NC STATE UNIVERSITY

SEREP

SOUTHEAST EQUINE RESEARCH & EDUCATION PARTNERSHIP

Progress Report II

Identifying Opportunities

February 2018

CONTENTS

EXECUTIVE SUMMARY

Introduction

The Southeast Equine Research and Education Partnership (SEREP) extends from a contract between North Carolina State University (NC State) and Isothermal Community College via a grant the latter received from the Appalachian Regional Commission. The project is designed to explore the feasibility and design of a multidisciplinary Equine Research and Education Center (EREC) where private industries and local and regional academic institutions can work in partnership on enhancing the regional equine-based economy. More specifically, a successful EREC would support the following community-identified needs:

- Develop a research, education, and training programs to support this burgeoning equine economy;
- Ensure a strong connection to the local community; and
- Provide the innovation necessary for sustained success.

Over an 18 month period beginning in March 2017, an interdisciplinary team of researchers from NC State is meeting with stakeholders across the area, researching comparable equine research and education facilities across the country, identifying the types of research, education, and training programs that a center could support, and generating physical design scenarios that would best fit the local area. The broader goals will be to determine opportunities for equitable and sustainable local development, to evaluate the potential for broader regional and international linkages, and to identify options for partnerships between local and regional institutions.

Summary of the July 2017 Progress Report

The July 2017 progress report shared our preliminary findings in each of the areas listed above. The contents represented knowledge derived through interaction with the local community members and stakeholder groups, key equine-connected organizations and businesses, and NC State University faculty and administrators. Key findings included:

Time, Place, and Identity:

- The Isothermal Region in the foothills of Western North Carolina has a long and rich history of equestrian economic, social and cultural activity. Primarily centered in Polk County, the equine economy extends eastward through Rutherford county, northwest to Buncombe County, and across the southern border of the state as far Greenville South Carolina. Notably, multiple economic analyses over the past few years have pointed to the strengths and assets of the Isothermal Region, as well as the challenges and opportunities for growth. In addition, the equine industry has deep roots in North Carolina as represented by a total economic impact to the state in 2009 of $1.9 billion and 19,183 jobs (The Rural Center, 2009).

Case Studies of Equine Research and Education centers around the country:

- Many universities have developed their equine centers close to their main campus, with the exception of situations in which the centers could be located in a region that affords access to opportunities specific to a region.

- Centers are funded from a variety of sources, including tuition from academic programs, revenues from rental of facilities for events, fees of boarding research herds used in extramurally funded studies, as well as donations by donors and appropriation of public funds.

- The funding of new centers is usually associated with the political influence and/or philanthropic support of high-profile alumni and community members. Horse ownership and interest in equine sports and events help foster relationships with key supporters.

Potential Research and Education Activities for the EREC:

- Pasture management; to include activities like hay production research, pasture erosion prevention, rotational grazing patterns, waste management research, forest canopy and pasture edge relationship, sustainable best management practices.

- Equine health sciences; to include equine vet-tech training facilities, hay and pasture sample testing lab, equine nutrition research, equine quarantine research, equine rehabilitation research and training.

- Community engagement, to include therapeutic riding research, event hosting, community educational programming, equine and pedestrian trail stewardship, interinstitutional equine training and education programs.

Preliminary Geo-Spatial Analysis of Potential Physical Sites for an EREC:

- Understanding that selecting a site will continue to remain an ongoing process, our preliminary site analysis has revealed that the Green Creek site followed by FENCE and the Henson Rd./ U.S. Hwy 221 site have the most ideal environmental conditions out of the five sites that were investigated earlier in the report. However, there are other non-environmental factors that must be accounted for in the next stage of this study, including potential partnerships, funding, program fit, potential for expansion beyond site boundaries, and community/stakeholder input. The information provided in this report is therefore preliminary and represents the initial phase of the site identification and selection process. Once the research and education activities are identified, it will be possible to evaluate how each site will be able to support those activities and the required spaces they demand. This will enable us to further identify the ideal site features and design the future EREC site.

Current Progress Report

The goal of this report was to advance our research and understanding in each of the areas that would contribute to a sustainable Equine Research and Education Center (EREC). A second and equally important goal is to help potential stakeholders understand the context and opportunities for an EREC that would attract potential public and private investors in academic (including NC State), research, industry, and commercial arenas. In summary, our findings point to the following:

1. Community Engagement

Listening to the multiple voices in communities across the region has allowed us to gain an understanding of the assets, opportunities, and challenges that will play a role in a future Equine Education and Research Center. Overall we have found that:

- The geographical location and conditions, deep roots in the equine tradition, and a network of supporting institutions are key assets that many believe can be leveraged for economic growth and job creation.

- The existing equine economy is seen as stable and broad throughout most of the region although many also believe that the prospects for large-scale economic growth resulting from the sector is limited. Relatedly, given that the equine culture in the two-county area lies more heavily in Polk rather than Rutherford, attracting people potential workers from the latter, more populous county, has proved to be a challenge. Notably, Isothermal Community College continues to its certificate and degree programs and has recently received funding to expand its physical plant to meet those educational needs.

- The region enjoys a core set of citizens and organizations, both horse lovers and non-equestrians, that care deeply about the area and support the equine industry and the benefits it brings. This civically engaged group may not always be obvious among the many stakeholders but nevertheless forms the foundation of what makes the area attractive to potential investors, and, can be mobilized to create new opportunities, including a potential EREC.

- While many community members appreciate and support the opportunities for growth in the area resulting from the presence of the Tryon International Equestrian Center, those views are accompanied by equally strong views that those opportunities must be balanced with the desire to maintain and enrich the character of the community, particularly the equine culture, and, the importance of creating opportunities that provide living wage jobs both within and outside the equine sector.

- The number of stakeholder institutions span both the government and private sectors, and, from our vantage point, are mostly anxious and willing to collaborate on bringing opportunity and investment to the area. This too is a plus for moving strategically towards an EREC.

- While North Carolina State University is unlikely to invest in a high-end medical and research facility, aOne Health research and education model, perhaps organized around the equine economy, holds great promise that we will continue to explore. In particular, a center that builds the capacity for equine assisted research and therapy has the potential for attracting national as well as international attention. Moreover, the prospect for an interdisciplinary research and education center may also be a more viable solution. Over the next couple of months, in addition to meeting with administrators and faculty in the more obvious areas of Animal Science and Veterinary Medicine, we will explore connections with faculty across all colleges of NC State University.

2. Feasibility Study

In regards to specific business activities:

- Breeding Services and Equine Appraisal and insurance stand out as the activities with the least attractiveness and human capital availability.
- Home and Barn Construction emerged as the most advantageous activity with relatively high local human capital.
- Hotels, Inns and B&Bs, as well as restaurants, bars and cafes were perceived as very advantageous but with need for improved human capital through education and training.
- Real estate is perceived as a business activity involving a capable few but it was perceived to bring modest benefits to the local community.

An examination of equine and non-equine education and research centers operating in the US and internationally revealed that these units were usually characterized as:

- Equine research centers integral to land grant universities, located close to a main campus and rely primarily on research funding and donations.
- Equine R&D centers owned and operated by industry focused on conducting research that is best kept away from the public view, and
- Engaged research and learning centers operated by universities and characterized by a great deal of involvement with local stakeholders and industry peers.
- Each type of center demands specific financial models relying on a combination of public fund appropriation, philanthropy of a donor network, research administration fees, and hosting of recreational and educational visitors.

Overall, these findings suggest that the long-term feasibility of a prospect research and education center would likely need to be based on:

- Initial sizeable investment of local and state funds for land acquisition and building;
- Academic institution investment of initial staff and subsidization of initial programming and administration;
- Donor support coordinated by a "friends of" group integrating the primary academic institution and possibly high-level local equine groups;
- Research administration fees from active research programs complementary to research conducted in the parent academic campus(es);
- Lodging, food and activity revenues earned from hosting Extension, engaged learning, and tourists/visitors.

3. Design Analysis

The key planning principles guiding the future EREC complex include:

- Identifying potential locations and sites with essential landscape characteristics in place.
- Achieving quality facilities on the site that will reflect the EREC's vision and its research and educational activities.
- Prioritizing sustainability that will minimize energy use and emissions, supporting sustainable land management for research, teaching, farming, natural areas, and other uses; and ensuring that land, facilities and activities work together to maximize knowledge transfer and positively impact local equine economy.
- Developing and promoting healthy environment, which may also represent One Health mission in support of well-being of researchers, faculty, students, visitors, staff, and horses.

Site Identification and Analysis Process:

- Easy access to state highway, proximity to local equine suppliers, proximity to population centers, availability of water source, cost of land, adequate size of land (min. 100 acres), relatively flat land, existence of wooded areas on-site, proximity to existing equine activities, and proximity to other equestrian and agricultural lands, existence of infrastructure in place, and good quality of soils are considered as important factors for the future location of the EREC complex.

- The SWOT analysis revealed that the FENCE followed by the Green Creek and the Henson Rd./U.S. Hwy 221 sites have the most ideal environmental and contextual conditions out of the five sites that were identified and evaluated.

Preferences

One of the primary driving planning and design principles of the future EREC complex includes but not limited to:

- Creating a strong image through site layout and its facilities' architectural characteristics that will also be a good fit to the region's character.
- There is a strong desire for having the rustic style and timber/wood buildings on the site that will be surrounded with pastures including substantial tree presence.
- Centralized facilities with larger building masses located away from the roadside are preferred.
- The future site should have appropriate amount of natural vegetation with more pasture/open spaces around the facilities.

SEREP Timeline

(From March 1st, 2017 to May 31st, 2018)	Apr-Jun 2017	Jul-Sep 2017	Oct-Dec 2017	Jan-Mar 2018	Apr-Jun 2018
Partnership Building					
Visits with stakeholders to clarify expectations, objectives, and action plans					
Collaboration and mutual learning with ICC faculty and students					
Community Engagement and Appraisal					
Secondary data gathering about local assets and local needs					
Participatory appraisal meetings with community and civic organizations					
Writing of technical reports and public information materials					
Feasibility study					
Interviews with local businesses and institutions about demand for services					
Interviews with institutional stakeholders about revenue sources					
Engagement with communities and local businesses to assess needs					
Writing of technical reports and public information materials					
Design Analysis and Development					
Analysis of the context; mapping assets; gathering stakeholder input					
Planning/design visioning workshop					
Development and evaluation of alternative plan/ design strategies					
Development and refinement of final physical development plan					
Writing of technical reports and public information materials					
Scholarship and future funding					
Production of reports, manuscripts and presentations					
Identification and application for additional funding opprotunities					


PARTNERSHIP
BUILDING
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The New Engagement Model for University: Community Engagement

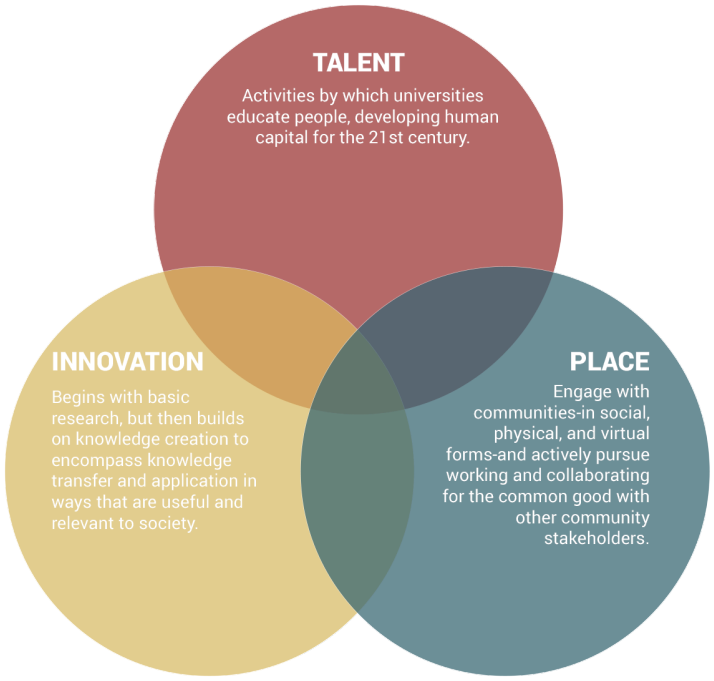


Figure 1: Talent - Innovation - Place (TIP Model)

NC State's University Outreach and Engagement (UO&E) office is committed to enhancing the extension and engagement mission of the institution through a number of strategies. Goal 2 of the 2016-2020 Strategic Plan is designed to "leverage the distinct assets of the university to realize opportunities that emphasize reciprocity, collaboration and strong partnerships". Accordingly, UO&E developed a University-Community Partnership (UCP) model in three geographically distinct regions of the state of North Carolina. The Isothermal region, and particularly Polk and Rutherford counties in Western NC includes rural, small town, and semi-urban areas, has a strong historical and cultural mix of agriculture (including equine) and industry, and is seeking to transition from stronger economies and a workforce based on these assets but has experienced considerable decline in recent years. The framework for NC State's UCP model (see below) is designed to engage local communities in a reciprocal process that builds on the talent in both the area and the university to develop new and innovative economic and workforce models that take advantage of the uniqueness of place. Accordingly, the Southeast Equine Research and Education Partnership, generated through the partnership between Isothermal Community College and NC State, is a major part of the Rutherford-Polk University-Community initiative. At its core, it seeks to take advantage of the talent and innovation of both institutions as well as the broader Isothermal region.

Principles of Engagement

Developing effective and reciprocal university-community partnerships requires an approach that is shared and transparent among all stakeholders. From the beginning of the SEREP initiative, our interdisciplinary team from NC State operated from an approach that emphasizes good data, strong scholarship, and an understanding that success would be greatly determined by how we adhered to the following principles of engagement:

1. Interdisciplinarity

Interdisciplinarity involves collaboration between two or more disciplines to achieve a common goal. Interdisciplinary research recognizes that many of the the complexities of the world are best approached using expertise from multiple fields, both academic and non-academic. Interdisciplinary approaches to research broaden opportunities and can offer creative solutions to practical challenges by identifying insights that no single discipline may be able to provide alone. Although the primary disciplinary focus of SEREP is on equine science, we continue to explore opportunities across multiple disciplinary areas as they may contribute to the primary outcomes for a research and education center: economic and workforce development, enhancing community assets, and attracting investment.

2. Sustainability

In its simplest form, sustainability refers to the ability for something to withstand the test of time. As we have been exploring the feasibility of a future EREC , we are looking at how both the physical structures, as well as the economic and revenue generating model should be sustainable. Sustainability also refers to how well the center is embedded in the local and regional community and is environmentally-friendly, well planned, and well executed. Thus, our work has attempted to understand and learn as much about the people, businesses, places, and culture of the region.

3. Placemaking

Placemaking can best be understood from this quote by “Project for Public Spaces:”

“Many residents of small towns and rural communities care deeply about the future of their towns and they value their uniqueness and strong sense of community. At the same time, many of today’s rural communities face urgent challenges: How can they add jobs and support local businesses? How do they create a positive future for their kids? How can they most effectively utilize limited financial, human, and infrastructural resources?”

