Prehistoric Hanging Canals of the Safford Basin

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Some recent studies have investigated the scale and scope of a remarkable series of late classic prehistoric (est. 1350 CE) water management structures found in Arizona's upper Gila Valley. These canal systems are characterized by their being literally "hung" on the edges of steep sided, gently sloping mesas formed from remnant **Quaternary** age **bajadas**. The mesas today will appear characteristically rocky, sparsely vegetated, thinly soiled, and largely infertile.

At places, the hanging structures are placed as much as 60 meters above their surrounding drainage basins. It is quite clear that **the highest feasible points on mesas were carefully selected** for canal routes "on purpose". In several cases, direct drainage routes seem to have been clearly avoided.

Eight or more distinct hanging canal systems have been identified. Most of which trend from southwest to northeast. Eventually leading northward to the Gila River valley proper.

System lengths are estimated to total thirty kilometers or more. These systems seem to nearly totally exploit a number of adjacent **Mount Graham** fed perennial streams that include Jacobson, Marijilda, Rincon, Deadman, Frey, Spring, Ash, and Lefthand canyons. Whose present **stream flow rates** are typically in the fractional to low CFS ranges with seasonally higher peaks.

The systems appear clearly distinct and separate from other extensive but more conventional prehistoric area canals based upon fertile bottomlands and Gila River and tributary water sourcing.

Associated with the systems are well above-grade **aquaducts** of significant height and length. Along with apparent elaborate methods of purposeful switching of the water routes between major delivery drainages.

In sum, these systems appear to represent a major understanding and a careful exploitation of hydraulic fundamentals. Typical canal cross sections might be one meter wide by twelve centimeters deep.

Their use seems to be primarily associated with long distance water delivery to conventional northerly fields. Most mesas reveal little other ag activity.

Assisted somewhat by historic maintenance and rebuilds, **several reaches of the canals still flow to this day**. Other portions of most of the systems remain largely pristine. Although currently filled with fine grained and **loess-like** or sedimentary depositional sands.

Present ownership is typically **Arizona State Lands** and currently remains largely undeveloped or exploited. Although of often rather difficult access, **major canal portions are usually easily traced and clearly identifiable**. There are few access roads and fewer linking trails. Especially on the mesa tops.

The canals often create the illusion of "water flowing uphill" in that **the chosen mesa top slope is usually somewhat steeper than the rate of fall of the canal system itself**…

After reaching a mesa top through a long, gentle, and an apparently carefully calculated optimal grade, and then continuing as far as seems possible along the characteristically flat but gently sloped mesa top, the canal systems will typically "fall off" the far end of their mesa in steep but apparently highly controlled and nondestructive cascades.

Some eventually ending up in areas characterized by habitation sites and ag structures such as **grids**, mulch rings, field houses, linear features, or trincheras.

Most systems seem to have a "breakaway" initial diversion point. At which major flood damage would appear to be easily and quickly repaired without significantly impacting the main structural portions of the canals themselves.

Some Examples

From South to North, some of the systems can be arbitrarily named **Ledford**, **Marijilda**, **Rincon**, **Deadman**, **Robinson**, **Allen**, **Jernigan**, and **Lefthand**.

These might be examined in more depth…

Ledford

The Ledford system starts at the John's Dam and climbs "up" onto the remnant bajada mesa just north of Metate Peak. It then passes Goat Tank, Ledford Tank, and similar structures still apparently in use for modern stock raising. Several of the switching arrangements can be noted that provide steep cascading descents on south to various valley floor tanks.

There does appear to be considerable modern use of this resource. The final and easternmost "dropoff" point is quite obvious owing to rather extensive parasitic vegetation. The Ledford canal system appears to be the least well explored and interpreted of the hanging canals and remains difficult of access.

Some speculation exists as to whether prehistoric hydraulic features were also exploited further to the south, based on Spring Canyon, Veech Canyon, and in Stockton Wash itself. While the terrain seems clearly advantageous, no obvious features are known to have been observed. Except for a few short sections of deep vee ditches, larger modern diversion channels, and canals that seem to be historic or modern. The area remains of considerable interest.

Marijilda Canyon

Earlier and upcanyon portions of the Marijilda system have long been rebuilt by historic pioneers. These concrete lined ditches now deliver water from reliable sources in Marijilda Canyon to seasonal Lebanon irrigation storage reservoirs. The rebuilds are comparable in size and depth to a modern final delivery cotton field ditch. And of a classic deep vee shape. Which is quite distinct from the prehistoric originals elsewhere.

