

**NM WRRRI Student Research Grant Final Report
May 15, 2019**

1. Student Researcher: Christine Gilbertson
Faculty Advisor: Dr. John Montgomery

1. Project title: Historic and Ancient Ditch Irrigation Inform Current Systems: A Cross Cultural Comparison from Creekside Village of Tularosa, New Mexico.

2. Research Problem and Objectives: The research question for this study is, what canal profile shapes, sediments and systems' layout on the landscape can be identified in Creekside's prehistoric and historic irrigation ditches, and can these attributes be used to identify different periods of occupation in the Tularosa Canyon. If there is shown to be a link between culture and aspects of irrigation systems, this adds to our knowledge of how different cultures addressed issues of water scarcity and opens up the possibility of current populations benefiting and having a stake in solutions to water issues that derive from ancestral knowledge.

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4. *Methods.* Two trenches were excavated in identified prehistoric canals and two trenches were excavated in a historic canal ditch. A stratigraphic profile was drawn of each of the trench cross sections. Soil samples were then taken to Eastern New Mexico University geoarchaeological laboratory for analysis using sieves and hydrometer, and loss on ignition tests. Data was graphically presented (Sigma Plot v. 14.0) and analyzed with the use of a spreadsheet program (Excel). Layout of irrigation systems has made use of a Total Station and mapping.

5. *Results.* This study used a limited sample of four trenches bisecting three irrigation ditches. Landscape placement, morphology, and sediment data were collected in order to determine whether there is enough evidence to show cultural affiliation. Creekside's prehistoric canals are situated, for the most part, on the slopes below the village site. There is evidence of terraced fields being watered by a branching irrigation system that fed garden plots and fields using floodwater irrigation. From the alignment of irrigation systems, it appears that the prehistoric canals may have used a human-constructed reservoir as a water source. Historic irrigation systems run parallel to the Rio Tularosa and are situated in the floodplain. This system appears to have used the river as a water source.

Morphological differences between prehistoric and historic canals have often focused on the V- and U-shape characteristic, but at Creekside variation in size seems more diagnostic. Historic channels were often more than twice (sometimes closer to three times) as large as prehistoric channels. This may have relevance to water sources, the type of crops being grown, available farming technologies, the terrain being irrigated, or elevation on the slope. Sediment analysis shows that Creekside trench and canal sediments are primarily sandy loam in texture. Sand has a higher percentage in prehistoric sediments (4%), and silts (3%) and clays (1%) are a bit higher in frequency in historic sediments. Geotechnically historic sediments are less stable and more prone to erosion than prehistoric sediments. Geological assessment of Creekside sediments show differences between prehistoric and historic sediments are likely related to a difference in terrain occupied by the two systems but also a difference in sediment deposition. Hillslope location meant that prehistoric sediment deposition was colluvial, and that floodplain location meant that historic sediment deposition was alluvial.

Creekside sediments are, for the most part, sandy loam which is excellent for agricultural purposes (Strahler and Strahler 1973: 272-273). Layers next to canals in both prehistoric and historic systems have higher percentages of silt. Irrigation would transport silts onto these adjacent layers from over flow or ponding of water. Prehistoric canal channel sediments have more sand, and historic canal channels have more silt, clay, and gravel. This may be a post abandonment difference in terrain erosional infilling and possible evidence of a difference in water sources.

Prehistoric sediments show higher percentages of organics than historic sediments. Overgrazing and settler crop strategies may have contributed to the diminished levels of organics shown in historic sediments (Ashman and Puri 2002: 146-150). Carbonate levels are somewhat inversely related to organic levels, which may be a function of acids in organics dissolving carbonates. Carbonate levels might also be related to a changing stream microenvironment as this area was overgrazed and became more arid.

Occupation of the landscape by these two cultural groups represents two different choices as to how they situated themselves and their irrigation systems on the land. The choice of water sources significantly affected where fields and garden plots could be maintained. Some prehistoric crops would have done well on the Rio Tularosa floodplain, but additional hillslope garden sites were probably needed to maintain a growing population. With animals and farm technology at their disposal, historic settlers may have been more adept at retrofitting flood-eroded canals. Bottomland agriculture is what they preferred (Doolittle et al. 1993: 15-16), and hillslope irrigation systems would not have provided the extensive field agriculture needed to make a living in the Tularosa Canyon. These were choices representing not only different time periods, but also different cultures with their own solutions to how best to survive in the foothills of the Sacramento Mountains along the Rio Tularosa.

Conclusions Cultural affiliation of irrigation systems at Creekside may explain the differences in morphological canal profile dimension, elevation placement on the landscape, sedimentary deposition, levels of organics, and possible water sources.

Dimensional differences in canals are most pronounced in width and cross-sectional areas, show historic profiles larger than prehistoric profiles. Both prehistoric and historic canals were U-shaped or bowl like with prehistoric ditches showing some evidence of having a narrower parabolic shape. Differences in profile dimension are attributed to position on the landscape and digging technology, in particular the Fresno scraper in the case of historic canals, possible water sources, and engineering requirements.