Accordingly, our approach has asked the question of how can placemaking be used to collectively reimagine and reinvent the already-existing equine-based historical, natural, and cultural assets of the communities in the region. Moreover, and consistent with what we have heard from citizens across the area, how can we create a place that will contribute to keeping young people in the area and attracting the talent pool to help rebuild the economy?

4. Community Wellbeing

Although not the direct focus of SEREP, sustainable and place-based community and economic development is successful to the degree to which it contributes to community wellbeing. Community wellbeing is defined as "...the combination of social, economic, environmental, cultural, and political conditions identified by individuals and their communities as essential for them to flourish and fulfill their potential" (Wiseman & Brasher, 2008). In other words, and similar to the principles listed above, our hope is that an EREC will be sustainable, achieve placemaking goals, and contribute to the overall wellbeing of communities in the Isothermal region and the citizens who live within them.

Figure 2: Community Well-being and its components
(Source: http://www.npsp.sa.gov.au)

COMMUNITY ENGAGEMENT and APPRAISAL

Summary of Engagement Activity

Over the past few months our NC State Team has engaged a number of individual and organizational stakeholders in the local (Polk and Rutherford counties) and regional (Isothermal and equestrian-economy) areas. Our local engagement efforts, which included a series of two to five day visits over the last 10 months, have allowed us to meet with stakeholders and experience the culture and explore the history of the area. We have had formal and informal conversations, interviews, and focus groups with a variety of community residents, as well as representatives from groups and agencies listed in the List of Engaged Stakeholders table below.

In addition, we have sought to identify and gauge the interests of the potential higher education institutions and how they may intersect with an Equestrian Research and Education Center (EREC). We are in the process of sharing the information we have collected thus far with administrators and faculty at NC State University and have continued discussions with Isothermal Community College. And finally, in recognition of the fact that an ideal and sustainable EREC model should also be able to serve the needs of the equestrian communities throughout the state of North Carolina, we have met with representatives from other equine programs and veterinary clinics in Wake and Guilford counties, as well as the North Carolina Horse Council. We will be reaching out to others in the Isothermal region over the next couple of months as well.

Isothermal Region	Educational Institutions
• Citizens of the Isothermal region (individuals) • Foothills Equestrian and Nature Center (FENCE) • Isothermal Council of Governments • Isothermal Planning and Development Commission • Isothermal Community College • Polk County Government • Polk County Tourism Development Authority • Polk County Extension • Polk County Schools • Rutherford County Extension • Rutherford County Schools • Rutherford County Government • T. C. Hilton Foundation • Tryon Equine Hospital • Tryon International Equestrian Center (TIEC) • Tryon Horse Country, Horse Country Promotions • Tryon Riding and Hunt Club Non-Isothermal Locations Visited CORRAL Riding Academy (Cary) Helping Horse Therapeutic Riding Program (Raleigh) NC Horse Council (Raleigh)	• NC State University College of Agriculture and Life Sciences Office of the Dean Animal Science NC Cooperative Extension College of Design Landscape Architecture College of Humanities and Social Sciences Applied Social and Community Psychology Communication College of Natural Resources Office of the Dean Parks, Recreation and Tourism Management College of Veterinary Medicine Office of the Dean Equine Primary Care Equine Surgery Office of Partnerships and Economic Development University Outreach and Engagement • Isothermal Community College Office of the President Academic and Student Services Business Sciences Community Workforce Development • Clemson University Therapeutic Equine Recreation • University of Tennessee Animal Science

The List of Stakeholders Engaged

In addition, we have sought to identify and gauge the interests of the potential higher education institutions and how they may intersect with an Equestrian Research and Education Center (EREC). We are in the process of sharing the information we have collected thus far with administrators and faculty at NC State University and have continued discussions with Isothermal Community College. And finally, in recognition of the fact that an ideal and sustainable EREC model should also be able to serve the needs of the equestrian communities throughout the state of North Carolina, we have met with representatives from other equine programs and veterinary clinics in Wake and Guilford counties, as well as the North Carolina Horse Council. We will be reaching out to others in the Isothermal region over the next couple of months as well.

Community Engagement Findings

Four main themes emerged from our observations, meetings, interviews, and conversations with individuals and groups across the local and regional communities. These are summarized below as assets, needs, opportunities, and challenges.

a) Assets

Environmental - The natural beauty and climate of the region has been repeatedly highlighted by many who live in the area, as well as those from the outside. Thousands of acres of natural resources in Polk and Rutherford counties, as well as the surrounding counties in North and South Carolina, have been protected by the Carolina Mountain Land Conservancy and the Pacolet Area Conservancy since the late 20th century (Rayner, 1994; Reinhard, 2017). These resources include rare plant and animal species (Padgett, 2006; Conserving Carolina, 2017), as well as water and soil conservation efforts. Appreciation for this natural beauty has led to the creation of at least 16 individual trails in Polk County (Polk County Parks and Recreation, 2017), 29 individual trails in Rutherford County (Rutherford Outdoor Coalition, 2017), and an estimated 125 - 150 miles of trails maintained by the Foothills Equestrian Trail Association (Foothills Equestrian Trails Association, 2017).

Additionally, the counties' unique location in the Isothermal region of the North Carolina foothills results in a temperature inversion that causes mild weather year-round. Some community members have also cited the weather as one reason for emigration into the region and as a possible factor in the local establishment of the Tryon International Equestrian Center (TIEC). Lastly, the quality of the land and climate has allowed for diversified options for the development of EREC that could serve the needs of both Polk and Rutherford Counties, as well as the larger equine-economic region.

Economic - The Isothermal region is also broadly connected to the mid-Atlantic area of the southern United States and includes three international airports, five interstate highways, and two railroads, rendering it highly accessible both domestically and internationally. The town centers of Rutherfordton, Columbus, Tryon, and Saluda are becoming increasingly revitalized and attracting local and tourist dollars to enjoy the regional art, music, dining, and shopping (REF). The region's natural resources (e.g., Chimney Rock, Lake Lure, and the state forests and gamelands) have a long history of drawing national and international visitors. The beer brewing and distilling industries are on the rise and complement the existing wineries and farmer's markets that sell local products. Family and child-friendly activities are also highly valued in the region, as evidenced by the numerous events at the Foothills Equestrian and Nature Center (FENCE), Saturday Night Lights at TIEC, and a youth-oriented history walk and a children's museum in downtown Rutherfordton, to name only a few. And finally, although mostly centered in Polk county, the business and recreation industries that support the equine industry is broadly represented in both North Carolina and South Carolina. The economic contributions and opportunities related to this industry are more fully explored later in this document.

Institutional - Polk and Rutherford Counties have numerous institutions interested in supporting community members and development. The public education sector from elementary through high school is working to develop programs that provide educational opportunity that respond to to changing economic opportunities in the region. This includes STEM education programs within the High Schools and the equine-related job training programs being offered and developed by Isothermal Community College's (ICC). Institutional assets also includes, however, the work done by the North Carolina Cooperative Extension offices in both Polk and Rutherford County. The agencies offer services that are dedicated to providing agricultural assistance, 4-H youth development, and family and consumer sciences. In addition, the equine industry has numerous institutions devoted to it including a number of businesses that provide products and services (see Feasibility section below), a high quality veterinary hospital, and the educational, social, and entertainment contributions of numerous equine-centered organizations (e.g., FENCE/TROT, TIEC, the Tryon Riding and Hunt Club, etc).

Civic Participation - One of the key indicators of a healthy community is the degree to which local residents feel a sense of attachment to the area and are involved in maintaining its desired characteristics and contributing to its growth (Cordes, et al., 2003; Choi, et al., 2015) . In the isothermal region, dedicated and engaged community members have fostered relationships across county, state, and international lines. Many citizens are working hard to maintain an atmosphere described as "small-town friendly" while cautiously taking advantage of the attention and development being driven by TIEC and the World Equestrian Games. Moreover, when asked about the prospects for an Equestrian Research and Education Center, many community members involved in the equestrian life expressed their desire to see it preserve and promote the long standing equine history and culture, as well as the infrastructure of land conservation, in ways that can also stimulate jobs and growth.

b) Needs

Despite the numerous assets in the Rutherford and Polk county areas identified above, several community members suggested it would be good to conduct a similar inventory throughout the larger equine region that includes the Greenville/Spartanburg areas of South Carolina and adjacent counties in North Carolina. Nevertheless, the needs reported included those related to a significant shortage of skilled farm labor in both equine and agriculture as well as the burgeoning hospitality arena, the limited education and job training opportunities in all of those areas, and employment services to connect people with those jobs. In the areas of research, waste management (horse), biofuel production, pasture and management, and forage development that is specific to the climate and soils of the region were mentioned among the top needs. And finally, an improved tourism infrastructure was also mentioned as something that could greatly improve the economic prospects and job creation in the region. It should be noted that many of these needs were consistent with the recent local and regional reports from a variety of sources mentioned in the first SEREP progress report (Carolina Foothills Chamber of Commerce, 2012; DeBellis & Homes, 2016; NC Isothermal Region C Economic Development Plan, 2017; Polk County Board of Commissioners, 2010).

c) Stakeholder Identified Opportunities

Despite the numerous assets in the Rutherford and Polk county areas identified above, several community members suggested it would be good to conduct a similar inventory throughout the larger equine region that includes the Greenville/Spartanburg areas of South Carolina and adjacent counties in North Carolina. Nevertheless, the needs reported included those related to a significant shortage of skilled farm labor in both equine and agriculture as well as the burgeoning hospitality arena, the limited education and job training opportunities in all of those areas, and employment services to connect people with those jobs. In the areas of research, waste management (horse), biofuel production, pasture and management, and forage development that is specific to the climate and soils of the region were mentioned among the top needs. And finally, an improved tourism infrastructure was also mentioned as something that could greatly improve the economic prospects and job creation in the region. It should be noted that many of these needs were consistent with the recent local and regional reports from a variety of sources mentioned in the first SEREP progress report (Carolina Foothills Chamber of Commerce, 2012; DeBellis & Homes, 2016; NC Isothermal Region C Economic Development Plan, 2017; Polk County Board of Commissioners, 2010).

North Carolina State University - Many stakeholders in the region have expressed a strong interest in fostering a greater NC State university presence in the area. At this point in the SEREP project, It is our view that EREC presents an opportunity for creating a mutually beneficial relationship between NC State and the local communities and have identified multiple research platforms to this end. Although one possibility (and desired by several) is a high-end medical research facility that would be an extension of the College of Veterinary Medicine. For a variety of reasons, and after exploring the possibility with faculty and administrators at the university, this scenario is highly unlikely.

Another option, however, and one that has been initially met with more enthusiasm, is a facility dedicated to equine assisted research and therapy, one of our more interesting and innovative discoveries. In addition to the services offered in the are by FENCE/TROT (REF), many local and statewide professionals (CORRAL, Helping Horse-REF) have pointed to the growing need for research on the effectiveness of different therapeutic techniques, the populations who can most benefit, and the training of both horses and humans. Currently there are an abundance of equine assisted activities and therapy being used worldwide, with little quality research conducted on their benefits. In addition, the equine therapy industry does not have a strong presence in the United States (REF) and most of the more consolidated research and training centers are located in Europe (REF). Given the strength of the local equine community and culture in the region and state, the opportunity for equine therapeutics to be a centerpiece of an EREC is one we believe stakeholders should seriously consider, and, we will continue to explore.

Relatedly, another research vision that also holds promise is an interdisciplinary and holistic One Health program model devoted to studying interactions between all members of an ecosystem (equine, human, plant, etc.) in order to promote health and wellness. Indeed, a version of this model already exists at NC State University (NC State Veterinary Medicine, 2017). Although we are unaware of such a model that is based in equine, this type of research could include examining the best forage for horses and to maintain the natural ecosystem of the region, the interaction between horses and humans, and best practices for maintaining ecologically and financially sustainable farms and businesses. In addition, the One Health model would create a unique focus that distinguishes it from other equine centers in the southeast such as those in Kentucky and Florida.

In the short run, NC State Extension, and perhaps with support from the local communities, should strongly consider adding an agent who specializes in equine-related services, a request that was highlighted on multiple occasions by extension staff in Polk County and the Western Region, as well as several horse and farm owners in the region. The needs that this extension specialist would assist with include education in horse health and emergency medical training, equine geriatric care, colic prevention and treatment, equine dental care, hoof care, equine nutrition, parasites, and farm management.

Summary of Community Engagement Activities

Listening to multiple voices has allowed us to gain a more comprehensive understanding of the existing assets and opportunities in the region that will ultimately determine the viability of an EREC. We believe this work has also contributed to the ongoing efforts to identify, articulate and address the current and forthcoming issues they deem important. Overall, we have found that the geographical location, deep roots in the equine tradition, institutional infrastructure, and civic engagement of its citizens provides a strong foundation on which to build an EREC or comparable new and innovative resource for generating jobs, growing the economy, and serving the research and education needs of the equine community. Although the initial desire for a major presence in the area by NC State University has been less viable, we remain optimistic about the option of the university pursuing a more interdisciplinary, yet still equine-centered investment. Moreover, in addition to the community engagement work, our team has been enumerating and examining various other avenues that might support the long term feasibility of an EREC. The following section reports findings from the perspectives and insights we collected from local entrepreneurs, business owners, and managers, operating in the local equine economy, a review of a variety of secondary data collected, and via the input of equine faculty from various institutions in the broader region.

FEASIBILITY STUDY

Examination of Equine-Based Business Sector Attractiveness

The long term feasibility of a prospect equine research and education center in the NC Foothills region depends on the center's ability to serve as a catalyst for the local communities' economic development ambitions. Accordingly, in October 2017, the SEREP research team created and administered an on-line survey, aiming at learning the opinions of the local business community on the scope of work and design of a possible university-led center devoted to helping the Foothills region leverage the growing local equine-based economy. In particular, this survey targeted community members involved in and/or cognizant of the various business subclusters in the local equine-based economy. The participants were inquired about which equine-based business activities were likely to bring the most benefits to their counties. In this context, we asked them to rate each of the business activities listed below according to four indicators:

1) Local availability of human capital - the amount of knowledge, talent, and skills their county has to advance each business activity;

2) Potential to create and support jobs - the potential of each business activity to create and support jobs for residents in their county;

3) Potential to attract investment - the potential of each business activity to attract investment of financial capital for economic development initiatives in their county;

4) Potential to support new local small businesses - the potential of each business activity to generate new local small businesses in their county.

