



Apple Trees at Los Luceros February 2014 (Left) and June 2014 (Right)

## **The Los Luceros Historic Property: A Business Strategy**

**Prepared for the New Mexico Department of  
Cultural Affairs**

**June 2014**

## Section 1

### Introduction:

Los Luceros is located in Rio Arriba County in north central New Mexico. The property is approximately 10 miles north of Espanola on U.S. Highway 68. Santa Fe and Los Alamos are both less than 45 minutes from Los Luceros. Albuquerque is less than two-hour drive from Los Luceros.

The New Mexico Department of Cultural Affairs (DCA) purchased the property in 2008 for \$2.5 million using funds appropriated by the Legislature for that purpose in 2007. Deed restrictions require preserving the historic buildings and maintaining an apple orchard on the property. DCA estimates that operation and maintenance of the property costs between \$400,000 and \$500,000 annually.

A previous study (2013) by Consensus Planning, Inc. (“Facility Use Study for Historic Los Luceros”) provides detailed background information and several recommendations for the property. Consensus Planning suggested three main options for the property (p.3):

1. Manage the property as a New Mexico State monument or museum
2. Sell the property as is, with deed restrictions in place,
3. Enter into public/private partnerships for different aspects of the property.

The Consensus Planning study contained more detailed recommendations and possibilities for options 1 and 3. More than a year after the completion of the Consensus Planning study, the recommendations have not been implemented.

This report builds on the Consensus Planning recommendations and provides additional options for managing the Los Luceros property. This report has been prepared by Arrowhead Center (AHC) at New Mexico State University (NMSU). The report has been prepared under the terms of a Memorandum of Understanding (MOU) between DCA and AHC agreed to in March 2014. In the MOU, DCA provided the following guidelines for the development of a business plan for Los Luceros:

- The goal of the business plan is to provide the best-use and greatest return on investment recommendations for land utilization at Los Luceros.
- The business plan should consider current agricultural land uses as well as potential uses, consistent with national and state preservation requirements and purchase agreement restrictions.

In preparing the report, AHC personnel visited the Los Luceros property, held discussions with DCA officials and staff, had discussions with local stakeholders, consulted personnel from the NMSU’s Alcalde Research Center located nearby, obtained professional assessments of the condition of the apple orchard and irrigation system by Alcalde researchers, and consulted numerous others in the area.

The report is organized as follows. After this introduction, AHC’s recommendations appear in Section 2. Section 3 contains a discussion of agricultural recommendations. Sections 4 and 5 contain assessments of the apple orchard and irrigation system. A final section describes Arrowhead Center.

## Section 2

### General Recommendations:

Establish a consolidated budget for the operation of Los Luceros including detailed revenue and expense data. DCA estimates that operation and maintenance of the Los Luceros property costs between \$400,000 and \$500,000 annually, but more precise financial data are not currently available. The minimal requirements of sound financial management include creating a budget document. Without a budget it is not possible to assess the financial operation of Los Luceros on a systematic basis or to make appropriate decisions regarding cost reductions or revenue enhancements. The budget document should include as much detail as possible on expenses and revenues for Fiscal Year 2014 with projections of anticipated revenues and expenses for Fiscal Year 2015 and beyond. *Creating a budget should be the highest priority item for the management of Los Luceros.* No private or public sector organization should operate without a budget.

From a strictly financial perspective, the best option for the state is to sell all or part of the Los Luceros property with appropriate deed restrictions. Properties as large as Los Luceros (148 acres) rarely appear on the market. Agricultural land in the region currently (mid 2014) sells for \$25,000 to \$30,000 per acre. Land sold for commercial development sells for much more –approximately \$50,000 per acre. Selling the entire property at \$25,000 per acre would yield \$3.7 million. Selling the property would raise revenue and eliminate the annual operation and maintenance costs of approximately \$400,000 to \$500,000 per year.

Selling a portion of the property is also a viable option. If the state sold 100 acres of the agricultural land at \$25,000 per acre, the sale would generate approximately \$2.5 million for the state. The funds raised through such a sale could be used to finance improvements and operations of the historic buildings on the remaining state land.

Leasing all or most of the agricultural land to local producers is also an effective strategy. Agricultural land in the area can be leased for approximately \$2,000 per acre per year. Leasing even 50 acres would generate approximately \$100,000 annually and relieve current Los Luceros staff of many responsibilities. Leasing and other agricultural options –including crop diversification--are analyzed in Section 3 below.

There are several non-agricultural possibilities for increasing revenue at Los Luceros. These include leasing the existing commercial grade kitchen to a restaurant, opening a gift shop, charging higher fees for events such as weddings and family reunions, establishing a Los Luceros Festival, or creating a farmer's market on the property. None of these possibilities are likely to generate enough revenue to completely cover current operating expenses of the property. Substantial investment is required in some cases. Some of these possibilities are discussed in Section 4.

## Section 3

### Agricultural Potential

The Los Luceros property offers a unique agricultural setting in Rio Arriba County, NM. The uniqueness of this property is the size for the region. Many of the other agricultural properties are much smaller and thus offer fewer alternatives for production. Due to its overall size and availability of water, Los

Luceros may be attractive as an agricultural unit or as an investment unit. The farm portion of the Los Luceros property could be operated as it is currently or it could be leased to another individual or group of individuals. Each of these options may prove sustainable for the overall objectives of this historic property. Clear production, cultural and financial objectives and decisions need to be made.

The Los Luceros property has excellent access to water and some of the most senior water rights in the State of New Mexico. Its northern location on the Rio Grande and the Acequia Alcalde, the long-term period over which irrigation has been taking place in Rio Arriba County, and location next to the river and acequia all combine to indicate that Los Luceros water rights are very secure. There are markets for those water rights, but the value of the land without water is significantly reduced. Efficient irrigation, however, requires an adequate water delivery system across the entire acreage of the Los Luceros property. Regardless of whether the land is leased or farmed by the state, substantial improvements to the irrigation system must be made. A recent assessment of the irrigation system was conducted; that report is included as section 5.

Currently the property supports both forage and orchard crops. There are limiting factors associated with the current cropping pattern which include the age and variety of the trees in the apple orchard, climatic conditions, water delivery systems and crop productivity. These constraints have the potential to be corrected with the exception of climatic conditions relative to crop selection and productivity. Correcting these factors will require substantial capital intensive in the short-run and will provide a low annual return on investment in the long-run. For land to be a wise investment vehicle, appreciation in the value of the land is critical. There are virtually no situations in which land investments will cash flow themselves, if the land is to be purchased. Clearly the Los Luceros property does not need to be purchased or financed, but to expect a substantial rate of return from the land would be a mistake.

