Oklahoma Water Resources Center

Virtual fencing to control cattle for improved ecosystem services
EPA Project No. MX – 02D00721

Quarter no. <u>10</u> From <u>October 1, 2023</u> Through <u>December 31, 2023</u>.

I. Abstract

Virtual fencing (VF) demonstrations and cattle movement tracking continue at the experimental ranges and cooperating ranches. Since June 20, 2023, VF has been used to implement rotational grazing and riparian exclusion from the East Native Range sites (EN1 & EN2). Riparian assessments were conducted, and drone images were captured at both the experimental ranges and cooperating ranches. No water quality samples were collected this quarter due to the continuing drought. Initial modeling results have been completed and comparisons with available data has started. Extension programs reached over 150 people this quarter, while Oklahoma Conservation Commission (OCC) soil health programs reached another 70+ producers. Our social media had a reach of almost 280,000 this quarter as well, while presentations at conferences reached another 40+ researchers. A manuscript was submitted and continued progress was made on guidance and protocols. Next quarter we will continue monitoring water quality and riparian health, tracking cattle movement, and observing the effectiveness of VF to implement best management practices.

II. Overall Progress and Results by Task

TASK 1: PROJECT ADMINISTRATION

Subtask 1.1: *OWRC will prepare electronic quarterly progress reports (QPRs) for submission to the EPA. QPRs shall document all activities performed within a quarter and shall be submitted by the 15th of October, January, April and July. QPRs shall be distributed to all Project Partners.*

The following actions have been completed during this reporting period:
   a. The 10th quarterly report was prepared and submitted on January 17, 2024.

75% Complete

Subtask 1.2: *OWRC will perform accounting functions for project funds and will submit appropriate Reimbursement Forms to EPA at least quarterly.*

The following actions have been completed during this reporting period:
   a. As of December 31, 2023, $330,563 (46%) had been expended and another $42,903 encumbered.
   b. A request for a no cost extension through December 31, 2024, was submitted to allow completion of the project objectives.

46% Complete

Subtask 1.3: *OWRC will host coordination meetings, at least quarterly, with the project team to discuss project activities and schedule, communication needs, deliverables, and other requirements.*

The following actions have been completed during this reporting period:
    a. Bi-weekly calls are held among the project team to coordinate cattle management, get updates on tasks, prepare for upcoming events, and coordinate efforts.
    b. An in-depth meeting will be held next quarter to evaluate status of all tasks and develop our plan for successfully completing them by December 31st.

75% Complete

Subtask 1.4: *OWRC will develop a Final Report that summarizes activities completed and conclusions reached during the project and discusses the extent to which project goals and measures of success have been achieved.*

The following actions have been completed during this reporting period:
    a. No activity to report this quarter.

0% Complete

TASK 2: QUALITY ASSURANCE

Subtask 2.1: *OWRC will develop a QAPP consistent with the most recent versions of EPA Requirements for Quality Assurance Project Plans (QA/R-5).*

The following actions have been completed during this reporting period:
    a. The project QAPP was submitted in September 2021.

100% Complete

Subtask 2.2: *OWRC will implement the approved QAPP. OWRC will submit revisions and necessary amendments to the QAPP as needed.*

The following actions have been completed during this reporting period:
    a. No activity to report this quarter.

75% Complete

TASK 3: VIRTUAL FENCING DEMONSTRATIONS ON COOPERATING RANCHES

Subtask 3.1: *Identify cooperating ranch(es).*

The following actions have been completed during this reporting period:
    a. Research activities have officially started at cooperating ranch #2.

100% Complete

Subtask 3.2: *Install VF system on cooperating ranch(es).*

The following actions have been completed during this reporting period:
    a. Virtual fencing has been installed at 6 locations in Oklahoma (3,175 acres) including 2 cooperating ranches and 1 research ranch in the Stillwater vicinity (funded by this project) as follows:

Ranch	Location	Acres under VF	Collars	Features	Activity
OSU BRR	Stillwater, OK	800	65	Riparian protection, rotation grazing	Deployed 2019; Samples collected under standard grazing until June 2022; Riparian protection initiated in June 2023
Demo Ranch #1	Stillwater, OK	350	90	Intensive bermudagrass, rotation grazing	Deployed 2021
	Sallisaw, OK	225	26	Sallisaw Creek	Deployed 2022
	Haskell, OK	300	38	Intensive bermudagrass	Deployed May 2023
	Minco, OK	1200	80	South Canadian River bottom	Deployed Aug 2023
Demo Ranch #2	Stillwater, OK	300	20		Deployed Sept 2023

75% Complete

Subtask 3.3: *Implement grazing management & riparian protection on demonstration ranch(es) using virtual fencing.*

The following actions have been completed during this reporting period:
    a. Demonstration of virtual fencing at cooperating ranch #1 and #2 continued this quarter.

60% Complete

Subtask 3.4: *Perform Stream Visual Assessment.*

The following actions have been completed during this reporting period:
    a. Stream visual assessments were conducted this quarter at cooperating ranches on November 17 and December 01, 2023, representing fall conditions.
    b. The stream conditions this quarter were good in cooperating ranch #2 (7.3) and poor cooperating ranch #1 (3.5).

65% Complete

Subtask 3.5: *Remote assessment of wildlife & pollinator habitat.*

The following actions have been completed during this reporting period:
   a. Nothing to report this quarter.

40% Complete

TASK 4: VIRTUAL FENCING EVALUATION AT OSU RESEARCH RANGE(S)

Subtask 4.1: *Implement grazing management and riparian protection via VF*

The following actions have been completed during this reporting period:
   a. Background data collection on cattle movement continued until June 19, 2023.
   b. Virtual fencing for best management practices began on June 20, 2023 at sites EN1 & EN2 while cattle will continuously graze sites LCB 1 & LCB2.