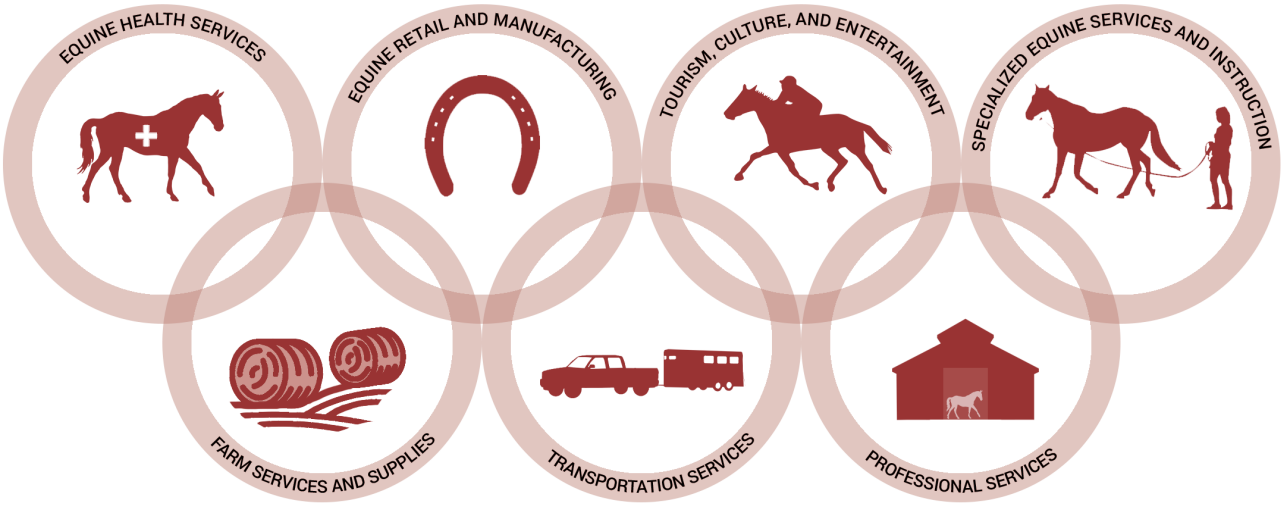


Figure 3: Equine-based business subclusters

According to Porter (2000), a business cluster is a "geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities" (p. 16). This concept helps us understand the complex relationships and social dynamics that link seemingly disparate businesses into a competitive economic sector, as is the case with the equine industry in the NC foothills. We used Garkovich, Brown, and Zimmerman's (2008) equine economic cluster model observed in central Kentucky as the starting point for the categorization of equine-based business activities. Then we refined the categories using input from stakeholders and from our team's fieldwork observations and interviews. The final equine-based business cluster model is illustrated in Figure 4.

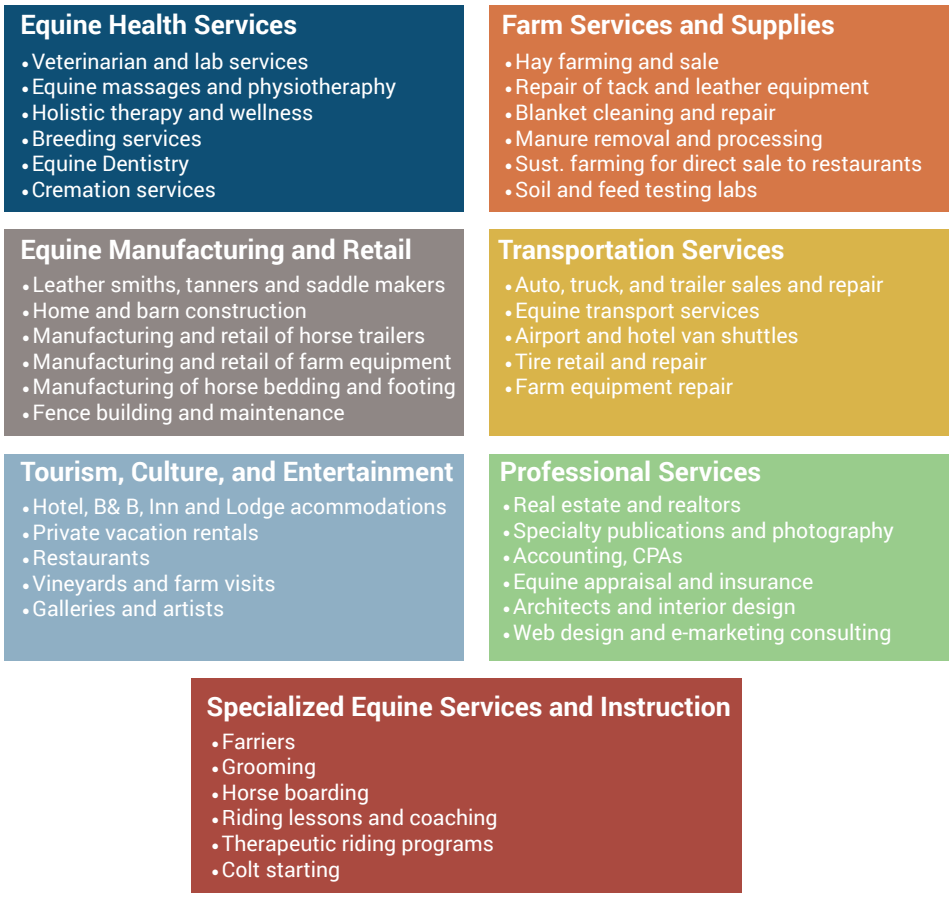


Figure 4: Equine-based business subclusters in the NC Foothills

The research team collaborated with key equine community leaders as well as with stakeholders from county-level economic development, chamber of commerce and tourism in Polk and Rutherford Counties to assemble a comprehensive list of equine-related businesses located in the region. Inspection of the list revealed that some subclusters were underrepresented, for which we used web searches to garner additional contacts and ensure that all subclusters were represented in our sample. The final database of equine-related businesses in the NC foothills region was comprised of 340 businesses.

Upon obtaining institutional approval to conduct the online survey (IRB #12355) the team administered the survey online using Qualtrics web application. The survey was first pilot tested with the team members for a quality-check. After receiving the results of pilot-testing, the team decided on the specific dates and times for the official administration of the survey with the study sample. The first email invitation to participate in the survey was sent on Thursday September 28th, with reminders sent the following Monday October 2nd, Thursday October 5th and Monday October 9th.

We closed the survey on Thursday October 12th, at which point we had received a total of 85 responses, yielding a response rate of 25.0%. We expected a higher response rate because of the relevance of the study topic to our target sample; however online survey research is now often yielding similar or lower response rates (Groves, 2011) and the findings seem consistent with our field observations as well as with follow-up checks with key informants which makes us confident of the validity of the study findings.

Local Business Community Sample

The majority of respondents said they resided in Polk County (42%), followed by Rutherford County (17%), and Spartanburg County (13%). A significant slice (28%) reside in neighbouring counties within North Carolina and also across the state line in South Carolina. Except for one participant who claimed to be a frontline staffer, all the remainder participants were either owners of a business or held managerial positions within the ranks of a company. This particular owner/manager perspective was deliberately sought by the research team, given that these individuals are likely to have a more nuanced perspective on the economic development potential of the region.

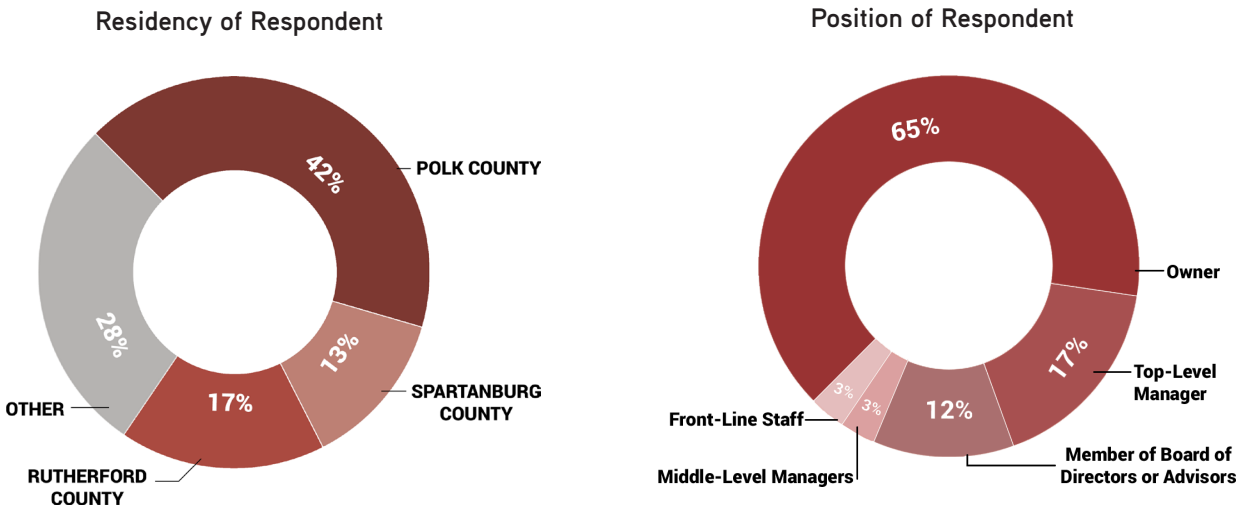
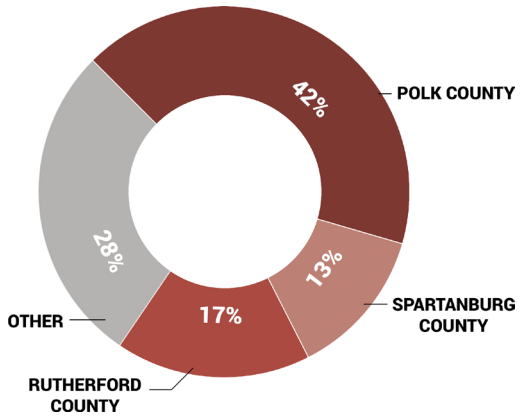


Figure 5: Local residence and management position of participants

When it comes to the location of the businesses, they were mostly from Polk County (42%), Rutherford County (17%), and Spartanburg county (13%). The businesses ranged from 0 employees (single owner/manager business) to 200 employees, with a mean of 6.4 and a median of 2 (the business with 200 employees was considered an extreme outlier and thus not accounted for in descriptive analysis). The most represented subclusters were professional services (15), followed by Equine services (14), and Tourism, culture and entertainment (12) (refer to the histogram). Farm Services and Supplies and Transportation services were not represented in the sample, albeit businesses in these subclusters were included in the original sample of contacts. A sizeable portion of businesses surveyed (15%) appear to offer services or products encompassing more than one subcluster (refer to the pie chart). In the future, it would be interesting to examine if this is a deliberate business strategy of local entrepreneurs reflecting diversification or the flux caused by a transitioning and rapidly changing local economy.

Location of Business



Representation of Equine Clusters

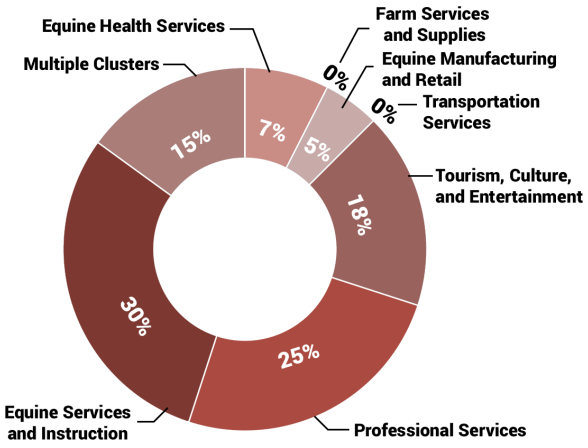
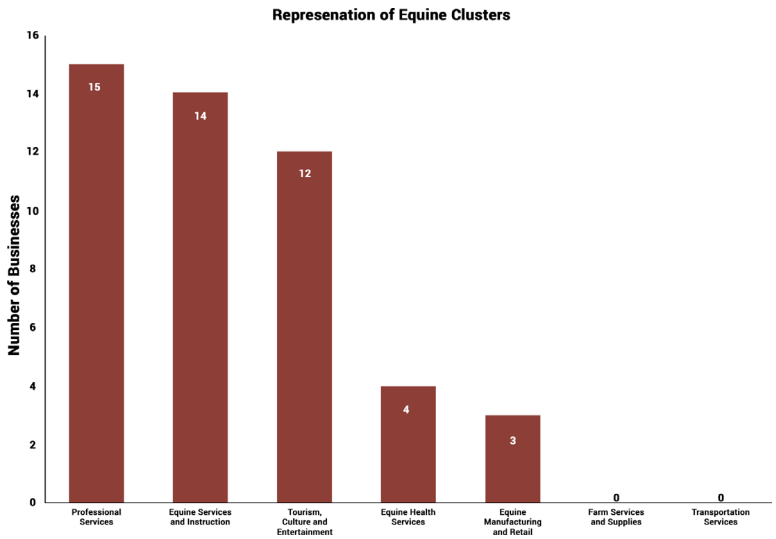


Figure 6: Location, size and type of businesses surveyed



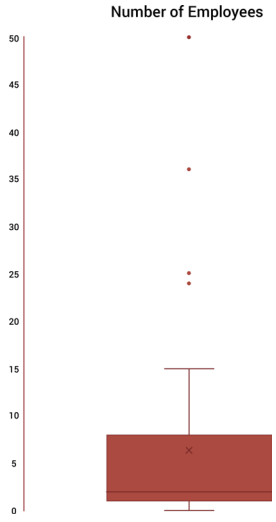


Figure 7: Types of businesses surveyed

The Business Cluster Optimization Matrix

The goal of this section is to help identify the potential impact of different equine-related economic activities in the region and provide insight to strategies that would privilege the development of activities more beneficial to the community, and regulate activities that might be yielding benefits of just a few residents or mostly for outsider investors or organizations.

There is an established convention of viewing aspects of an economic actor's performance in terms of its position in a matrix. This convention has been developed by a number of highly credible organizations, including the Boston Consulting Group (BCG) and the General Electric Company (GE). Matrix representations allow economic actors to be viewed in terms of their performance on two measures, and also in terms of the interaction between those measures (Thacker & Handscombe, 2003). For this study we developed a 3x3 matrix (an adaptation of the GE matrix to the context of community development) plotting local availability of human capital in the y-axis and advantage for the community on the x-axis. In Figure 8 we indicate what kinds of strategic actions are advised for business activities falling in the various cells.

Relative Business Cluster Opportunities

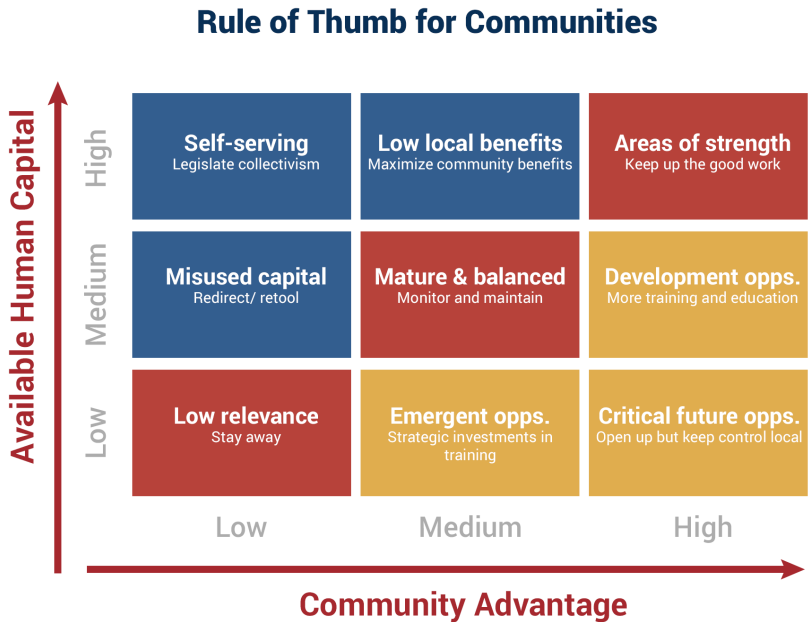


Figure 8: Business Cluster Optimization Matrix

In order to measure the economic potential of the different business subclusters, we asked the respondents to rate 40 business activities according to four criteria:

1) Local availability of human capital (i.e., the amount of knowledge, talent, and skills your county has to advance each business activity);

2) Potential to create and support jobs (i.e., the potential of each business activity to create and support jobs for residents in your county);

3) Potential to attract investment (i.e., the potential of each business activity to attract investment of financial capital for economic development initiatives in your county);

4) Potential to support new local small businesses (i.e. the potential of each business activity to generate new local small businesses).