The current apple orchard presents a number of challenges for Los Luceros. A recent horticultural assessment of the apple orchard provides great insight into the problematic nature of the Los Luceros orchard from both a productive as well as a financial perspective. The report is included as section 5. The orchard is not currently in a productive condition. If apples are to be included in the long-term plan for agricultural (rather than esthetic) purposes, virtually the entire orchard should be replaced with varieties suited to the area from both marketing and cultural perspectives, modern irrigation systems, and modern frost control systems. The development outlay associated with new trees, plantings, frost-control and irrigation systems, and other inputs necessary are estimated to be \$2,000 to \$2,500 per acre. (A typical wind machine installed for frost control costs about \$15,000 to \$25,000, covers approximately 10 acres, and is picture below.) In addition to the need for the apple enterprise to be completely re-started it is estimated that sustainable economic yields will not be reached until year 7. A final note of caution on commercial apple production is that several commercial apple producers in the Rio Arriba County area are struggling. Few producers harvest a crop every year; losses to frost are quite common. One producer not far from Los Luceros pulled out his trees this year after 7 consecutive years of losses. While there are methods that can be employed to mitigate some of that yield risk (primarily wind machines), the vulnerability of apples in a river valley in Northern New Mexico is a clear threat to sustainable yields and profitability and will require active, intense management.



Forage crops dominate agricultural production in this region of New Mexico. A strong derived demand function is in place with livestock enterprises throughout the region. Hay crops could be sold outside the region, but most are sold within the area as winter feed supplements to seasonal summer forest pastures for beef cattle grazing. Potential forage crops that could be considered effective include alfalfa hay, oat hay, grass hay and other hay crops. The potential for production of hay crops is high as water and soil profiles both seem conducive for the present situation. Economic returns for forage crops range from approximately \$70 an acre for grass hay to just over \$100 per acre for alfalfa under normal environmental and operating conditions. Planted permanent pastures would return substantially less, however, as noted below, grazing of the bosque areas and of dormant alfalfa or other grass hay lands is not only feasible, it would be expected as part of the overall grazing management plan for an owned livestock herd, or as part of a short-term grazing lease opportunity.

The potential for vegetable crops is very positive. A variety of vegetable crops could potentially be grown and marketed in the area. These may include but limited to chile, radishes, squash, cucumbers, zucchini and others. Potential fruit crops would include vine and cane crops – wine grapes, table grapes, raspberries and blackberries have all been shown to grow well in this region. Wine grapes involve a completely different marketing plan and development of a winery. Grape sales to an existing winery are always possible if a long-term contract is developed with a winery, a contract that specifies amounts, quality characteristics, and very importantly, variety. The economic return on vegetable crops is high, but also highly variable and difficult to estimate due to the ever changing nature of the crops included. Because of the high returns, high costs, and high yield and price risks associated with both vegetables and fruits, a very intensive level of management is required.



**Grape vines at Los Luceros (June 2014)**

A livestock enterprise should be included on the Los Luceros property. Livestock such as beef cattle, sheep and goats would be best suited for a situation of this nature, but internal and external fencing investments must be added or improved. It is expected that a livestock enterprise would not provide the potential economic return that forage crops would in this scenario, so a crop aftermath / winter dormant period grazing is envisioned. Yearlong grazing in the bosque is possible, but likely not a significant revenue source due to economies of scale. Neither of these options would require that the Los Luceros Historic Property invest in a livestock herd; crop aftermath and winter bosque grazing pastures could be rented to neighboring livestock owners. \$25 per month per AUM; probably one cow per two acres for October through March. \$2,000 for cross section fencing.

Marketing of any of the potential agricultural enterprises can be accomplished utilizing local markets. Apples may be sold in a variety of methods and outlets. The methods could include direct sales, intermediary sales or a forward contract approach. Each of the forage crops could employ the same methods as well. Livestock could use local markets, auctions, forward contracts or video sales. The fresh vegetable and fruit crops provide the most unique marketing structure of the proposed enterprises. These could include farmers' markets established in nearby Santa Fe, Espanola or Taos, or possibly even a market at the Los Luceros property. Farmers' Markets provide an outlet for fresh, locally grown agricultural goods that are in high demand by the local customer.

Leasing the property through a competitive bid process has the potential to reduce operating costs, environmental risks and capital outlay. This approach would lend itself well to the current structure of the Los Luceros property. This process may be a method to include the community in the historic culture of the region, provide opportunities for local residents to become involved in an agricultural enterprise, and / or provide an opportunity for beginning, young farmers and ranchers the opportunity to get a start. Furthermore, it would limit the exposure of the State of New Mexico to the vagaries of agricultural markets – both substantial yield risk and price risk. Further, it would reduce the necessary high capital requirements for equipment needed to farm the land. Lastly, farmers must understand and have a passion for the land and for making the land produce income. That passion does not translate well to public entities that attempt to engage in agricultural production. Whether labeled the will or the passion to farm, or any other label, farming requires a mindset and a willingness to live through tough times that are seldom present in public or corporate agencies.

Any lease developed for use at Los Luceros should include a long-term renewable approach directed at local residents and must include a plan for investment, repair and maintenance of the land, fixed irrigation systems and any other attached systems (such as wind machines for apple orchards). The lease approach will provide greater long-term net income possibilities for the current management team at Los Luceros, if the decision is made to retain ownership of the property.

## **Section 4**

### **Non-agricultural potential**

As stated in Section 3, agricultural production alone is unlikely to generate adequate revenue to cover operation and maintenance costs of the property. Los Luceros is an attractive property with many historic buildings. Additional revenue can be generated from selected non-agricultural activities. A major obstacle to enhanced revenue from such activities is the low volume of visitors to the site.

Currently, the property is open to the public only by appointment. The flow of visitors could be increased by:

- (1) Implementing a fixed 'open to the public' schedule. A starting point would be to keep the property open to the public from 10 to 6 Thursday through Sunday. Other schedule are certainly possible but keeping the property open to the public on designated days would require an additional staff member at a cost of \$25,000 to \$30,000 per year plus benefits. An admission fee could be collected to off-set some or all of the additional cost. Continued use of a visiting by appointment only policy will reduce the chances for success of other recommendations in this section.
- (2) Seek designation as a National Historic Site for the Los Luceros property to further increase the flow of visitors.

