Northern Kentucky University's

NKU Research & Education Field Station

Research and Education Field Station (REFS)

Five-year Strategic Plan

St. Anne Wetlands St. Anne Woodlands Research & Education Center

Soil Conservation Districts of Kentucky — The Soil is in our Hands

NSF

Kentucky Heritage Land Conservation Fund

KOFS Kentucky Organization of Field Stations

March, 2018

Executive Summary:

The Northern Kentucky University (NKU) Research and Education Field Station (REFS) has a mission of enhancing the university's strategic goals by serving as a center for environmental and ecological discovery and learning using natural areas as a classroom and laboratory for scholars, students, and the broader community. REFS maintains a Memorandum of Understanding (MOU) and works with the Campbell County Conservation District to use, manage, and conserve the St. Anne Woods and Wetlands (SAWW) natural areas. These contain 155 acres (63 ha) of open and closed canopy wetlands along the Ohio River, upland old-growth forest, secondary forests, and associated grasslands. In the spring of 2017, a REFS Steering Committee comprised of NKU faculty, the director of the Center for Environmental Restoration, and the director of the Campbell County Conservation District began working on a five-year strategic plan for REFS with funding from the Field Station and Marine Laboratory Division of the National Science Foundation. Stakeholder groups in research, university curriculum, community and P-12 outreach, and university administration met for two separate strategic planning conferences. They drafted vision and mission statements and conducted a SWOT (Strength-Weakness-Opportunities-Threat) organizational analysis of REFS. A sustainability plan to address the SWOT assessment was then used to develop a set of goals for programming, operations, and management of REFS. The seven broad goals for REFS include: 1) to support and expand research and creative activities for NKU and non-NKU scholars and students; 2) to develop human resources for efficient field station operations, management, and programming; 3) to upgrade REFS facilities to accommodate building space and cyberinfrastructure; 4) to enhance student success and serve as an ecological and environmental resource center for outdoor-based university curricular activities; 5) to provide community engagement and become a center for nature-learning for the community and P-12 students in the Northern Kentucky Region; 6) to seek financial sustainability as a field station while REFS functions as a field-based research and education unit within NKU; and 7) to aid in the conservation of the SAWW natural areas managed by the Campbell County Conservation District (CCCD). In addition to the SWOT analysis and the sustainability plan, a budget model canvas and an evaluation plan to measure success were also developed for REFS. Visits to regional field stations and participation in two Organization of Biological Field Stations meetings and an ESA-SBI Strategic Success workshop provided additional direction and assistance in the development of this strategic plan.

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Overview

Biological field stations have long been centers of environmental science, where scientists study ecological processes in their natural context, and students explore natural systems, unlocking the mysteries of life (Janovy and Major 2009, National Research Council 2014, Tydecks et al. 2016). They facilitate innovation and discovery of the natural world, support long-term studies (often of critical habitat), serve as a repository for historical ecological information, and function as hubs for the exchange of research ideas, amalgamating projects from multiple disciplines and geographic areas. Thus, field stations centralize research activities and educational opportunities and allow for processing and analyses of field samples; they often host real-time environmental monitoring instrumentation; and they provide the infrastructure to support complex experiments and integrated complementary field studies.

The Northern Kentucky University (NKU) Research and Education Field Station (REFS) is located adjacent to 155 acres of the St. Anne Woods and Wetlands (SAWW) natural area, a conservation easement on and near the Ohio River (http://nku.edu/refs.html). REFS facilitates the use of wetlands (both open and closed canopy), and upland old-growth forest (a mixed mesophytic, beech-dominated, woodland), secondary forest, and open grassland areas. Research at REFS conducted by NKU faculty and students over the past 10 years have focused on invasive species and their ecological impacts, biogeochemical processes, amphibian and reptile diversity, bird nesting biology, environmental restoration, and Ecological Research as Education Network (NSF-EREN) studies (DeMeo et al. 2015, Rice and Durtsche 2016, Boyce et al. 2012, Boyce et al. 2014). REFS facilities provide space for indoor laboratory and field processing research, meetings, teaching areas, and indoor restrooms. A future storage facility will hold equipment and supplies, and a workshop, while providing additional space for educational needs and setting up research experiments. The proximity of REFS to the NKU campus expands the opportunity for undergraduate instruction in an outdoor, ecological setting while offering unique interdisciplinary teaching opportunities over a range of other disciplines. This facility enhances community outreach programs, summer camps, and teacher continuing education. REFS also functions as a conduit for programs sponsored by NKU's Center for Integrative Natural Sciences and Mathematics (CINSAM), Center for Environmental Education (CEE), and Ecological Stewardship Institute (ESI). The Center for Environmental Restoration (CER), an instruction-based environmental consulting center, currently uses REFS to train undergraduates in improved techniques of land management and restoration. NKU REFS provides many opportunities to connect and engage the public with nature, including a summer Talk-&-Walk Nature Series, a spring family day nature outing, and future business leadership building programs and citizen science camps.

VISION: To inspire an understanding and appreciation of Northern Kentucky's natural areas from riparian wetlands and the Ohio River, to upland forests and grasslands through time.

MISSION: In support of NKU's mission and core values, REFS serves students, scholars, and the broader community. As a data-driven learning center, REFS fosters regional environmental and ecological research, and is an operations hub for field studies, multidisciplinary nature and outdoor-oriented courses, and interactions between professionals, students, and local citizens.

SUMMARY OF PRIMARY GOALS FOR REFS OVER THE NEXT FIVE YEARS:

- *To support and expand research, scholarly, and creative activities at REFS.*
- *Development of human resources for station operations, management, and programs.*
- *To upgrade REFS facilities to accommodate building space and cyberinfrastructure needs for researchers, university classes, and public engagement.*
- *To function as a center for experiential education in an outdoor setting for university-based courses of all disciplines.*
- *To connect REFS and the SAWW natural areas with the Northern Kentucky community, and become a center for nature learning in the Northern Kentucky region.*
- *To seek financial sustainability as a field station while REFS functions as a field-based research and education unit within Northern Kentucky University, and reflects the mission, values, and goals of NKU.*
- *To aid the Campbell County Conservation District in conserving the surrounding natural areas, maintaining their ecological processes, and enhancing biodiversity.*

STRATEGIC APPROACHES: NKU REFS will employ these predominant approaches in pursuit of our goals

- Build partnerships and alliances that use REFS within the NKU community, and with other universities, the Kentucky Organization of Field Stations, regional conservation organizations and agencies, and the public at large.
- Leave all users with an improved understanding and appreciation of wetland, riverine, and forest ecosystems for all users.
- To accommodate current and future activities at REFS, seek support from NKU, federal and local funding agencies, donors, stakeholders, and the community for staffing and facilities expansion to accommodate current and future activities at REFS.
- Be flexible in considering ideas for sustaining and maintaining REFS financially, ideologically, and practically.
- Maintain an NKU-based inclusive excellence atmosphere for station management and for the learning, research, and engagement activities of REFS users.

HISTORY AND DESCRIPTION OF NKU REFS AND THE SAWW:

In the summer of 2015, NKU purchased and refurbished a small two-story building on a small plot of land with a large parking area adjacent to the SAWW natural areas. REFS is the first field station acquired by NKU. REFS is located in Melbourne, Campbell County, KY, approximately 6 miles from the NKU campus and 8 miles upstream from Cincinnati, on the Ohio River (Fig. 1). Fig. 2 shows the research

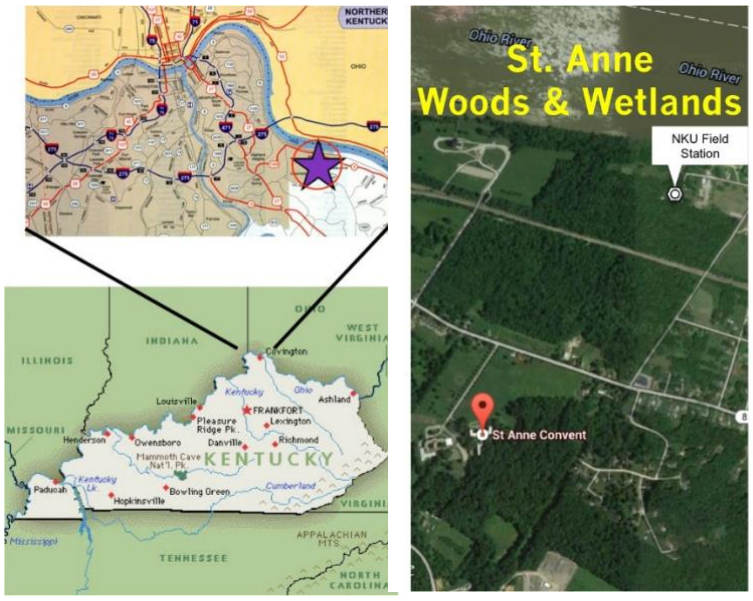


Fig. 1. Maps and aerial photograph of the location of the NKU Field Station in Melbourne, KY in close proximity to the Ohio River and adjacent to the St. Anne Woods and Wetlands natural area.