We used an ordinal scale with three anchors for the effect, namely "1=low", "2=medium", and "3=high" to plot the first dimension against a composite of the remaining dimensions, to which we called "community advantage". The resulting plot (Figure 8), centered around the intersection of factor means, reproduces the Business Cluster Optimization Matrix above, with each cell having a height and width of 2 standard deviations. The bar chart illustrates the average ratings each business activity received from the sample. The business activities are listed in decreasing order of the advantage they are expected to bring to the community.

In Figure 10 [the scatter plot] each subcluster of business activities is represented by a different color, with numbered circles representing all the business activities (a color-coded legend is provided). The analysis reveals that Professional Services is the subcluster with the lowest availability of local human capital and also the type of business that is perceived to bring the least benefit to the local communities. Conversely Tourism, Culture and Entertainment emerge as a very attractive business subcluster with a moderate availability of local human capital. One should stress what appears to be a positive linear relationship between these two dimensions, which indicates that, at least in the eyes of the respondents, the higher the subcluster attractiveness the higher the availability of human capital or vice-versa (no implied causal relationship). Also, pairwise, values of human capital are consistently lower than attractiveness for any given activity or subcluster, which might indicate that there is a general perceived need to improved human capital, justifying further investments in education and professional training.

In regards to specific business activities, Breeding Services and Equine Appraisal and insurance stand out as the activities with the least attractiveness and human capital availability. These and other activities proximal to them in the matrix denote low importance to the region's equine-based economy, and should be maintained at baselines.

On the other side of the spectrum, Home and Barn Construction emerged as the most attractive activity, and there is a perceived high availability of local human capital for the activity. This is consistent with field observations suggesting that the the region has a long equine tradition and a healthy horse farm and estate history; in addition, it was noteworthy to observe that the Polk County school system has a high-school home construction program that enables local youth to get started as contractors or to be more competitive when seeking civil engineering university degrees.

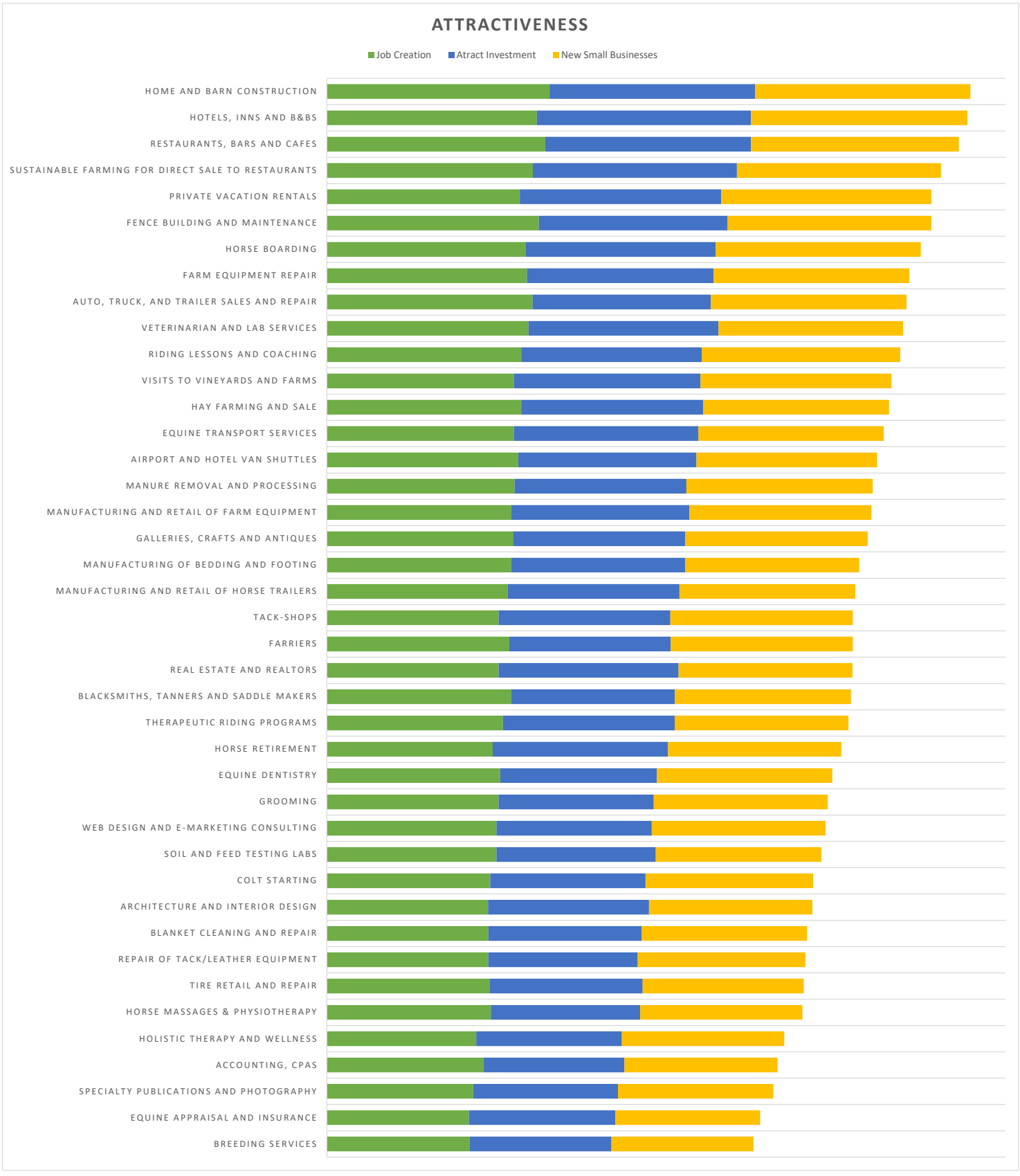
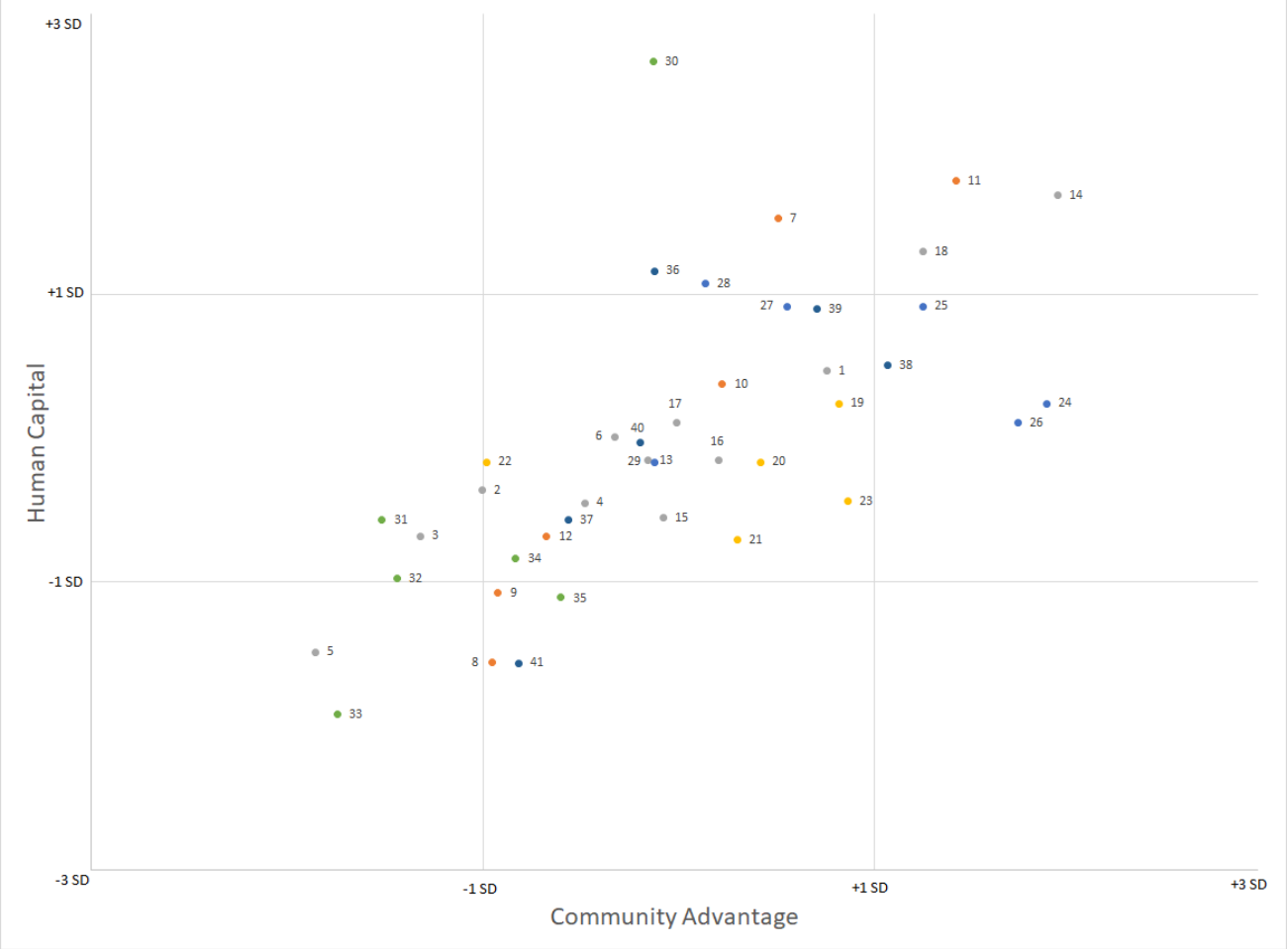


Figure 9: Attractiveness of equine-based activities

Hotels, Inns and B&Bs, as well as restaurants, bars and cafes, are deemed business activities with great potential to bring benefits but they show comparatively lower levels of human capital available. Accordingly, we commend the Isothermal Community College for attempt to close this human capacity gap through offering the Hospitality & Tourism Institute, which prepares local youth for hospitality careers. In addition, the findings suggest that appropriate tourism service and entrepreneurship educational programs might need to be developed in the local school systems.

Real estate and realtors business activity was identified as the business activity with the highest availability of human capital, but it was deemed as bringing modest benefits to the local community: therefore local stakeholders should explore policies that mitigate negative impacts of real estate development and retain benefits locally.



Legend:

Equine Health Services:
1 Veterinarian and lab services
2 Horse massages & physiotherapy
3 Holistic therapy and wellness
4 Equine dentistry
5 Breeding services
6 Horse retirement

Farm Services & Supplies
7 Hay farming and sale
8 Repair of tack/leather equipment
9 Blanket cleaning and repair
10 Manure removal and processing
11 Sustainable farming for direct sale to restaurants
12 Soil and feed testing labs

Equine Manufacturing and Retail Service
13 Blacksmiths, tanners and saddle makers
14 Home and barn construction
15 Manufacturing and retail of horse trailers
16 Manufacturing and retail of farm equipment
17 Manufacturing of bedding and footing
18 Fence building and maintenance

Transportation Services
19 Auto, truck, and trailer sales and repair
20 Equine transport services
21 Airport and hotel van shuttles
22 Tire retail and repair
23 Farm equipment repair

Tourism, Retail, Culture and Entertainment Services
24 Hotels, Inns and B&Bs
25 Private vacation rentals
26 Restaurants, bars and cafes
27 Visits to vineyards and farms
28 Galleries, crafts and antiques
29 Tack-shops

Professional Services
30 Real estate and realtors
31 Specialty publications and photography
32 Accounting, CPAs
33 Equine appraisal and insurance
34 Architecture and interior design
35 Web design and emarketing consulting

Specialized Equine Services
36 Farriers
37 Grooming
38 Horse boarding
39 Riding lessons and coaching
40 Therapeutic riding programs
41 Colt starting

Figure 10: Business Cluster Optimization Matrix applied to the NC Foothills equine-based economy

Examination of Equine-Based Research and Education Opportunities

The SEREP team examined a comprehensive list of fourteen equine and non-equine education and research centers operating in the US and internationally. The purpose was to learn from managerial best practices, ascertain how the specific topic of research relates to the local context, and understand how different centers generate revenue either by offering services to the public, through the administration of research grants or by securing endowments. In this report, we will report six of these centers, which we believe best represent the three categories that emerged from our research.

1. Equine research centers integral to land grant universities - These may tend to be close to a main campus and rely primarily on research funding for operation. Some considerations for a center like this would be the willingness of O -IED to use shared facilities funds to operate a new facility a few hours West of Raleigh; as well as the perceived need of NC State faculty to write such a center into major multi-year grants.

- Colorado State University Equine Science program
- Michigan State University

2. Equine R&D centers owned and operated by industry - We want to examine how much interest there might be from select equine companies, considering possible proximity to their headquarters, and ties to Tryon. Private research institutions seem to focus on applied research, and in research that is best kept away from the public view. Additionally, marketing and public relations are primary functions for these facilities owned by feed and pharma companies.

- Purina Horse Research Farm in MO - Grey summit farm
- Kentucky Equine Research – Joe Pagan

3. Engaged research and learning centers operated by universities and with multiple user groups - These centers are characterized by a great deal of involvement from local stakeholders and industry peers, which may help local communities connect better with local natural resource economies (e.g., field ecology training programs).

- Wits Rural Facility in ZA
- David H. Murdock Research Institute in Kannapolis, NC

Benchmarks

Colorado State University

The Equine Sciences program is housed in the Foothills Campus, composed of three barns, an outdoor arena, multiple indoor stalls and outdoor pens, and two indoor arenas. One of them, the B.W. Pickett Equine Center is a $5.2 million, football field-sized, indoor facility with seating for 2,000 spectators, concession stands, ticket booths, a show office and crow's nest, faculty offices and a multimedia classroom, and a conference room. In addition, the program has the Temple Grandin Equine Center (projected), specifically focused on equine-assisted activities and therapy (EAAT). According to the website, research conducted through the center will provide a body of evidence that supports practice and education in EAAT, expands services to broader groups of people, and promotes horse welfare. The program collaborates with the College of Veterinary Medicine, which offers specialized training at the college's Equine Reproduction Laboratory and Orthopaedic Research Center.

Financial Model:
The facilities are primarily used for education and research purposes. In addition, third-party organizations provide EAAT programs and services, such as therapeutic horsemanship and hippotherapy. The program has several revenue-generating activities outlined in their outreach and engagement page. The program rents the facilities when they are not busy with research and education program. The Equine Orthopaedic Research Center is associated with high-level philanthropic contributions from university supporters - for example, the Malone family donated $42.5M for regenerative medicine research and services in 2014 because of their love of horses. In the same line, the Temple Grandin Equine Center is being partially funded through Naming and Endowment opportunities. In terms of research funding, Equine Orthopaedic Research Center declared 53 research accounts in fiscal year2012-2013, totaling $1,175,924 for the biennium, with the biggest contributor being the National Institutes of Health.

