conceivable that the foregoing strategies may also have been instituted to ameliorate socio-political, and perhaps ceremonial/religious, conflicts arising from an increasing population of local as well as ethnically, and probably linguistically, diverse immigrant peoples.

Socio-political organization must also be considered in the light of the increasing human modifications of the landscape, for it is only through the organized efforts of groups that large-scale projects could be accomplished to increase the availability and predictability of moisture. Although the prehistoric agricultural strategies of the Safford Basin apparently involved relatively large areas and complex infrastructure, they have been modeled as products of a group, or groups, with a kin-based organization that was strengthened by cross-cutting ceremonial affiliations (Neely 1997b, 2005a, 2008a; Neely and Doolittle 2004). Aspects of that organizational model have received additional support from a recent publication considering the plausible ethnographic analogies for the social organization of Hohokam canal irrigation (Hunt et al. 2005), as well as studies of Hohokam community organization and exchange in the Phoenix Basin (Abbott 2000; Abbott et al. 2006). Now that some aspects of the prehistoric agricultural strategies of the Safford Basin have been investigated and are at least partially known, we need to seek information to understand the interrelationships of the agricultural system with the economic, socio-political, and ceremonial systems.

Some of the many questions that arise from our study, that may only be answered through additional work, are: (1) How did the Gila River canals and fields interrelate with the other prehistoric subsistence and agricultural strategies of the Safford Basin? (2) What was the scale of these canals, were they enlarged incrementally through time, and were there several prehistoric canals in operation contemporaneously? (3) When, and by whom, was each of these canals engineered and excavated? (4) Was each of the major canal systems engineered, excavated, and maintained by a specific socio-political and/or ceremonial/religious entity?

The study of cultural continuity, change, and process involve the recovery and utilization of good qualifiable and quantifiable data. Although the present corpus is presently limited, we have seen that such data are available from the Safford Basin. This paper constitutes an initial attempt to study one aspect of agricultural intensification, as achieved through Gila River-based canal irrigation. Although it is only one aspect in the study of agriculture as process, such studies are important in understanding the development of, and regional variations in, prehistoric subsistence strategies in the Safford Basin and throughout the American Southwest.

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**SEE FIGURES BELOW** > > > > > > > > >

