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### Of Ruptures and Raptures: Locating Ideology with LiDAR Imagery

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## OF RUPTURES AND RAPTURES: LOCATING IDEOLOGY WITH LIDAR IMAGERY

Archaeological praxis necessarily requires at least one object (a piece of technology or something that functions as an object) to articulate and explain the past. Following Lewis Binford's dicta (1962), Historical Archaeologist Mark P. Leone investigated technologies which facilitated Mormon settlement, survival, and adaptation in the American West in the 19th and early 20th centuries: fences, the plat of the ideal City of Zion, Mormon temple architecture, plan, and program, and dams (1973, 1974, 1977, 1978, 1979). In 2010, Leone critically revisited his life-work including an examination of his original research on Mormon historical ecological ritual of 19th and early 20th century Mormon settlements along the Little Colorado River in Arizona. In the interim, Leone read Philosopher Slavoj Žižek's *The Sublime Object of Ideology* (2008). Leone's discussion of Žižek is almost a footnote and deserves wider examination. Žižek's definition and rubric have a potential to answer a pertinent research question that emerges out of Leone's life-work: What is or was the object of Mormon ideological desire? Žižek finds there are three types of ideological objects: voids (or absences); large, unattractive objects left over or resultant from the past of which we are all aware; and a circulating object, one that is known to have existed and requires an ideological structure to understand it, e.g. Capitalism or Mormonism. A critical examination reveals that none of the technologies or objects Leone previously identified meets Žižek's criteria completely. Is there another technological object that does satisfy? Leone mentioned irrigation features associated with dams as important factors for community survival, but did not publish any research on irrigation specifically beyond a few mentions. Suffice it to say, the ultimate ideological desire of Mormonism in the 19th and early 20th centuries, the creation of New Zion in the arid American West, was realizable only through irrigation practices; New Zion was and is reified in and by a Mormon Irrigation Pattern (MIP) evident in the archaeological record in Grand Teton National Park. This articulation and integration is only really visible with LiDAR imagery in GIS at a landscape scale using landscape archaeology landscape analysis. To resolve the research problem, the MIP was searched for in publicly available aerial imagery of Leone's original study area along the Little Colorado River in Arizona. In each of the communities at least one relict field containing the MIP was located. Thus a perversion of logic reveals that Leone did identify irrigation's importance but did not consider it as an ideal technological object perhaps because, unlike fences, settlements, temples, and dams, the whole object could not be seen.

## **Introduction**

Archaeological praxis necessarily requires at least one object (an artifact; a piece of technology or something that functions as an object) to articulate and explain ideologies from the past. The problem is that the object of ideological desire is abstract and difficult to locate in the archaeological record in reified form. Historical Archaeologist Mark P. Leone attempted to locate such an object several times while conducting archaeological investigations into historical Mormonism, Mormon historical ecology, and technologies employed by Mormons in the arid American West. It is posited here that the object of Mormon ideological desire in the archaeological record within capitalism can be identified and located if certain assumptions and definitions are accepted from philosopher Slavoj Žižek and if one deconstructs a myth. There is a presupposition that if one deconstructs a myth, one stands an increased chance of discovering evidence of the truth behind it. Historical landscape archaeology landscape analysis of LiDAR imagery in GIS facilitated the interpretation of a local legend (a myth), archival maps, records, and Mormon land-use patterns in two historic landscapes—Grosvont, Wyoming/Mormon Row Historic District (Figure 1) and the Little Colorado River basin in Arizona (Figure 12)—leading to the identification and location of such an object.

## **Research Problem**

Leone by way of Lewis Binford has four principle goals for archaeology: to add a formal and scientific approach to the profession, to increase the temporal depth of the field, and to study technology within the framework of culture while arresting the perpetuation of false information or myth. Putting the past in order and discovering if there is a positivist cause and effect relationship that changed over time evident within artifacts and objects or pieces of technology

and the role technology has had in shaping ideologies is a noble pursuit that too often results in mute data (Leone 1978).

In *Archaeology as the Science of Technology: Mormon Town Plans and Fences* (1973, 1978), Leone hypothesized the ideal technology through its social and ideological uses and economic contexts, and

... despite overwhelming changes in Mormon culture, there is an unchanged relationship between a key set of artifacts and a set of religious symbols. Fences still keep the same things in and keep the same things out. ... The fences enable them to redeem the earth and manipulate and act out the categories used to deal with the world. Despite changes in form, there have been few changes in function. ... Nothing has been said here about town plans and fences that is necessarily true outside of Mormonism. A comparative generalizing study has not been done. [Leone 1978:199]

This is interpreted to mean that fences and the ideal Plat of the City of Zion are truly unique to Mormons and Mormon ideology. The latter part of that technologically determinative supposition can be accepted; no other religious or faith-based community has attempted to create a City of Zion in the same manner as the Mormons. This leaves open the question: Are fences the ideal expression of technology employed by Mormons in the past and present?

In 2010, Historical Archaeologist Mark P. Leone critically revisited his life-work including an examination of his original research on Mormon historical ecological ritual. In the interim, Leone read Slavoj Žižek's *The Sublime Object of Ideology* (2008). Leone's discussion of Žižek is almost a footnote and deserves wider examination. Žižek's definition and rubric have a potential to answer a pertinent research question that emerges out of Leone's life-work: What is or was the ideological desire of Mormonism?

According to Leone by way of Louis Althusser (1971),

Ideology is a set of masks of illusions, which disguise the operations of daily, exploitative life in capitalism that serve to reproduce society intact. Such masking is achieved by using notions, or assumption, that appear to be the taken-for-granted, or givens, of our daily lives. Such obviousnesses act through material things, like spaces, measures of time, and manifestations of individual personhood. The two key points are (1) that the givens of daily life (2) act through things. [2010:65]

Žižek also finds,

The dialectical approach is usually perceived as trying to locate the phenomenon-to-be-analysed in the totality to which it belongs, to bring to light the wealth of its links to other things, and thus to break the spell of fetishizing abstraction: from a dialectical perspective, one should see not just the thing in front of oneself, but this thing as it is embedded in all the wealth of its concrete historical context. ... The problem is thus not that of how to grasp the multiplicity of determinations, but rather of how to *abstract* from them, how to constrain our gaze and teach it to grasp only the notional determination. [2008:x-xi; emphasis in original]

Leone finds that,

Žižek's objects achieve two things. First, they reveal an ideological—that is fantasy—quest for the perfect, the ideal, the stable; and then, second, the object helps find the ideal in some other time. There is nothing new there, although he is doing better than Althusser did with ideology. This makes ideology a wish, and a deliciously anticipated one, he says. Then, Žižek notices that the object is real. It has to be or would not be convincing. [2010:209]

Žižek outlines three types of ideological objects: voids (deficiencies or absences); large, unattractive objects left over or resultant from the past of which we are all aware; and an index or circulating object, one that is known to exist or have existed and requires an ideological structure to understand it, e.g. capitalism (*supra*). Žižek's rubric has a potential to answer a pertinent research problem that emerges out of a re-examination of Leone's life-work: Can the object of Mormon ideological desire be identified and located in the archaeological record within capitalism?

### **Purpose**

The purpose of this paper in historical landscape archaeology is to re-examine Mark P. Leone's oeuvre, argument, and method for identifying the object of Mormon ideological desire in the archaeological record within capitalism starting with technological objects Leone previously identified that have potential to answer research questions central to a postprocessual archaeological paradigm that considers technology and culture reflexively. The first task is to test these objects against Žižek's rubric and definition to discover if there is a match; a fitness test. If there is not a perfect match, the variance or gap that is revealed may elicit clues to the identification of the true object of Mormon ideological desire in the archaeological record within capitalism or it may return to ideology itself. Technological objects Leone previously identified can be tested if certain assumptions and philosophical reasoning are accepted. What are the assumptions?

Leone followed a path blazed by Lewis Binford in processual archaeology, Robin George Collingwood in philosophy, history, and archaeology, and anthropologist Roy Rappaport's inquiry into ritual and ecology. After a lifetime investigating historical Mormonism from a processual archaeological perspective, in 2010 Leone re-contextualizes ideology within

capitalism because in a postprocessual paradigm "...ideology's actual history can be discovered in its tie to material variables, and because those variables are the subject matter of historical archaeology, ... there exists the possibility for an important extension of materialist archaeology into historical archaeology" (2010:55). Indeed, archaeologists and historians can read artifacts (objects; pieces of technology) in reverse if certain assumptions are accepted (Binford 1962, 1982). One assumption is that artifacts and pieces of technology are, in some sense, determined in form and distribution by other systems including the social and ideological. Leone promotes the idea that if one can gain access to the processes, then one can more accurately interpret the past (Leone 1972, 1973, 1974, 1977, 1978, 1979, 1984, 2010). More,

We might consider asking how the system of artifacts, the primary and undestroyed system of technology, caused or determined the social and ideological systems to take shape. What is there about the system of technology that either facilitated or determined parts of the social or belief systems? [Leone 1978:194]

Given the parameters outlined above, Leone argued that "[a]rchaeology could profitably study both the manipulation of material culture (why and how we do what we do with technology) and the manipulating that technology does on the rest of culture" (1978:195).

One of the newest theoretical approaches in landscape archaeology in the Americas is materializations of worldviews. Worldviews incorporate cosmology, genesis stories, theology, spirituality, and celestial events among other cultural aspects, features, and functions of a social group. Hence, "[e]xtending landscape to the celestial sphere ... afford[s] new insights into the timing and significance of practices ... and their meanings in terms of particular belief systems" (Patterson 2008:79), an endeavor of Leone in Mormon Arizona that returned trenchant insight into Mormon adaptation strategies orchestrated by local High Councils (1979).

Professional Geographer, Environmental Designer, and Professor Emeritus of History, Geography, and Religious Studies Richard V. Francaviglia begins, *The Mapmakers of New Zion: A Cartographic History of Mormonism*, with a Sausseurian parsing of the paradox of maps as symbol and metaphor. He posits that if fiction, fantasy, and film ‘places’ can be cognitively mapped, then, as Thomas A. Tweed suggested in 2006, “religions themselves are maps” (2015:3). This suggests that ideology can be mapped, perhaps in GIS as made visible by LiDAR imagery, an idea shared in theory by Leone (Harmon et al. 2006).