Image Credits Colorado State University http://tgec.agsci.colostate.edu/

Faculty Input:
The center was built by in the 60s, largely funded by the reproduction/breeding horse industry. It has a research part with a world class reproduction program, and a teaching part offering short courses where they train people. Despite generating considerable revenue, they have to pay overhead to the central administration. Overall, the center may not be very lucrative. Later, they created what is now a world-renowned orthopedic center for helping hurt horses recover. The center has strong ties with horse owners, which were forged by services to their horses. If researchers want to use the facilities and the horses, they have to build in costs into the research grant. The same applies to the education program, for expenses with barn managers and maintenance. University administrators are sympathetic with the center because it brings in big donations.

Michigan State University (http://www.msuarabians.com/facility.html)

The MSU Horse Teaching and Research Center (HTRC) is located on 100 acres, and consists of a show/training barn, a reproduction barn, 2 quarantine barns, a breeding shed, an indoor arena/classroom complex, and a storage shed. It is the site of the majority of the horse classes taught at Michigan State University, both in the Animal Science Equine Program and the Horse Management Program. The annual student sale is also conducted at the HTRC. The farm is also the site of many of the Adult Extension and Youth Extension programs at Michigan State University, as well as several ongoing projects of the Equine Research Lab. The horse facility has a long history of breeding purebred Arabians since the 1940's, and continues to use them in the teaching and research programs conducted at the center.

It is also home to the annual student-run horse auction. This auction is incorporated into the Animal Science and Horse Management programs, and give students the opportunity to experience all aspects of marketing, from horse preparation to sales ring design and advertising.

Financial Model:
At present, Michigan State is home to approximately 200 equine oriented students enrolled in both the two-year certificate-granting program offered by the Institute of Agricultural Technology Horse Management program and the Bachelor of Science degree offered by the Animal Science Department.

The Endowment for the Preservation of the Arabian Breeding Program at MSU was established by an organization called "Friends of The MSU Horse Teaching and Research Center", and is supported by membership dues and annual fund raising activities, including the annual MSU Friends Arabian Horse Show conducted on campus at the MSU Pavilion.

Every year, horses bred at the center are auctioned off at the The MSU Spartan Spectacular Arabian Horse Auction. Within the student-engaged enterprise system, students work with a horse then get a slice of the sale when the horse is auctioned off.

Faculty Input:
A referendum was passed during the early nineties passed with the support of the horse industry. It is primarily an educational facility, which enables the center to be financially supported through the legislature. However, there is limited involvement by the Veterinary school, which may limit the center's ability to generate revenue.

Image Credits: Google Maps

Purina Horse Research Farm in Missouri

This facility houses more than 70 horses, ranging from newborn foals to senior horses, including a group of rescued off-the-track Thoroughbreds used in exercise physiology research. Over the years, their in-house nutrition research has led to the creation of a number of new products and patents on feed and manufacturing processes.Purina's nutritional research generally falls into the following categories: growth and development, digestive physiology, exercise physiology, palatability and intake behavior, and life stage investigations.

Financial Model:
Research is financed by the commercial branch. In most cases, they utilize their own herd of horses to conduct their studies, but they also partner with university equine research programs with specialized capabilities for particular projects.

Faculty Input:
Purina develops and sells many kinds of animal feed. Purina does product development and research in this facility, but the primary function of the facility is marketing. Accordingly, the company brings in groups of customers and vets. Given that are the source of recommendations and advice for most horse owners, they strive to make them feel they are the only company that has such a specialized experimental facility.

Image Credits: AIA Chicago https://www.aiachicago.org/dea_archive/2015/purina-animal-nutrition-center/

Kentucky Equine Research

Kentucky Equine Research (KER) is an international equine nutrition, research, and consultation company serving horse owners and the feed industry. KER's goals are to advance horse industry knowledge of equine nutrition and exercise physiology; to apply that knowledge to produce healthier, more athletic horses, and support the nutritional care of all horses throughout their life. KER was founded in 1988 when Joe Pagan, Ph.D., who realized that information generated from research was not disseminated to the individuals who needed it most: feed manufacturers and horse owners.

Financial Model:
The company has two main revenue streams. First and foremost, they provide consultancy to feed manufacturers. Secondly, their nutritionists work with mill owners and managers internationally to formulate feeds that complement typical local forages. The website claims KER is one of the most prolific private equine nutrition and exercise physiology research organizations in the world, with a publication rivaling that of leading universities. However, it is not clear whether they have any active research grants.

Faculty Input:
This organization tests products for industry. Nevertheless their researchers take part in academic conferences, and usually report and share research findings. In general, they are competent, engaged, and respected scientists.

This organization does not compete directly with university programs because they focus on applied research. This and a few other similar organizations (with or without a physical facility) tend to conduct research projects that are better conducted less visible to the general public.

Image Credits: Saracen Horse Feeds https://www.saracenhorsefeeds.com/company/kentucky-equine-research

Wits Rural Facility

Wits Rural Facility (WRF) is a rural campus of the University of the Witwatersrand, established in 1989 with a grant from the Anglo-DeBeers Chairman's Fund. The purpose was to create a base from which Wits could bring academic resources to bear on development challenges created by the Apartheid homeland system. The facility continues to support a wide range of research, student training and community engagement in a rural setting. Infrastructure includes a variety of visitor accommodation, seminar and conference facilities, a restaurant, staff housing, offices, and laboratory space.

Financial Model:
The facility hosts faculty and students from the Wits University and other collaborating universities. In addition, Wits Rural offers accommodation and catering to the general public, as well as venues for conferences and other events.

The facility has a small group of resident research faculty involved in long-term externally funded research. The research focuses on rural development and rural health, with some research involvement in neighboring wildlife preserves and Kruger National Park. The center's proximity of Kruger national Park has helped Wits faculty and international colleagues develop a close relationship with South Africa's National Parks.

Faculty Input:
Wits Rural Facility is a satellite research and education campus of Wits University. This "campus" enables many Wits faculty to attract research grants. There are a few residential field research faculty, and many faculty from Wits and other international universities do semester-long residencies. Likewise, many groups of domestic and international students enroll for mid-length courses. Ultimately, the facility exists to help local communities connect better with local natural resource economies (e.g. field ecology training programs).

Image Credits: University of the Witwatersrand, Johannesburg
https://www.wits.ac.za/campus-life/arts-and-culture/wits-rural-facility/accommodation/

David H. Murdock Research Institute (http://dhmri.org/)

The David H. Murdock Research Institute (DHMRI) is a nonprofit life sciences research institute that provides collaborators research and development solutions at the intersection of human health, agriculture and nutrition. DHMRI contains instrumentation, resident expertise, and well-equipped laboratories that bring together a variety of disciplines under one roof. DHMRI has developed a multidisciplinary, integrated approach that incorporates a variety of scientific platforms.

Although there is not any reference to equine research engendered by the Institute, its founder is a breeder of more than 200 prized Arabian horses. In addition, at the time of this survey, there were two faculty members of NC State Vet College working at the institute.

Financial Model:
The institute offers technical support to customers with research projects, or can act as a subcontractor on research grants. Lab space rental is also available. They also offer laboratory sabbaticals including walk-up access to state of the art equipment. In addition, David Murdock, the founder started an endowment in 2014 that donates $15 million a year to the center.

Equine Consulting Faculty Summary Input:
There are a couple faculty from NC State's main campus housed in this institute, but they are perceived to visit the NC State main campus or interact with other faculty very infrequently. Those faculty members are perceived as competent but other faculty struggle to reach out to them in Kannapolis.

Likewise, none or few faculty from NC State's main campus have visited the Kannapolis institute. Therefore, it is likely that the faculty in the institute may feel isolated and unsure about their colleagues.

Image Credits: NC Research Campus https://transforming-science.com/350-acre-campus/

Input from the Equine Faculty from NC State University, Clemson University, and University of Tennessee

According to early stakeholder input, the prospective equine research and education center is expected to address the educational, research and extension missions of universities in the Southeastern US region. Accordingly, between April and November 2018 faculty from NC State University, Clemson University and the University of Tennessee were interviewed face-to-face, by phone, and by email, using in-depth unstructured interviews. The questions used in these interviews included:

- If an equine education and research center were built in the NC Foothills region, to what extent would you personally see yourself involved in professional activities there?

- Based on your insight into other equine centers devoted to research and education, how do you think such a center could be financially viable in the long-term?

- As we explore the appropriate scope and business model for a prospect equine research and education center in the NC Foothills region, what tips do you have for our team!

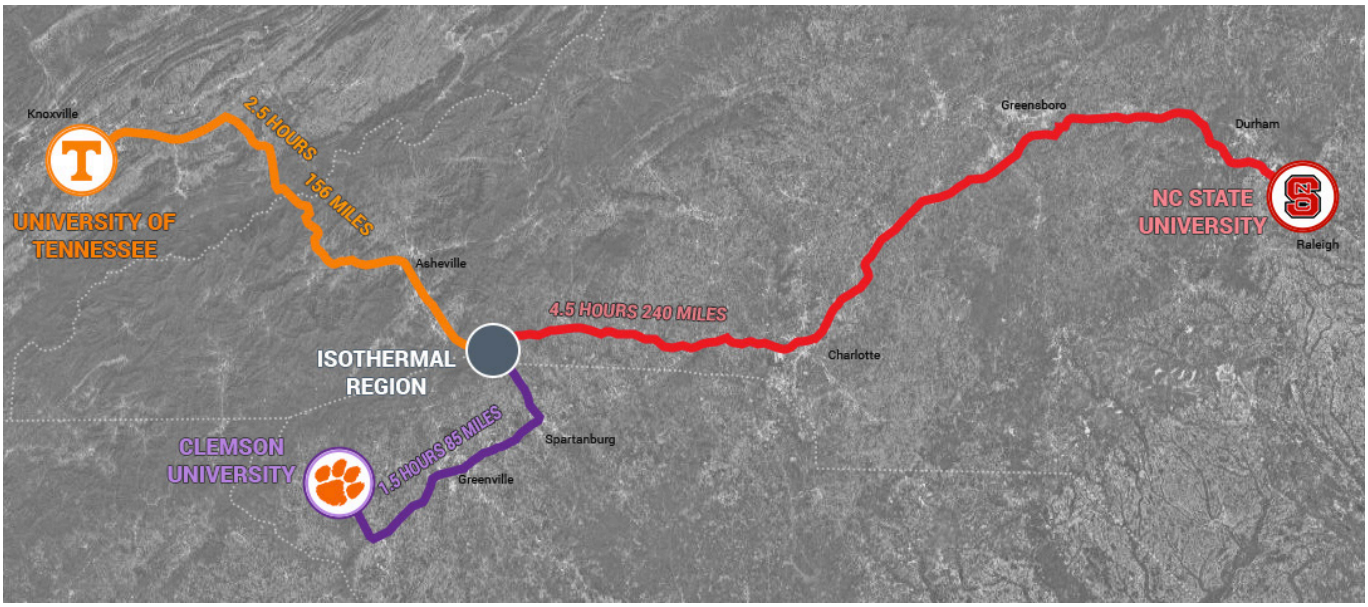
A total of eight faculty in equine sciences, veterinary medicine and equine therapeutic recreation were recruited for the study, and 5 were able to participate in the interviews. The interviews were recorded,transcribed, and shared with one more member of the SEREP team. The two SEREP team members conducted a thematic analysis of the data using constant comparison as a form of researcher triangulation, and then shared the summarized findings with the rest of the team for insider briefing validation.The analysis yielded the following insights:

Focus of center must fit local socio-cultural characteristics and equine culture.

In terms of research related to equine physiology, medicine, nutrition and animal care, informants explained that *"The focus in Tryon is on competition - so if this center is close by the research should be related to those issues as well."* We learned that contrasting with Kentucky where racing is the focus *"Tryon is focused on sporting equine activities. These horses [in NC] have much more longevity than the race horses that have a very short lifespan."* Indeed, *"After racing prime [horses] are repurposed – only the best ones are used for breeding stock. In North Carolina many people buy racing veterans for our sporting industry."* Therefore in Kentucky research and education would focus on improving race performance, and in North Carolina the focus should be on issues related to healthy longer lives. Additionally, we learned that in North Carolina *"there are procedures associated with breeding horses that veterinarians have to do these procedures. Some of the big reproduction centers/facilities will be in states where technicians can conduct the procedures with the supervision of vets. NC has never been in the biz of high-level equine reproduction because we do not have racing.*

These centers are located in States with gambling horse racing [and loser regulations]." Therefore, breeding services are not very central to the context of equine research and education in the NC foothills.

Participants also explained that high-level equine sporting teams *"that come to tryon do not have many [equine care] needs other than their food and boarding."* They noted that those teams would not likely allow their horses to be involved in research projects due to their high value and proprietary care processes. Nevertheless the region will have an inherent draw for researchers and educators in the equine fields, therefore becoming *"Possibly a good place for conferences in this center. Equine conferences could be organized there. There are many equine groups that could organize meetings there. [The center should have] Capacity to host a lot of people..."*



The relationship between the center and a parent campus will be challenging.

Equine faculty voiced several concerns in regards to the ability to develop a sustained synergistic collaboration between a center in the NC foothills and their respective parent campus. One noted that *"Distance from main campus is a problem - we cannot separate the equine faculty and we cannot move them all there" and "faculty do not like to drive often."* They noted that competitive teams are increasingly multi-disciplinary involving regular formal and informal interactions across campus including equine and non-equine researchers; therefore researchers located full time in a remote location would be at a great disadvantage. In addition, some research activities require constant or regular involvement by the specialized researcher, for example *"you may have to monitor a pregnant mare every day".*

Informants alerted that a possible center would need permanent staff on site, and that the composition of that team should be very carefully delineated. One noted that overlap in research foci might bring conflict because *"in terms of funding, whether it*

is big or small grants (NC Horse Council) [they would be] competing with our faculty here." Subject-matter gaps varied across institutions including genetics, therapeutic equine recreation, and livestock.

The center must serve the local community.

A third salient theme stemming from the equine faculty interviews was that a prospect center should be designed to serve the needs of the broad community groups in the NC Foothills and not just equine sporting elites, specific business factions or *"the Tryon center and high-end horse owners."* Very importantly, *"This center should not duplicate or compete"* with existing businesses and institutions like the Isothermal Community College or the Tryon horse Hospital. One participant suggested that *"Maybe it would work to have a farrier horse school"* in the center, but such program could encroach on the future plans of local education and training institutions like the county public school systems, the community college and the NC Cooperative Extension offices. Another participant suggested that the center could conduct applied research on how hay desired by high-end horses could be grown in the region and marketed to local horse owners as well as visiting equine teams. Indeed, research and subsequent local training and take-to-market efforts on growing and selling hay/feed seem to be emerging as a thread consistent with needs expressed by community stakeholders in the course of this project, and suitable to be pursued by a multidisciplinary team including specialists in equine sciences, nutrition, crop and soil scientists, as well as agribusiness and consumer behavior.