The rebuilt system route deviates from one branch of the prehistoric just at the watershed crossover between the Marijilda and Rincon drainages. At that point, the eastern reach goes over a significantly above grade aqueduct. One that is roughly 1.5 meters high and as much as 100 meters long.

The aquaduct apparently provides a shorter and more direct route. Some minor elevated or built-up transitions appear where useful on the other canals.

The aqueduct exactly follows a watershed ridge and consists of solid fill. There is no apparent provision or need for cross flow under that canal at this point.

The eastern reach then goes into its hanging canal mode, sloping "up" onto its mesa and reaching the top a kilometer or so later. This portion is dry and largely full of fine dirt particles.

Largely making up what today is a nearly ideal hiking trail. Cross sections can be evaluated at numerous points due to some erosion cut throughs. These usually suggest a fractional meter width and a ten centimeter water channel depth.

Occasional brush directly along the canal route suggests a minimum of fifty or more years of disuse.

In many places, the mesa slope forms the upcanyon wall, while a constructed rock barrier takes care of the downcanyon side. Construction consistently shows an extreme economy of energy, with the fewest possible rocks and the least amount of dirt moved in a minimalist manner.

There seems to be no obvious evidence of use of draft animals or iron scrapers or wheelbarrows, or anything of that nature.

Nonetheless, countless thousands of man hours over long time intervals appear to have been involved in engineering and building these highly unique systems.

Presumably, water was hand carried or otherwise diverted to mesa top needs.

After running as far as practical along the mesa top, the water system steeply drops off a cascade system. And eventually returns to modern storage reservoirs in the valley floor. Numerous valley branches then continue to various ag sites further downstream.

Rincon Canyon Area

The Rincon Canyon area is an extension upon the Marijilda system.

At its northern extreme, it climbs back "up" onto a mesa and in two large sweeping loops, then **doubles back** upon itself. Making a "U" turn and then heading up canyon **in a reverse direction**.

The canal here is somewhat wider than normal, with its upmesa wall set by the gently sloping bajada, and a single rock wall usually retaining water on the downmesa end.

An earlier habitation site is nearby, and numerous ag structures are present just off canyon in the form of grids, linear features, field houses, and mulch rings.

The canal in this region is quite distinct in its **web based satellite photography**. Eventually the canal goes once again into a shorter and lower mesa edge hanging mode, this time returning south to the valley floor while heading off the bajada.

Deadman Mesa

The initial portion of the Deadman Mesa hanging canal has only been postulated to date, having been seemingly replaced by a modern pipeline. Nonetheless, the route follows the characteristic pattern of being hung on a steep wall. In this case, a canyon wall is used rather than a mesa edge.

After a one kilometer "climb", the optimally graded system reaches a modern pond. At that point, historic water was diverted down a side canyon through transite pipes to become part of the presently unused Frey Mesa water system.

Just beyond obviously modern headgates, vee weirs, and concrete structures, the canal continues down the Deadman Mesa remnant bajada.

The presumed prehistoric continuance is absolutely devoid of modern materials and techniques. And consists primarily of two rows of guide rocks half a meter to a meter apart. The water route is typically along the **highest** feasible portion of the mesa. This canal reach remains fully functional and often flows to this day.

Following a two kilometer run, the canal traverses an extremely narrow portion of Deadman Mesa. There is an apparent three way water switch at this point whose appearance is rather obvious on **satellite imagry** of the area. Owing to parasitic vegetation along the water routes.

Switching water routes seems to consist simply of moving rocks around. No headgates or modern diversion structures are involved.

The northernmost switching routes water down a steep canyon into Porter Springs tank. From there, the water flow apparently continued to known and rather dense prehistoric habitation and ag sites.

These sites are also characterized by a large number of small peripheral check dams. Some of which have downstream aprons, and others of which a full double width splash containment. Sizes appear consistent with plant nurseries.

Significantly, **prehistoric occupation seems centered upon the probable water route**. Locations to the north and south are largely and conspicuously absent of prehistoric development.

There are fascinating but unverified and unproven hints of canal extensions that go beyond the habitation areas. Other ag features in the area include grids, linear features, and mulch rings.