Placement of irrigation systems is shown to be at higher elevations on hillside terrain for the prehistoric systems at Creekside than historic systems, which occupy river floodplain bottom land. Differences in this choice are cited as being possible water sources, crop versus garden production, engineering requirements of gravitational water systems, technology employed in terrain, and flooding hazards. Elevation placement necessarily affected the depositional sediments observed in Creekside's trench profiles. Prehistoric sediments are colluvial and historic are alluvial floodplain. Sediment differences are noted as prehistoric sediments having higher percentages of sand, silts, and gravels and historic sediments having the higher percentage of clays. Geotechnical analysis shows prehistoric sediments to be more stable and self-filtering, while geological analysis confirms that there is a wider diversity in prehistoric sediment grain size than historic sediments.

Organic percentages in prehistoric sediments are higher than in historic sediments. The difference in prehistoric levels in some layers is twice that of historic percentages of organics. Differences are attributed to the historic choice of single crops as opposed to diverse cultivars in garden plots, intensified production, water sources, overgrazing, and possible length of time for organics to accumulate. Finally, there is evidence proposed that different water sources may have been utilized by these two systems. Prehistoric systems may have accessed a reservoir, springs, basin runoff, or some combination of these as well as stream water. Historic systems appear to only access the Rio Tularosa. Differences are attributed to the engineering requirements of these two systems' placements on the landscapes, sediment differences in canals, and crop and garden water requirements.

Further Study. For confirmation of accurate dating on the irrigation systems at Creekside, it is noted that single-grain luminescence analysis (OSL) along with accelerator mass spectrometry (AMS) C^{14} has been used successfully (Huckleberry and Rittenour 2014; Neely and Lancaster 2019: 66). To fully understand the complete picture of irrigation systems, many more trenches will need to be excavated, and remote sensing may be a beneficial additional resource in this effort. Excavating the historic irrigation system on the south side of the Rio Tularosa would help confirm parallel systems on either side of the river. Cross trenching confirmation of the reservoir connection to prehistoric Canals 56 and 57 would help confirm this as a water source. Gradient and velocity calculations of prehistoric and historic canals would also be useful for helping to confirm water sources. Pollen and botanical analysis of canal sediments and fields would help determine the types of plants and crops being grown. Mapping all of the known Jornada sites in the area would be helpful for determining the extent of occupation in the basin and surrounding area. Investigating the Mescalero Apache Reservation's knowledge of and

connection to the Creekside site allows for Indigenous peoples' perspective and inclusion into the investigation.

References Cited

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6. The beneficiaries of this research are most immediately, The Jornada Research Institute of Tularosa, New Mexico and its efforts to inform citizens in the community. Since 2002, the Institute has focused on the history and archaeology of Tularosa Canyon encouraging students, local residents and interested scholars to participate in the archaeological, ethnographic historic, historic, and natural resources of the Chihuahua Desert. This study proposes to add to the growing body of archaeological evidence at Creekside Village and to heighten awareness of the significance of water resources in the Tularosa Canyon through access to a wider audience of both scholars and local residents. I think this project has also brought the importance of water issues to the attention of archaeology graduate students and undergraduates in the department through my prospectus presentation at ENMU. I have also mentored undergraduates and participated in developing a museum display on water in the campus archaeology museum.
7. To date the \$3755.00 NM WRRI and New Mexico State Legislature grant NMWRRI-SG-2018 monies have been spent. This has gone to soil experiment equipment, supplies, Munsell color sediment books, and GPS units that were useful additions to mapping the site and can be used in the future.

8. I have made two presentations on Creekside. One was my colloquium prospectus presentation and the second was my thesis presentation to the faculty and graduate students of ENMU's anthropology/archaeology department. I also presented a poster on Creekside to the NMWRRRI 63rd Annual New Mexico Water Conference Oct 17-18, 2018 in Las Cruces, NM. I will be giving a third speaking presentation of my findings at The Tularosa Basin Conference, in Tularosa, New Mexico on May 17, 2019.

9. This project is a part of my master's thesis at Eastern New Mexico University.

10. The faculty, students, and archaeologists that have assisted with this thesis are:
My Committee: Dr. John Montgomery, Dr. Heather Smith, Dr. Kathy Durand
Faculty: Dr. Katy Putsavage, Dr. Erick Stanley, Dr. Jim Constantopoulos
Students: ENMU Field School students 2017 at Creekside
Nathan Shelley
David Greenwald and Dr. Jim Neely, Jornada Research Institute

11. I received a first-place award in Anthropology at the ENMU Student Research and Creativity Conference for my poster on Creekside on April 3, 2019.

12. I am receiving my master's degree this Spring, 2019. My plans are to continue with my volunteer work in archaeology and anthropology as it relates to water both in New Mexico and the Southwest as well as in Canada.