If an open to the public schedule is implemented, there are several other possibilities to generate revenue including the following:

- (1) The existing commercial kitchen is in good shape (see photo below ) could be leased to a restaurant. The keys to success are high quality food and high quality service. There is some evidence of adequate demand for a full-service restaurant. Adjacent to the Los Luceros property is a small tea-house that offers various teas and a very limited menu of snacks. This teahouse has a following and customers come from as far away as Albuquerque. Other than a newspaper article or two, advertising has been word of mouth. The kitchen may need to be leased at a nominal rate for the first year (e.g., \$1,000 per month) until the operation was established well enough to warrant a higher lease payment. An emphasis in the menu on fruits and vegetables grown at Los Luceros or nearby could be very attractive to potential customers.



Los Luceros Commercial Kitchen, June 2014.

- (2) A small gift shop was once operated at Los Luceros. There is more than adequate space to re-establish a gift shop. Leasing space for a gift shop to a local entrepreneur appears to be a better option than a staff operated store. During the first year and possibly longer, space for a gift shop should be leased at a nominal rate (e.g. \$500 per month).
- (3) Los Luceros currently generates some revenue from special events such as weddings and family reunions. We recommend increasing the price of such events to at least \$250 (from \$100 currently).

The three options described above require little or no capital investment from DCA. With significant capital investment there are many other possibilities for revenue generation activities on the property. Examples of more capital intensive activities include: an RV Park, a small hotel, several guest cottages, a Bed and Breakfast, a campground, or a health spa. Other examples require only a little imagination. All would need to be evaluated carefully as either state or public-private partnership investments.

## **Section 5**

### **Apple Orchard Assessment**

#### **Los Luceros Orchard Assessment 5-1-2014**

**Prepared by Shengrui Yao and NMSU-Alcalde staff, in consultation with current Los Luceros staff.**

Figure 1 is a map of the Los Luceros property in northern New Mexico, not far from the NMSU Alcalde Sustainable Agriculture Science Center. Los Luceros is about 10 miles north of Espanola. In this map, areas A and B are apple orchards totaling 20.4 acres. To the best of our knowledge, most of the apple trees were planted in the late 1960s on semi-dwarfing rootstocks; the cultivars are Red Delicious, Golden Delicious and Winesap (personal communication with Ed Costanza who harvested all apples 5-6 years ago from the Los Luceros property). With varied pruning methods, variable soil textures, non-uniform irrigation, and some harsh winters, trees survived better in some areas and worse in others. The total tree number is around  $1107 \pm 50$  with varied tree sizes in both orchard areas A and B (Fig. 2). Most trees have only 1-3 limbs or new upright branches developed from water sprouts; only 50-80 full size trees remain (Fig. 3). Also, the majority of trees have bad sunscald on the south or southwest side of the trunk and the base of big limbs (Fig. 4). Trees look totally different from the north side compared with the south side. They look acceptable if you are on the north side of the tree but most trees are struggling with bad sunscald and exposed dead wood if you look from the south side. Most of the healthy part of the trees consists of 3-5 year old new branches growing upright, and which need to be carefully pruned (fig. 4). Orchard maintenance crews have pruned most of the dead branches out.

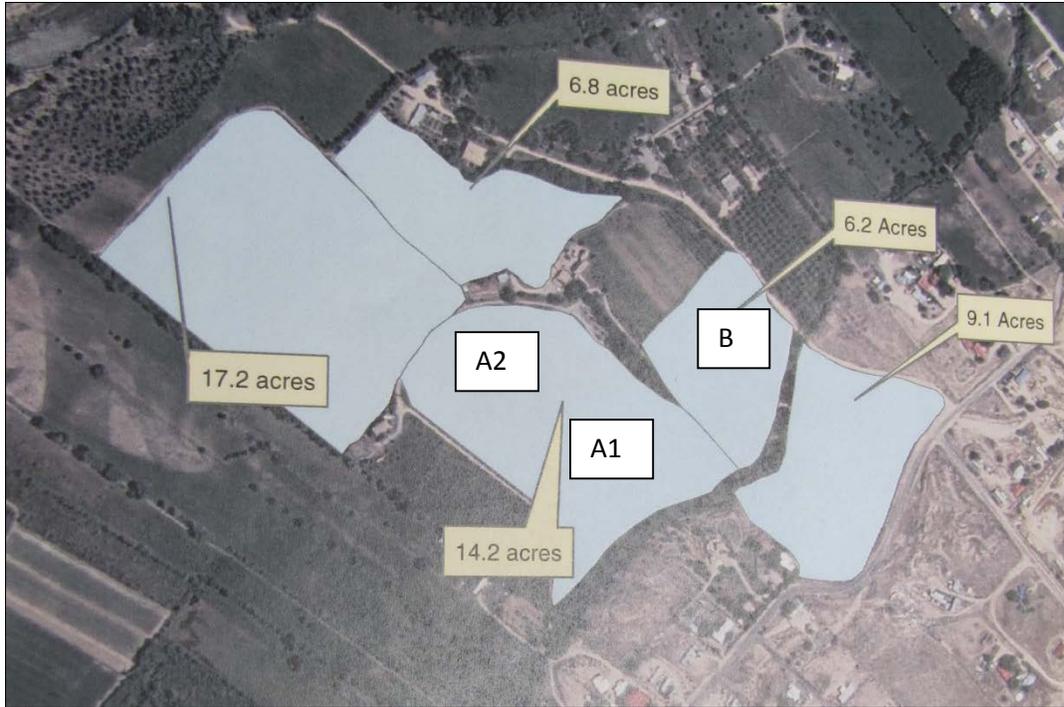


Fig. 1. Map of the Los Luceros historic property.