### **Leone’s Research Problem and Potential Objects Re-contextualized and Re-examined**

When Leone undertook a personal investigation into what bothered him about historical re-enactments and displays of class, gender, and perceived race at Colonial Williamsburg, he discovered that it was the perpetuation of national myth that was most unsettling, especially when there was ample archaeological evidence available to tell the truth and set the archaeological record straight. Leone wrestled with this issue in structuralist analysis and even psychoanalytical evaluation before realizing that the “conclusion could not be the conclusion; it had to remain a hypothesis” (2010:20).

In 1978, Leone concluded that “nothing has been said here about town plans and fences that is necessarily true outside of Mormonism” (199). This is interpreted to mean that fences and the ideal Plat of the City of Zion are truly unique to Mormons and Mormon ideology. The latter part of that supposition can be accepted; no other religious or faith-based community has attempted to create New Zion in the same manner as the Mormons. Perhaps it is time to test hypotheses related to Leone’s central research problem. Two hypotheses emerge from Leone’s line of reasoning in 2010 if Žižek’s rubric is included:



H<sub>1</sub> There is a real, material, mediating object of Mormon ideological desire that is a void or deficiency, a large and unattractive leftover from the past about which all are aware, and something that is identifiable in the archaeological record which circulates within capitalism.

Alternatively:

H<sub>2</sub> The sublime object of Mormon ideological desire is not identifiable or locatable in reified form in the archaeological record; it is an immaterial, abstract notion and byproduct of human consciousness; a deliciously anticipated wish designed to fill a void or gap in the daily lives of righteous Mormon believers.

The sublime object of Mormon ideology, the '*object petit a*,' to use Žižek's lexicon, in the 19th and early 20th centuries was the creation of New Zion, the abode of Jesus Christ and the righteous and endowed Mormon Chosen Ones who will reside in the City of God on Earth during the Future Tribulation or The Rapture. Can we in the present identify and locate New Zion in the archaeological record? Given Žižek's concept of a sublime object of ideological desire, how, then, does one recognize the real object of ideological desire? Fences, the Plat of the City of Zion, Mormon temple architecture, plan, and program, and dam re\construction each facilitated the desired creation of New Zion and each will be re-examined to determine if they satisfy the criteria set forth above. Perhaps a combination of two or more technologies will completely satisfy Leone and Žižek's criteria for *the* object of Mormon ideological desire.

While fences served a particular function in Mormon society, it is not clear that fences determined Mormon society if the City of Zion was never fully actualized (Francaviglia 2015). There appears to be a disconnect or a deficiency. More, fence technology compartmentalizes space while being permeable; a general type of deficiency. Despite their skeletal construction,

materials, and techniques, fences keep certain things in and certain things out (Leone 1978:199). In this regard they appear to satisfy part of Žižek's criteria. The compartmentalization of farm task spaces may not be endemic to the Mormons however; any religious, ethnic, or cultural affiliation could have engaged and many did engage in the compartmentalization of task and living spaces. Any homestead or working farm in America could have been or was divided into use or task areas such as corrals, sheds, coops, and garden spaces using fence technology.

Mormon fences on the frontier were constructed out of local raw materials. A frontier fence can disappear in a moment; it can be reduced to ash in a wildfire or obliterated by a flood. An entire system of fencelines that once demarcated a Mormon settlement could be absent due to various natural factors. Absent features are difficult to locate archaeologically. Material evidence, descriptions, empirical measurements, and aspects of integrity are needed in order to formally assess, record, and make any evaluations of significance for a cultural resource.

Mormon fences are not necessarily large, unattractive leftovers that everyone is aware of; not everyone can distinguish a Mormon fence from a non-Mormon fence. By virtue of their role in the compartmentalization of task spaces within property boundaries, fences participated in some capacity within capitalism. Fences facilitated the cultivation or ranching of discrete areas that produced commodities. In this context, fences participated in capitalism in an important way. Fence technology minimally qualifies as a circulating object that functioned in the daily life of Mormon yeoman farmers and frontier settlers while hiding within capitalism. Fence technology appears to mask its real identity when placed within the context of the ideal City of Zion where they serve a sanctified role and purpose, yet without material evidence, fences are more void than they are substance, therefore they do not qualify as the object of Mormon ideological desire in the archaeological record within capitalism.

Leone was only partially successful in singling out the ideal Plat of the City of Zion because the City of Zion, as it was originally envisioned, was never fully actualized (Francaviglia 2015)—a type of void or deficiency within Mormonism in general (*sensu* Žižek 2008). Because the ideal City of Zion was never fully actualized, it is not an unattractive material leftover, though it may persist in the minds of the Mormon faithful. The City of Zion does not materially exist yet it may exist symbolically and ideologically where it circulates conceptually within capitalism. Thus the ideal City of Zion is closer to Slavoj Žižek’s concept of the ‘*object petit a*,’ something that is a byproduct of human consciousness and needed to fill a void. The ‘*object petit a*’ is something sometimes best left in ignorance and not confronted in reality otherwise the lattice of illusions might crumble and fall. If this is the case, what remains is a desire to desire something beyond the here and now, a *jouissance*, and that keeps Mormon subjects engaged in a deliciously anticipated wish (*sensu* Žižek 2008) in salvation history. Mormonism holds that, “life has neither beginning nor end but is a continuous existence which always was and ever will be ... which each Mormon has the ability and right to know and interpret” (Leone 1979:9). Ideology attaches itself to the essence of *jouissance* and is always an excess beyond the lived experience of faith, labor, and suffering in the pursuit of ideological desire.

*Jouissance* is peculiar. *Jouissance* means enjoyment, but it has a shadow side. Life should contain joy; *jouissance* entices and entrains humans to seek good in the here and now as well as the future. There is, however, a threshold beyond which the pleasure of the pursuit of happiness or the good becomes suffering. This results, paradoxically, in a pleasure in pain and suffering. Not only is there a threshold that reveals itself to us as a point after which there is a diminished return on the original investment in pleasure, there is also a satisfaction in achieving

a level of suffering beyond the normal tolerance or threshold; a badge of honor of sorts. Those Mormon pioneers who endured several and serious trials, travails, and tribulations on the wagon routes to the Great Basin bore and continue to bare testament to the faith and belief in a better world to come. In this articulation, labor or life-work (righteousness) is likened as God's-work and permits a subject, a person, a Mormon Saint, to experience a pleasure from the labor required to redeem the earth in advance of Jesus Christ's return while also experiencing suffering when natural disasters occur, e.g. the Kelly Flood of May 18, 1927. Natural disasters are tolerated when a religious (ideological) reason for it is accepted as the cause. There is also suffering due in part to an excess zeal and desire to create a Utopia while there exists the potential impossibility of ever realizing it, e.g. the City of Zion. Thus the moment a person, a subject, realizes that his or her existence and *jouissance* is contained and held beneath a mask of ideology a momentary release from needless suffering can begin. In other words, ideology is a mask, a fantastical Other that structures and directs social realities both internal and external to empirical experiences of the subject much like social culture. In this arrangement the sublime object of ideology is phenomenal and real; it is a fantasy wish and a reality that is simultaneously mediated through joy and suffering. This rather simple (yet psychologically complex) utility is one way in which ideology functions in the daily lives of subjects. Because an ideology, a system of beliefs or Žižek's "The *Big Other*," an immaterial structure or collection of social conventions, codes, norms, laws, et cetera, like Mormonism is believed by its followers to be true, i.e. Mormonism exists simultaneously inside and outside of individual subjects; it serves to perpetuate Mormon society. Much the same can be said about Capitalism and its adherents who simultaneously experience joy and suffering and structure society around a belief in it.

Leone tried again to locate the object of Mormon ideological desire in 1977 (before it was a concept *sensu* Žižek 2008) as Mormon temple architecture, plan, and program, and again was only partially successful (2010). Temples are technically void spaces inside. Some are rather large, e.g. the Salt Lake Temple or the Washington DC Temple, but they are not exactly unattractive leftovers from the past. A Mormon temple is a material object yet few are archaeological, e.g. the Nauvoo Temple. Some people may not like or appreciate the architectural elements or choices made by the architects, but that does not disqualify them as ideological objects. If anything, the iconography of Mormon temples makes them more appreciable as ideological objects. Mormon temples do not circulate in capitalism per se. Whereas Mormon temples required capital and labor to construct and tithed capital was collected and centralized by the temple, they are not the object because the endowment ceremony—an ordinance designed to prepare the most righteous Mormons to become kings, queens, priests, and priestesses in the afterlife—is not open to the public. In other words, only *inter item* Mormon Saints are permitted to experience the interior architectural program of a Mormon temple as it relates to the endowment ritual. Mormon temples, therefore, are not an object about which all are aware. Perhaps the object of Mormon ideological desire within capitalism Leone seeks is external to the church, mundane, and “of the earth.” Dams are literally “of the earth” and Leone investigated their cyclical construction, destruction due to flood, and eventual reconstruction. This process can be symbolized by a hash line and written as re\construction.

Leone investigated historical Mormon dam re\construction on the Little Colorado River valley of Arizona in the late 19th century in a quest to discover the relationships between ideology and technology by interrogating Mormon High Councils, local authority hierarchies,

and calendrical ritual (1974, 1977, 1979; Figure 13). Dams initially appear to satisfy the criteria for an object of ideological desire, yet they fail at an elementary level.

Dams are not a void in the traditional sense of the word. A dam is a physical mass and volume. Dams create or may result in the formation of a void space if there is no water behind them, though rarely are dams not holding water. In this sense they may be regarded as a deficiency. Dams may be large and unattractive leftovers from the past about which we are all aware as in the case of the most charismatic dams on the Colorado or Columbia rivers. In other places, dams may be far from public view and surrounded by barriers to protect water supplies from tampering or contamination. Many reservoirs are located several miles from the users, thus it cannot be said that dams are an object that all are aware of. Furthermore, dams by definition do not circulate. Dams impound water that has a future value and a price to consumers and in this sense may be regarded as circulating within capitalism. Hydroelectric dams participate in capitalism in a very real way; many in the West were built by the US Bureau of Reclamation, participated in historic war efforts, have powered and continue to power large metropolitan areas, and have generated and continue to generate millions of dollars annually. Thus hydroelectric dams very nearly completely satisfy Leone's and Žižek's criteria, yet no hydroelectric dams were built by the Mormon settlers of the Little Colorado River in Arizona. Whereas Mormon historical ritual responses to re\construction was unique and special to the Mormons of the Little Colorado River valley in the 19th and early 20th centuries (Leone 1979), an historical ecological response is not an object. A response very nearly functions like an object but has no material substance nor was the practice ubiquitous, i.e. not all historic Mormon settlements built dams. There are or were no manmade dams at Mormon Row for example.

