



COLLEGE OF AGRICULTURE & LIFE SCIENCES

Natural Resources
& the Environment



Cooperative Extension



THE UNIVERSITY OF ARIZONA

Arizona
Experiment Station

Virtual Fence 101

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The findings and conclusions in this preliminary [publication/presentation/blog] have not been formally disseminated by the U. S. Department of Agriculture and should not be construed to represent any agency determination or policy.



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**Western SARE
USDA-NIFA AFRI
The Nature Conservancy**



National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

Overview



What is Virtual Fence?



How It Works



Components of a Virtual Fence System



Cost Breakdown



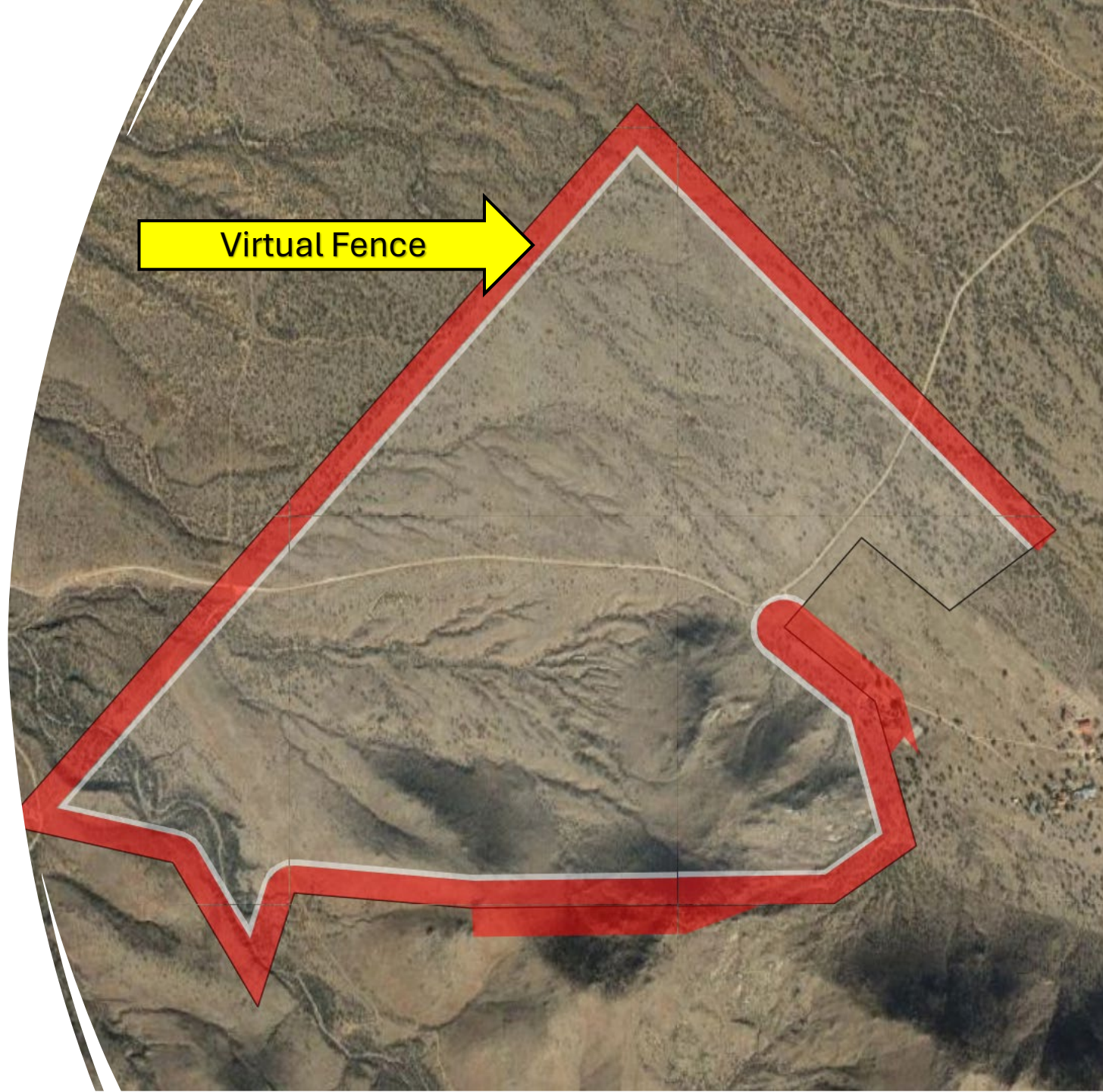
Potential Applications



Additional Resources

What are Virtual Fences?