75% Complete

Subtask 4.2: *Perform Stream Visual Assessments at OSU Research Range(s).*

The following actions have been completed during this reporting period:
   a. Stream visual assessments on the four experimental range riparian areas were conducted this quarter on November 15 and 17, 2023.
   b. Streams at EN 1 and EN2 were in fair condition with overall scores of 5.9 and 6.5, respectively. Streams at LCB1 and LCB2 were in good condition with overall scores of 7.0 and 7.1 respectively.

60% Complete

Subtask 4.3: *Install ISCO samplers at paired watersheds at OSU Research Range(s).*

The following actions have been completed during this reporting period:
   a. No activity to report this quarter.

100% Complete

Subtask 4.4: *Monitor water quality at OSU Research Range(s).*

The following actions have been completed during this reporting period:
   a. No water quality samples were collected this quarter as drought conditions continued.
   b. Regularly scheduled maintenance for ISCO samplers was conducted monthly (October 11, November 15, December 18).

75% Complete

Subtask 4.5: *Remote assessment of wildlife & pollinator habitat at OSU Research Range(s).*

The following actions have been completed during this reporting period:
   a. No activity to report this quarter.

60% Complete

TASK 5: WATERSHED MODELING

Subtask 5.1: *Gather input data*

The following actions were underway during this reporting period:
   a. Data was gathered and procedures reviewed for APEX modeling.
   b. Different soil data was gathered including STATSGO and Polaris.

70% Complete

Subtask 5.2: *Model development*

The following actions have been completed during this reporting period:
   a. Baseline APEX models have been created for watersheds at East Native 1, East Native 2, Lake Carl Blackwell 1, and Lake Carl Blackwell 2.
   b. Continuous and Rotational grazing scenarios have been defined in the model.
   c. A SWAT model has been developed for East Native 1 watershed to evaluate the APEX model capabilities and compare the results.
   d. Ms. Afsaneh Kaghazchi has been working closely with APEX model developers at the Texas A&M AgriLife Blackland Research & Extension Center in Temple.

80% Complete

Subtask 5.3: *Model calibration*

The following actions have been completed during this reporting period:
   a. Water quality and quantity values from the East Native 1, East Native 2, and Lake Carl Blackwell 1 watershed are being compared with modeled values.
   b. Manual and Automatic calibration (APEX-Cute) is being done for hydrologic and water quality parts.

40% Complete

Subtask 5.4: *Model validation*

The following actions have been completed during this reporting period:
   a. No activity to report this quarter.

20% Complete

Subtask 5.5: *Perform long-term simulations*

The following actions have been completed during this reporting period:
   a. No activity to report this quarter.

10% Complete

TASK 6: OUTREACH

Subtask 6.1: *Develop Extension programs and materials.*

The following actions have been completed during this reporting period:
a. Videos have been created to show the various steps for installing virtual fencing and how the cattle react to collar cues.

35% Complete

Subtask 6.2: *Deliver Extension programs to producers.*

The following actions have been completed during this reporting period:
a. Attendees of the Sept 26, 2023 VF Field Day in Clayton, NM (co-hosted by OSU, New Mexico State University and the USDA Climate Hub) reported they intend to use VF on 273,000 acres.

55% Complete

Subtask 6.3: *Develop standards, specifications, and guidance.*

The following actions have been completed during this reporting period:
a. Nothing to report this quarter.

30% Complete

Subtask 6.4: *Deliver results to producers via Soil Health programs.*

The following actions have been completed during this reporting period:
a. Nothing to report this reporting period.

35% Complete

Subtask 6.5: *Communicate results via social media, newsletter, webpage.*

The following actions have been completed during this reporting period:
a. Oklahoma Water Resources Center
   ☐ Analytics for the Oklahoma Water Resources Center social media posts are as follows.

	Posts	Reach/Impressions	Engagements	Reactions
Facebook	3	822	82	45
Twitter	2	275	8	N/A
Total	5	1097	90	45

b. OSU Natural Resources Extension
   ☐ No activity to report this quarter.

75% Complete

Subtask 6.6: *Deliver presentations at conferences.*

The following actions have been completed during this reporting period:

a. Modeling results were presented at the Oklahoma Governor's Water Conference and Research Symposium in Norman, OK on November 29-30 where Ms. Kaghazchi's Poster was awarded the Outstanding Student Poster Award.

50% Complete

Subtask 6.7: *Publish manuscripts in peer reviewed journals.*

The following actions have been completed during this reporting period:
a. Submitted/In Review:
- Murray, B., K. Wagner, R. Reuter, L. Goodman. *In review*. Use of virtual fencing to implement critical conservation practices. *Rangelands*.
- Jeffus, J., K. Wagner, L. Goodman, T. Parker, B. Wilson, A. Foote, R. Reuter. *In review*. Virtual fence does not cause more stress than conventional electric fence in rotationally-stocked beef cattle. *Rangelands*.

50% Complete

III. **Related Issues/Current Problems and Favorable or Unusual Developments**

- Continued drought resulted in very few water quality samples being collected.
- Austin Phillippe left OSU this quarter. Graduate student, Cole Davis, came on board and is being trained to take over for Austin on the project.
- Additionally, Josephus Borsuah has accepted the Research Specialist position at the Water Center and will begin next quarter overseeing field monitoring and data management efforts and assisting students with analysis, etc.

IV. **Projected Work for Next Quarter**

- Continued data collection for water quality sampling, riparian/stream visual assessments, and cattle movement using GPS collars.
- UAV flights and vegetation sampling continue to address pollinator and wildlife habitat assessments (2-3 annually)
- Progress on model development using available data sets and incorporating runoff data