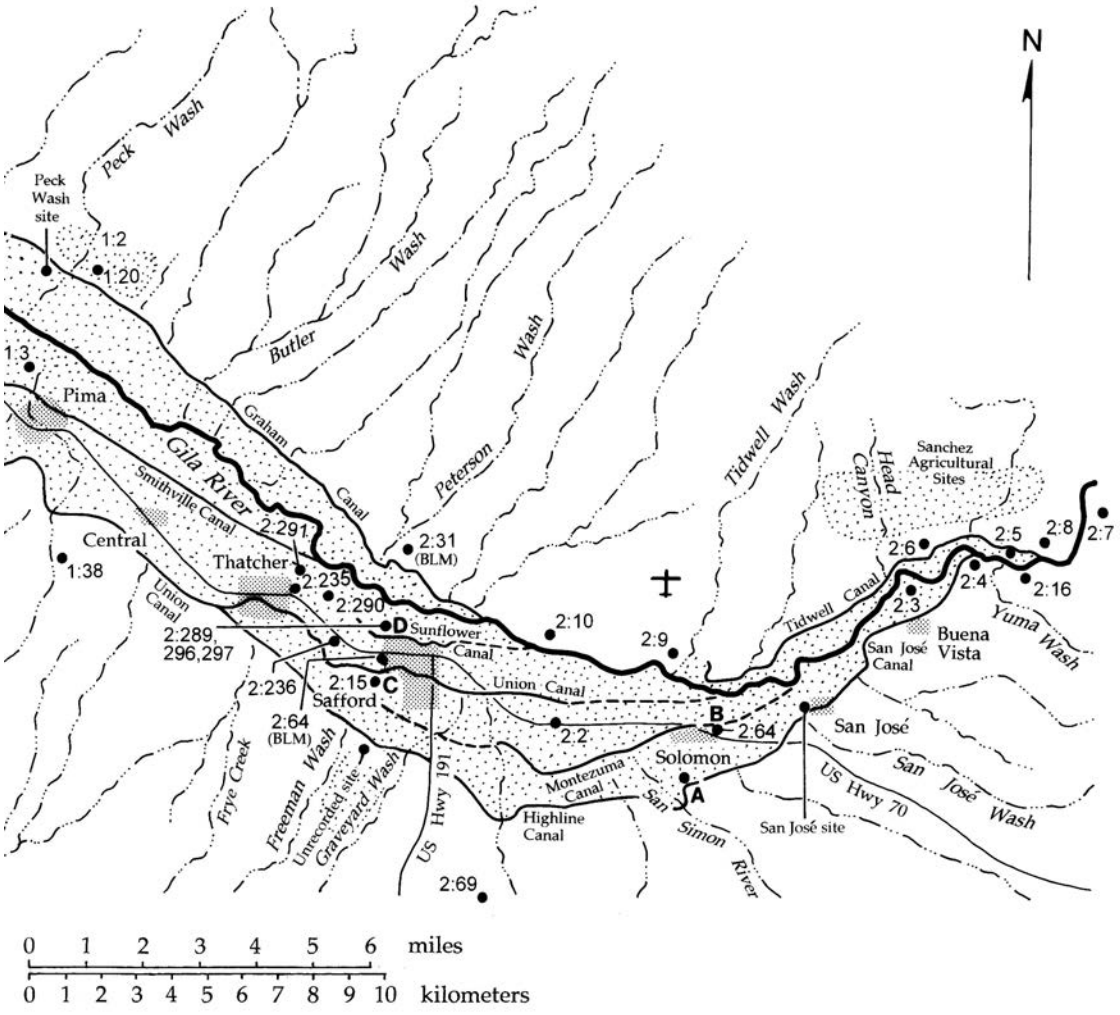


Figure 17. Map of a portion of the Safford Basin centering on the City of Safford. This map shows the location of sites mentioned in the text as well as the canals proposed to have prehistoric counterparts. The numerals (e.g., 2:290) represent the grid square and site number in the Arizona State Museum (ASM) site survey (AZSITE) system. The state and quadrangle designations (i.e., AZ and CC) have not been included due to lack of space. Note that sites 2:31 and 2:64 are from the Bureau of Land Management (BLM) site survey system files.

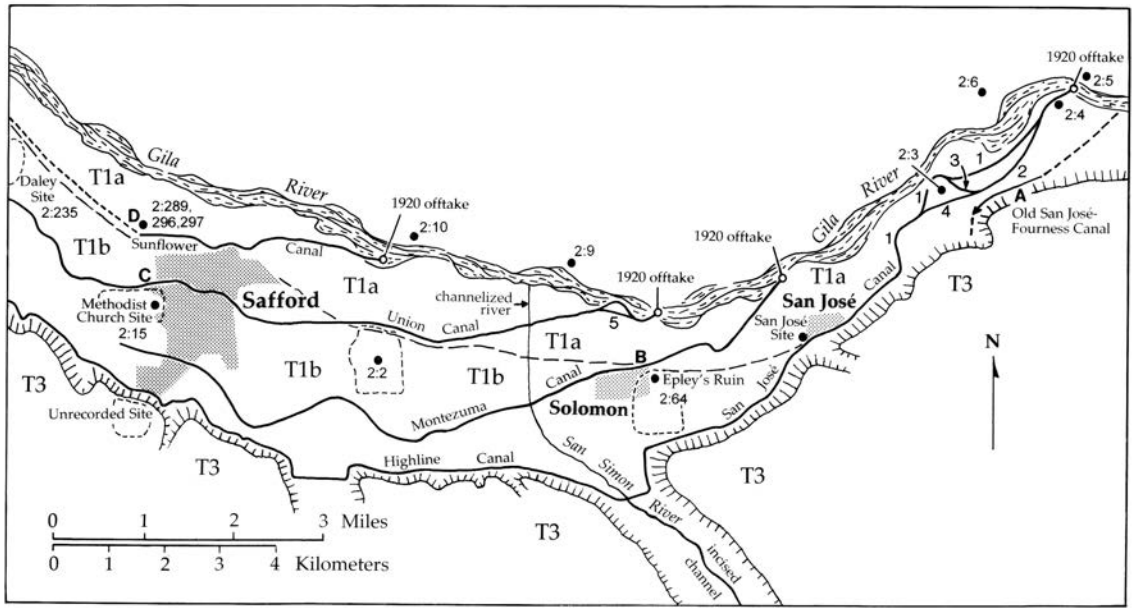


Figure 18. Map of the eastern portion of the Safford Basin. The canals proposed to have prehistoric counterparts are shown in their 1920 map (Arizona State Water Commissioner 1920) locations relative to the terraces south of the Gila River (Doolittle 2007; Huckleberry 2005:Figure 3.2) as well as the major archaeological sites and modern communities of the area. Numbered San José Canal segments: (1) pre- 1897; (2) post-1897; (3) post 1897 and pre-1920; (4) later than (3) but pre-1920. Numbered Union Canal segment: (5) post 1920 and pre-1935. A dashed line indicates an approximate route or boundary. U.S. Highway 70 generally follows the northern boundary of the T1b terrace.