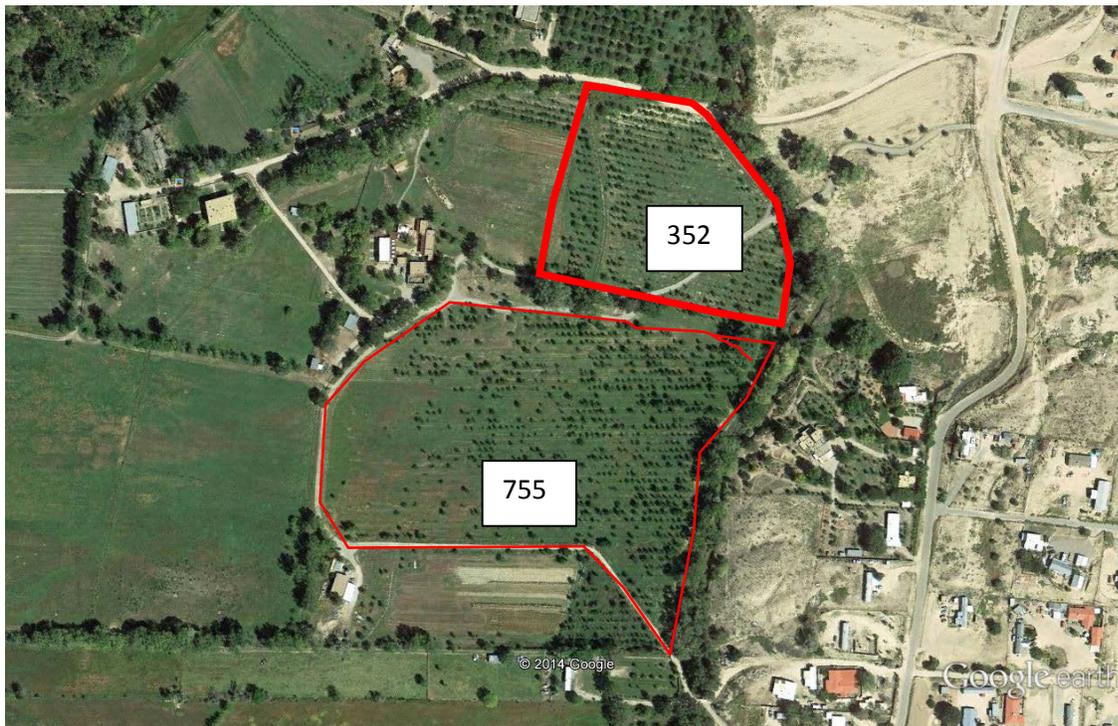


Fig. 2. Tree number in orchard areas A and B.



Fig. 3. Most trees have 1-3 branches and few have full canopy.



Fig. 4. Tree trunks and base of big limbs were badly sunscalded with dead wood exposed. Photos by Shengrui Yao.



Fig. 5. Trees near the acequia in orchard area A (A1; top photo) survive better than those far from the acequia (A2; bottom photo). The acequia is on the far end of the picture in A1. There are fewer trees in orchard area A2 than A1 which is closer to the acequia. Photos by Shengrui Yao.



Fig. 6. There are more missing trees in orchard area B, and trees also lost more limbs, than in orchard area A. Photo B2 is close-up of B1. Photos by Shengrui Yao.

In general, trees in orchard area A are in better shape than trees in area B. There are more missing trees in areas A2 and B than area A1 (Figs. 5 and 6). Soil texture could be another factor contributing to this. Soil in area A2 has more rocks and appears sandier than in area A1.

#### Recommendations:

Depending on the purpose of this property, the management strategies would be different. If orchard areas A and B are used for commercial production, my recommendation would be to remove all the trees and totally replace them with some newer and late blooming cultivars.

If this property is managed like a museum for visitors, one could keep the better trees in orchard area A1 (Fig. 7) that are close to the acequia and only replace the missing or badly damaged trees. The majority of trees in area B are in bad shape and should be replanted first, and then gradually also replant area A2. Trees in area A1 are better than trees in areas A2 and B, but due to the severe sunscald, they might survive another 5-20 years and the management would not be easy. Since the pruning done recently on this property was just to remove dead wood, extensive additional pruning is required to maintain those trees. With the bad sunscald and new upright branches, many branches are at high risk of breaking off if fruit set is heavy.

To replant or replace missing trees, avoid the planting holes/locations of removed trees if possible, especially when replacing newly dead trees. If trees have been removed a long time ago, replanting should not be a problem (replanting new trees in spots of recently removed trees can stunt the new trees due to various replant disease issues). If replanting areas A2 and B, tree spacing could be closer than the existing trees.

For apple cultivars, late bloomers have a better chance to have a crop than early bloomers. Honeycrisp blooms later than others while Pink Lady and Braeburn are early bloomers. Gala, Gingergold and Fuji also crop well in this area.

For the irrigation system, flood irrigation was used in the past without any ditches near the trees. Lack of irrigation uniformity could be one of the reasons why some areas have more missing trees. Now they are making ditches on both sides of the trees which will improve the irrigation uniformity and save some water (Figs. 5 and 8). Drip or sprinklers are highly recommended for commercial production. Both systems will save water and may also reduce tree micronutrient deficiency. Sprinklers can also be used for frost protection during blooming time. If acequia water is used for irrigation, a filter system is required to make the water suitable for drip or sprinkler systems.