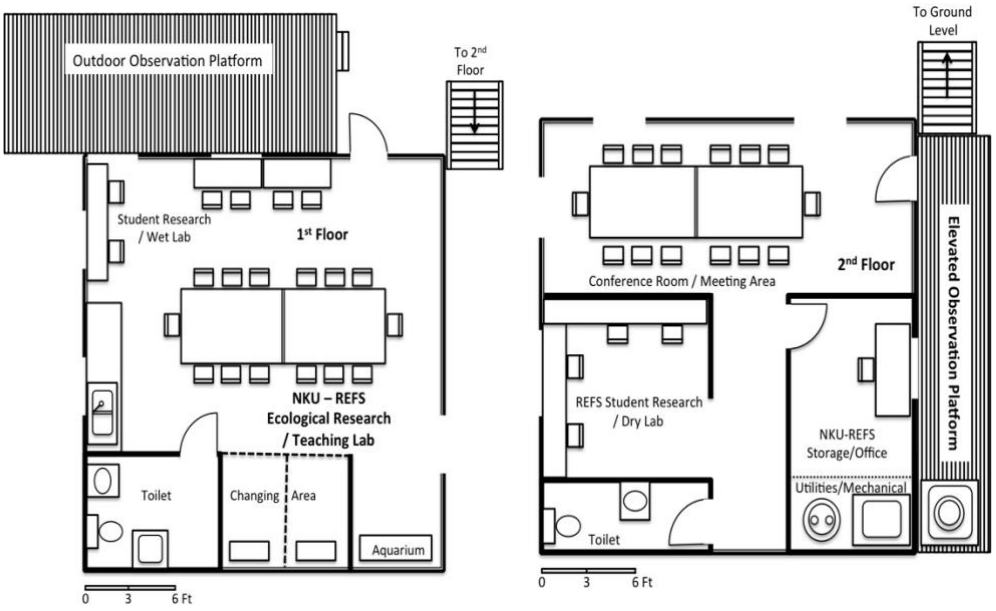


Fig. 2. Floor plans of both the first floor and second floor of the facility at REFS. The first floor is set up as a wet lab for research and has a main teaching section. Outside the first floor is a large observation platform The second floor has a dry lab and student research space. It also has an office and a main conference area. There is a small elevated observation platform off the main entrance.

and teaching space distribution in the facility at REFS. The REFS property is bordered on two sides by the fenced north portion of SAWW. SAWW is 63 ha (155 acres) of wetlands, upland old-growth forest, and some grasslands located along the Ohio River in Northern Kentucky. Dr. E. Lucy Braun, first female president of the Ecological Society of America, conducted research in these woods over 100 years ago. During the past few decades, NKU and Thomas More College scientists and students have regularly used the SAWW property to study flora and fauna that are rare in the region. In 2007, a Community Partners Grant from NKU brought together local universities, government agencies, community participants, and industry with the Sisters of Divine Providence at the St. Anne Convent to establish a set of trails in these lands (Fig. 3) and to develop research and education programs. This has benefited residents and visitors of the Northern Kentucky/Greater Cincinnati region, including, but not limited to, P-12 students of both public and private schools, college and university students and professors, and other education or nature groups of all ages (Fig. 4). The woods and wetlands were preserved by the Sisters of Divine Providence until 2013, when the Campbell County Conservation District (CCCD) obtained the site through a grant from the Kentucky Heritage Land Conservation Fund. The land is now protected in perpetuity by a conservation easement held by the Commonwealth of Kentucky. REFS maintains an MOU and works closely with the Campbell County Conservation District for the use of the SAWW property for research, education, and outreach activities.

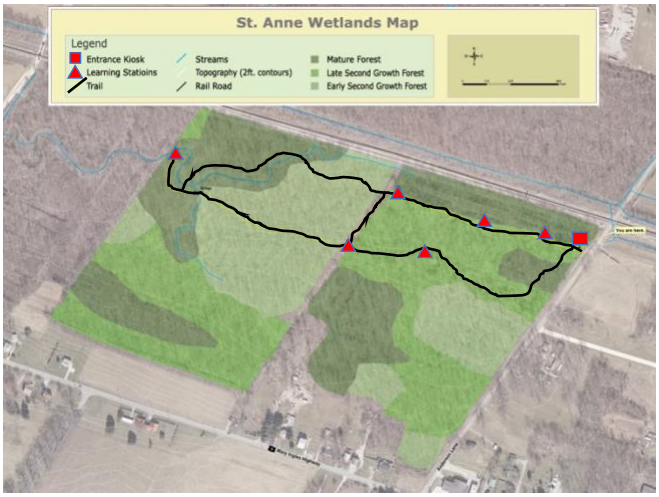


Fig. 3. Trail system in south section of SAWW that are open to the public. Red triangles and square represent information kiosks and trailhead kiosk.

This area is located in the Outer Bluegrass Ecoregion, a portion of Northern Kentucky that was covered by a continental glacier during the early Pleistocene Epoch. In the approximately one million years since the retreat of that ice sheet, erosion has produced a landscape of streamside lowlands separating moderately dissected uplands. Euroamerican pioneers found the lowlands and uplands of the ecoregion to be completely covered by deciduous trees. Tree species that grow in the lowlands occupied wet and moist soils, while the upland woods primarily consisted of mixed mesophytic forests, the type of woodland that covered most of pre-settlement Northern Kentucky. Mixed mesophytic forests occupy a position between moister mesophytic forests, often dominated by beech (*Fagus grandifolia*) and sugar maples (*Acer saccharum*), and drier mesophytic forests, typically dominated by oaks (*Quercus* spp.) and hickories (*Carya* spp.). As expected in an intermediate community, canopy dominance in a mixed mesophytic forest is shared by several tree species, not just one or two. The upland woods also support a diversity of fungi, herbs, shrubs, and trees, as well as an abundance of bird, amphibian, reptile, mammal, and invertebrate animal species. A portion of the forest stand encircles an abandoned farm field supporting grassland/meadow organisms.

Fig 4. Educational group prior to a spring flora trail hike.

The wetlands portion of the property (approximately 40 ha) is dominated by forest stands of various types and ages. The wetlands are bounded by the Ohio River on the north and Kentucky Route 8 on the south. The earthen fill of an east-west railroad divides the wetlands into north and south sections. The north section holds a floodplain forest along the river, as well as a set of six established (fall of 2012) open canopy ephemeral ponds (Fig. 5). The floodplain forest is comprised of trees that tolerate frequent flooding and reduced soil aeration, e.g., silver maple (*Acer saccharinum*), cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), and black willow (*Salix nigra*). A population of beaver inhabits burrows in the riverbank, and muskrats live in several of the wetland ponds. Both the north and south sections of the wetlands contain poorly-drained depressions separated by slight ridges. The depressions are water-filled during wet seasons and following river flooding. Pin oak (*Quercus palustris*) and red maple (*Acer rubrum*) dominate the depression woods. Trees adapted to less-saturated soils appear on the slight ridges separating the depressions, e.g., beech, tulip poplar (*Liriodendron tulipifera*), black cherry (*Prunus serotina*) sassafras (*Sassafras albidum*), and box elder (*Acer negundo*). Shrubs, herbs, fungi, invertebrates, and vertebrates, especially amphibians, inhabit the lowland forests. This habitat is unique in Northern Kentucky in having some of the only breeding populations of wood frogs (*Rana*

Fig 5. North St. Anne Wetlands newly constructed ephemeral pond (2 years post- construction).

sylvatica) and mole salamanders (*Ambystoma barbouri* and *Ambystoma jeffersonianum*).

The wetlands and mature woodlands are essential habitats for many species and provide ecosystem services such as water quality protection, soil conservation, and pollution remediation. A nature trail through the south section of the wetlands is accessed from a parking area on the east side of SAWW. The trail, with several information kiosks, is open to the public during daylight hours. REFS uses the site for a variety of research activities, environmental monitoring, transdisciplinary collegiate education, P-12 and teacher environmental education, summer science camps for the public, and community activities. The fenced northern wetlands and upland forest are reserved for research and education groups through REFS. REFS/SAWW is a member of the Kentucky Organization of Field Stations (KOFS).