The center needs a unique and locally-appropriate focus.

In business development terms, the participants explained that we need to identify the center's *unfair advantage* - i.e., an innovative and savvy focus that can be pursued in this region better than in any other region. When talking about this theme, faculty considered numerous factors like:

a) the rich equine sporting culture
b) the local soil and climate
c) the regional socio-economic profile
d) the State's substantial military presence
e) the State's legal structure governing equine care services
f) the grand challenges affecting our society and extramural funding

A focus on the convergence between human and animal health (like in Colorado State University) seemed agreeable to most participants. More specifically, some mentioned the opportunity to focus on holistic veterinarian medicine (e.g., equine acupuncture), and possibly the health benefits of recreation with horses for humans (e.g., military vet recovery through equine recreation therapy). And another possibly complementary thread was to focus the center in researching and enabling a region to adapt in a sustainable and equitable manner from agriculture and manufacturing - to an equine services economy.

The funding and function of the center will be shaped by philanthropy and influence

The equine faculty noted that existing equine research and education centers were created or significantly expanded due to high-value philanthropic donations or the political lobbying of strong supporters that generate public fund streams. For example, Colorado State's Equine Orthopaedic Research Center was built thanks to a donation of $42M by the Malone family whom were thankful of the institution's role in caring for one of their very beloved family horses. Michigan State's Horse Teaching and Research Center was started with state funding resulting from a referendum supported by the horse industry, and since more recently it also is funded by fundraising campaigns and membership fees for the Endowment for the Preservation of the Arabian Breeding Program. And *"in KY set portion of all racing funds get designated towards equine research and education. [So, the] University of Kentucky, etc, they all get a portion of those funds."* In this regard, the faculty wondered if NC Horse Council funding could support the centers; and whether this would be a constraint for the involvement of out of state institutions.

On one hand, equine faculty noted that fundraising for the center *"might compete with donations for"* their parent campuses. On the other hand they ventured that a center in the NC foothills might provide their respective institutions *"access to high value donors that go to Tryon."* In this context, a participant stated that *"if there is going to be a building then it is likely that we'd like to be involved because if not us, then someone else might become involved."*

Summary of Feasibility Study

The long term feasibility of a prospect equine research and education center in the NC Foothills region depends on the center's ability to serve as a catalyst for the local communities' economic development ambitions. In this regard, following a 6-month participatory fieldwork in the region, the team administered an online survey asking participants to rate business activities according to availability of local human capital, potential to create and support local jobs, attract outside investment, and support new local small businesses. Analysis generated a matrix illustrating the relationship between perceptions of community benefits and human capital for each business activity. Breeding Services and Equine Appraisal and insurance stood out as the least advantageous and also among the activities with the least human capital. Home and Barn Construction emerged as the most advantageous activity with relatively high local human capital. Tourism sector business activities were perceived as very advantageous but with need for improved human capital through education and training. Conversely real estate is perceived as a business activity involving a capable few but does not yield proportional equitable benefits to the overall community.

The team concomitantly interviewed faculty from NC State University, Clemson University and the University of Tennessee, and examined a comprehensive list of equine and non-equine education and research centers operating in the US and internationally. These primary and secondary data suggest that research and education centers fall under three categories:

1) equine research centers integral to land grant universities, which tend to be close to a main campus and rely primarily on research funding;

2) equine R&D centers owned and operated by industry, which tend to conduct research that is best kept away from the public view, and

3) engaged research and learning centers operated by universities characterized by a great deal of involvement from local stakeholders and industry peers.

Each type of center would demand specific financial models relying on a combination of public fund appropriation, philanthropy of a donor network, research administration fees, and hosting of recreational and educational visitors. Overall, these findings suggest that the long-term feasibility of a prospect research and education center would likely need to be based on:

a) Initial sizeable investment of local and state funds for land acquisition and building;

b) Academic institution investment of initial staff and subsidization of initial programming and administration;

c) Donor support coordinated by a "friends of" group integrating the primary academic institution and possibly high-level local equine groups;

d) Research administration fees from active research programs complementary to research conducted in the parent academic campus(es);

e) Lodging, food and activity revenues earned from hosting Extension, engaged learning, and tourists/visitors.

The findings from this Feasibility Study built upon Community Engagement insights and they inform the following section focused on design orientations for a proposed future center facility.


DESIGN
ANALYSIS

Planning and Design Process Overview

The successful implementation of the future Equine Research and Education Center and its mission requires a strong vision, partnerships, research and educational focus, and physical environment that effectively support and address the equine related needs in the region. The intent is to improve the equine industry in the region, while providing cutting edge education and research in support of care and welfare of the horse. Therefore the SEREP team aims to develop a vision plan with guiding design principles that will demonstrate how a site and functional facilities can encompass the required equine related educational and research activities, as well as provide growth and flexibility for the future.

The partnership model required for this new equine complex is currently unknown. However, using a systematic approach merged with design thinking process, as well as placemaking principles, the SEREP team aims to develop a spatial program and conceptual site design scenarios that will support potential research and education activities in a premier equine research and education complex that might also become a focal place for various community equine-related services in the region. The key planning principles guiding the future EREC complex include:

- Achieving quality facilities on the site that will reflect the EREC's vision;
- Prioritizing sustainability that will minimize energy use and emissions, supporting sustainable land management for research, teaching, farming, natural areas, and other uses; and ensuring that land, facilities and activities work together to maximize knowledge transfer and positively impact local equine economy.
- Developing and promoting healthy environment, which may also represent EREC's *One Health* mission in support of well-being of researchers, faculty, students, visitors, staff, and horses.

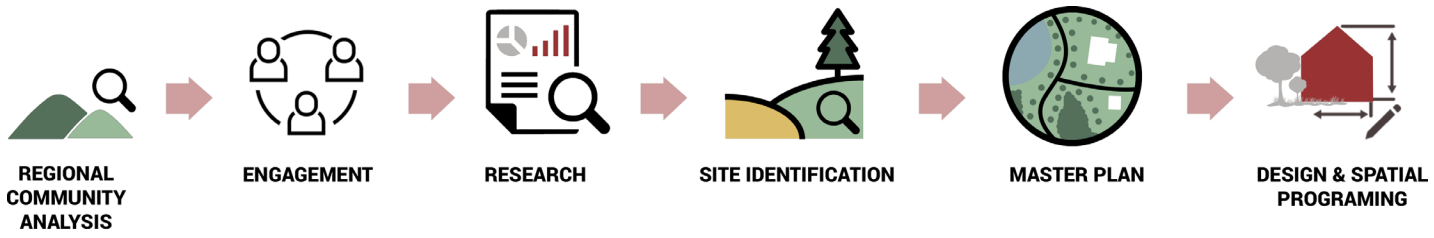


Figure 11: Planning and design process considered for SEREP

The SEREP design and planning process started with regional community analysis, stakeholder engagement and GIS analysis. Identifying potential sites for the future EREC complex has been a priority for the SEREP team. During the first phase of this project, the team has identified several sites for consideration through various stakeholder meetings (in both large/small groups and individual meetings) and the GIS based mapping and evaluation. Site identification process aimed to identify locations where sites will be used most efficiently and new development will not negatively impact critical environmental and cultural resources in the area.

The team then conducted a context-sensitive site analysis evaluating the preliminary site conditions and contextual factors that can sustain the future uses or activities of the EREC complex. This analysis included documentation of site conditions including biophysical features such as topography, soils, geology, and vegetation. The team also mapped the contextual factors, which included physical conditions such as the size of land, access to utilities - water; access to population centers; access to transportation routes; visibility/visual quality; landscape types such as rolling hills, pastures, mature vegetation; adequate soil drainage and quality topsoil; and absence of hazards. Using these factors, strengths, weaknesses, opportunities and threats of each site (SWOT analysis) have been identified. This process enabled the team to rate each site and create a short list including 3 sites for the new EREC complex under consideration.

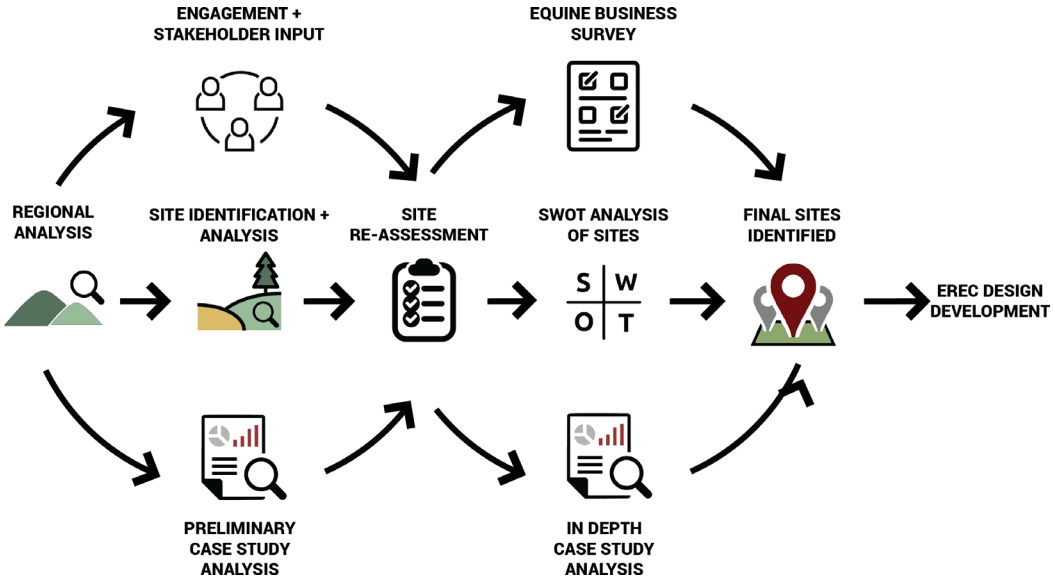


Figure 12: Site identification and analysis process

The second phase of our efforts focused on understanding the expectations of the equine business community, as well as the preferences for site options, layout, and the aesthetic characteristics and qualities of the future EREC complex. Using the on-line survey administered in October 2017 (as presented in the earlier section), the SEREP team tried to understand how the new EREC complex can achieve a physical environment that effectively supports the key educational and research activities, while providing quality environment and strong identity that are best fit to the character of the region.

The findings from the survey intend to formulate the design and planning principles, which will inform the spatial programing and design scenario development efforts during the next phase of this project.

Site Identification Process

The site identification process was conducted on the basis of the future project uses and activities. Each project program generates site requirements that must be met. These may include minimum parcel size, proximity to transportation routes and utilities, suitable soils, and many other parameters. Hence, the site selection criteria were established during the first phase of the project aiming to help identify alternative sites that can be evaluated and compared before selecting the preferred site(s).

The key driving site selection criteria included:

- Transportation – Site(s) within 30'-50' of an existing road with no more than 1 linear mile away from highway/interstate were considered. Accessibility is an important factor to future employees and visitors of the EREC complex.

- Soils – Prime farmland and well-drained soils are preferred to provide ideal pasture conditions. An equestrian research and education center is ideally expected to provide pasture and possibly other types of farmland.

- Watershed/Floodplains – The sites that are not within substantially large floodplains are preferred. Constructed area must be 200ft away from surface waters and 200 ft away from floodplain. This is essential in order to protect any substantial property damage during storms and the water quality of streams, rivers, and floodplains. The future site must therefore have space outside of the floodplain to locate structures, as well as an adequate buffer area to separate surface waters from any potential pollution the center might create, such as animal waste and eroded sediment.

- Slope/Elevation – The future site will have less than 20% slope. Avoiding steep slopes will protect against erosion, provide safe pasture, and promote ease of access. For an equestrian research and education center complex the site should have minimal slopes to allow for safe horse movement and limit erosion resulting from both horse traffic on pasture and the future development on the site.

- Canopy/Tree Cover – The future site, with less than 50% of property, will have tree coverage. It is a priority that the future development will protect against deforestation and damage to natural beauty of the area.

- Land Use/Zoning – The future site will have minimum 50 acres and will be 200ft away from residential properties and units.

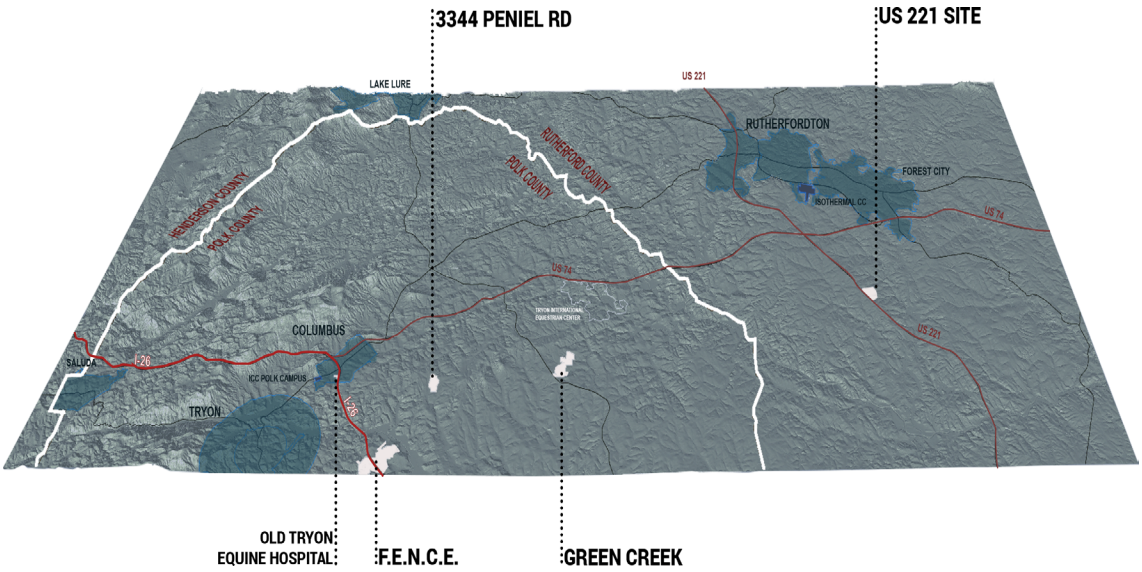


Figure 13: Identified sites for the future EREC complex

Using GIS based site analysis and the stakeholder input for potential partnerships the following sites have been identified for further consideration:

- F.E.N.C.E (non-profit)
- Green Creek (private)
- Rutherford County (public)
- Tryon Vet Hospital (private)

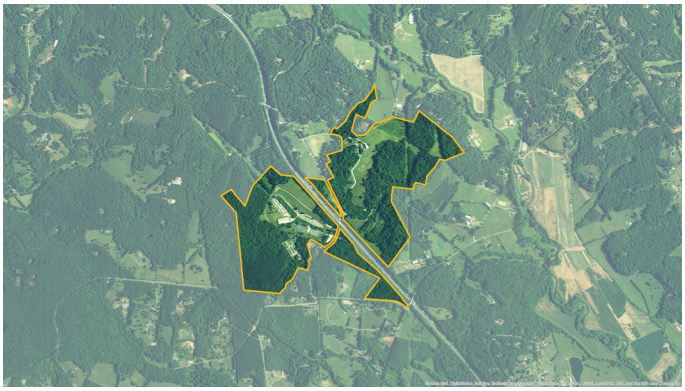
Additionally, various sources such as multiple listing services for property that is for sale, as well as the GIS analysis of vacant and redevelopable lands were used to identify more sites for consideration. Based on this analysis the following sites was identified:

- Peniel Road (private)

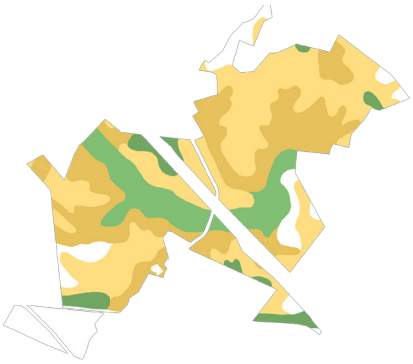
The following section provides further information on the analysis of each site revealing how best each site is suitable for the future EREC complex.