The center Deadman switching once routed water to Lower Deadman Tank and is largely unused and dry today. No obvious evidence of prehistoric occupation has been found or verified in this immediate area to date.

The southern Deadman switching currently routes water to Upper Deadman Tank. Significant prehistoric cultural resources are present in the Rincon Canyon area below this tank.

Robinson Ditch

This ag structure was named for a historic Mormon pioneer who apparently restored, maintained, and improved the canal system.

Arguments that the structure was in fact initially prehistoric include (A) Its astonishing similarities to known prehistory in adjacent canyons; (B) Mesa top bajada routing more consistent with prehistoric needs and goals; (C) A total absence of concrete, iron, headgates, or more modern techniques; (D) Much lower pioneer historic populations; and (E) The size, depth, rock relocations, and energy levels required appear totally consistent with stone age technology.

The Robinson Ditch starts off with an apparent three-way routing switch in Frey Canyon. At this point, water can be routed "up" the ditch onto a bajada remnant mesa, down past Sheep Tank into Spring Canyon, or follow its traditional route down Frey Canyon.

After "rising" to the mesa top and continuing along its narrower portions, the canal rather steeply descends to end up very near the Spring Canyon route after a unique run of nearly five kilometers.

Modern Frey Dam overflow usually routes through Spring Canyon. Most of the Robinson Ditch is presently full of loess or water borne sediments and in need of restoration. Large parasitic trees adjacent to the hanging canal portion appear to be long dead…

Allen Canal

The Allen Canal is located largely south of Allen Reservoir and west of **Thatcher International Airport**. Known portions are as much as five kilometers long.

Much of the canal lies on the top of a gently sloping mesa. The canal is typically the usual one meter wide by ten or twelve centimeters deep. The normal paired rock borders are present along each edge. Long portions of the canal can now be easily traced and remain in largely pristine condition. Except for an apparent windblown or loess fill.

The canal apparently sources from Spring Canyon. This water resource is presently minor and intermittent. The "hanging" portion is somewhat vague in that it is just less steep than the canyon bottom. But hangs nonetheless. A **CCC** "steal the plans" adaption rebuild of Hawk Hollow Tank seems to straddle the prehistoric canal.

A rather dramatic dropoff appears present near the north end of the mesa. While this dropoff is within two kilometers of the Jernigan site, It is not yet clear which prehistoric fields got served in what manner. While the intermediate terrain is slope favorable, there are three stream crossings and possible sheet flooding.

Several cuts in the canal exceed half a meter in depth. Large barrel cacti are present mid stream in at least three places, strongly suggesting long disuse.

Jernigan Site Canal

The Jernigan Site is well documented and registered as **CC:1:38 (ASM)**. A short half kilometer hanging canal is present that links two field areas after crossing along the edge of a mesa.

While clearly "hanging", the maximum height above the fields is typically only eight meters or so. The canal "hangs" for nearly its entire length and never actually reaches the mesa top. This site is near the abandoned Central landfill.

This canal appears more of a "local" to deliver water between two fields, rather than an "express" to transport water long distances. Its relationship to the Allen Canal is not yet clear, although it approaches within two kilometers. There are two other less tenable but possible water sources involving Ash Creek or else a hypothetical route over the Mud Springs bajada.

Both ends of the Jernigan canal are clearly defined. The lower far western end terminates in a "French Drain" type of rock cobble cascade. This canal seems moderately wider and deeper than the other hanging examples. In one place, a cut over one meter deep clearly represented significant labor and planning. Preservation is surprisingly complete except for a few minor and short washouts. As with reaches of the Rincon Canal, routing is over a distinct "U" shape that runs contrary to the local terrain.

The Lefthand Canyon Region

The **Goat Hill / Lefthand / Spear Ranch** area is well known archaeologically and has been studied in depth by **Neely** and others. A number of canals are associated with fields and plant nurseries in the area. These canals seem consistent in design and size and style with those in adjacent canyons. As with the Jernigan site, the canals appear to be localized for immediate delivery rather than intended for long distance transport. No significant hanging portions or long delivery reaches are currently known.

There are a number of other largely unexplored possibilities for hanging canals in the immediate area. Ash Creek in particular has a high historic flow rate but has no obvious recently explored sites or artifacts. Possibly the Cluff Ranch facility of **Arizona Game and Fish** has covered or obliterated prehistoric uses.