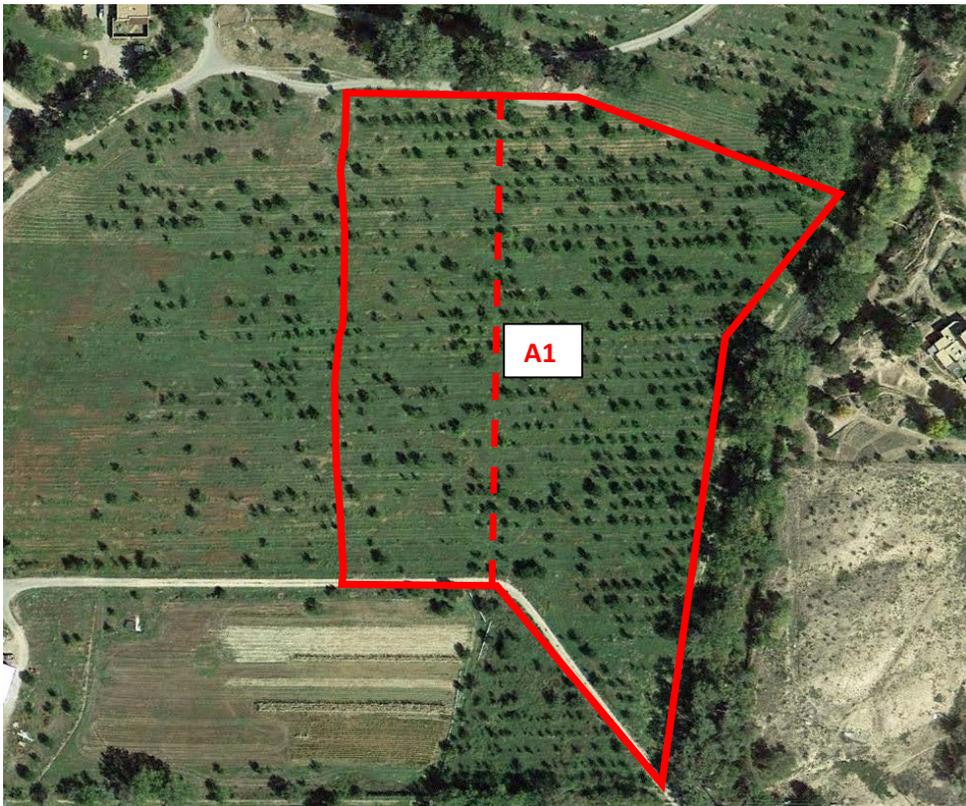
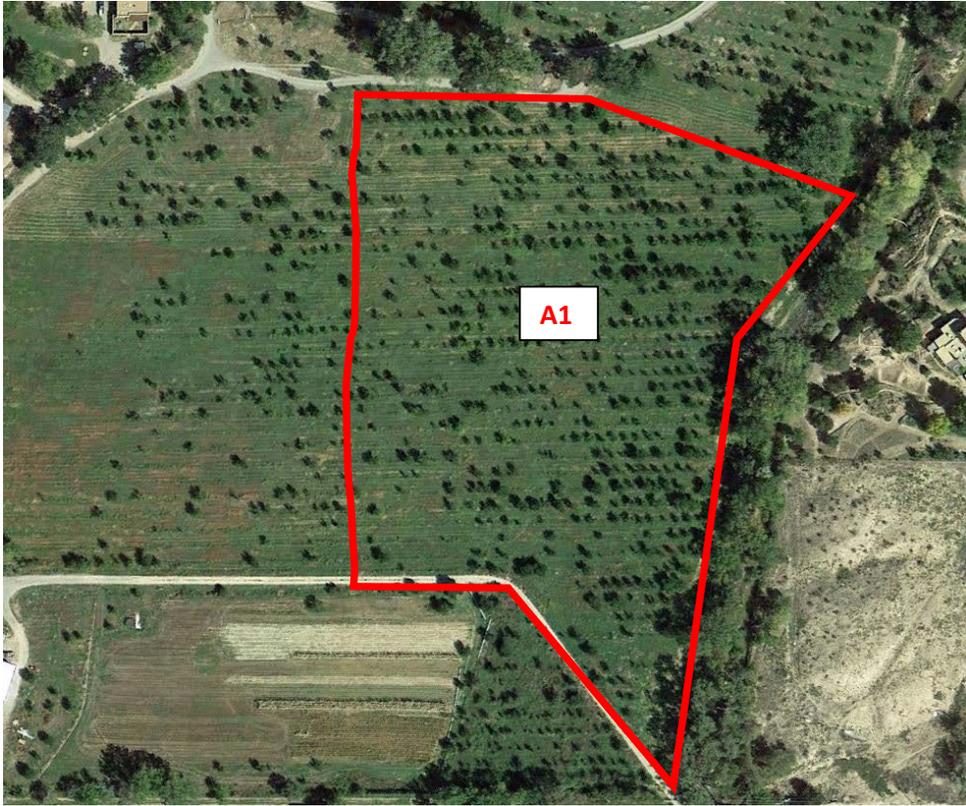


Fig. 7. Orchard area A1, outlining areas where trees may be worth keeping for historical or aesthetic purposes.



Fig. 8. Irrigation furrows along rows of trees. Photo by Shengrui Yao.

## Section 6

### Los Luceros Irrigation Assessment

**Prepared by NMSU-Alcalde staff (Robert Heyduck, David Archuleta, Steve Guldán), in consultation with current Los Luceros staff.**

#### Overview

Historic Los Luceros is situated among the floodplain and terraces of the Rio Grande just north of Alcalde, NM. The property consists of a total of 148 acres of cropland, orchards, pasture and bosque, with associated buildings and roadways. According to Los Luceros staff, 61 acres (41%) are irrigable, and currently about 55 are irrigated. The property is served by a total of six headgates, all originating from the Acequia de Alcalde, which runs along the eastern edge of the property. Five of these are functional, but the sixth and southern-most goes unused as there are water rights issues for the fields served by this headgate.

In talking with Los Luceros staff, irrigation on the property has several issues that extend across the property. First and foremost is the labor involved with irrigation: it was estimated that it takes a 40-hour week for two caretakers to water the total 55 acres currently being irrigated. This normally involves two to three headgates being opened simultaneously on any given day. All irrigation takes place during work hours; nothing is left running overnight.

Lack of water flow is the primary difficulty in efficient irrigation of the property. Los Luceros is located at a point along the acequia where water flow is normally adequate. Also, having five headgates available for the acreage irrigated should be adequate. Some ditches, culverts, and/or underground pipelines have become choked with sediment, compromising water volume delivery. Installing flush valves at appropriate points on the underground pipelines would be useful. All irrigation is accomplished through flooding; lack of field leveling complicates even and thorough water distribution.

There are also two areas of special sensitivity with regards to irrigation, the first being the Historic Los Luceros Hacienda building. Past flood irrigation in the direct vicinity of this structure has caused the onset of deterioration of the outer wall base (Fig. 1). Current irrigation practices keep flood irrigation flows away from the structure and utilize sprinklers to water a small area of grass near the structure without over-saturating. A second structure, KGB Spirits Distillery, is located on a neighboring property to the south, but has experienced problems from Los Luceros irrigation surface water and/or seepage reaching the building. Again, current practices avoid bringing irrigation water within too close a proximity to this structure.

Since the five functioning headgates service different areas, the following is a summary of the status and issues related to each area. Headgates are numbered starting from the north. Figure 2 shows these headgates and their associated irrigation areas, as well as property boundaries and other features.



Figure 1. Hacienda building showing lower wall damage apparently from surface water and/or seepage. Photo by David Archuleta.