SWOT Analysis

Foothills Equestrian & Nature Center (F.E.N.C.E.)



The F.E.N.C.E. site is owned by a non-profit organization which serves as a community resource for the preservation of green space while providing educational and recreational opportunities linking nature, animals, and people. Located on 356 acres in Tryon, Polk County, FENCE provides programs in nature study, outdoor recreation and equestrian competition through its equestrian facilities and outdoor amenities available on its site. It is a very well-known and visible site in the local community and it is deeply rooted in local equine community.



Soils/Prime Farmland

Water Resources/Floodplains

Transportation Access

Canopy/Tree Coverage

Slope Percentage

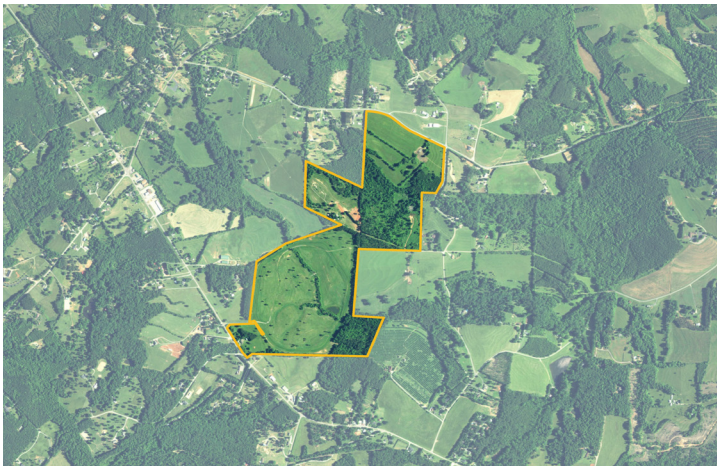
Figure 14: Site Analysis

Using the site selection criteria the F.E.N.C.E. site provides the following biophysical and contextual factors:

- Much of the F.E.N.C.E. site has suitable soil for crops/pasture and is considered as a farmland that has statewide and local importance.
- The site contains a medium sized tributary of the Pacolet River, which is currently under a conservation easement, with a limited floodplain and no wetlands.
- The site contains the largest percentage of canopy cover but the areas without canopy are undeveloped providing an opportunity for developing the new EREC complex on the site.
- The site has quite steep slopes but contains a large total acreage of undeveloped area that is not steeply sloping and out of a floodplain.
- The largest roadway in the area (Interstate-26), which runs from Charleston, SC to Kingsport, TN, cuts through the F.E.N.C.E. site. This might be considered as a challenge while considering connectivity between existing and future amenities on the site. However, easy access to this corridor is extremely important for the future development in the area.
- The site is located within a close proximity to major population centers (i.e. Landrum and Tryon).
- The F.E.N.C.E. site provides an opportunity to build on in addition to the existing facilities and infrastructure on the site. The existing natural ecosystem presents recreation and education opportunities in support of the existing and future programs as part of the new EREC complex. However, any future new development on the site can provide increased potential for ecological harm and risk of displacing current community uses on the FENCE site.

Image Credits: Benjamin Jones

Green Creek Site



The Green Creek site is located in Tryon, Polk County. This 183 acres site is owned by the Tryon Equestrian Foundation and the Green River Farm, LLC. The site currently contains limited existing infrastructure (e.g. existing race track) and limited highway access due to its location. It is also surrounded by residential areas.

Soils/Prime Farmland

Water Resources/Floodplains

Transportation Access

Canopy/Tree Coverage

Slope Percentage

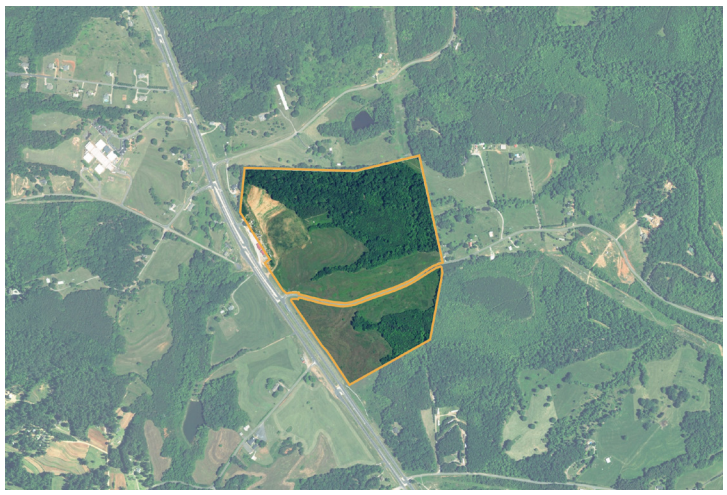
Figure 15: Site Analysis

Additionally the site provides the following biophysical and contextual factors:

- The Green Creek site contains the highest percentage of soil suitable for crops and pasture. However, much of the land is currently dedicated to a race track for the Blockhouse Steeplechase.
- The site contains the least water resources, consisting of only medium headwater streams with no area of floodplain or wetland.
- The canopy coverage on the site is limited. However, the site has the most open area, which is currently dedicated to the racetrack for the Blockhouse Steeplechase.
- The site has the lowest percentage of steep slopes. However, most of that flat land is currently dedicated to the racetrack for the Blockhouse Steeplechase.
- The site is only accessible by two lane roads, although one is heavily trafficked locally (Highway 9). There are no nearby interstates or multi-lane highways.

Image Credits: Benjamin Jones

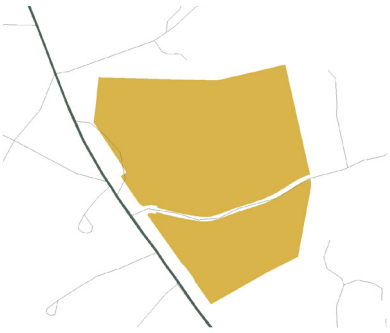
The Henson Rd./US 221 Site (Rutherford County)



This 103 acres of land is owned by the Rutherford County and is located on a major highway in Forest City, in Rutherford County. The site is within close proximity to major population centers including Rutherfordton and Forest City, however it is located farther outside of the existing equine community in the area. It currently has large amounts of cleared land usable for future development, however the site currently has no existing infrastructure available.

Soils/Prime Farmland

Water Resources/Floodplains



Transportation Access

Canopy/Tree Coverage

Slope Percentage

Figure 16: Site Analysis

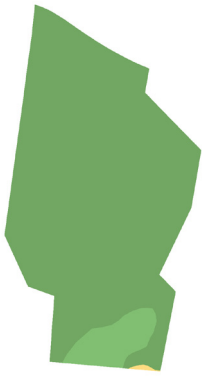
Additionally the site provides the following biophysical and contextual factors:

- Much of the site contains farmland of statewide importance with functional agricultural land.
- The site contains the second least water resources, consisting of multiple headwater streams entering the site with no area of floodplain or wetland.
- The site contains the second highest percentage of canopy cover but the area without canopy is entirely undeveloped.
- The slope across the site increases as you get further away from Highway 221. However, the majority of the site has a consistently minor slope.
- The site is adjacent to Highway 221, a four lane highway and is closer to the freeway (US-74), which is closer than the Greek Creek site.

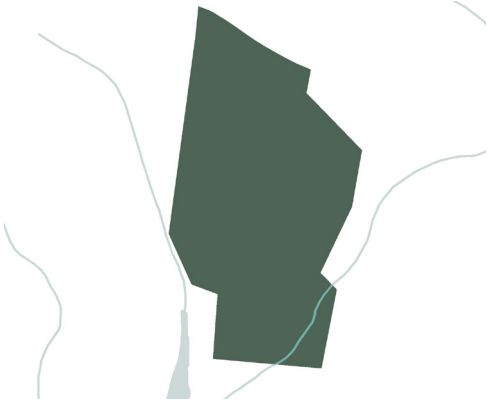
Image Credits: Benjamin Jones

3344 Peniel Road Site

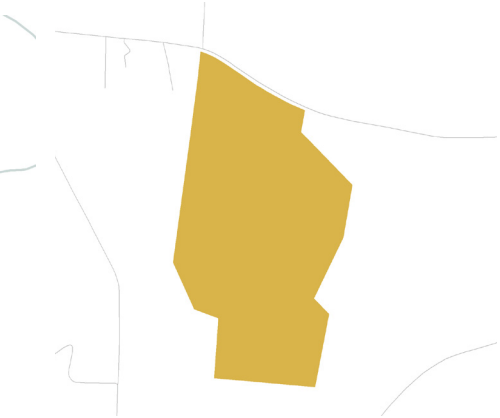
This 83 acres of property is owned by the Peniel Farms LLC and is located in Tryon. The site is currently valued at approximately $1.8 million. The site currently does not include much infrastructure except for a housing unit on site.



Soils/Prime Farmland



Water Resources/Floodplains



Transportation Access

Canopy/Tree Coverage

Slope Percentage

Figure 17: Site Analysis

The site provides the following biophysical and contextual factors:

- The site contains the highest concentration of quality soil acreage suitable for crops/pasture out of all the sites examined. Over 85% of the property is considered to be prime farmland.
- The site contains the least amount of water systems on site, consisting of only small headwater streams with no area of floodplain or wetland.
- The site contains the lowest percentage of canopy cover. Most of the canopy is either concentrated around already existing built infrastructure and property edges or is scattered throughout the landscape.
- The site has the lowest percentage of steep slopes out of all the sites examined. Much of the steeper slopes are concentrated along the property edges and existing water systems.
- Even though the only access to the site is along two lane roads, it is a seven-minute drive to a population center (Columbus, NC) as well as a major interstate highway.

Image Credits: wwerealty.com https://wwerealty.com/property-details/

Former Tryon Vet Hospital Site

The former Tryon Vet Hospital is the smallest site (6 acres) identified for consideration. The site is owned by the D&M Partners LLC in Columbus, NC. It provides a small amount of land for development with restricted equine use within the property. The site provides not much opportunities for land expansion. It currently contains infrastructure and it is within a very close proximity to population centers including Tryon and Columbus. It is also very close to the ICC Polk Center. Although this site has limited long-term expansion and programming opportunities for EREC's vision, it provides an opportunity to implement the short-term goals and small scale equine based educational activities.

Image Credits: Benjamin Jones

Summary

Overall site identification and analysis process utilized the criteria developed based on the future EREC complex program and the site requirements that must be met. These criteria were also verified by the survey input received from the equine business community residing in the region. The survey results revealed that the prioritized contextual and site specific biophysical features were indeed considered as important factors for the future EREC site complex. All the criteria the SEREP project team set forth were considered as moderately important by the business community. The most important criteria identified were the availability of water resources, proximity to existing equine programs and activities, and proximity to other equestrian and agricultural lands. Among all criteria the two lowest ranked factors considered were the existence of wooded areas on site and the proximity to population centers.