While REFS and SAWW offer a variety of habitats for study, the station is also near a variety of other habitats for research, education, or outreach activities. Within 10 mi of the station on the Kentucky side of the Ohio River alone there are eight local streams, the Licking River, and many small lakes. REFS is an excellent outdoor laboratory and outdoor classroom for all educational levels from pre-school through university level. It is a facility that while small still has the potential to support all types of outdoor education, including classes in the natural, social and environmental sciences and education, the arts, communication, as well as instruction in resource management. As a protected natural area, SAWW and REFS is also a valuable place to conduct research in ecology and natural resource management.

REFS Steering Committee:

A REFS Steering Committee was established in the spring of 2017. The Committee meets periodically to plan for upcoming events (e.g., REFS Family Nature Adventure Day), or to discuss changes, improvements, priorities, new opportunities, funding and development, and organizational issues for the station. The Committee includes: Dr. Richard Boyce, Professor of Biological Sciences, NKU; Dr. Richard Durtsche, Director of NKU REFS and Professor of Biological Sciences; Mr. Scott Fennel, Director of the NKU CER; Mr. Rob Kues, Lecturer in Biological Sciences, NKU; Dr. Maggie Whitson, Associate Professor of Biological Sciences, NKU; and Ms. Amy Winkler, Director of the Campbell County Conservation District.

CURRENT ACTIVITIES AND PROGRAMS AT REFS

During the 2016-2017 year, REFS had a total of 1250 researcher, students, educators, and public users of the facility and the surrounding natural areas. Research activities were varied and included researchers from both NKU and Xavier University, making up 24% of the annual activities at REFS. University curriculum included 13 different courses from NKU, Xavier University, and Cincinnati State all using the facilities at REFS. Curriculum was the major REFS activity (40.9%). Outreach programs were varied, and we kicked off the field station with a great response at our Grand Opening for both stakeholders and the community at large. Community engagement was 35.1% of the activity at REFS this past year. Below are some descriptions of research and programs that are on-going at REFS.

University Curriculum Activities at REFS:

- Ecology Lab: NKU BIO 304L – The general ecology laboratory by far makes the greatest use of REFS and SAWW as all of their outdoor activities and experiments are based out of the field station (7-8 visits per term). This course is taught in one or two sections per

semester throughout the year. Students learn experimental design, field techniques, data analysis, and participation in a collaborative study (e.g., tree ant occupancy) that is occurring statewide.

- Dendrology: NKU BIO 312 – This upper division course on trees and tree identification makes several visits to the field station, because of the great diversity of habitat and forest types.
- Botany: NKU BIO 313 – The laboratory section of this fundamental course on plants makes visits to REFS to learn about the diversity, morphology, and ecology of these organisms.
- Entomology (2 institutions): NKU BIO 320 and XAV BIO 271 – Students are introduced to the world of insects, and the field station is used for both day time collecting, and night time mercury vapor light collection. Students gain hands on experience with learning about temporal differences in insect activity and their ecology.
- General Biology Laboratory: NKU BIO151L – HS dual credit - The General Biology Laboratory is a dual credit (high school/college) course with students from Bishop Brossard High School and Holy Cross High School and students are brought to REFS to gain hands-on experience with field ecology studies.
- Herpetology: NKU BIO 404 – Students learn bioassessment techniques for amphibians and reptiles, and spend several visits during the semester at REFS learning about the natural history of herps.
- Environmental Sciences – Careers: NKU ENV 115 – The Orientation to Environmental Careers class visits REFS to see how a field station is operated, and to learn the kinds of research that takes place at field stations. The students even get involved with some trail building and other activities.
- Vertebrate Zoology: NKU BIO 303 – The Vertebrate Zoology students spend an extensive amount of time at REFS and SAWW during the term. While at the station, they learn observational and bioassessment techniques of birds, amphibians, reptiles, and mammals, and also have the opportunity to spend time observing these animals in their natural habitat. Students also participate in field experiments (foraging ecology study) on birds.
- Water Management / Treatment Technologies (2 institutions): NKU ENV 220 and Cinci State EVT 230 – Both of these courses look at water management and water treatment. The wetlands at REFS is an ideal site for students to learn first-hand about water filtration and hydrologic movement through that wetlands ecosystem.
- Invertebrate Zoology: NKU BIO 301 – This course visits the field station to see living examples of animals without backbones, and learn about their natural history. Crayfish and other pond invertebrates are a main focus for students on site in the wetlands.
- Techniques in Biological Research: NKU BIO 399 and Directed Research: NKU BIO 492 – These courses are taken by students either starting to learn about research (BIO 399) or actively involved in a research program (BIO 492). Student projects are carried out at REFS every semester and over the summer with guidance from NKU faculty members.

Research Activities at REFS & SAWW (all studies involve undergraduate research students):

- Long-term amphibian and reptile biodiversity monitoring (Durtsche)
- Physiological ecology of amphibians (Durtsche)
- Invasive species (Boyce, Durtsche, Dr. Kristy Hopfensperger, NKU, Fennel and CER)

- Wetlands Restoration and long term impacts on the ecosystem (Fennel and CER)
- Botanical biodiversity and collections for the NKU Herbarium (Whitson)
- Long-horn beetle biodiversity (Dr. Ann Ray – Xavier)
- Permanent forest plot long-term data collection (EREN): change in site parameters and plant conditions over time (Boyce)
- Wetlands nutrient cycling, gas exchange, and biogeochemistry (Hopfensperger)
- Chickadee nesting activity (Dr. Lindsay Walters, NKU)

Community Outreach Activities at REFS:

- NKY Sierra Club – occasional, various nature outings, 10 – 20 per outing.
- Sanitation District 1 – Environmental Science Carriers – initial event, high school students.
- Langdon Club meeting – rotational with other locations in the area, 30 people.
- Earth Day Trail Hike at REFS and SAWW – annual, up to 170 people attending.
- NKU Biology Alumni "Herping with Durtsche" – annual, ~15 attending.
- NKU Biology Alumni "Birds and Blooms" – annual, ~15 attending.
- REFS Talk-&-Walk Nature Series - Summer – weekly, 5-15 attending.
- The Art of Nature Exploration: Middle School Camp (CINSAM) - daily for 1 week, 15 campers

Strategic Plan Development

In developing the 5-year strategic plan for REFS, we hosted two stakeholder conferences to gather their views on the needs and goals of REFS. The stakeholder groups included 10 – 20 professionals from around the region in the areas of 1) Research, 2) Curriculum and University Education, 3) Outreach and Community Engagement, and 4) Administration. In addition, five outside experts (field station directors) and a facilitator provided advice and comment. To assess the organization of REFS and its long-term viability, a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis was conducted at the stakeholder conferences to identify key points to address, strengthen, or modify for the future sustainability of REFS (Appendix A). From these key points, a sustainability plan was developed to address the SWOT analysis by 1) maintaining strengths, 2) converting weaknesses, 3) capitalizing on opportunities, and 4) mitigating threats (Appendix B). Where possible, we match our strengths with opportunities and both convert weaknesses into strengths and threats into opportunities. This sustainability plan then formed the basis for the Goals, Objectives, and Implementation Strategies that comprise the core of our 5-year strategic plan.

DETAILED GOALS AND OBJECTIVES FOR THE NKU REFS OVER THE NEXT 5 YEARS:

Goal 1: Scholarly Activity: ***To support and expand research, scholarly, and creative activities at REFS.***

- **Objective 1:** To promote scholarly activity by NKU faculty and researchers from other institutions or agencies, and to facilitate undergraduate training through class and individual research projects.
  - Implementation Strategy:
    - ❖ Orient first time researchers to the natural areas (SAWW) and identify on-going field studies, cover available resources (facilities, equipment and supplies, field assistance, contact information, communications and cyberinfrastructure, storage, etc.), safety protocols, and policies and procedures of REFS. Create maps and lists of important resources.
    - ❖ Work with neighboring land owners to allow student research projects on their property as well as maintain good working relationships.
    - ❖ Maintain a list of active research, curriculum, and outreach programs to maximize the efficient use of habitat/natural resource areas by researchers and students interested in studies at REFS without compromising the integrity of those programs.
    - ❖ Establish an annual symposium (possibly joint with the Thomas More College Biological Field Station) for faculty researchers and students to share information and ideas for enhancing the educational and research values of REFS.
    - ❖ Host workshops on new technologies or research themes (e.g., R-Programming for Ecologists)
    - ❖ Offer agencies (KY Division of Water, EPA) and local government the opportunity to use REFS and SAWW as a laboratory for modeling best management practices, studying ecosystem processes, and developing natural resource protection programs.