### **Landscape Archaeology Landscape Analysis**

Landscape archaeology seeks to understand patterns and their connections to “human behavior with particular places and times” (Anscheutz et al. 2001:157), an idea that has roots in the 1920s and Emile Durkheim’s sociology (Hirsch 1995). Henry Chapman loosely defines landscape archaeology as “an amalgamation” of three principle branches: landscape analysis, past reconstruction(s), and the generation of new theory to interpret recovered data (2006:89). Landscape analysis is the first or at least one of the early steps of a landscape archaeology investigation and process. In it maps are collated, chronologically ordered, and examined for patterns. Often there is text associated with lines on a map or published commentary. Landscape analysis is therefore multidisciplinary (Francaviglia 2015), multiscalar, multifaceted (Chapman 2006), and can accommodate multiple perspectives. Landscape archaeology landscape analysis is a powerful theoretical tool to read any landscape and discover where people in the past performed daily life activities within natural environments and constraints of ideologies such as capitalism or Mormonism (in the American context).

The use of GIS landscape analysis to answer positivist research questions and hypotheses is limited by cultural factors of and meanings people have about certain places that are the subject of archaeological investigation. In other words, culture tends to muddy the waters of an otherwise scientific methodological process (Chapman 2006:23). Given such seemingly antagonistic inputs and factors, anthropological theory is nonetheless necessary in order to make sense of the empirical and experiential cultural data extracted from archaeological study areas and the maps said investigations examine and or generate. Henry Chapman makes clear that, “...GIS only simulates the physical world and, in the case of archaeology, it can demonstrate how sometimes this simulation is the closest way of approaching the unknown, past realities being studied” (2006:37). Indeed, Mark Gillings and Glyn Thomas Goodrick find that, “... GIS

is increasingly being seen as much as a place to think as a simple data management and mapping tool” (1996:5.1), or as Leone phrased it, the conclusion has to remain a hypothesis (2010:20) until it can be tested in an effort to move archaeological praxis forward.

James Harmon, Mark P. Leone, Stephen Prince, and Marcia Snyder utilized LiDAR and GIS to qualitatively and orthographically visualize two 18th century Maryland gardens, William Paca’s Wye Hall Plantation and Samuel Galloway’s Tulip Hill Plantation, at a landscape scale thus enabling the entire site at each location to become the focus of analysis because “the spatial relationships that comprise the whole often cannot be elucidated through application of standard field methods” alone (2006:649; cf. Leone 1984). In this paper, Harmon et al. approach the two 18th century Maryland gardens from a landscape archaeology paradigm without ever labeling it as such. This raises a question: What if an historical landscape archaeology approach is taken and landscape analysis using LiDAR imagery, archival records, and GIS software is performed on a known Mormon landscape? Maybe an object or pattern will emerge out of this approach that will meet the criteria for an object of ideological desire as set forth above.

LiDAR imagery and Digital Elevation Models (DEMs) assist in interpretation of space and place because they are viewed top-down. This elevated, Apollonian perspective cuts through the more experiential qualities that one would have in person on the ground. GIS manipulation of LiDAR imagery such as shading or color ramping, the ability to remove the essence of vegetation or wooden structures, the representation of faint and shallow traces that can be associated with human land-use patterns discernable from natural features and animal land-use patterns, and the projection of simulated height or elevation on a two-dimensional map image all assist landscape archaeological survey data collection, management, and interpretation (Chapman 2006:20-21). Thus the Apollonian and Cartesian perspective that GIS and LiDAR



affords landscape archaeology studies is not only illuminative it is phenomenal (all connotations intended). Donna Haraway, distinguished American Professor Emerita in the History of Consciousness and Feminist Studies departments at the University of California, Santa Cruz, has called this phenomenon the “God-trick” (1991:189).

### **The Legend of “Miracle” Spring**

On June 23, 1925 ca. 50,000,000 yd<sup>3</sup> of earth on Sheep Mountain rotated and slid downhill in a mass wasting event that dammed the Gros Ventre River just east of Kelly, Wyoming. A 5-mile-long lake known as Lower Slide Lake formed behind the Gros Ventre Slide. After a severe winter and an extended rain-on-snow event the landslide dam collapsed and on May 18, 1927 sent up to 6 ft. of water 25 miles downstream (USFS n.d.:2). The Kelly Flood demapped the Town of Kelly, Wyoming and six people perished including three members of the Kneedy Family, members of the Grovont Branch Church of Jesus Christ of Latter-day Saints. Two other Grovont, Wyoming/Mormon Row community members, sisters Cora Sebastian and Mary Lovejoy, lost their lives on that fateful day while trying to escape the wall of water.

Reed Moulton, one of the last residents of Grovont, WY/Mormon Row, spoke in John Parrott’s Jackson Hole High School History class about the Kelly Flood as he remembered it as a child. Reed recalled that:

Just before the flood the farmers were building a cannal [sic] to the Gros Ventre river.

After the flood the church was used as a mortuary. That is when the Kelly Warm Springs

came up. Because the water didn’t freeze in the winter, the ranchers called [it] Miracle

Springs. After the flood, the U.S. government completed the canal. [Jackson Hole

Historical Society & Museum [JHSSM] n.d.:2-3, transcript, Accession number

2002.0054.001]

Candy Vyvey Moulton, a surviving relative of Reed Moulton, summed up the events of 1927 thus:

The Mormon Row homesteaders were late in planting their crops that spring; they had been too busy helping less fortunate neighbors who lost their homes and loved ones in the flood. When they planted crops in early June, the homesteaders knew they would be hard pressed to mature. Rocks and mud filled the irrigation ditches, temporarily ruining their use as water conveyances.

Some good came from the flood for the Grovont families, however, because state and federal aid poured in, making it possible to rebuild the irrigation ditches that had been damaged and to finish those that had never been completed.

After the flood, the area was assured it could get water from the Gros Ventre to raise hay and oats. The Settlers gave thanks for their fortune. Their appreciation became more profound when, shortly after the flood, a warm spring developed at the mouth of the Gros Ventre canyon.

The natural spring provided running water for the Moultons and others homesteading along the north end of the row near Blacktail Butte. For more than twenty years, the families had hauled river water, but a disaster brought a blessing. No longer did they have to travel regularly to the Gros Ventre to get water for gardens or livestock; now a small creek provided it naturally. Because the water was warm, it ran year-round. Mormon Row residents called it the Miracle Spring. [2007:121]

Bonnie Kreps quotes former Governor of Wyoming and U.S. Senator, Clifford Hansen, who told an audience at the Jackson Hole Historical Society & Museum (JHHS&M); date

unknown) that in 1927, "... a warm spring erupted a mile north of Kelly. ... The grateful ranchers named it Miracle Spring (2006:117).

Samantha Ford, Director of Historical Research and Outreach at JHHSM found:

After the flood swept through, nothing was left but a three mile wide swath of broken trees, boulders and other debris that ruined the farmlands that had been painstakingly cleared. Ditches were flooded, head gates were destroyed ... [h]owever, they did discover that the nearby Mud Springs had begun to produce water that could be their new source of irrigation. Because the waters were warm and it flowed year-round, the name was now "Miracle Springs," [2016a]

and

... The nearby Mud Springs (only good for mud) began producing water after the Kelly flood and became known as Miracle Springs. Today, it is known as Kelly Warm Spring. As the modern name suggests, the water it produced was warm so that the nearby homesteaders could make use of the spring year-round. In 1929, [Joe] Heninger and his neighbors filed for water rights on Ditch Creek, which fed into the spring. [2016b]

### **Preliminary Results**

It is clear from William O. Owen's 1894 Cadastral plat map of Township 42 North, Range 115 West based on surveys conducted in 1891 and 1892 that there were two geothermal water sources already in existence (BLM 2016; Figure 2). Between 1972 and 2012, 10 site records and reports for archaeological survey, testing, and inventory of, in, and around Kelly Warm Springs (48TE449-450) were written and submitted (Wright 1972, 1975, 1984; Connor 1991, 1992; Crockett 2000; Reher, Bartholomew, and Crago 2001; Bartholomew and Crago 2001; Adams 2011; Whitman and Albertson 2012). Curiously, none mention William Owen's

Cadastral map in any background research sections. Owens indicated and drew “warm Sulphur springs” in the location of Kelly Warm Springs today. Owens also indicated and drew “Springs” in the SE¼ SE¼ of Section 2. Is it locatable in the present?

The Kelly Warm Springs archaeological site (48TE449-450) is a combination of two sites that were originally located and recorded by Gary Wright of State University of New York-Albany in 1972. The sites were combined in 1999 for management purposes. 48TE449-450 site records do discuss site contents: a variety of prehistoric lithic materials, debitage, flake tools, modified flakes, formal tools, diagnostic projectile points, and point bases dating back ca. 1,500 years; archaeological evidence in the valley goes back 8,000 to 11,000 years before the present (Walker and Graves 2007). Several test units have been executed across this site and there is a subsurface component. 48TE449-450 has been recommended and found eligible to the National Register of Historic Places (NRHP) under criteria A and D. This site is also regarded as a Traditional Cultural Property or Place (TCP) by the consulting Native American tribes as well as the local non-Natives of Jackson Hole, Wyoming; formal documentation leading to a nomination of Kelly Warm Springs (48TE449-450) as a TCP has not been compiled by GTNP yet.

Sean Larmore and Jessica Gabriel of ERO Resources Corp. recorded Hot Spring Ditch in October, 2013 as 48TE1945, but did not report permits, dates, or volumes of water allowed. Larmore and Gabriel also did not reference the BLM GLO Cadastral map for T 42 N, R 115 W. According to WYSEO records, Permit # 2208—Hot Springs Ditch—was assigned to James Budge, J. W. Henrie, Martin Henrie, and James I. May on July 31, 1899. A hand-drawn Plat of the Hot Springs Ditch Enlargement ca. 1908 indicates a stair-stepped irrigation lateral from the Hot Springs Ditch in Section 4 going to James Budge’s Desert Land Claim of 120 acres in the

SW ¼ SW ¼ Section 4 and the E ½ SE ¼ Section 5 granted on January 27, 1908 (Figure 3). In total, 9.26 cfs in water rights were granted to Mormon Row hay farmers to irrigate 550 acres.