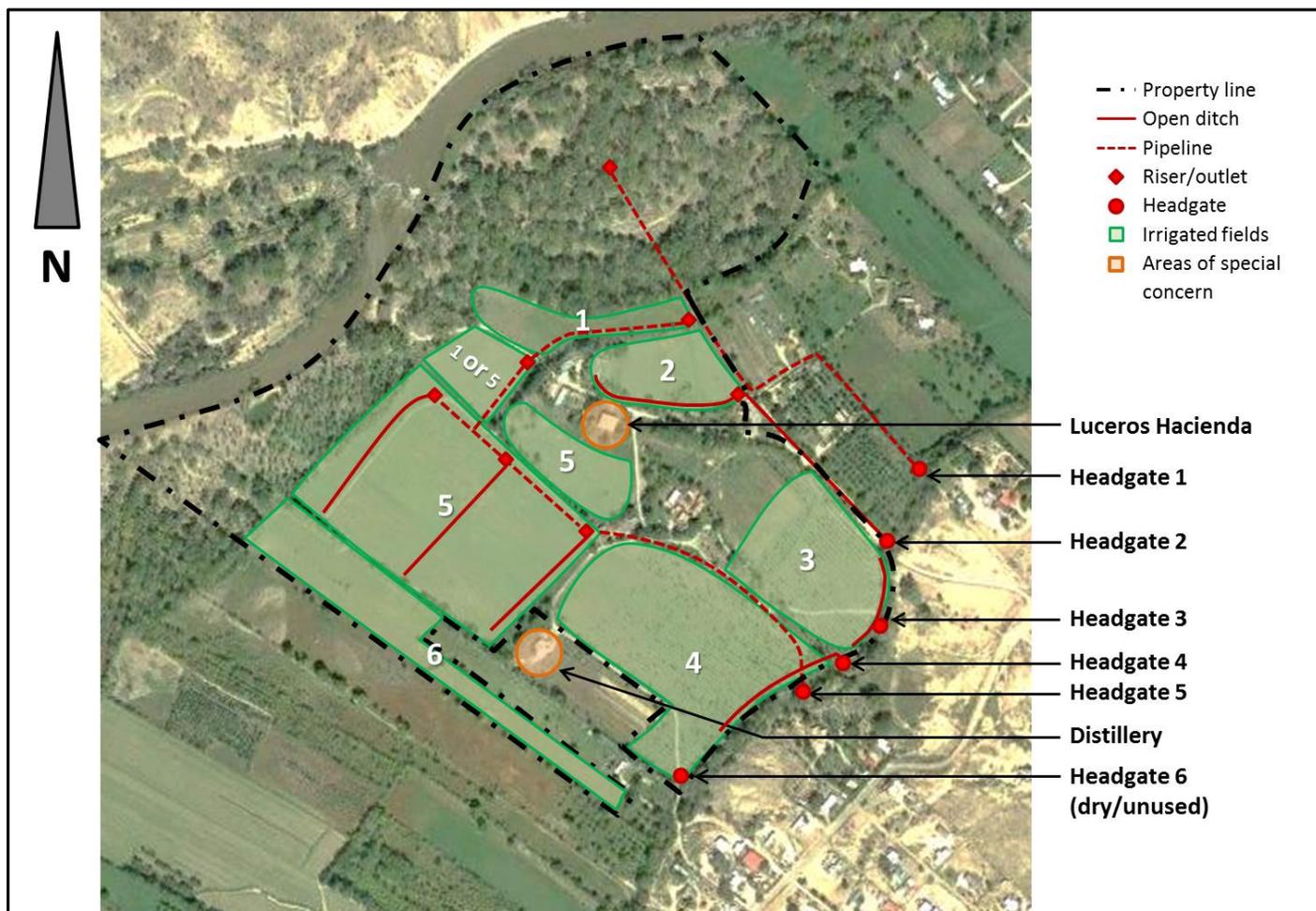


Figure 2. General map of Los Luceros showing irrigation related features.

### Headgate Area 1

**Size:** 12-14 inches

**Functionality:** Good

**Field size and cropping:** 2.6 acres currently mostly in oats, with a portion in an alfalfa/grass mix; alfalfa will follow

**Time to irrigate:** 3 hours

**Issues:** Water comes through a buried pipeline, which is shared with a neighbor. The location is not known for the entirety of the underground run. Additional risers could be added to supply other areas along the run.

**Comment:** A relatively small field with a single riser, a lateral ditch and soil and/or tarp dams turnout water into the field at various points. Labor must constantly monitor flow and adjust. In addition, the pipeline continues into the bosque where there is another riser, purportedly for fire control.

### Headgate Area 2

**Size:** 12-14 inches

**Functionality:** Good, recently repaired

**Field size and cropping:** 3.8 acres currently in oats, alfalfa next

**Time to irrigate:** 4 days (8 hour work days)

**Issues:** lack of water flow, shape of fields, drainage issues

**Comment:** Another relatively small field with a single riser, a lateral ditch and soil and/or tarp dams turnout water into the field at various points. Labor must constantly monitor flow and adjust. Part of the conveyance to the field includes a culvert that contains sediment blocking flow, a significant problem for irrigation time and labor efficiency. Also reported were organic matter accumulations that slowed infiltration in low spots in this field.

### Headgate Area 3

**Size:** 12-14 inches

**Functionality:** Good

**Field size and cropping:** 6.2 acres of apple orchard

**Time to irrigate:** 1 day (8 hour work day)

**Issues:** Approximately 20-30 minutes to irrigate each row, very labor intensive.

**Comment:** Orchard area directly west of acequia with approximately 24 rows of trees. Furrows have been cut on each side of each tree row. One to two rows (2-4 furrows) are run simultaneously for 20-30 minutes before moving to the next rows. Although the furrows allow more control of water and greater ability to get water to the end of tree rows, open ditch watering requires much labor for watering fields because of continually breaking and remaking dams in the lateral ditches. More surface ditch gates could improve labor efficiency. Gated pipe or other systems are a more expensive option, but could also greatly increase labor efficiency.

### Headgate Area 4

**Size:** 12-14 inches

**Functionality:** leaks; approximately 1-inch pipe worth of water flow when shut off

**Field size and cropping:** 14.2 acres apple orchard

**Time to irrigate:** 2 days (8 hour work days)

**Issues:** similar to Headgate Area 3

**Comment:** A larger orchard area than Area 3, but the same irrigation technique is employed here.

### Headgate Area 5

**Size:** 12-14 inches

**Functionality:** Good

**Field size and cropping:** 22.2 acres irrigated grass/alfalfa field (includes current goat and sheep pasture near Hacienda building)

**Time to irrigate:** 1 day (8 hour work day); Very easily watered

**Issues:** Some leveling issues to correct direction of flow in area adjacent to bosque.

**Comment:** An underground pipeline runs beside or underneath Area 4 and then has outlets at 3 risers along the north side of Area 5. Each riser fills a lateral, which then distributes water across the field. While farm staff noted that this is the most easily watered field, gated pipe could potentially reduce time and effort on this field.

Although some open ditch metal gates are in use at Los Luceros, labor efficiency would increase if more were obtained and installed. For a more elaborate option, in almost all situations described

above, a gated pipe system should improve overall irrigation labor use efficiency, allowing staff to attend to other needs. With the greater control of water that gated pipe affords, there may be some fields that can be irrigated overnight without the need for monitoring.

Soils in the area fit mainly into two mapping units: Fruitland sandy loam and the Abiquiu-Peralta complex (Fig. 3) (details of soil characteristics are below). Fruitland soils make up the majority of the orchard areas towards the southeast (Areas 3 and 4). These soils are sandy, deep and well drained, and could potentially hinder progress of irrigation water downfield. Abiquiu-Peralta complex—including areas of Sparham and Walrees soils—comprise the northwest area of the property as they approach the river (Areas 1, 2, and 5). These soils range from fine sandy loams to silt loams, and tend to be somewhat poorly drained, which can result in standing water in these fields. These soils also have a very low water holding capacity. More detail on soil conditions is provided by area below.