- **Objective 2:** To encourage student projects at REFS and within SAWW.
  - Implementation Strategy:
    - ❖ Identify areas of the Reserves that can be utilized for student projects.
    - ❖ Encourage student projects that facilitate land management decisions by the Campbell County Conservation District.
    - ❖ Assist students in gaining access to places where they can carry out their projects whether these are scientific studies or other scholarly or creative activities.

- **Objective 3:** Maintain a cyberinfrastructure to supports data collection and web-based communication that facilitates information flow on station activities, use, for anyone interested in research, education, or outreach opportunities at REFS.
  - Implementation Strategy:
    - ❖ Expand our current DSL internet connection to fiber-optic connections.
    - ❖ Create wireless (e.g., WiFi) connections to the north wetlands for instrumentation data collection.
    - ❖ Revise the website (https://www.nku.edu/refs.html) to communicate REFS research-education-outreach opportunities and station use for both NKU and non-NKU scholars/educators to include:
      - availability and reservations
      - research protocol to clearly communicate steps necessary for conducting research at

REFS and SAWW, updated as REFS develops
- downloadable forms & policies, maps, species lists
- research permit application
- real-time field data (e.g., climate parameters)
- link to the REFS data management system for long-term data sets (see Objective 3 below).

❖ Establish new forms of social media outlets (e.g., Facebook, Twitter, LinkedIn, YouTube, Flickr, Instagram, etc.) to connect with potential users.

- **Objective 4:** To expand biodiversity inventories and maps of the SAWW natural resources, and expand current and initiate new long-term ecological databases for monitoring changes in habitats or ecosystem processes
  - Implementation Strategy:
    - ❖ Periodic inventory of wildlife (aquatic and terrestrial inverts [insects], amphibians and reptiles, birds, mammals) and vegetation (grasses, herbs, shrubs, trees).
    - ❖ Continue long-term data collection of temperature, relative humidity, soil moisture, and pond water depth) and expand to include more parameters and other areas in REFS/SAWW.
    - ❖ Generate hydrologic, soils, and geologic maps of natural areas, and produce GIS mapping layers of SAWW natural areas.

- **Objective 5:** Develop a data management system for digital archiving databases, scholarly work, and REFS use metadata.
  - Implementation Strategy:
    - ❖ Establish and maintain a data management system with a database (NKU Digital Repository) of all research projects done, data collected, study locations (GPS), and research protocols carried out at REFS and adjacent natural areas (SAWW). Connect to the Environmental Data Initiative (EDI) to archive and management of data and metadata for re-use and re-distribution. Obtain a REFS Digital Object Identifier (DOI) for all researchers to use with projects from REFS to track publications. Use Qualtrics to obtain data from users at REFS including pre- and post-visits. Metadata includes aspects of station use (natural areas used, facilities used, size and demographics of research team, time of year, project duration, etc.) by researchers, educators, and outreach group leaders.

Goal 2: Personnel: ***Development of human resources for efficient station operations, management, and programming.***

- **Objective 1:** To acquire and maintain a staff that will ensure an effectively run field station and facilitate research, education, and outreach opportunities for all.
  - Implementation Strategy:
    - ❖ Hire a Station Manager/Education & Research Coordinator.
      - This position would be a non-tenure track faculty position, and would include some teaching responsibilities, hopefully based out of REFS.
      - This position requires at least a Master's degree.
      - This position would be responsible for day-to-day management of REFS facilities

and activities on-going both at REFS and SAWW. This would include coordination of P-12 outdoor education programs and associated assessments; community education programs; coordination of student interns, class visits, and research activities associated with NKU and other institutions.
- Develop, in conjunction with NKU Environmental Education Faculty, curriculum for specific grade levels to incorporate Kentucky Environmental Education Standards, and encourage teachers to use these curricula.
- Add to the current list of stand-alone curriculum activities developed for different ages for use at REFS and in the SAWW natural areas.
- Create trail maps indicating kiosks for various age-specific student activities.

❖ The REFS Director (Durtsche) is a tenured faculty in the NKU Department of Biological Sciences and oversees the operation and development of the field station, identifying funding sources, and coordinates program development. He also chairs the REFS Steering Committee when they meet.
❖ Solicit Federal work study or student grants for student interns to assist with station operations, trail maintenance, leading tours, and as research assistants.
❖ Enlist the help of retired professor volunteers to work in station operations or leading field activities.
❖ Recruit local community volunteers to help assist with station activities, tours, and operations assistance.
❖ Seek external funding for a post-doc to work with the station manager on programming design, program grant writing, and station management.

Goal 3: Facilities: ***To upgrade REFS facilities to accommodate building space and cyberinfrastructure needs for researchers, university classes, and public engagement.***

- **<u>Objective 1</u>:** Seek multi-source funding and assistance from NKU facilities management, information technology, and campus planning along with student and volunteer labor to improve and expand facilities and cyberinfrastructure at REFS.
  - Implementation Strategy:
    ❖ Develop a Master Plan for facilities at the REFS property that will accommodate current and future planned programs, sustainable "Green" infrastructure, creative work spaces (areas for nature art), and parking needs (including an area for bus turn around).
    ❖ Construct a 24'x30'x16' shed that will accommodate current and future equipment and supply storage needs, have a small workshop for the construction of innovative field-based study apparatus, serve as a location for indoor experimentation, and function as a temporary space for classroom or meetings for larger groups and to avoid adverse weather or if the main REFS facility is occupied. (expected completion date: June, 2018)
    ❖ Seek NSF – FSML Improvement Grant funds for the expansion of the current REFS facility for much needed research and teaching space that is at least large enough to accommodate a full class of students (24 + instructors) on each level of the facility.
    ❖ Seek NSF Campus Cyberinfrastructure Grant funds to promote network improvements and data collection and storage solutions for current and expanded research activities and long-term wireless ecosystem monitoring at REFS, and for state-wide networking among other field stations within Kentucky via KOFS.
    ❖ Explore an option for researchers to overnight at REFS, possibly a stand-alone

bunkhouse with additional residence capacity for a student caretaker. Funding sources would include private and corporate donors and an NSF FSML Improvement Grant.
- ❖ Seek to achieve greater sustainability by using renewable energy sources, 'green' (LEED) construction, and other water and power-saving technologies when possible.
- ❖ Research the need for a covered meeting area (pavilion) with toilets, electricity, and water as an extension off the new shed for programming and outreach activities.

Goal 4: Student Success: ***To function as a center for experiential education in an outdoor setting for university-based courses of all disciplines. Faculty and students can gain understanding and appreciation of ecological systems and use REFS and the surrounding natural areas (SAWW) as both a nature classroom and a nature laboratory.***

- **Objective 1:** To provide a supportive, student-centered education that promotes academic success, and to incorporate outdoor-based education across campus and across curricula that can be innovative, distinctive, experiential, and transdisciplinary, resulting in superior graduates while encouraging life-long learning.
  - Implementation Strategy:
    - ❖ Encourage students to use the outdoor space to learn about natural systems, particularly wetlands and upland forests, through course activities and faculty mentor-supported individual research, scholarly, or creative activity projects at REFS. Hands-on experiences in field activities promotes academic success.
    - ❖ Expand the current use of REFS with curricula from within the Biological and Environmental Sciences.
    - ❖ Promote expanded REFS use by disciplines outside of Biological and Environmental Sciences (e.g., Education, Arts, Communications, Theater, Geology, Physics, etc.) and by transdisciplinary courses for outdoor learning.
    - ❖ Encourage the addition of one new course per year that use REFS over the next five years
    - ❖ Prioritize a list of areas and subjects that would be appropriate for long-term studies by classes with each class building on previous class data.