James I. May, James Budge, J.W. and Martin W. Henrie, and William Biener helped W. F. King survey for an extension of the Warm Springs Ditch in August, 1897 and July, 1899. This hand-drawn Plat map places the “Warm Springs” in the SE ¼ SE ¼ Section 2, Township 42, North, Range 115 West (Figure 2). The Plat of the Hot Springs Ditch Enlargement, a hand-drawn map in the GTNP Archives is without a date, also depicts springs originating from Section 2 (Figure 3). A 1953 US Department of the Interior engineering map of Hot Springs Ditch indicates a different headgate for Hot Springs Ditch (Figure 4). Mud Springs is also indicated in the same place as “Miracle” Spring also known as Kelly Warm Springs today. This map from 1953 somewhat contradicts what Samantha Ford found.

The original hot springs was groundtruthed on August 23, 2017 and photodocumented (Figure 5). Due to its precarious location, however, GPS coordinates could not be obtained only estimated for the record. The hot springs themselves did not produce 9.26 cfs, rather water rights from the Gros Ventre River were combined with warm geothermal water in the SW¼ SW¼ Section 1, T 42 N, R 115 W and not Section 2 as previously indicated. The net result was that Hot Springs Ditch did not freeze over during winter. Without the geothermal water it is doubtful whether the first-wave of Mormon Row settlers and their livestock would have survived their first winters on the northern floodplain terrace of the Gros Ventre River and the Ditch Creek alluvial fan in Jackson’s Hole, Wyoming between 1896 and 1900. Additionally, WYSEO records indicate that William S. Kissinger filed a water right for Mud Spring(s) Ditch on July 24, 1896 to deliver 0.92 cubic feet per second (cfs) of irrigation water to 65 acres from Mud Spring(s) in the

NE ¼ NW ¼ Section 2. Later, on December 22, 1900, Kissinger filed a second water right to deliver 0.57 cfs to 40 acres.

We know now that what Kreps claims by way of a former Governor of Wyoming that “there was no open water in Mormon Row” (2006) is simply not true. There were two geothermal water supplies for fields and livestock before 1927. Mormon Row settlers had rights to take supplemental water from a warm Sulphur spring in 1896 later supplemented from the Gros Ventre River via Savage Ditch Enlargement and not from Ditch Creek in 1929; Mormon Row Ditch was recorded as a contributing element of the MRHD (48TE1444; Hubber, Miller, and Caywood 1996). Archaeologically recovered evidence from 48TE449-450 suggests that water emanated from the same source that was known as Mud Spring(s) then “Miracle” Spring then Kelly Warm Springs potentially thousands of years prior to the Kelly Flood of May 18, 1927. In other words, the ‘miracle’ of “Miracle” Spring was never a miracle; the spring was already there. What changed was the hydrology of the landscape and the Mormon Row community’s perception of the spring (and its name). Reinterpretation of historical events was and is an adaptation strategy of Mormonism that facilitated and continues to facilitate their ecological strategy (Leone 1979:25).

### **Landscape Analysis**

All previously recorded resources discussed in site reports including sites not digitized in either the GTNP or WYCRIS databases were manually sketched on 1:9,000-scale field maps for reference before conducting field reconnaissance and groundtruthing in the summer of 2016 (Figure 6). LiDAR imagery was used as the base for field maps because it provides the best resolution of the surface. Anomalies and features were examined in field maps and the most efficient path was taken to reach them. To distinguish the irrigation network from other linear

features, all irrigation ditches, laterals, and sublaterals were traced on LiDAR imagery in GIS (Figures 7, 8, 10, 11) and projected along with digitized site records in their respective GIS databases and layers. All traced irrigation features were then checked against a 1958 Wyoming State Engineer's Office (WYSEO) map of registered water rights, priority dates, cfs allowed, and acres served (Figure 9). The benefit of this map is the texture schema used to distinguish fields served by different permits. Landscape archaeology landscape analysis of LiDAR imagery, archival maps and documents, and the archaeological record of Kelly Warm Springs (48TE449-450) revealed a common denominator: the original unnamed hot spring and Mud or Kelly Warm Spring each supplemented geothermal water to irrigation ditches that served the Mormon Row community from 1899 until today. Four of the five local legends about "Miracle" Spring mention irrigation directly or indirectly; the fifth legend mentions wells; none mention the original hot spring.

Landscape archaeology landscape analysis of LiDAR imagery also revealed a pattern of predominantly parallel sublaterals across the study area (Figure 10). An irrigation network of distributary channels is an object created by humans in the past that was also involved in capitalism and persists in the archaeological record. This prompts the question: Is irrigation or are irrigation features the object of Mormon ideological desire in the archaeological record within capitalism?

### **Final Analysis**

When Leone interrogated Mormon dam re\construction on the Little Colorado River valley in Arizona he made a connection with the wider landscape:

... irrigation demanded dams, canals, and a systematic, controlled access to water. The paramount necessity for irrigation intensified the type of hierarchical control that had characterized Mormonism from its start. [1979:21]

and

The irrigation system was operated and regulated through the use of religious rituals. Rituals and beliefs thereby combined to aid in the continual improvement of, and hence effective control over, the environment. Effective control constituted the first phase of the church's success. [1979:88]

Curiously, the irrigation system was not the focus of the rest of the text. Like fences, a “comparative generalizing study ha[d] not been done” (Leone 1978:199).

According to Mormon Doctrine, the ultimate Mormon ideological desire in the 19th and early 20th centuries was the creation of New Zion, the abode of Jesus Christ and the righteous and endowed Mormon Chosen Ones who will reside in the City of God on Earth during the Future Tribulation or The Rapture. If what Leone surmises is true (but was previously not tested), the creation of New Zion in the arid American Great Basin was possible only through irrigation practices. When the Mormon Pioneer Company or Camp of Israel reached the Great Basin and the Great Salt Lake in 1847, the first tasks were to plow arable land, stockpile plows and related machinery, and cut a ditch to irrigate their new homeland (Francaviglia 2015:78). Moreover, William Abruzzi's human geographical analysis of the Mormon settlement and colonization and of the Little Colorado River found that upon arrival in 1876 to the place that would become Joseph City, Arizona, “First plowing was begun on March 25th, only two days after the first settlers had arrived. Surveying for the irrigation ditch began within two days and the first logs to be used in constructing the dam were cut on the third day” (1987:319).



Dams and irrigation ditches are intimately integrated; this is nothing new; what is new is the perspective from which they are capable of being viewed. Typically only a segment or a portion of an irrigation network is visible to any one person on the ground proper at any one time (Figure 11). Indeed,

The pattern of material objects that is a dam and its connected irrigation system is both passive and active. It is produced by Mormonism and produces parts of it. ... The irrigation system **can be seen** as one of the prime factors causing a certain level of population, stratification, social control, and regional cooperation. It has certain deterministic properties and is an apt case of technological determinism. [Leone 1974:742; emphasis added]

Leone links dams and the irrigation network of water distribution, but the irrigation network is regarded as a 'prime factor' and not as central as the dam. Leone then proffers that, "[c]ertainly it is necessary for technological determinists and their opposites to come to grips with the dynamic connection between the two halves of any piece of technology. This is especially true when examining the connection between technology and belief" (*supra*).

The phrase, 'can be seen,' is interpreted to connote the simple, common, and abstract idiom of logical evidence presented; no material evidence is presented in Leone's published argument. A perversion of logic reveals that while Leone did identify irrigation's importance, he did not describe, detail, or deconstruct irrigation as a technological object that facilitated Mormon settlement, subsistence, and participation in capitalism perhaps because, unlike fences, plats, temples, and dams, the whole object could not be seen. Can this technological object be materially quantified (reified; empirically seen) not just qualified in words?

A final test of Leone's historically Mormon Little Colorado River settlements is necessary to determine if the irrigation pattern evident in the Mormon Row study area is or was employed elsewhere in the American West. If the same or a similar irrigation pattern exists, then an argument can be made that there is a Mormon Irrigation Pattern (MIP) identifiable and locatable in the archaeological record that represents historic Mormon attempts to create New Zion anywhere and everywhere practicable in the American West.

Figure 12 is a distribution map of Leone's Mormon Arizona study area (1979:xvi). Unfortunately, there is not a publicly available LiDAR data set available for the area Leone investigated; there is publicly available orthoimagery. Recent orthoimagery was examined for the parallel sublateral pattern in and around each known historically Mormon settlement along the Little Colorado River and Silver Creek in Leone's original study area. At least one representative relict field that contains the pattern was digitally traced in ArcGIS in each settlement. The resultant distribution map indicates that in each historically Mormon settlement along the Little Colorado River and Silver Creek in Leone's original study area there is at least one relict field that contains the parallel irrigation sublateral pattern or MIP.

### **Significance and Conclusions**

It is evident in landscape archaeology landscape analysis of a 1:500,000-scale orthographic projection of Leone's original study area in Arizona that the MIP existed and still exists in relict and active fields (Figure 13). With this revelation, one can say with an increased degree of certainty that the historic Mormon creation of New Zion anywhere and everywhere practicable in the arid West (Leone 1979:28) is evident in irrigation features and in an MIP. Said MIP hid(es) a void, a deficiency in large, unattractive landscape features left over or resultant from the past that circulated and or circulates presently in the daily lives of the Mormon settlers

of the Little Colorado River and Silver Creek in Arizona and the northern floodplain terrace of the Gros Ventre River and the Ditch Creek alluvial fan in Jackson Hole, Wyoming in the late 19th, the 20th, and even the 21st centuries.

Ditches are literally mundane, as in, of the world, of the earth. Irrigation canals, ditches, laterals, parallel sublaterals, and rills are physical, material ruptures in the surface of the Earth; they are also void spaces unless “filled” with flowing water. Standing water does not do work except in the case of a reservoir impoundment that captures potential energy for future use as flowing water. Irrigation ditches are large, unattractive objects left over or resultant from the past which we are all aware of, yet hide in plain sight. Irrigation features mask their true identity so well that they go overlooked and are commonly mistaken for natural streams (Fiege 1999). Ecologically speaking, irrigation networks circulated and continue to circulate water as part of the Earth’s hydrological cycle. Given that the water was ‘free’ yet required vigilant labor to make it work, an irrigation network was a circulating object that functioned in the daily life of Mormon yeoman farmers and frontier settlers while masking its role in capitalism.