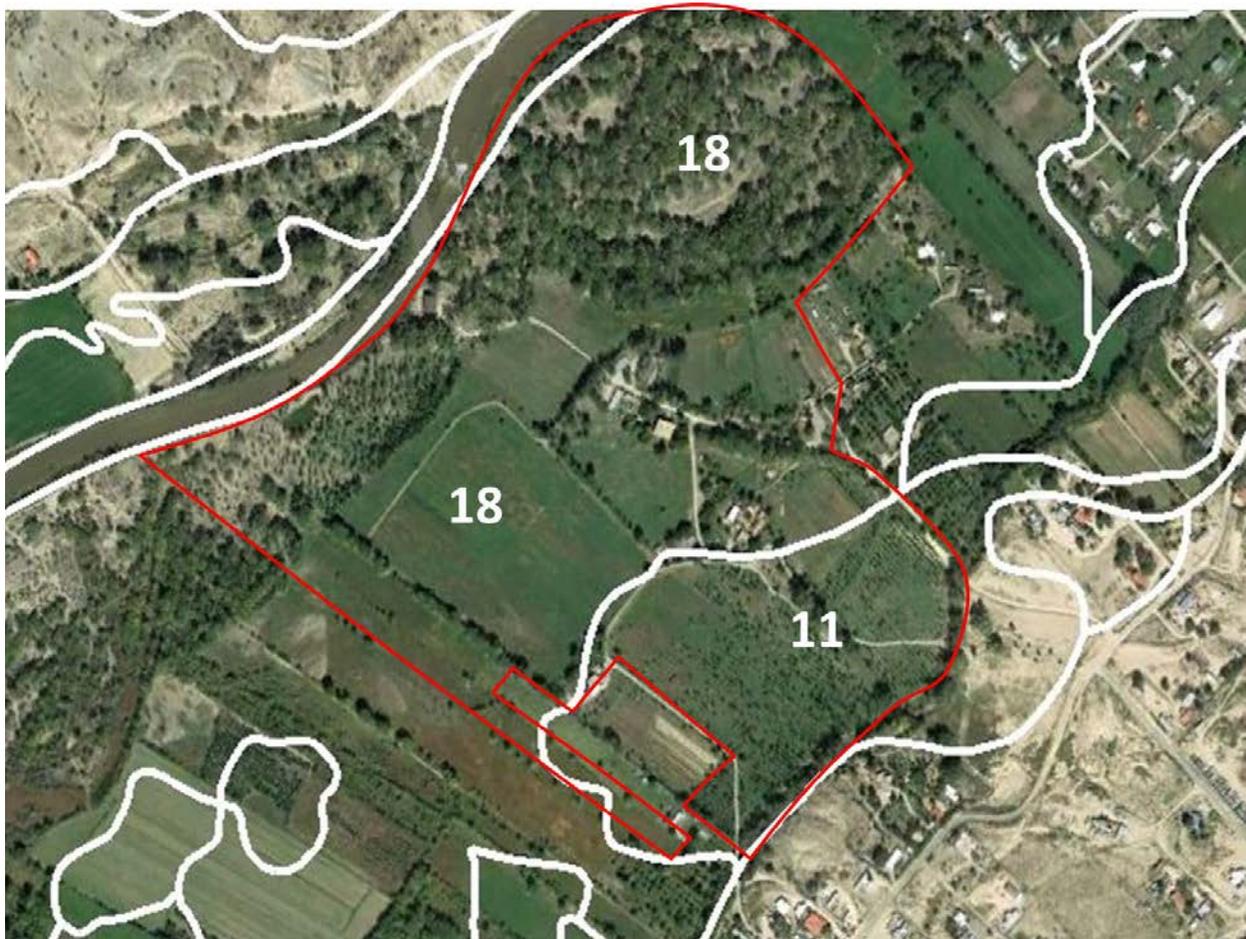


Figure 3. Soil mapping units for Historic Los Luceros and surrounding areas. Property Boundary in red, soil unit boundaries in white.

### **11—Fruitland sandy loam, 0 to 3 percent slopes**

Elevation: 5,500 to 6,000 feet (1,676 to 1,829 meters)

Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)

Mean annual air temperature: 50 to 52 degrees F. (10.0 to 11.1 degrees C.)

Frost-free period: 140 to 160 days  
Fruitland and similar soils: 85 percent  
Minor components: 15 percent

#### Component Descriptions

### **Fruitland soils**

Landscape: Uplands  
Landform: Alluvial fans, stream terraces  
Parent material: Stream alluvium derived from sandstone and/or fan alluvium derived from sandstone  
Slope: 0 to 3 percent  
Depth class: Very deep  
Drainage class: Well drained  
Slowest permeability: 2.0 to 6.0 in/hr (moderately rapid)  
Available water capacity: About 7.1 inches per 60-inch profile (moderate)  
Shrink-swell potential: About 1.5 percent (low)  
Runoff class: Very low  
Calcium carbonate average in horizon of maximum accumulation: About 8 percent  
Gypsum average in horizon of maximum accumulation: None  
Salinity average in horizon of maximum accumulation: About 2 mmhos/cm (nonsaline)  
Sodium adsorption ratio average in horizon of maximum accumulation: About 1 (slightly sodic)  
Ecological site: Sandy  
Potential native vegetation: blue grama, western wheatgrass, Indian ricegrass, bottlebrush squirreltail, dropseed, needleandthread  
Land capability subclass (irrigated): 2e  
Land capability subclass (nonirrigated): 7e  
Typical Profile: A—0 to 2 inches; sandy loam  
                  C—2 to 60 inches; sandy loam

### **18—Abiquiu-Peralta complex, 0 to 3 percent slopes**

Elevation: 5,500 to 6,100 feet (1,676 to 1,859 meters)  
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)  
Mean annual air temperature: 50 to 52 degrees F. (10.0 to 11.1 degrees C.)  
Frost-free period: 140 to 160 days  
Abiquiu and similar soils: 50 percent  
Peralta and similar soils: 40 percent  
Minor components: 10 percent

#### Component Descriptions

### **Abiquiu soils**

Landscape: Valleys  
Landform: Flood plains  
Parent material: Stream alluvium derived from sandstone  
Slope: 0 to 3 percent  
Depth class: Very deep  
Drainage class: Somewhat poorly drained  
Slowest permeability: 0.6 to 2.0 in/hr (moderate)  
Available water capacity: About 2.2 inches per 60-inch profile (very low)  
Shrink-swell potential: About 1.5 percent (low)