- **Objective 2:** To serve as a teaching and training center for students, especially in the areas of environmental education and environmental consulting/restoration through collaborations with the Center for Environmental Restoration (CER) and through field station networking opportunities with the Kentucky Organization of Field Stations (KOFS) and regional colleges and universities.
  - Implementation Strategy**:**
    - ❖ Use REFS and SAWW in place-based student training sessions for specific techniques or program goals.
    - ❖ Offer field-based teaching programs and teacher training like Project Wet or Project Wild.
    - ❖ Use REFS as a site for environmental assessment techniques (e.g., invasive plant identification and removal) for Environmental Science students working at CER.
    - ❖ Develop a course in "Field Station Management" with lectures and hands-on work at REFS, with site visits to other field stations to work with managers and directors within the hub of KOFS, and other regional field stations (e.g., Thomas More College, University of Cincinnati, Miami of Ohio, University of Kentucky).
    - ❖ Through KOFS develop a multi-institution/multi-field station course or modify a current

course, where students receive lectures at home institutions or on-line, and then travel to REFS and other KOFS sites for laboratory - field experiences / studies, or research activities.
- ❖ Develop wetland and natural resources training programs for environmental consultants, students, and the public at-large
- ❖ Use KOFS to advertise REFS classes and research opportunities to other institutions

- **Objective 3:** To inform faculty about REFS and the SAWW natural areas and how they can use and benefit from them.
  - Implementation Strategy:
    - ❖ Create an "Introduction to REFS" as a PowerPoint, YouTube video, or other multimedia product for presentation at departmental meetings to inform faculty at NKU and other institutions of the opportunities that exist at REFS and the SAWW natural areas.
    - ❖ Create an introductory-level teaching module for use by university classes from any discipline that would provide background information and logistics about REFS and the SAWW natural areas.
    - ❖ Provide tours to show prospective instructors the potential of REFS for their classes.

Goal 5: Community Engagement: ***To connect REFS and the SAWW natural areas with the Northern Kentucky community and the Commonwealth of Kentucky, and become a center for nature learning in the Northern Kentucky region.***

- **Objective 1:** To enhance outreach for the community to understand wetland and upland forest ecosystems, nature conservation, habitat enhancement, education, and research.
  - Implementation Strategy:
    - ❖ Conduct a Melbourne community program such as an annual Family Nature Adventure Day and hike. Invite the public to participate in habitat enhancement, land management and ecological conservation (e.g., Earth Day) activities.
    - ❖ Initiate a Talk-&-Walk Nature Series, possibly jointly with the Thomas More Biological Field Station in future years during evenings in the summer.
    - ❖ Use social media to communicate with the community about REFS programs.
    - ❖ Working with the CER, invite landowners to observe and learn about various management practices on the SAWW natural areas.
    - ❖ Link with other local environmental groups (Green Umbrella, Greater Cincinnati Council of Environmental Educators, etc.) to offer joint activities and programs at REFS (e.g., NKY Sierra Club outings, Northern Kentucky Fly Fishers).
    - ❖ Work with partner groups like the Outdoor Adventure Clubs of Greater Cincinnati (inner-city youth group focus) to give underrepresented groups (e.g., inner city youth) the opportunity to experience a wetlands and nature learning adventure.
    - ❖ Host business/political groups for team-building workshops nature experiences
    - ❖ Create an interpretive center at REFS that explains the purpose of REFS and provides background on the wetlands and upland old growth forest. This interpretive center would inform users about research activities that take place at REFS and provide directions to public access in the south wetlands.

- **Objective 2:** Create educational camps and nature interpreter instruction at REFS.
  - Implementation Strategy:

- ❖ Hold camps (summer or weekend) and other programs at REFS (e.g., The Art of Nature Exploration – middle school and other NKU CINSAM camps). Develop a child-parent explorer camp.
- ❖ Train community volunteers and undergraduates to become nature interpreters and interns to help with leading tours for the public and help with activities at REFS.
- ❖ Participate in the KOFS collaborative effort with the University of Kentucky Extension to develop a Kentucky Master Naturalist Program for the community where instruction and volunteer opportunities and at REFS would be part of the certificate program.

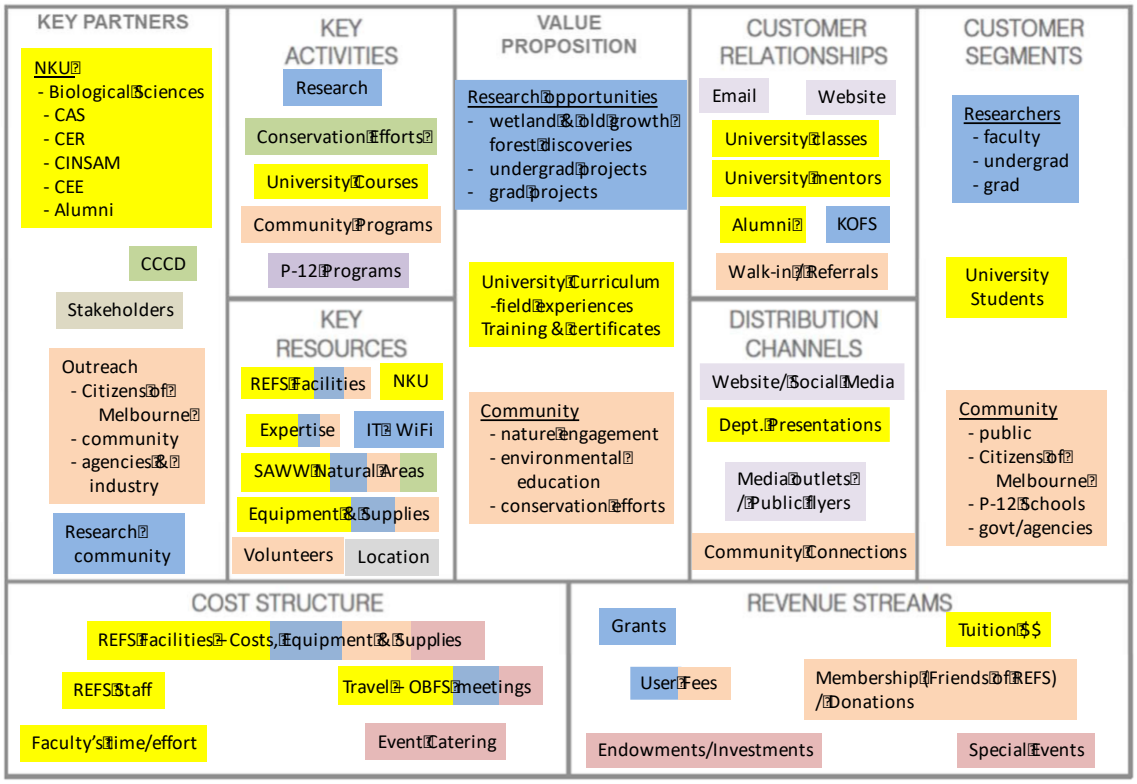
- **Objective 3:** To use REFS as an outdoor classroom for P-12.
  - Implementation Strategy:
    - ❖ Accommodate classes as funding and other resources allow without serious degradation of natural or cultural resources.
    - ❖ Create introductory modules about REFS for P-12 classes. The modules will be designed to present the learning opportunities for children by highlighting the resources at REFS and the SAWW natural areas.
    - ❖ Work with NKU's Center for Integrative Natural Science And Mathematics (CINSAM) and the NKU Environmental Education programs on developing or jointly hosting P-12 programs at REFS to avoid duplication of services and to enhance program efficiency.
    - ❖ Give teachers website access to our selection of REFS K-12 field studies with resources (e.g., handouts, teaching aids, duration, difficulty).

Goal 6: Financial Sustainability: ***To thrive as a field station while REFS functions as a field-based research and education unit within Northern Kentucky University, and reflects the mission, values, and goals of NKU.***

- **Objective 1:** To maintain and grow REFS as a financially sustainable unit within Northern Kentucky University, and to develop a business model that describes a rationale for how REFS creates, delivers, and captures value.
  - Implementation Strategy:
    - ❖ With utilities (outside of internet and security) provided by NKU, we will maintain standard operations based on donor and fee revenues generated. By generating additional funding (see below), we will expand operations, research activities, and program development.

❖ Use a business model canvas for REFS to guide business operations for a fiscally sustainable field station.

REFS Business Model Canvas



- **Objective 2:** Seek external funding for research activities at REFS.
  - Implementation Strategy:
    - ❖ Ask all researchers and faculty who submit grants to include support for REFS in their budgets.
    - ❖ Seek a connection to undergraduate research grants though NKU.
    - ❖ Fees for researchers, and for use by departments, centers, and other programs.
    - ❖ Seek donor funds (endowment) for aid in the sponsorship of a field station manager and program coordinator (NTTT).
    - ❖ Submit a joint NSF REU proposal between NKU REFS (wetlands and upland forest habitat) and Thomas More College Biological Field Station (TMC BFS – Ohio River habitat). These two field stations are only 11 miles apart but together we offer a broader range of research opportunities among these different habitats.
    - ❖ Seek funding from govt., NGO agencies (NSF, KY DOW, etc.) for workshops and symposia

- **Objective 3:** Financial support for REFS and community programs.
  - Implementation Strategy:
    - ❖ Seek grants and donations to support REFS outreach programs.
    - ❖ Fees for P-12, community outreach programs, camps and courses
    - ❖ Develop a "Friends of REFS" for community members, donors, and NKU alumni.