When irrigation worked, water facilitated the growth of fodder crops. Harvested hay became a commodity that acquired a value derived from the labor invested in the construction and maintenance of the irrigation network, the time and labor planting and harvesting (communal efforts performed by Mormon communities), and the use value the hay generated when it was consumed by livestock. Fodder crops fed livestock that were sold at market (capital); dairy cattle produced dairy products the surplus of which was sold for cash or exchanged for other commodities. Similarly, tithed vegetables and other perishables were first and foremost for the survival of a Mormon community; any surplus commodity that could have been sold on the open market for cash or exchanged for other commodities including labor was. Tithing and the sale of

commodities facilitated and facilitates the community's participation in regional capitalism if only marginally while benefitting the entire Mormon community nationally.

Mormon reclamation of arid lands anywhere and everywhere practicable in the American West via ritually and hierarchically managed irrigation networks was the sublime technological element necessary for community survival. Once again, "all pragmatic matters aimed at redeeming and building up the earth were sacred" (Leone 1974:732). Thus, through labor Latter-day Saints transmogrified *terra nullius* frontier environments into sacred landscapes and capital. Through righteous redemption Latter-day Saint labor or life-work was likened to God's work which sanctified the earth thereby setting it notionally apart from common ground; holy land. Indeed, "the open fields, semi-arid mountainous setting, irrigation ditches, and occasional rows of poplars and primitive fences lining fields give the rural landscape an almost biblical quality" (Francaviglia 1978:7).

Joseph Smith and Brigham Young encouraged 19th and early 20th century Latter-day Saints to fill a conceptual void—the City of Zion—with a New Zion anywhere and everywhere practicable. The achievement of a New Zion in the arid Great Basin of the American West, as discovered, could only have been realized if irrigation practices were employed. The technology of irrigation incorporates void space to artificially distribute water using gravity and gradient across a landscape to facilitate the production of vegetal commodities or feed livestock which in time become commodities (and or labor) themselves in one manner or another. Irrigation is precarious if there is a drought or other deficit of water.

It takes an Apollonian perspective in contemporary GIS and LiDAR imagery (Haraway 1981; Chapman 2006) to identify and locate *the* object of Mormon ideological desire in the archaeological record (Leone 1973, 1974, 1977, 1978, 1979, 2010) because the object—an

irrigation pattern of closely arranged parallel sub-laterals visible at a landscape-scale, the Mormon Irrigation Pattern (MIP)—is qualifiable and quantifiable and is both active and passive which permits it to be an object. Irrigation is a void, a deficiency, a technology from the past that is a recognizable, a material object all are aware of, and which circulated or continues to circulate within the daily lives of Mormons while simultaneously revealing and hiding its role within capitalism (Žižek 2008) so well it is sometimes mistaken for a natural feature (Fiege 1999). This can be explained. Irrigation is a technology most if not all people are aware of yet rarely does one see more than a segment or a portion of an irrigation network in person at the ground level at one time unless one endeavors to walk every inch of the network. There is a ideational disconnect or gap that emerges between the empirical experience of seeing a segment of an irrigation network and then seeing the entire network projected in two dimensions on a monitor or a map however; the same is true in reverse, going from LiDAR imagery to the artifact itself can be jarring. This is akin to the antagonism of *jouissance* and the Other.

Once a fantasy is seen for what it really is, there is a disappointment. When the quest to identify and locate the perfect, the ideal, the stable object of Mormon ideological desire in the archaeological record within capitalism is resolved, the result—irrigation technology and its features; a network of manmade earthen ruptures necessary to fill the Mormon ideological void of the ever-anticipated Rapture—may seem anticlimactic, too mundane. Yet landscapes transmogrified by Mormon Saints through irrigation practices were, are, and will always be “irrigated Eden” (*sensu* Fiege 1999) or New Zion in Mormon salvation time in preparation for His return. This revelation provides a new interpretive framework for understanding irrigation practices in the past that could have implications for the future. In the future it may be necessary to (re-)introduce irrigation practices to marginal environments for our survival; water is life.

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## Notes

This paper began as an internship with the National Park Service-Grand Teton National Park (NPS-GTNP; the Park) in 2016. A list of 10 objectives was presented and the end product was to be a National Historic Preservation Act (NHPA) Section 110 survey and inventory report of the Grovont, Wyoming/Mormon Row Historic District (MRHD; 48TE1444). Specifically, the Park wanted someone to investigate 2014 LiDAR imagery and locate evidence of homesteads that had not been previously recorded within the community as well as other cultural resources that may be significant and could potentially expand the historic district boundaries. It was quickly discovered on a pre-field visit that without LiDAR one person performing standard 10-20m interval parallel linear transects a cultural landscape which encompasses large portions of 25 Sections searching for evidence of possibly 27 additional historic-era homesteads walking back and forth across a cultural landscape which encompasses large portions of 25 Sections in waist-high sagebrush and hay fields in 10 weeks was impossible and impracticable (Figure 1).

LiDAR analysis, pedestrian survey, and access to archival records resulted in the recordation of 98 new or added cultural resource entered into the Wyoming State Historic Preservation Office (WYSHPO) Cultural Resource Information System (WYCRIS) accompanied by a report. The results were significant and led to a request to develop a research problem in historical archaeology into a doctoral dissertation. Specifically, the local legend of “Miracle” Spring was problematic and deserved deeper investigation. The park granted permission and so did University of Montana (UM) faculty in the Department of Anthropology’s Cultural Heritage and Applied Anthropology program. Hence a dissertation project began with a research problem: discovering the truth behind the legend of “Miracle” Spring. This led to the supposition that it is possible to identify and locate the object of Mormon ideological desire in the archaeological record. This supposition is based on the life-work of Dr. Mark P. Leone.

Tracing of irrigation features on LiDAR imagery within the Grand Teton National Park in GIS was accomplished by a group effort. The GTNP Science and Resources Management Branch—Water Resources Division and GIS Division—hired several seasonal technicians to perform GIS and data analysis of various projects conducted within the park. An annotated GIS layer begun in 2015 was revised and corrected by the author in 2016 and 2017. Several linear features revealed by LiDAR imagery were in reality paved, gravel, or dirt roads, game trails, utility corridors and access roads and not irrigation features as initially thought. Those lines or segments were “turned off.” One linear feature turned out to be an historic wagon route between Jackson and Moran, Wyoming that had not been previously archaeologically documented. The DIM Trail from Jackson to Moran was officially recorded as archaeological feature-site 48TE2067 in 2017 by the author. The names of the seasonal technicians who spent unknown hours digitally tracing faint indications of irrigation features within the park are unknown, but their efforts will not go unrecognized, especially now. Kathryn Mellander, retired GTNP GIS Specialist, gave permission to use, edit, and correct the GIS layer. Without this concerted effort, the significance of the extant irrigation network that served the Grovont/Mormon Row community during its period of historical significance might not be known. The integrity of the irrigation network lends to its significance; its significance lends to its eligibility for listing on the NRHP under all four criteria. Its eligibility for listing on the NRHP lent to a recommendation that the entire network (save discrete areas) and the MRHD (48TE1444) be formally documented as a Rural Historic Landscape (RHL). As an RHL, the bucolic beauty of the entire historic landscape—not just the extant houses and barns—is retained, its boundaries justified, and management of the resources within is facilitated. Irrigation in Wyoming now has a formal historic context statement for future resources management and recommendations of eligibility.

## Figure Captions

Figure 1. Internship and Dissertation Project Area (parcel map generated using the Teton County Geographic Information System website at <http://www.tetonwyo.org/GIS/>).

Figure 2. Detail of William O. Owen's 1894 Cadastral plat map of Township 42 North, Range 115 West, which depicts "warm Sulphur springs" in NE $\frac{1}{4}$  NW $\frac{1}{4}$  as well as "Springs" in SE $\frac{1}{4}$  SE $\frac{1}{4}$  Section 2 (BLM GLO 2016).

Figure 3. Plat of the Hot Springs Ditch Enlargement (n.d.) based on 1897/1899 survey map (map courtesy Grand Teton National Park Archives).

Figure 4. 1953 USDI engineering map for the enlargement of Hot Springs Ditch depicts Mud Springs; Enlarged Savage Ditch and Mormon Row Ditch are unlabeled (map courtesy Grand Teton National Park Archives).

Figure 5. Original hot springs in Section 1, T 42 N, R 115 W groundtruthed on August 23, 2017.

Figure 6. Previously recorded and newly identified cultural resources annotated on a 1:9,000-scale LiDAR imagery field map.

Figure 7. GTNP and WYOCRIS digitized site points and polygons near original hot springs projected on 2014 LiDAR imagery; irrigation features traced digitally in GIS.



## Figure Captions Continued

Figure 8. GTNP and WYOCRIS digitized site points and polygons near Kelly Warm Springs projected on 2014 LiDAR imagery; irrigation features traced digitally in GIS.

Figure 9. 1958 WYSEO irrigation delivery engineering map depicting all known water rights and named ditch features (map courtesy GTNP Archives).

Figure 10. All irrigation ditches, laterals, and sub-laterals traced digitally over 2014 LiDAR imagery in GIS.

Figure 11. An irrigation lateral in its natural habitat.

Figure 12. Mark P. Leone's Mormon Arizona study area (1979:xvi).

Figure 13. 1:500,000-scale orthographic projection of representative Mormon Irrigation Pattern (MIP) examples in or near known historically Mormon settlements on the Little Colorado River and Silver Creek in Leone's original study area in Arizona.