Figure 19. A wide-angle photograph of the terrace face into which has been constructed the small canal also shown in Figure 20. This is probably a segment of the Old San José - Fourness Canal. The white colored linear feature seen in the center of the photograph is the lower (western) berm of the canal. This small canal generally parallels, and lies as close as 50 meters east of, the San José Canal near the Buena Vista Site. Looking south.

Figure 20. The small canal channel shown in Figure 19, and believed to be a segment of the Old San José - Fourness Canal. The six-foot tall man is standing in the center of the channel. Looking southwest.

Figure 21. Photograph of the San José Canal a short distance down-canal from its head at the Gila River. Note the six-foot tall man standing on the canal's right (west) bank for scale. Looking southwest.

Figure 22. A canoa (cañoa) spanning an arroyo just east of the town of Trampas, New Mexico. Note the men standing at the left (north) side of the photograph for scale. Looking east.

Figure 23. Another view of the Trampas, New Mexico canoa, looking south. Two long logs have been cut to form U-shaped channels, and then partially overlapped to span the arroyo.

Figure 24. The ruined adobe building found just west of the San José Canal at the northeastern edge of the terrace on which the Buena Vista site is located. This is one of the better preserved of many similar structures constructed on both sides of the San José Canal between the Buena Vista site and the Solomon (Solomonville) community.

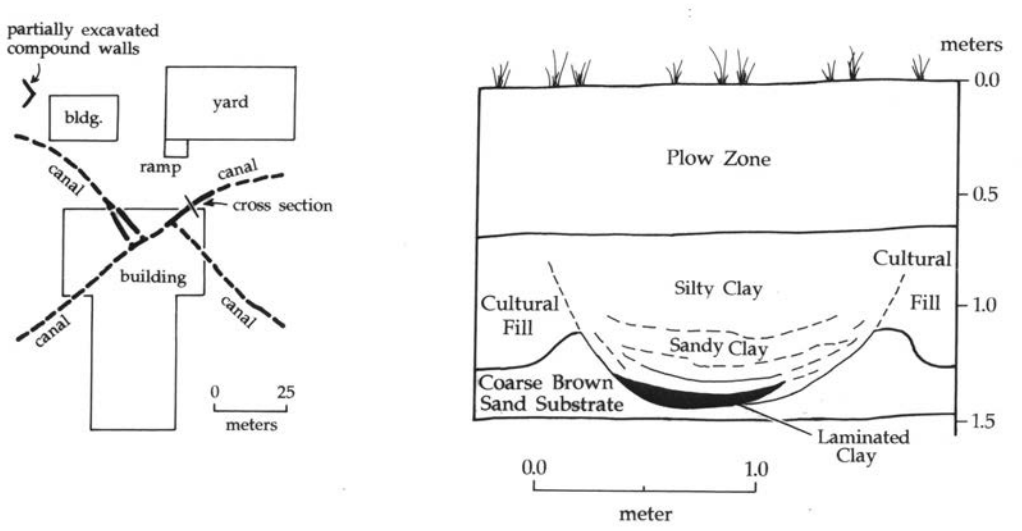


Figure 25. Drawings of the small prehistoric canals found during archaeological testing at the BLM Site (AZ CC:2:64 [BLM] - see "C" on Figures 17 and 18). The top of the plan drawing is north, and the cross- section is facing northeast. (Adapted from Botsford and Kinkade 1993).