- ❖ Seek donor funds (endowment) to support student interns/research, P-12 education, and research programs.
- ❖ Establish a fundraiser (e.g., Wine and the Wetlands [with wine from a Melbourne Winery]) to support outdoor education and research programs.
- ❖ Dinner Series: "Evening Ecology at REFS", "Theatre in the park"?

Goal 7: Conservation: ***To aid the Campbell County Conservation District in conserving the surrounding natural areas, maintaining their ecological processes, and enhancing biodiversity.***

- **Objective 1**: To promote conservation strategies to maintain and manage the natural areas (SAWW) surrounding REFS as entire ecosystems rather than at species level.
  - Implementation Strategy:
    - ❖ Replace non-native exotic species with native plant species in parts of the natural areas not under experimental study.
    - ❖ Work with the local (Melbourne) Fire Department to create and implement a fire management plan to carry out controlled burns on the open wetlands to stimulate vegetation restoration.
    - ❖ Look for alternative methods to exotic plant removal from chemical treatments, e.g., goats.
    - ❖ Use techniques to reduce erosion and environmental impact on both wetlands and woodlands. This can include establishing boardwalks through various "wet" sections of the wetlands, and erosion barriers in the woodland area.
    - ❖ Maintaining the public trails, interpretive kiosks, and providing self-guided tour information at trail heads and through the REFS website.

BUDGETING FOR OPERATIONS: A proposed 2022 budget using the business model as a basis for a business plan.

Our goal for REFS is to build toward financial sustainability by the year 2022. Below are our predictions of anticipated income and expenses for 2022. We used our 2017 budget and our projected programming goals as a basis for these predictions. The actual budget will be developed by the REFS Steering Committee in consultation with NKU administrators.

INCOME	Amount
▪ Grant related funds (equipment, supplies, student stipends, F&A)	$4,000
▪ University Lab Fees (proportion based on courses taught at REFS)	$4,000
▪ Endowments (based on ~4% interest)	$7,500
▪ Talk-&-Walk Nature Series – Summer	$ 500
▪ Fee for courses/certificates	$3,500
▪ Annual fund-raising event	$2,500
Total Income 2022	$22,000

EXPENSES	Amount
Personnel	
▪ Director (0.25 release time per academic semester)	$ 0*
▪ Director – one-month summer salary	$6,000*
▪ Station Manager – full time – NTTT	$ 0*
▪ Summer student workers (2 @ $10/hr ~ 25 hr/wk x 12 wks ea)	$6,000***
Travel	
▪ Director travel to OBFS national meetings	$1,500**
Equipment & Supplies	
▪ New equipment	$1,500
▪ New computers and software	$3,000
▪ Equipment repairs	$ 500
▪ Misc. Supplies	$1,500
Facilities Maintenance	
▪ Wi-Fi - Internet (~$41.50/mo)	$ 500
▪ SimpliSafe wireless security (~$16.50/mo)	$ 200
▪ Utilities (covered by Facilities Management)	$ 0
▪ Utilities repair	$ 800
Symposium & Special Events	
▪ Food, Paper supplies, Misc.	$1,000
Total Expenses 2022	$22,000

(* cost requested from College of Arts & Sciences and contingent on the College, University, and the Commonwealth of Kentucky's current budget situation; ** contingent based on available funds; *** contingent on extramural funding)

EVALUATION PLAN: MEASURING SUCCESS AND KNOWING WHEN WE HAVE ACHIEVED IT.

Below are the metrics of success for the REFS 5-yr Strategic Plan.

Quantifiable progress at the REFS:

- Number of courses held at REFS
- Number of users in curriculum
- Number of student (undergraduate and graduate) researchers
- Number of outreach/community participants in REFS activities
- Number of user days
- Affiliated institutions, researchers, and educators
- Recruiting and retaining students, #'s, impacts
- Revenue from services
- Education meetings, events, workshops, activities
- Research meetings, events, workshops, activities
- Community engagement meetings, events, workshops, activities
- Qualtrics surveys of activity experience – ranking (1-5 scale) activity quality, instructor/interpreter effectiveness, and improved understanding; with comments.
- Number of funded projects
- Extramural funding per annum
- Integrated or transdisciplinary activities/projects (among disciplines, education-research, community-research)
- Range of ages of users
- Number of "Friends of REFS"
- Number of presentation, reports, publications
- Number of articles or outside media reports about or referencing REFS
- Network activity among KOFS site locations
- REFS students – #s employment/grad school compared to non-REFS students.

Qualitative assessment of REFS progress:

- Are REFS activities in-line with NKU's strategic emphases
- Is there a growing or improved impact about the appreciation and knowledge of nature at the local community level (letter from Melbourne)
- Is there an increase in the use of the REFS by the public from around the Northern Kentucky area as a center for experiencing nature (Qualtrics surveys)
- Number of users from other schools, towns, counties, states (measure of breadth of use)
- Showcase of ongoing research activities (project titles) on the website
- Survey of community impressions
- Ask users how they heard about REFS or the program that they attended.

QUANTITATIVE METRICS FOR ANNUAL GOALS
(these numbers are appropriate based on our 2017 records)

Metric/Year	2017	2018	2019	2020	2021
1. Total Funding (fees, donors, contributions)	$35K†	$10K	$14K	$18K	$22K
2. Research activity#	10	11	12	13	14
3. Education activity#	10	11	12	13	14
4. University courses	8	9	10	11	12
5. Community activity#	10	11	12	13	14
6. Student researchers	5	6	7	8	9
7. Research output*	6	7	8	9	10
8. Affiliations**	6	7	8	9	10

† - includes a $30K facility renovation appropriation from the NKU Provost
# - number of meetings + activities + workshops + events
* - number of publication + talks + posters given at meetings based on work at REFS
** - number of institutions + researchers + educators affiliated with REFS

PRIMARY ACTIVITIES BY YEAR

- **see also Appendix C for a spreadsheet of these activities based on Goals, Objectives, and Implementation Strategies.**

2017 (completed)

- Launch a 5-year strategic plan for REFS
- Renovate the main building at REFS
- Remove old sheds as safety hazards
- Install a Wi-Fi system for the REFS facility
- Install a wireless security system for the REFS facility
- Build a field station sign at entrance to REFS
- Have state install directional road signs to REFS
- Construct a REFS website
- Establish a REFS Facebook page
- Develop a 5-year strategic plan for REFS
- Hold two strategic planning conferences with stakeholders and produce reports from each outlining the recommendations and what was learned
- Visit other field stations to learn about their operations and management (Eastern Kentucky University – Maywoods Natural Areas, Miami University of Ohio – Ecological Research Center, University of Cincinnati – Center for Field Studies, Thomas More College – Biological Field Station).
- Appoint a REFS Steering committee and hold an initial meeting in the spring of 2017
- Build a new loop trail in the north research wetlands with the help of research students, ENV students, and the CER.
- Hold a REFS Grand Opening evening ribbon cutting and tree planting

- Hold a REFS Grand Opening Community Nature Day
- University curriculum used by 13 different Biology or Environmental Science courses, of which three were from universities (Xavier University, Cincinnati State) other than NKU
- Offered 10 Talk-&-Walk Nature Series summer evenings for the community led an expert
- Hold two outdoor-based alumni events
- Hold one week-long CINSAM summer camp for middle school children, and one high school wetlands event
- Link research with KOFS state-wide data collection (ant-studies by Dr. Steve Yanoviak, University of Louisville)
- Develop an "Introduction to REFS" presentation

2018

- Construction of a new 24'x30'x16' storage shed (part of REFS renovations)
- Construct a Master Plan for the REFS property to accommodate future facilities and designated research, teaching, and visual arts areas.
- Submit a proposal to NSF FSML to fund improvement to the physical facility for expansion of our current research and classroom space.
- Establish an endowment for some of REFS operating costs.
- Develop a data management plan for REFS, and link the plan with the Digital Repository at the NKU Libraries.
- Create an introductory level module for use by university classes from any discipline that would provide background information about REFS and the SAWW natural areas.
- Speak to academic departments about the benefits of scholarly work and teaching classes at REFS.
- Create detailed maps of SAWW nature trails– available from website
- Complete inventory of amphibians and reptiles, vegetation?
- Initiate mammal, bird, and insect inventories.
- Establish a REFS twitter account to increase social media awareness of REFS
- Coordinate with CINSAM to host P-12 events at REFS
- Initiate Teacher Training workshops at REFS with an Environmental Science focus
- Submit a proposal for a Wetlands certificate program.
- Seek funding through the Campbell County Conservation District to initiate construction of wetlands boardwalks
- Continue activities initiated in previous years

2019

- Submit a proposal to NSF Campus Cyberinfrastructure to fund a fiber optic based wifi system for REFS and the north wetlands with connections to other Kentucky Field Stations, and database storage facilities at NKU.
- Submit NSF REU proposal jointly with Thomas More College for activities focused between REFS and the Thomas More Biological Field Station (TMBFS)
- Initiate an annual research symposium where students and faculty can present on their work or proposed projects at REFS with the potential for guest researchers.
- Seek greater sustainability with renewable energy technologies, and 'green' (LEED) construction (contingent on funding)
- Complete mammal, insect, and bird inventories. Vegetation?