Figures

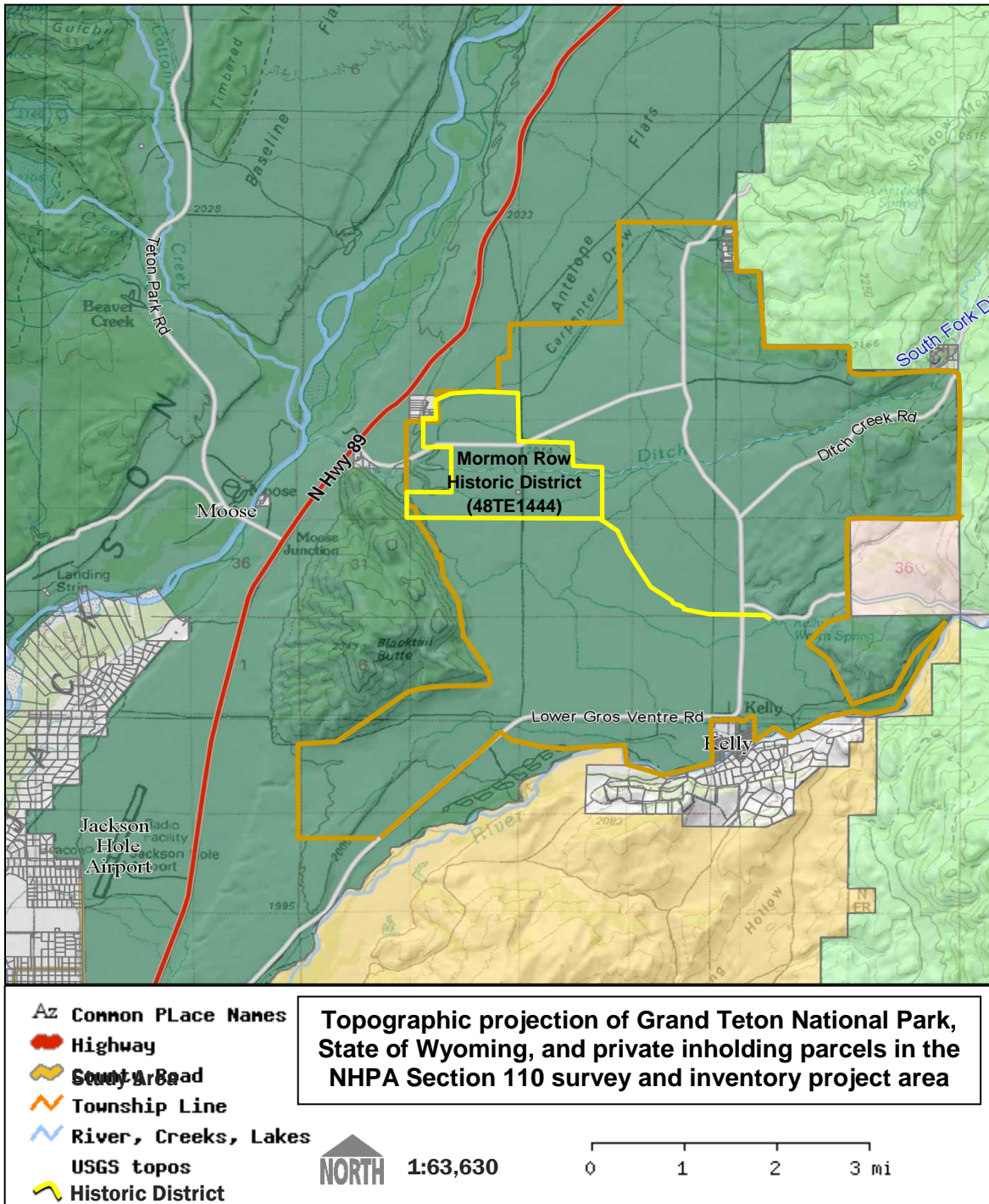


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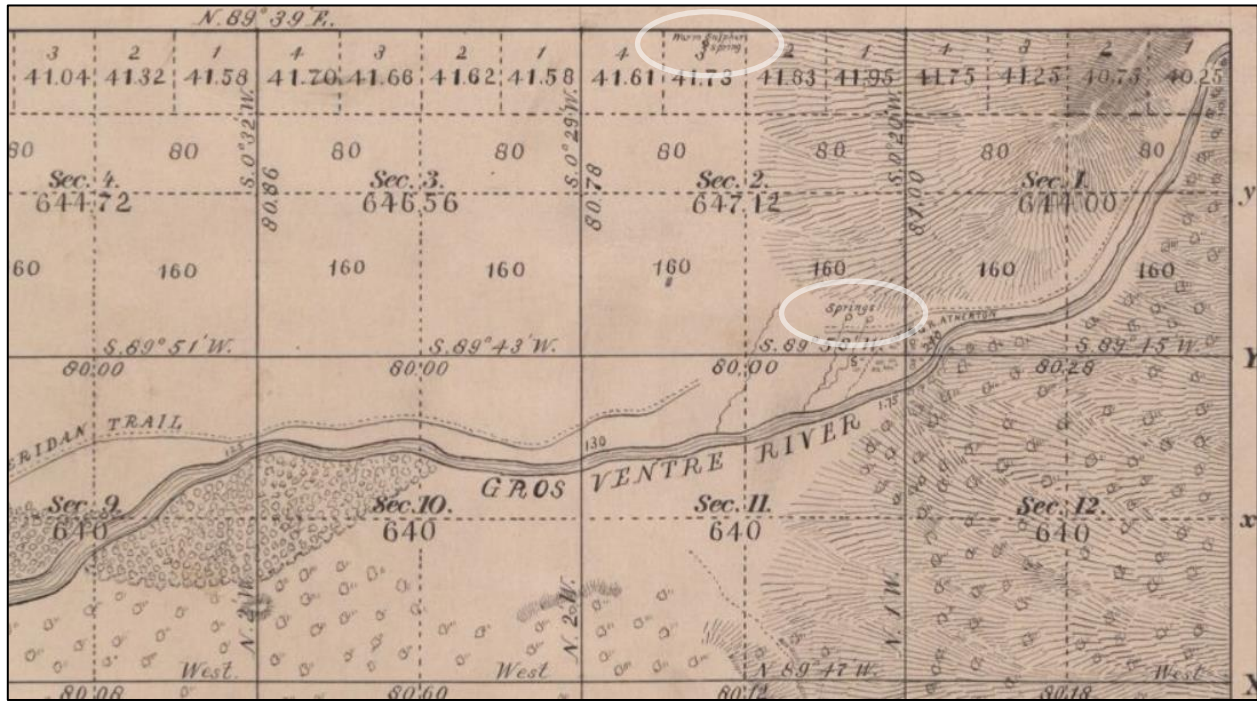


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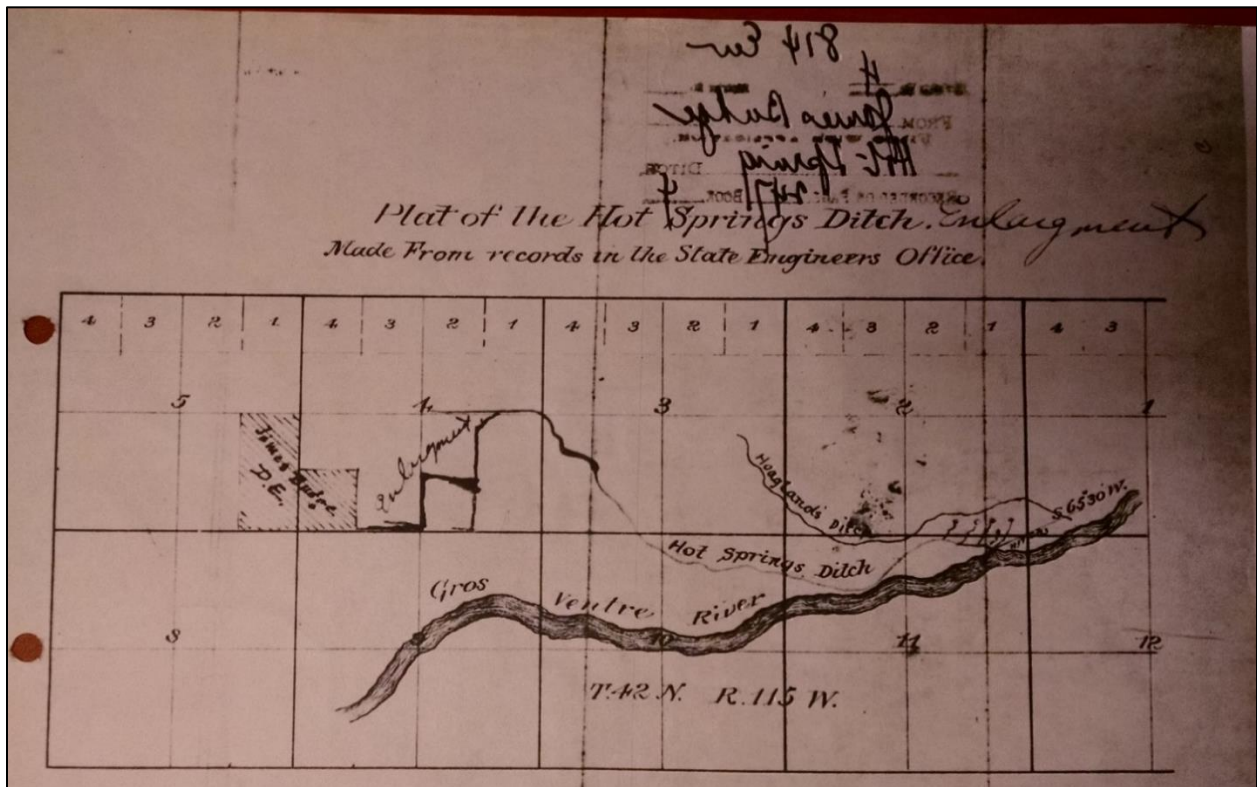


Figure 3. Plat of the Hot Springs Ditch Enlargement (n.d.) based on 1897/1899 survey map (map courtesy Grand Teton National Park Archives).

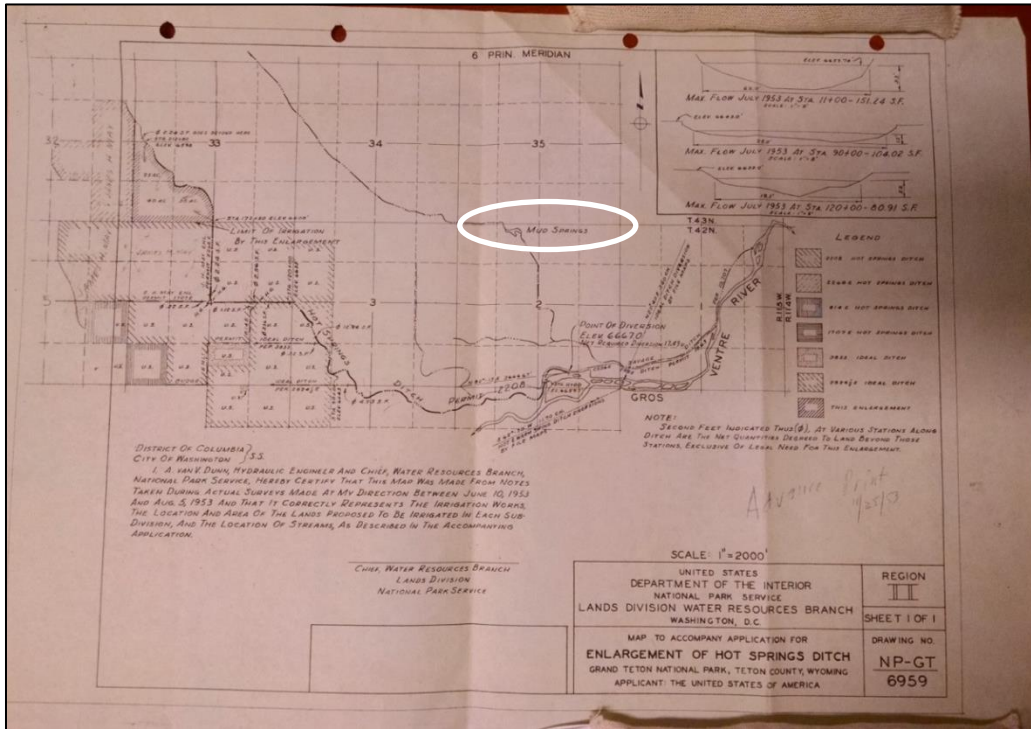


Figure 4. 1953 USDI engineering map for the enlargement of Hot Springs Ditch depicts Mud Springs; Enlarged Savage Ditch and Mormon Row Ditch are unlabeled (map courtesy Grand Teton National Park Archives).