The Mud Springs bajada is among the largest in the Grahams and could easily divert Ash Creek waters easterly. Slopes appear favorable. Its use and exploitation would seem conspicuously absent. Shingle Mill Canyon is also a wet stream with no obvious prehistoric canals present. It is also the site of a **historic tramway**.

Further afield possibilities might include steep sided mesas near the Stockton Wash and Marijilda Canyon juncture with known sites and artifacts. And some intermittent wet stream canyons further to the west such as Nuttall, Carter, or North Taylor canyons.

Siting Considerations

A reasonable question might be "**Why the apparent prehistoric manic obsession with hanging canals purposely built on the edges of steep sided mesas?**"

Engineering can be defined as **a sense of the fitness of things**. The following arguments, if accurate and relevant, suggest that "hung" canals could be an superbly optimal and engineeringly brilliant solution to reliable long distance water transport with minimal construction energy…

(1) On a hanging canal, slope is largely independent of terrain. This infers that optimal flow rates can be set over long distances without much in the way of local topographic restrictions.

(2) On a hanging canal, cuts and fills can be minimized. Simply by following the contours or crossing them at an intentionally predetermined flow delivery rate.

(3) On a hanging canal, one canal wall is largely "free" The rising portion of the mesa can form most, if not all, of the canal's inside wall. Which implies that significantly less effort, less construction, and less energy might end up being needed.

(4) On a hanging canal, long term catastrophic flood damage can be minimal. Any washouts are likely to be both short and easily repaired. As verified by most portions of most hanging canals surviving to this day.

(5) Mesa Top Slopes are usually gentle and nearly optimal. They also often range for long distances at near constant slope. Thus maximizing delivery for minimum construction effort. The mesa tops often include largely impermeable rocky soils which might minimize delivery losses.

(6) Mesa Top usage conflicts are less likely. Fields, grids, mulch rings, and habitation sites are more favorably located elsewhere.

Current work

As with most Southwestern Archaeology, any funding is sorely limited. As is the manpower needed for further study and interpretation. **Dr. James Neely**, professor emeritus at the **University of Texas** at Austin, is a long term researcher here. One of his many earlier papers appears **here**, and a second **here**. Several further publications are in process. Studies are ongoing. Additional champions and more support are urgently needed.

A crucial present issue is **an accurate mapping of the entire area to acceptable resolutions** far better than what is readily web available. It is possible that one or more **Draganfly** Drones might be suitable for this task.

A web published and open sourced detailed master index of all prehistoric ag features in the area would also seem to be highly useful. There are serious problems, outrageous costs, poor maintenance, and sharply limited availability involving the existing directory systems. The web has fully guaranteed that their attempts at extreme secrecy simply no longer work and are clearly no longer applicable. It is also only a matter of time for useful web based general aerial photography to make the needed 10:1 further resolution increase required for nothing to remain either hidden or hideable.

Needing addressing are successful methods of precisely dating and isolating differences between prehistoric, early pioneer, **CCC** (Civilian Conservation Core) and modern constructs.

Perhaps CSI forensic techniques may emerge of use here. For instance, "would CCC fingerprints survive on the undersides of rocks?" Resolution of that question should be a sure fire winner for a Master's Thesis in any of a dozen of fields.

Other obvious questions involve the instruments used to guarantee optimal canal slopes. As pure speculation, perhaps some "floating boat" scheme might have been used. Or some variation of a right angle sight being added to a plum bob system. No known examples appear to have survived.

Many of these hanging canals appear endangered. Several recent water tank constructions have run roughshod over the Rincon area hanging canals. They also have totally trashed numerous grids and mulch rings. Without even the most cursory questioning that clearly could have dramatically eased their impact at minimal costs.

Extensive **ADOT** studies are also underway that would realign US 70 well south of its existing urban route. **This might clearly endanger virtually all of the hanging canals!** Present studies do not so much as even mention prehistoric cultural considerations. With the apparent presumption that they do not exist.

Today, the Gila Valley is well noted for several examples of outstanding high technology. Most obviously involving **telescopes** , cotton drip irrigation, and new significantly "greener" energy efficient **mining** techniques.

When taken within the context of available stone age tools, techniques, and energetics, these prehistoric grids and hanging canals clearly illustrate many examples of comparably superb and exceptionally world class engineering.