- Initiate hydrologic, geologic and soils map of SAWW natural areas. (CER doing this?)
- GIS mapping layers of SAWW (CER?)
- Complete wetland trails boardwalk construction
- Work with Melbourne Fire Department on a fire management plan with controlled burn of open wetlands to stimulate vegetative growth.
- Work with NKU Admissions on including "Welcome Wednesday" tours to REFS for potential NKU students
- Start a "Friends of REFS" membership
- Initiate an annual fund-raising event "Wine and Wetlands"
- Develop a 2-day REFS Camp as an orientation for incoming students
- Integrate Governor's Scholars activities to include REFS
- Seek donor or other funds (internal or external) for summer student interns (2 @ 25 hr/wk for 12 wk) to work on facilities projects and maintenance at REFS
- Seek funding to support undergraduate research grants for work at REFS
- Continue programs from previous years

2020

- Initiate a joint REFS – TMBFS summer REU program with a group of students working at either or both field stations (assuming the NSF REU proposal is successful).
- Work with upgrades to upland forest trails – erosion prevention.
- Continue activities initiated in previous years
- Initiate Dinner Series "Evening Ecology at REFS"
- Initiate a joint annual REFS- TMBFS research symposium
- Outreach programs in inner city youth for nature experience partnering with the Outdoor Adventure Club of Greater Cincinnati.

2021

- Appoint a half-time permanent station manager to assist with operations and management of REFS and initiate P-12 programs.
- Submit a proposal to NSF FSML and seek university endowment funding for station improvement and the construction of a researcher bunkhouse and student caretaker residence.
- Continue activities initiated in previous years
- Submit a proposal to initiate a Natural Resources certificate program
- Hold workshop on new technologies in wetlands research and field studies

Citations: (* indicates undergraduate author)

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Appendix A.

NKU REFS ORGANIZATION ASSESSMENT - SWOT

This assessment offers a means to identify and monitor the factors both inside and outside the organization of REFS that impact or influence its long-term viability. A SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis provides key points to address, strengthen, or modify for the future the sustainability of REFS.

Strengths:

- Existing infrastructure for collecting environmental data.
- Unique habitats and ecosystem services of extensive open and closed canopy wetlands including ponds, old-growth beech forest, and old-growth upland mesophytic forests.
- Proximity to the NKU main campus and Greater Cincinnati.
- NKU students and their drive for learning and gaining field experiences.
- Core NKU faculty that devote their time, energy, and expertise to the operations of REFS.
- Association with NKU, because there can be course-associated work/study assignments that can take place at REFS and in the natural areas.
- Associations with NKU Center for Environmental Restoration (CER) and NKU Center for Integrative Natural Sciences and Mathematics (CINSAM).
- Trails to facilitate access to natural areas.
- Secure and safe:
  - Wireless (SimpliSafe) cell-based security system.
  - One-way road in and out.
  - Watchful neighbors.
- Wi-Fi and internet in the facility.
- Newly renovated building (new windows, countertops, equipment and supplies, etc.).
- Great reviews on Talk-&-Walk Nature Series.
- A multi-use facility of the university.
- Restricted research area, fenced with gates.
- Ability to collect and remove specimens for research provided permits are approved.
- Renovation funding and utilities coverage provided by NKU. Also, NKU facilities management, campus planning, campus police, and information technologies provide operational support.

Weaknesses:

- Size of the facility.
- Lack of storage space (however this will be solved with the proposed new shed).
- No station manager.
- No one living onsite, as there is no housing in the current facilities.
- No fiber optics for high-speed internet connection or large data transfer rates.
- No internet connection to NKU Police for monitoring security.
- Website is run through a different office on campus, without dedicated personnel.
- Limited mechanism for disseminating information about REFS activities – need a marketing plan and avenues to inform alumni and the public
- Need better communication with the local community (Melbourne) to inform public

about land management activities in the area.
- Narrow dirt road leading to the facility.
- Low enrollments in Talk-&-Walk Nature Series.
- Debris and litter from the Ohio River on the banks of the North Wetlands following flooding.
- Limited incoming funding.
- Trails between North and South Wetlands are not connected due to bisection by railroad tracks.
- Getting students to REFS for class/research if they don't drive.
- Moving people to natural areas once at REFS – lack of vehicle (shuttle "golf" cart).
- Lack of equipment/vehicle (UTV) for transporting equipment to study site.
- South wetland parking area is quite small.
- No staff for facilities maintenance.
- No staff for trail maintenance.
- Lack of research guidelines.
- Little social media presence.
- Hard for researchers to pay NKU.
- Difficulty in getting keys for use by external researchers.
- Potential conflicts for use between stakeholders (guidelines need to be developed).

Opportunities:
- Potential to be the center for nature learning in Northern Kentucky.
- Several local universities are interested in research and education at the site.
- Wetlands and Natural Resources certificate programs.
- Long-term data monitoring/experimentation programs.
- NKU students (clubs) can assist with activities, river clean up, trail building.
- Good collaboration with Thomas More Biological Field Station for future joint station activities (e.g., joint NSF-Research Experience for Undergraduates).
- Good collaboration with KOFS (Durtsche is currently President) for networking among field stations for research and education programs across the state.
- Create working partnership with the NKU Center for Environmental Education.
- Prospective majors trip and station tour to improve recruitment.
- Start a Governor's Scholars program at REFS, or incorporate REFS into the current Governor's Scholar program.
- Several local universities are involved with or interested in research and education at the site.
- Great set of stakeholders.
- Promotion potential for REFS as the gateway to the unique holding of wetlands and upland old growth forests in Northern Kentucky.
- New donors with gifts that will help sustain the REFS.
- Summer courses, workshops, camps, business leadership programs, conferences.
- Sustainability Programs – Demos at REFS.
- Potential for Govt, NPOs, NGOs to work at the site.
- Connection with the adjacent Cincinnati Food Bank – Giving Fields as a site for curriculum programming and possible research activities.

Threats:

- Injuries to users, REFS cannot be viewed as a liability for users (waivers needed).
- Equipment/instrumentation damage – lack of knowledge of users.
- Facility, equipment/instrumentation depreciation.
- Theft or loss of equipment.
- Fire.
- Natural disasters – flooding, as REFS is in the 100-year flood plain.
- A change in policies from the CC Conservation District.
- Some neighbors' view against nature … drain the swamp, mow everything.
- Decline in donors

Appendix B.

SUSTAINABILITY: ADDRESSING THE COMPONENTS OF THE SWOT ANALYSIS

In this section, we focus on responding to the features of the SWOT analysis to strategically plan for the sustained existence of the NKU REFS over the next five years. In doing so, we 1) maintain our strengths, 2) convert our weaknesses, 3) capitalize on our opportunities, and 4) mitigate our threats. Where possible, we match our strengths with opportunities and both convert weaknesses into strengths and threats into opportunities.