Figure 5. Original hot springs in Section 1, T 42 N, R 115 W groundtruthed on August 23, 2017.

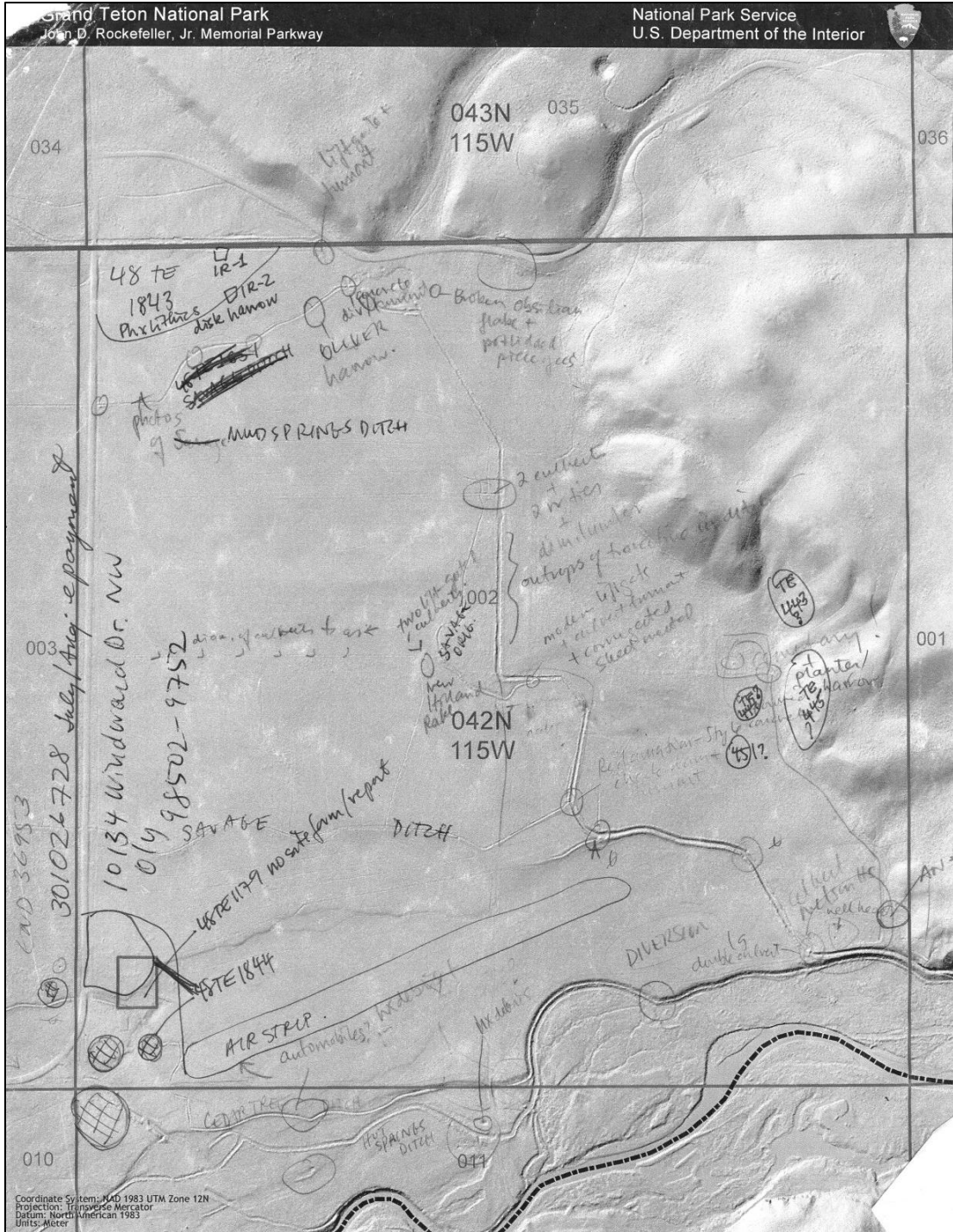


Figure 6. Previously recorded and newly identified cultural resources annotated on a 1:9,000-scale LiDAR imagery field map.

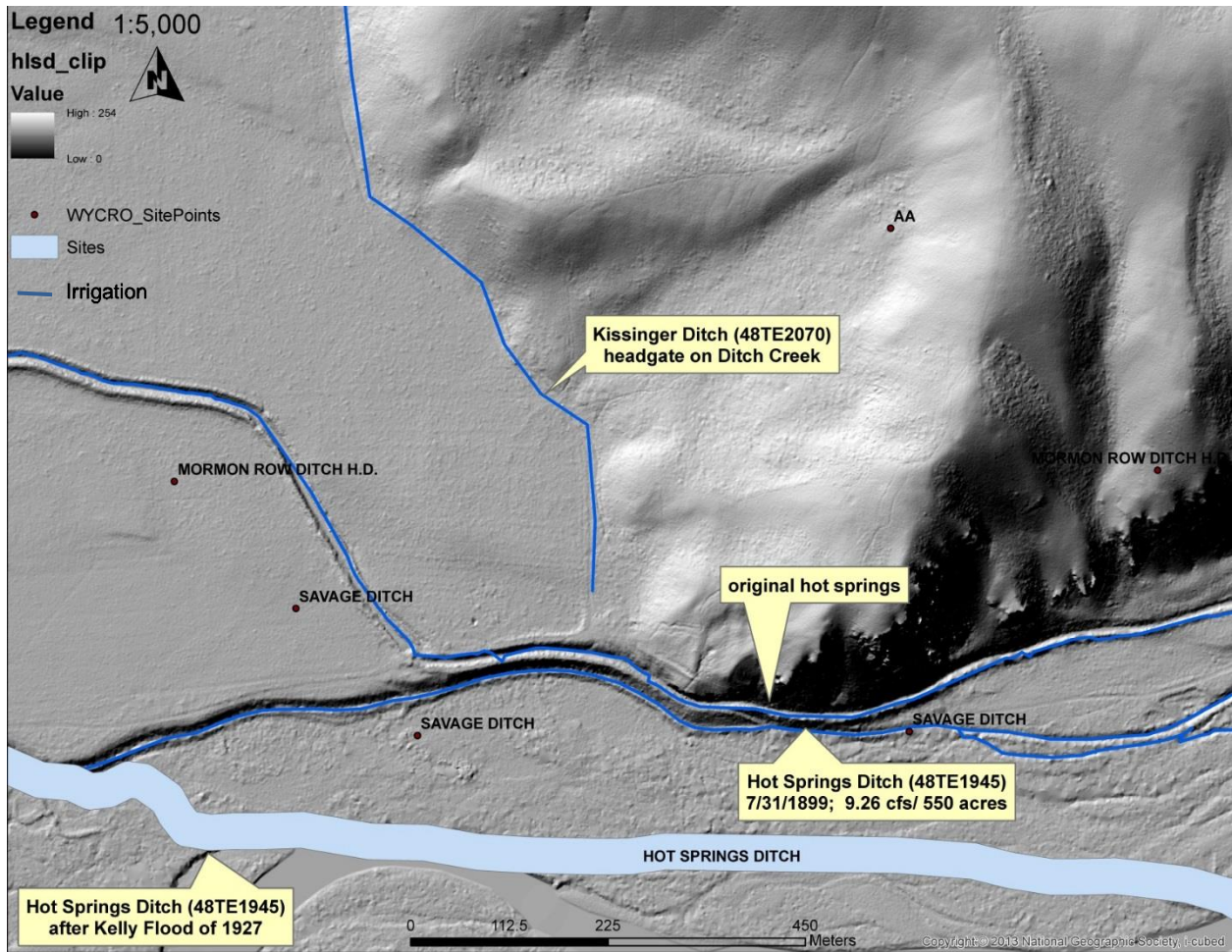


Figure 7. GTNP and WYOCRIS digitized site points and polygons near original hot springs projected on 2014 LiDAR imagery; irrigation features traced digitally in GIS.