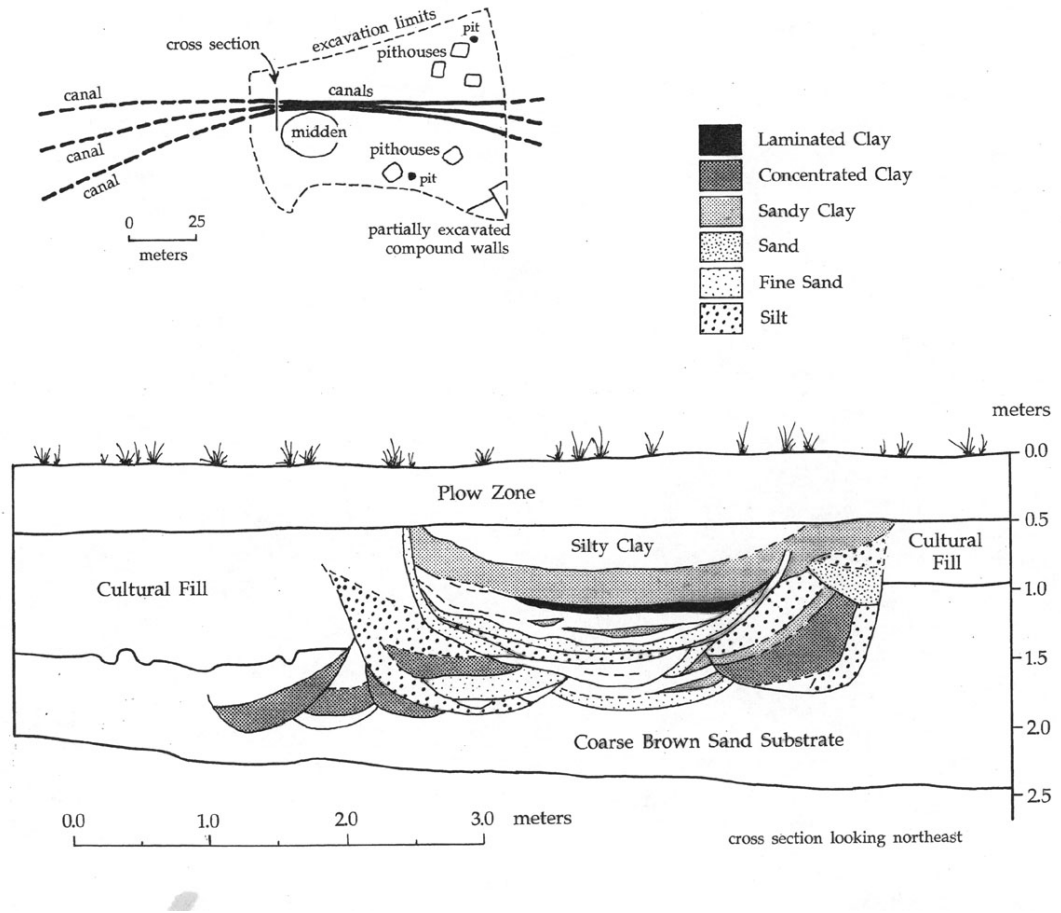


Figure 26. Drawings of the prehistoric canal found south of the BLM building in Safford, and just north of the functioning Union Canal. This canal may be a primary canal ancestral to the present Union Canal (see "C" on Figures 17 and 18). The top of the plan drawing is north, and the cross-section is looking west. (Adapted from Crary 1997).

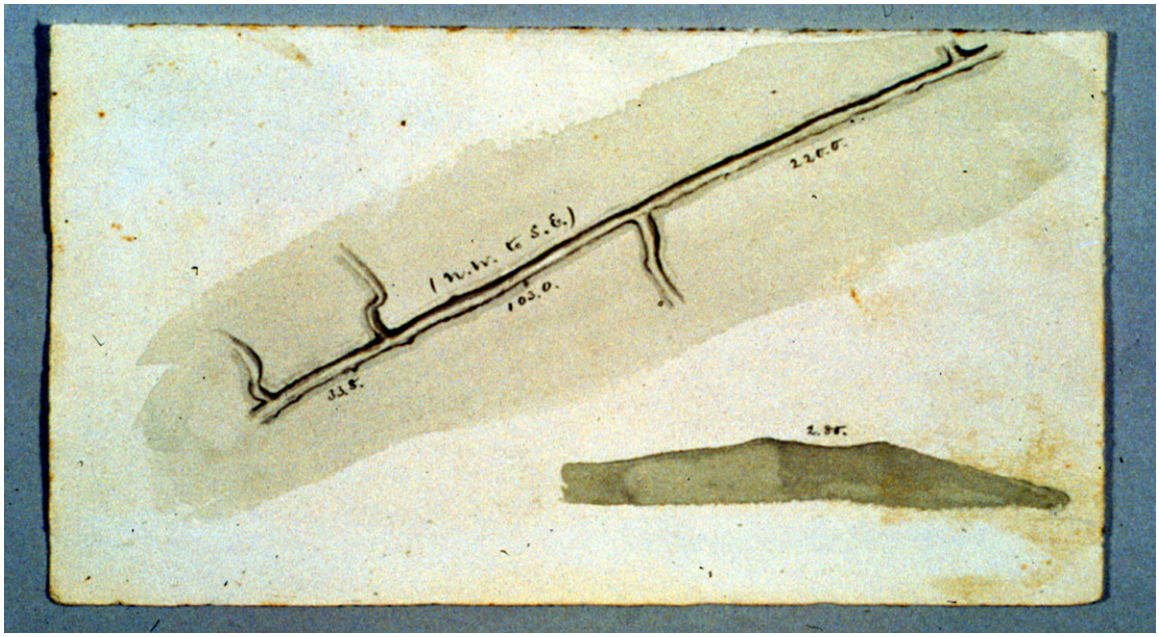


Figure 27. Plan and profile drawings of a canal segment with branching smaller canals found by Adolph Bandelier between Safford and Fort Thomas in the Safford Basin. From Folio #103 of the watercolor drawings by Adolph F. Bandelier in the Vatican Library (Burrus 1969:196).