- Geographic boundary that is programmed into an electronic device, typically a *collar* worn by livestock



Virtual Fence Collars

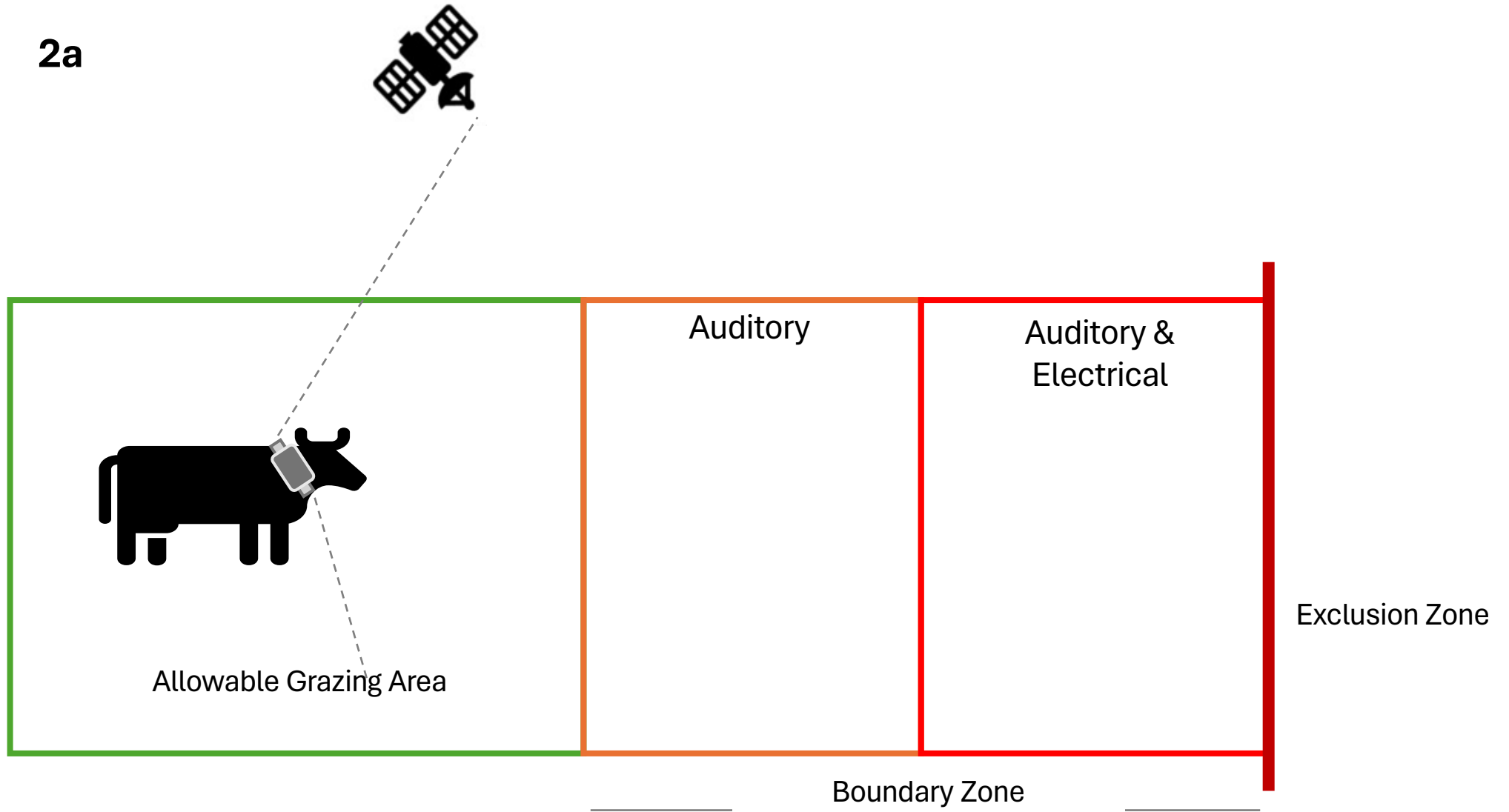
- GPS determines animal's geographic location
- Trains animals to stay within areas by sounds and electrical pulses
- Transmits data to the Internet via radio or cellular network