- **Maintaining strengths:**
  - Continue and increase Biology and Environmental Science users and courses
  - Maintain student projects at REFS and SAWW
  - Keep trails clear for researchers to access field sites
  - Continue and expand hands-on course-related outdoor job training skills for undergraduates
  - Continue community engagement programs, e.g., Talk-&-Walk Nature Series
  - Continue with and expand Alumni outings (currently 2 per year)
  - Continue summer camps (currently through CINSAM)
  - Continue and increase student and faculty use of REFS
  - Location and proximity to SAWW
  - Care for and maintain new equipment

- **Converting weaknesses:**
  - Hire a Station Manager half time initially, leading to full time appointment.
  - Design a Master Plan for REFS grounds – future buildings, activity spaces, parking.
  - Building large (24'x30'x16') storage shed (scheduled spring 2018)
  - Write an NSF FSML Improvement Grant to upgrade and expand the existing facility to accommodate needed research and teaching space and fiber optics cyberinfrastructure.
  - Establish a wifi connection to the REFS weather station
  - Install a complete coverage wifi system at REFS and the north wetlands connected by optic fiber to the internet.
  - Add video security (NKU Police monitored) once fiber optics is available to REFS
  - Evaluate the need and plan for the expansion of the shed with an attached pavilion to expand outdoor education programs
  - Plan for researcher's bunkhouse with student caretaker housing
  - Increase long-term data collection research programs from Biology and Environmental Science
  - Increase scholarly productivity from REFS, and add scholarship/research from other disciplines: art, geology, geography, physics, environmental education, communication, theatre.
  - Update research guidelines/field protocols/regulations in policies and procedures manual – post on REFS website
  - Establish time and use scheduling for research activities at REFS and SAWW – Outlook Calendar and REFS website based.
  - Establish a payment mechanism for visiting researchers, and set annual fee for

researchers/institutions carrying out long-term research projects – modify fees section of REFS Policies and Procedures
- Have all researchers and educators working with vertebrates obtain NKU IACUC – Wildlife Protocol approval (or have approved IACUC protocols from other institutions fast-tracked at NKU) prior to conducting field studies at REFS (add to REFS Policies and Procedures)
- Add courses from other disciplines: art, geology, geography, physics, communication, theatre, transdisciplinary.
- Establish an Introduction to REFS presentation for university departments that covers opportunities at REFS and SAWW, a how-to guide for visits to REFS, scheduling procedures, protocols for class use at REFS, safety procedures, liability forms, trail maps, directions and suggested procedure to transporting class to REFS.
- Explore the option of the Transit Authority of Northern Kentucky (TANK) dorm run bus transporting classes to REFS.
- Create an introductory educational module for use by classes to introduce them to the wetlands and the upper old growth forest habitats
- Personally invite community members to attend activities
- Spring (and maybe Fall) Family (Melbourne) Nature Adventure Day picnic and nature activities at the REFS
- Improved narrow road to REFS - paved (Facilities Management & Contractor)
- Fix the parking area at the south wetlands – scheduled with CER.

- **Capitalizing on opportunities:**
  - Engage with other university/agency researchers to use REFS and SAWW
  - Increase student projects on site
  - Train students interested in work at REFS to assist researchers when needed
  - Engage other universities, NGOs, Non-Profits, Govt agencies and citizen scientists to teaching programs/courses at REFS
  - Special events for donors
  - Boy Scout merit badges/projects – benefit REFS and SAWW
  - Initiate P-12 school activities at REFS initially run by CINSAM, and later through REFS once personnel are available for those activities.
  - Bring donor tours to REFS
  - Show alignment of REFS activities and NKU mission, vision, and values
  - Incorporate REFS tours into Welcome Wednesday's for prospective students – recruitment
  - Governor's Scholar Program - recruitment
  - Develop a two-day REFS camp for incoming student orientation (week before classes) - retention
  - Infrastructure improvement: (solar?, wind?), water, electricity, bathrooms associated with new shed/pavilion – NSF FSML Improvement Grant

- **Mitigating threats:**
  - Train instructors and students on proper techniques for equipment usage
  - Train instructors, students, and the public on trail-hazards (e.g., poison ivy, ticks) and how to avoid them

- Sign in/out sheet (Qualitrics) on equipment/supplies needed
- Qualtrics survey for improvements, quantify users and activities, metadata.
- Provide a backpack first aid kit for instructor in natural areas (currently available)
- Charge fees to researchers, institutions, public for events (outside special events), classes, or station/site use at REFS.
- User liability waiver form (currently part of REFS Policies and Procedures)
- Pursue outside funding opportunities
- Maintain communication with administration of activities on-going at REFS and upcoming events
- Show the impact on NKU students
- Show the engagement of the community
- Show the linkages with other universities
- Submission of NSF Station Improvement Grant for facility expansion after Strategic Plan and Master Plan of REFS property are completed.
- Seek out new "Friends" (donors) of REFS

Appendix C.

Implementation Strategies of Objectives for Goals by year.

Goal	Objective	Implementation Strategy	Year Initite					Completed	Continuing	To be completed
			2017	2018	2019	2020	2021			
1:Research										
	1:Promote scholarship									
		Orient 1st time researchers	x						x	
		neighboring landowners	x						x	
		list of activities at REFS		x						x
		annual scholarship symp.			x					x
		research workshops				x				x
		Offer agencies access	x						x	
	2:Student projects									
		identify areas for student use		x						
		land management student proj.				x				
		assist students in access to other local lands for projects		x						x
	2:Cyberinfra-structure									
		DSL Fiber Optics			x					x
		wireless field data collection								
		revise website		x						x
		establish media outlets	x						x	
	3:Inventory biodiversity									
		periodic wildlife & vegetation inventory	x						x	
		long term climatic data collection	x						x	
		maps: hydrologic, geologic, GIS	x						x	
	4:Data management									
		digital archive NKU, EDI		x						x

Goal	Objective	Implementation Strategy	Year To Initite					Completed	Continu-ing	To be completed
			2017	2018	2019	2020	2021			
2:Personnel										
	1:Station management									
		Hire Station Manager P/T initial, then full time				x	x			x
		REFS Director	x					x		
		Student Grants/Workstudy		x						x
		volunteers - local, retirees	x						x	
		seek funding - post-doc				x				x
3:Facilities										
	1:Facilities expansion									
		Property Master Plan		x						x
		Shed construction		x						x
		NSF-FSML Improvement Grant Proposal		x						x
		NSF Campus Cyberinfrastructure Grant Proposal			x					x
		Explore station housing option					x			x
		Seek LEED construction		x	x					x
		research need for pavilion				x				x
4: Student Success										
	1:Student-centered education									
		Encourage student use of REFS	x						x	
		Expand curriculum Biol/Env Sci	x						x	
		Promote to other disciplines	x						x	
		REFS course-use increase 1-2/yr	x						x	

Goal	Objective	Implementation Strategy	Year To Initite					Completed	Continu-ing	To be completed
			2017	2018	2019	2020	2021			
		prioritized list of course-based area use		x					x	
	3:Training center									
		place-based training field techniques Univ. courses	x						x	
		teacher training Project Wet		x						x
		environ assessment w/CER	x						x	
		Field Station Management course				x				
		KOFS multi-station course				x	x			
		wetland management/natural resources micro-credential			x		x			x
		advertise REFS classes/research via KOFS	x						x	
	4:Inform faculty									
		Intro to REFS media presentation		x						x
		Intro-level teaching module REFS		x						x
		tours for instructors	x						x	
5:Community Engagement										
	1:Enhance Outreach									
		community programs family nature adventure day	x						x	
		Talk-&-Walk Nature Series	x						x	
		social media to announce programs		x					x	
		land management for community				x				x
		link to local environmental groups		x					x	
		inner city youth group programs			x	x				x
		create interpretive center			x					x

Goal	Objective	Implementation Strategy	Year To Initite					Completed	Continu-ing	To be completed
			2017	2018	2019	2020	2021			
	2:Camps & naturalist training	education camps: Art of Nature Exploration Camp	x						x	
		nature interpreter volunteer training			x					x
		Kentucky Master Naturalist Program w/KOFS and UK Extension			x					x
	3:P-12 outdoor classroom									
		accommodate classes based on funding, natural area, and facilities availability				x				x
		P-12 intro-module to REFS				x	x			x
		CINSAM-REFS joint programs			x					x
		website access to materials for teachers		x						x
6:Financial sustainability										
	1:Maintain & grow REFS									
		base budget maintenance NKU	x						x	
		business model	x						x	
	2:External funding research									
		ask researchers to include REFS in grants		x						x
		connection to undergraduate research grants		x					x	

Goal	Objective	Implementation Strategy	Year To Initite					Completed	Continu-ing	To be completed
			2017	2018	2019	2020	2021			
		NSF-REU: NKU REFS TM BFS			x					x
		seek funding: govt. agencies, NGOs		x						x
	3:External funding community									
		seek funds/donations for outreach			x					x
		fees: P-12, outreach programs, camps, courses	x						x	
		develop "Friends of REFS"			x					x
		seek donor funds	x						x	
		fundraiser events		x						x
		dinner series: "Evening Ecology"	x						x	
7:Conservation w/CCCD										
	1:Conservation management									
		replace non-native exotic species	x						x	
		Melbourne Fire Dept controlled burns				x				x
		alternatives to chemical treatment removal of exotics				x				x
		reduce erosion boardwalks		x	x					x
		maintain trails, kiosks, habitat info	x						x	