Flooding hazard: Occasional  
Seasonal high water table depth: About 24 to 48 inches  
Runoff class: Low  
Calcium carbonate average in horizon of maximum accumulation: About 8 percent  
Gypsum average in horizon of maximum accumulation: None  
Salinity average in horizon of maximum accumulation: About 1 mmhos/cm (nonsaline)  
Sodium adsorption ratio average in horizon of maximum accumulation: None (nonsodic)  
Ecological site: *Populus fremontii*/*Salix exigua*-*Salix*/*Carex*  
Potential native vegetation: Common trees: Rio Grande cottonwood; Other plants: willow, stretchberry, western wheatgrass, Brickellia, Woods rose, alkali sacaton, bottlebrush squirreltail, fourwing saltbush, inland saltgrass, mule's fat, sedge  
Land capability subclass (nonirrigated): 7s  
Typical Profile: A—0 to 4 inches; silt loam  
                  C1—4 to 8 inches; fine sandy loam  
                  C2 to C4—8 to 60 inches; stratified extremely cobbly extremely gravelly coarse sand to extremely gravelly sand

### **Peralta soils**

Landscape: Valleys  
Landform: Flood plains  
Parent material: Stream alluvium derived from sandstone  
Slope: 0 to 3 percent  
Depth class: Very deep  
Drainage class: Somewhat poorly drained  
Slowest permeability: 0.6 to 2.0 in/hr (moderate)  
Available water capacity: About 5.8 inches per 60-inch profile (low)  
Shrink-swell potential: About 1.5 percent (low)  
Flooding hazard: Occasional  
Seasonal high water table depth: About 24 to 36 inches  
Runoff class: Low  
Calcium carbonate average in horizon of maximum accumulation: About 8 percent  
Gypsum average in horizon of maximum accumulation: None  
Salinity average in horizon of maximum accumulation: About 8 mmhos/cm (slightly saline)  
Sodium adsorption ratio average in horizon of maximum accumulation: About 6 (slightly sodic)  
Ecological site: *Populus fremontii*/*Salix exigua*-*Salix*/*Carex*  
Potential native vegetation: Common trees: Rio Grande cottonwood; Other plants: giant sacaton, alkali sacaton, willow, fourwing saltbush  
Land capability subclass (nonirrigated): 7c  
Typical Profile: A—0 to 18 inches; loamy fine sand  
                  C—18 to 65 inches; stratified loamy sand to clay loam

### **Minor Components**

#### **Sparham and similar soils**

Composition: About 5 percent  
Slope: 0 to 3 percent  
Drainage class: Well drained  
Flooding hazard: Rare  
Ecological site: Salt Meadow

## **Walrees and similar soils**

Composition: About 5 percent

Slope: 0 to 2 percent

Depth to restrictive feature: 14 to 60 inches to strongly contrasting textural stratification

Drainage class: Somewhat poorly drained

Flooding hazard: Occasional

Ecological site: *Populus fremontii*/*Salix exigua*-*Salix*/*Carex*

## About the Authors

This report was prepared by James T. Peach, Regents Professor of Economics, Applied Statistics, and International Business at New Mexico State University and James D. Libbin, Associate Dean, College of Agricultural, Consumer and Environmental Sciences at New Mexico State University.

## Acknowledgments

The authors offer our genuine appreciation to the many individuals listed below who contributed to this report. Naturally, none of them are responsible for any errors. We also apologize to anyone who helped us and was inadvertently left off the list.

Richard V. Adkisson, Professor and Head, Department of Economics, Applied Statistics, and International Business, New Mexico State University

David J. Archuleta, Farm and Ranch Supervisor, Agricultural Science Center at Alcalde, New Mexico State University

Kevin Boberg, Vice-president for Economic Development, New Mexico State University

Garrey E. Carruthers, President, New Mexico State University

Steven J. Guldán, Professor and Superintendent, Agricultural Science Center at Alcalde, New Mexico State University

Kathryn Hansen, CEO Arrowhead Center, New Mexico State University

Gerald M. Hawkes, Department Head, Extension Animal Resources, New Mexico State University

Robert F. Heyduck, Senior Research Assistant, Agricultural Science Center at Alcalde, New Mexico State University

Claude J. Law, New Mexico Department of Cultural Affairs

Donald E. Martinez, County Extension Agriculture Agent, Rio Arriba County, New Mexico State University

Paul E. Romero, Farmer, Rio Arriba County

Richard Sims, New Mexico Department of Cultural Affairs

David Thompson, Director, Agricultural Experiment Station, New Mexico State University

Shengrui Yao, Assistant Professor, Plant and Environmental Sciences, New Mexico State University

# About Arrowhead Center

Arrowhead Center was created by New Mexico State University (NMSU) to be an engine for sustainable economic development, ultimately improving the quality of life for all New Mexicans. Arrowhead Center is accomplishing this by collaboratively facilitating the creation of an innovation-driven economy, where New Mexico's ability to convert ideas into marketable technologies, faster and better than the competition, will determine the pace of the state's economic growth. Generating ideas in bulk and leaving commercialization to chance is not sufficient to spur innovation. To accelerate our innovation economy, Arrowhead Center brokers the constant interplay between those in the market in search of solutions, innovative researchers, savvy entrepreneurs, eager students, educated employees, advanced facilities, and effective public/private partnerships. We are equipped to leverage innovation as an ongoing mechanism for promoting new business development and the job growth that goes with it.

Arrowhead Center serves as a single portal to link the researchers and entrepreneurs with ideas for how to solve market problems and take advantage of market opportunities that will keep New Mexico on the leading edge of discovery and sustainable economic growth. We help researchers turn scientific discovery into intellectual property. We offer services to enable entrepreneurs to turn these new, researcher developed technologies into viable businesses. We manage a 200-plus acre state-of-the-art Business and Research Park for these new technology start-ups to locate amongst other established businesses driven by the discovery of new knowledge and technologies. These businesses in turn hire well-educated employees in high-paying positions.

NMSU is laying the foundation for discovery and innovation in fields ranging from unmanned aircraft systems to alternative energy, and through our state network of universities and national laboratories, Arrowhead Center is connected to some of the best ideas and practices emerging throughout the nation. We aim to grow new technology companies, retain and expand the ones we have, attract still others from elsewhere, forge actionable alliances, broaden partnerships, and provide systematic, continuous and adequate assistance to the actors of our innovation economy. We hope you join us in our mission.

Additional information about Arrowhead Center is available at:

<http://arrowheadcenter.nmsu.edu/about-us>