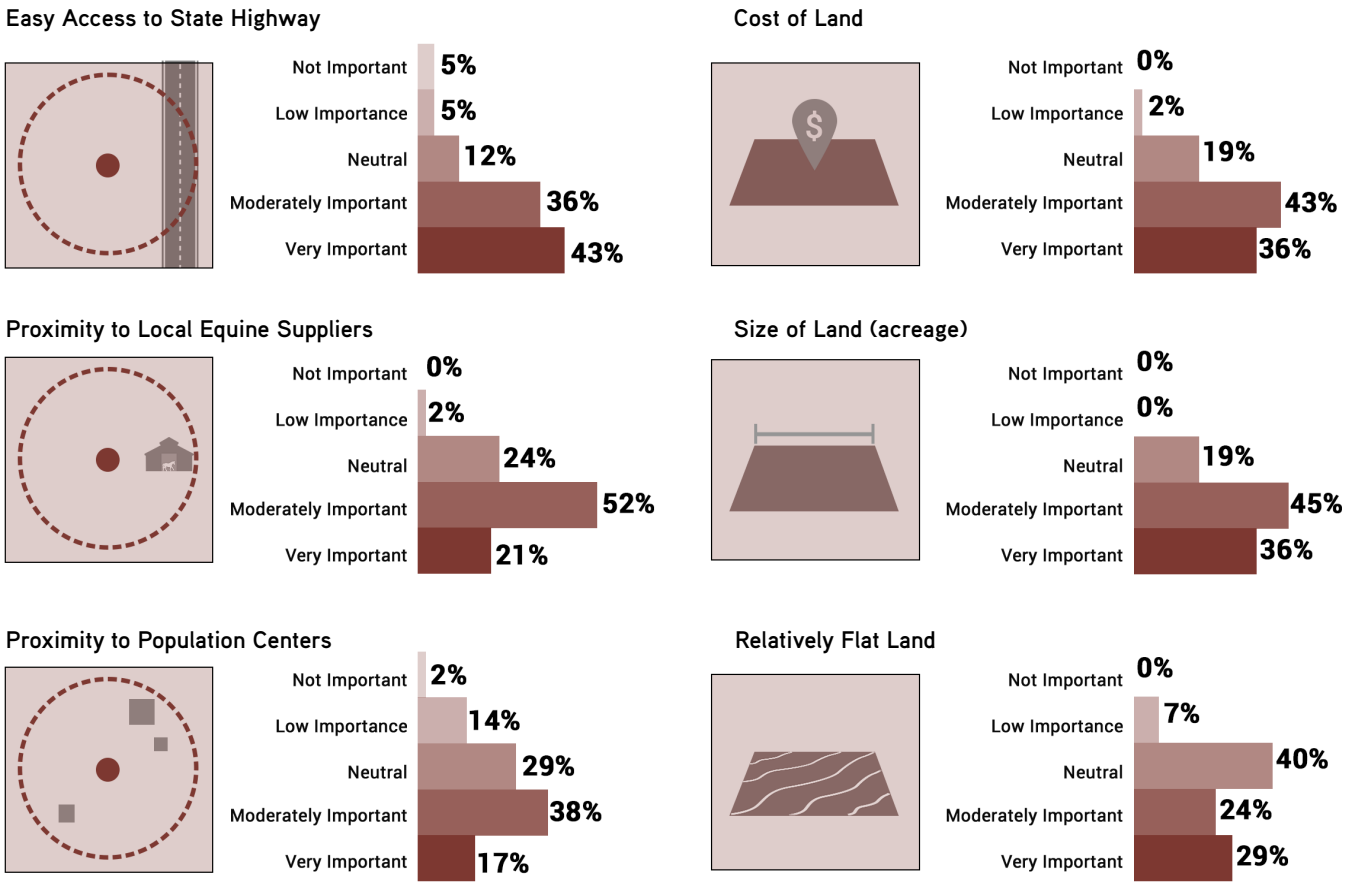


Figure 18: Site characteristics preference and survey findings

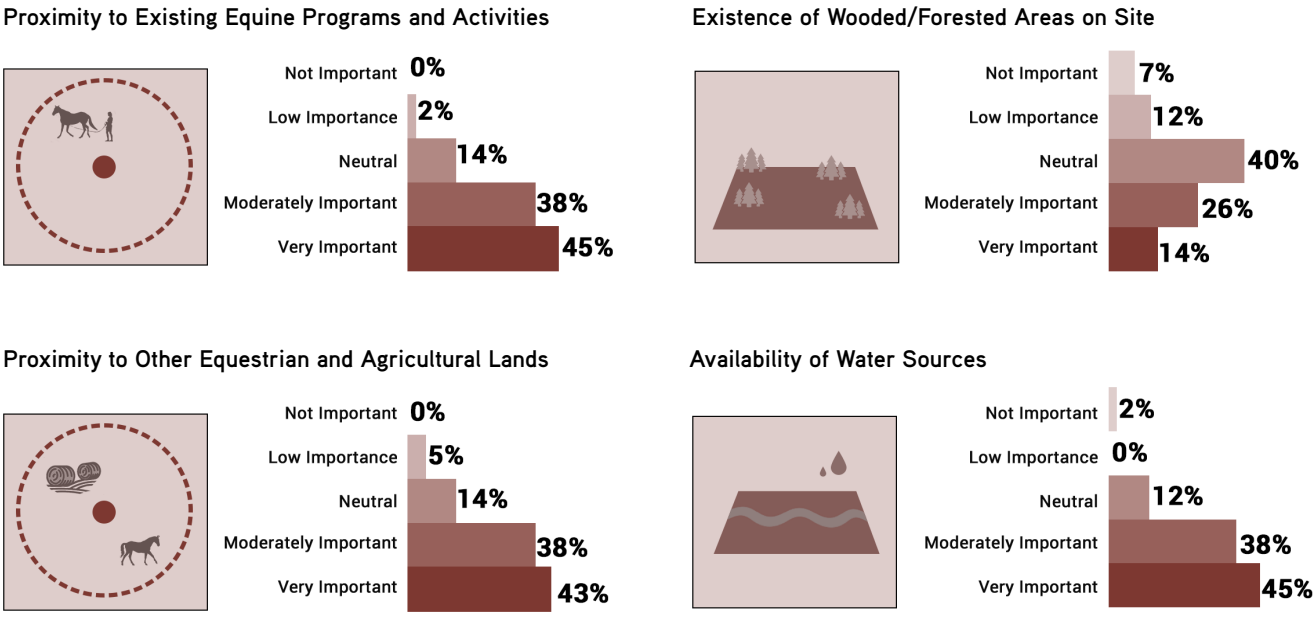


Figure 18: Site characteristics preference and survey findings (cont.)

The SEREP team's site evaluations were based on the SWOT analysis using the criteria listed earlier. Each site provides unique features related to its strengths, weaknesses, opportunities and threats that are important to consider for future site selection and decision making in the future. Our analysis revealed that FENCE followed by the Green Creek and the Henson Rd./U.S. Hwy 221 sites have the most ideal environmental and contextual conditions out of the five sites that were evaluated. During the next phase of this study the spatial programming elements will be developed in support of the EREC's vision. The SEREP team will then apply and evaluate how best each of these three short listed sites can accommodate the desired site program.

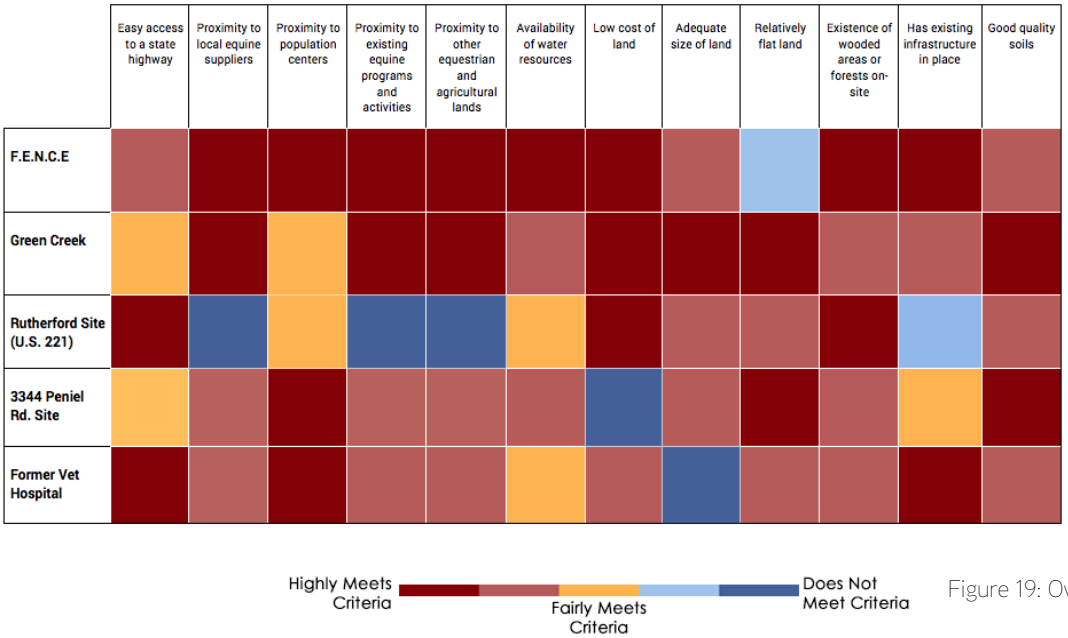


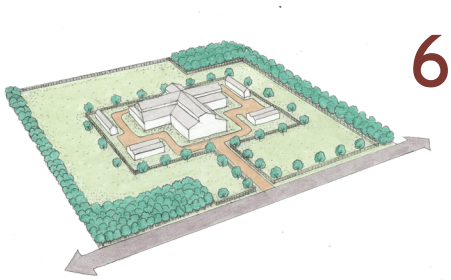
Figure 19: Overall site evaluations

Understanding Preferences on Site Layout and Aesthetic Characteristics

Creating a strong image is important to the development of the future EREC complex. This image through the site's architectural qualities, landscape features, and the overall site layout are expected to be responsive to its surroundings and the unique character of the Appalachian communities. Preserving the natural landscapes and open space characteristics in the area is also a priority. Easy access together with functional programmatic needs such as circulation, safety and function are important aspects of the future site. Movement of people, animals, and vehicles in and around the new EREC complex is very important and should be carefully planned to encourage safe and efficient flow and interaction of researchers, faculty, students, visitors, staff, and horses.

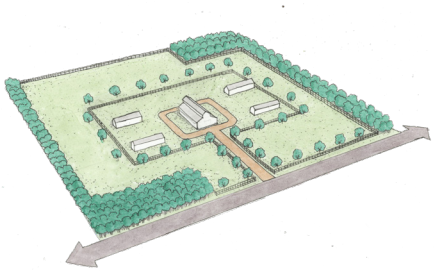
During the second phase of the project, the SEREP team inquired about the preferences of future EREC complex according to site layout, image, as well as the landscape and architectural characteristics. Understanding these expectations before the design phase was important since designing according to the existing character and qualities of the area is a priority set by the stakeholders. These preferences were captured via the online survey questions, among which were images of natural landscapes/horse pastures, equine related facilities, research and education facilities, and the schematic site layout of equestrian facilities.

Series of survey questions presented schematic site layout images, which included scenarios representing variation of site configurations, vegetation density, building configuration and its relation to major road, as well as the building coverage area and the footprint size on the site. Participants were asked to select the sets of images in each category indicating their most preferred site layout options. Majority of the respondents indicated that the future EREC complex should have larger building footprints (62%) and centralized facilities (59%), which will be located further away from the street but visible (74%) surrounded with reasonable amount of natural vegetation (with medium density) and pastures (67%) available on the site. Overall, the selected schematic schemes revealed that respondents prefer site layouts that provide proper transition from road (public space) to pasture (neutral outdoor spaces) and to center (denser building facilities).



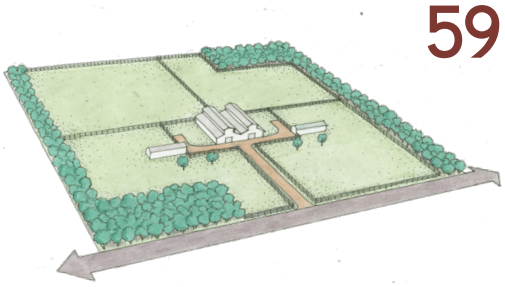
62%

Larger Amount of Built Space



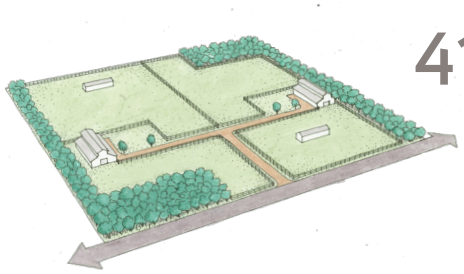
38%

Smaller Amount of Built Space



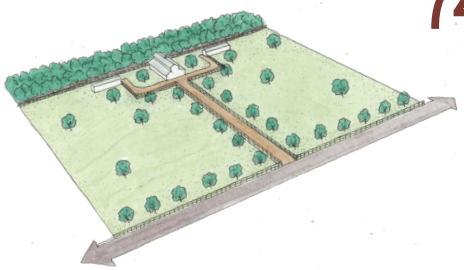
59%

Centralized Facilities



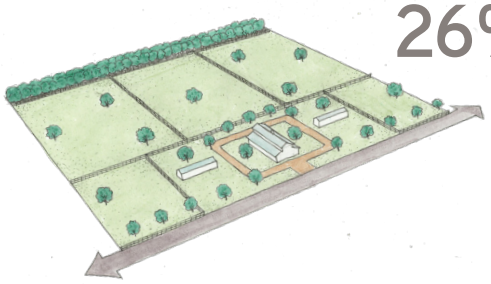
41%

Spread Out Facilities



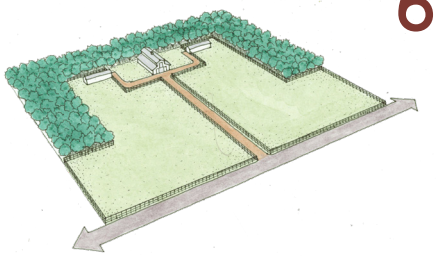
74%

Further from the Street



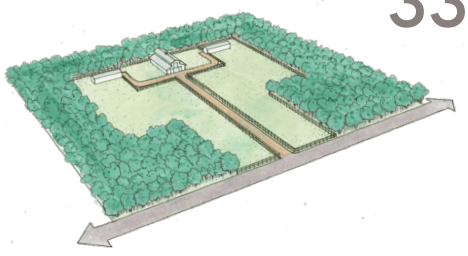
26%

Closer to the Street



67%

Less Natural Vegetation & More Pasture



33%

More Natural Vegetation & Less Pasture

Figure 20: Site layout preference survey results

The natural landscapes/pasture instances represented seven images presenting a diverse set of horse pasture types with a unique set of landscape characteristics. Participants were asked to select the image including the features that are the most appropriate for the region's character. 53% of the respondents indicated that the future EREC complex should include open pastures with rolling hills containing limited tree vegetation.

53%

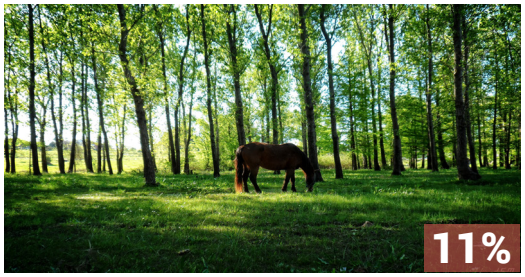


Figure 21: Pasture types preference survey results

Another question aimed to understand the preferences on the architectural style and aesthetic features of the future EREC facilities. Participants were asked to select the image (among seven options) that will be the most appropriate style and fit to the character of the region. The top two preferred images (38%) and (33%) show that people prefer rustic style and wood-panel façade buildings (iconic and grand entry areas) over modern style buildings with flat roofs.

38%

Figure 22: Architectural style and aesthetics preference survey results

Survey participants were also asked to select the image among seven options representing varying horse stable types with varying architectural styles. Majority of respondents (32%) indicated that they prefer common rustic style stables with earth-tone facades and gable roofs over modern ones with flat roofs.

32%

20%

17%

15%

10%

2%

0%

Figure 23: Horse stable types preference survey results

Summary

One of the primary driving planning and design principles of the future EREC complex includes (but not limited to) identifying potential locations and sites with essential landscape characteristics in place and creating a strong image through site layout and its facilities' architectural characteristics. In order to achieve these intentions the online survey was utilized to understand the preferences of local people from the area. The survey findings revealed that there is a strong desire for having the rustic style and timber/wood buildings on the site that will be surrounded with pastures including substantial tree presence. The respondents also indicated their preferences for centralized facilities with larger building masses and located away from the roadside.

They also indicated that the future site should have appropriate amount of natural vegetation with more pasture/open spaces. These findings are expected to provide better quality design that is more representative of local culture and better accepted styles by local stakeholders.

Moving Forward - Design Visioning and Development of Scenarios

Context sensitive site planning and design requires a process to understand relevant site and contextual attributes, thorough analysis of the site conditions, establishment of strong design vision, development of spatial programming in support of future user groups of the site, and development of conceptual design scenarios that will help envisioning the future EREC complex. The next phase will address these steps through the use of design knowledge, graphic skills and values that will aim to decide the future EREC site design. Three short-listed sites including F.E.N.C.E, the Green Creek and the Henson Rd./U.S. Hwy 221 sites will be used in order to demonstrate the application of design principles representing the vision of the future EREC complex. Participatory process involving input from stakeholders will be at the center of each phase.

SUMMARY and NEXT STEPS

Our research and community engagement efforts over the past few months point to a conceptual framework for an equine-based multimodal center that must:

1) broadly meet the needs of multiple stakeholders and communities in the isothermal region of North Carolina and beyond

2) attract investment from a number of research and academic communities (primarily NC State) as well as other public, private, and philanthropic interests,

3) operate through a market-savvy business model that considers research, teaching, and other revenue streams that builds on and supports local equestrian, conservation, and economic activities, and

4) leverage the growing national and international attention being generated by the Tryon International Equestrian Center (TIEC).

Over the course of the next few months of SEREP, we will solicit input from all stakeholders on this conceptual framework. This feedback will be incorporated into a proposed model that will delineate both the physical design and operational components of the center. The final report will provide a refinement of the conceptual model along with detailed physical designs that Isothermal communities can use to determine what and how a center can be best realized in the coming years.

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We look forward to receiving feedback from stakeholders across communities and sectors in the Isothermal region. Comments and questions should be directed to the NC State SEREP team via email at serep@ncsu.edu or via the project website: http://go.ncsu.edu/serep.