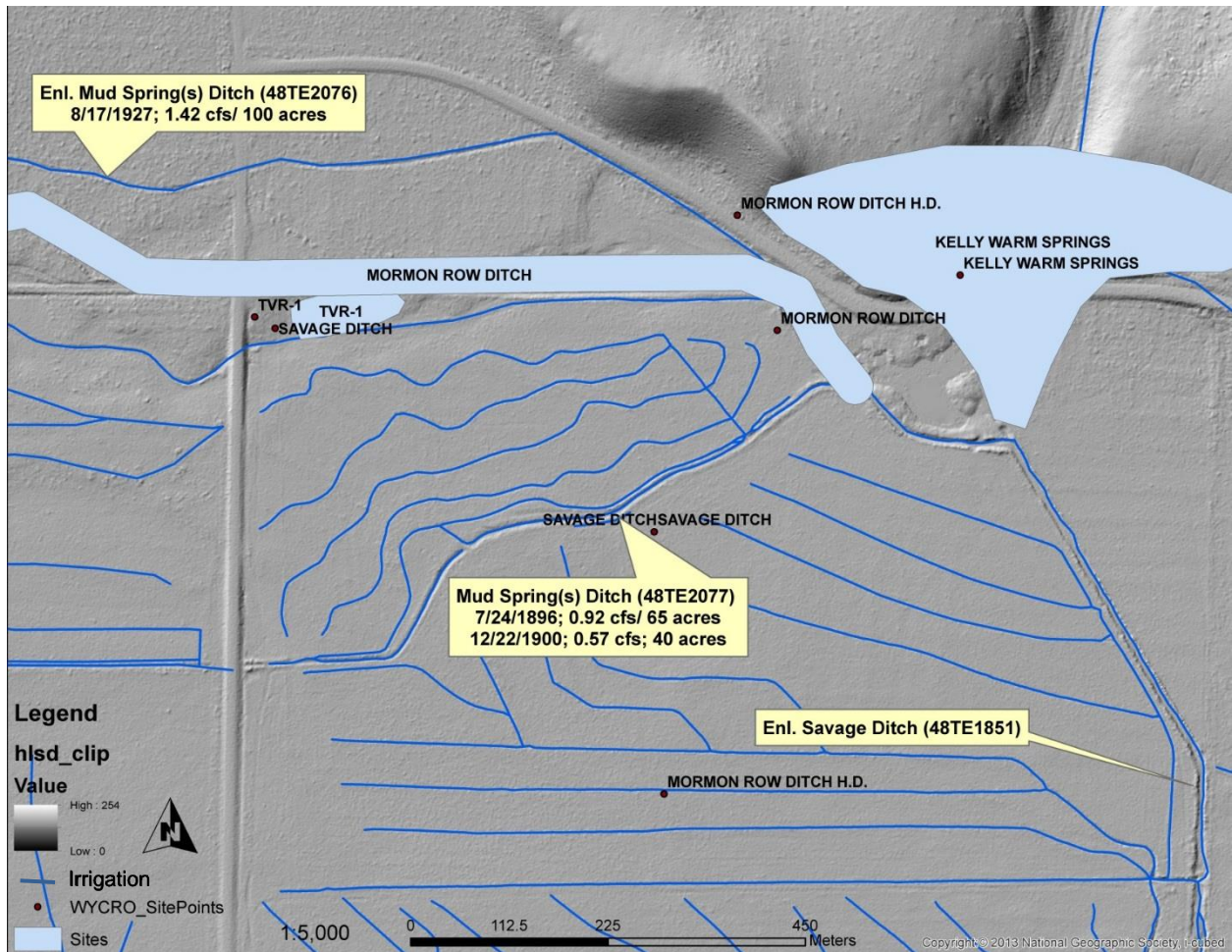


Figure 8. GTNP and WYOCRIS digitized site points and polygons near Kelly Warm Springs projected on 2014 LiDAR imagery; irrigation features traced digitally in GIS.



Figure 9. 1958 WYSEO irrigation delivery engineering map depicting all known water rights and named ditch features (map courtesy GTNP Archives).



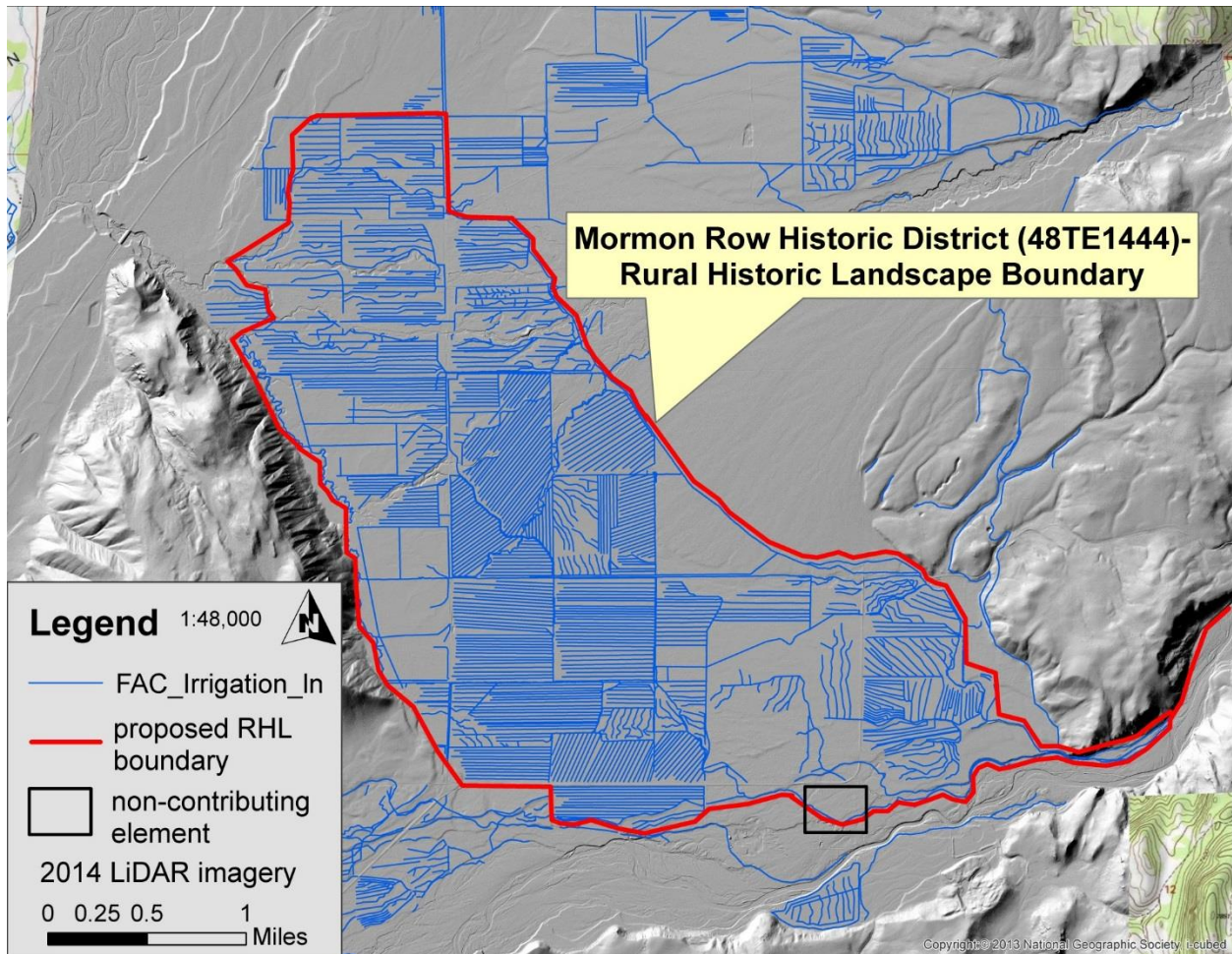


Figure 10. All irrigation ditches, laterals, and sub-laterals traced digitally over 2014 LiDAR imagery in GIS.



Figure 11. An irrigation lateral in its natural habitat.



Figure 12. Mark P. Leone's Mormon Arizona study area (1979:xvi).

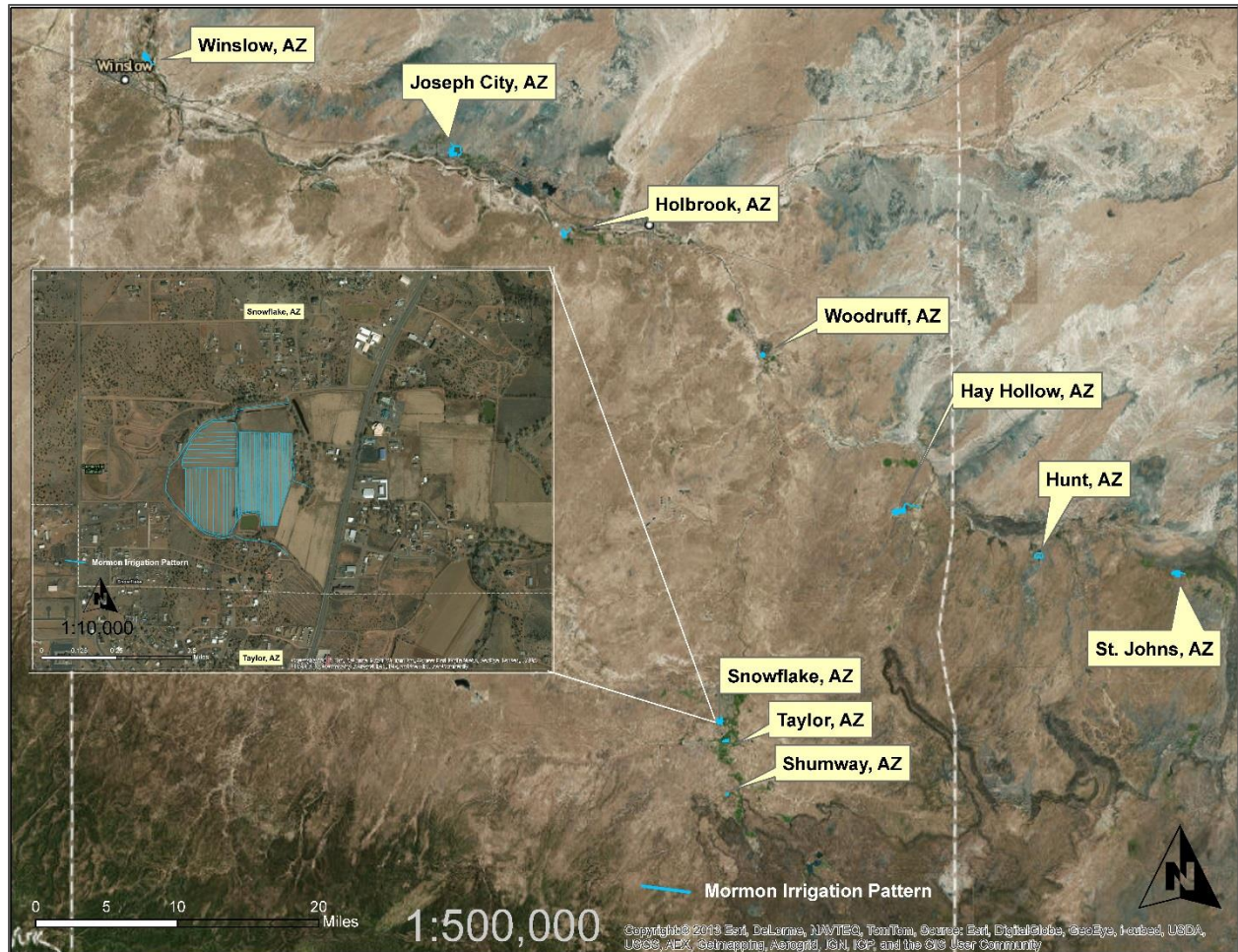


Figure 13. 1:500,000-scale orthographic projection of representative Mormon Irrigation Pattern (MIP) examples in or near known historically Mormon settlements on the Little Colorado River and Silver Creek in Leone’s original study area in Arizona.