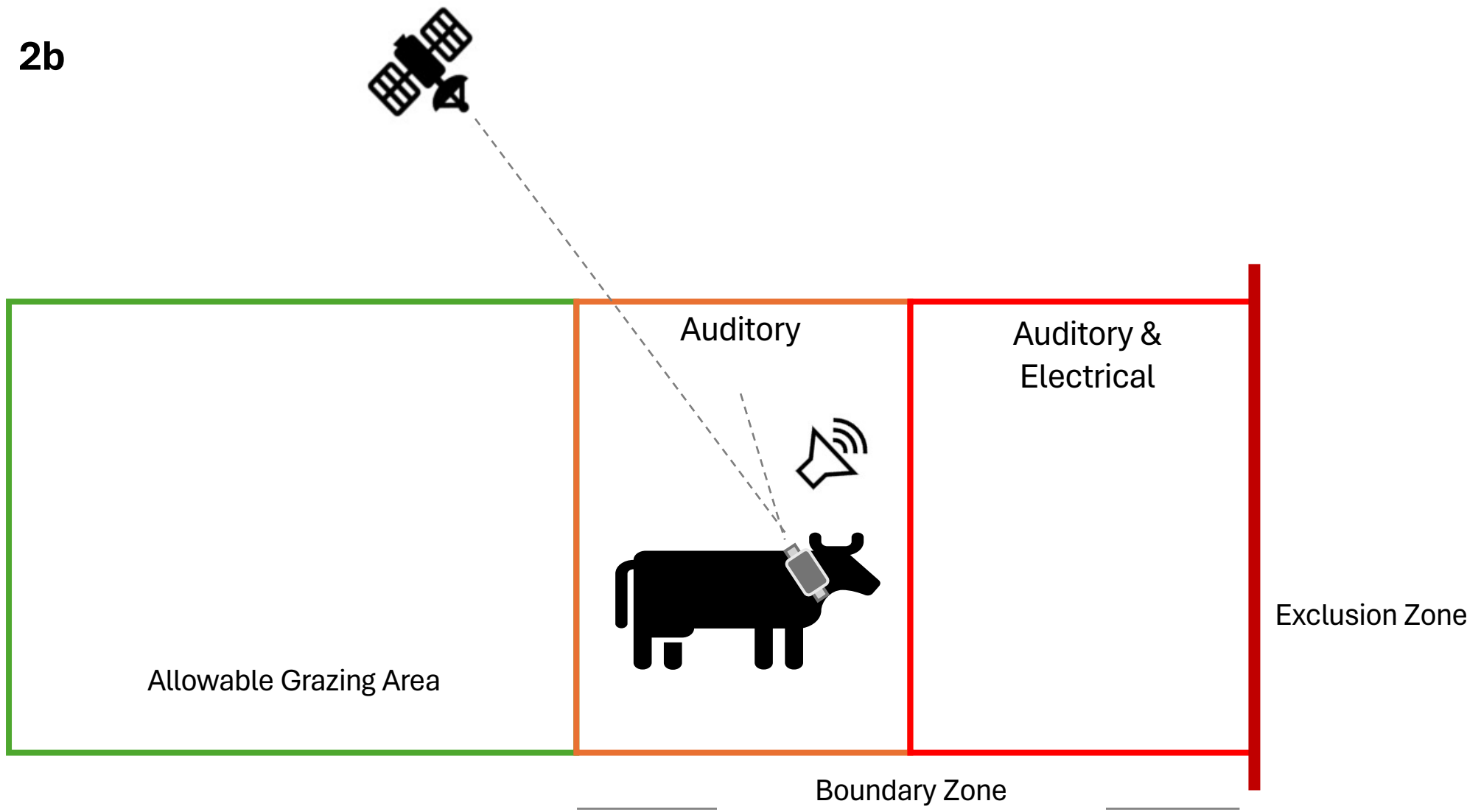
How Virtual Fence Works



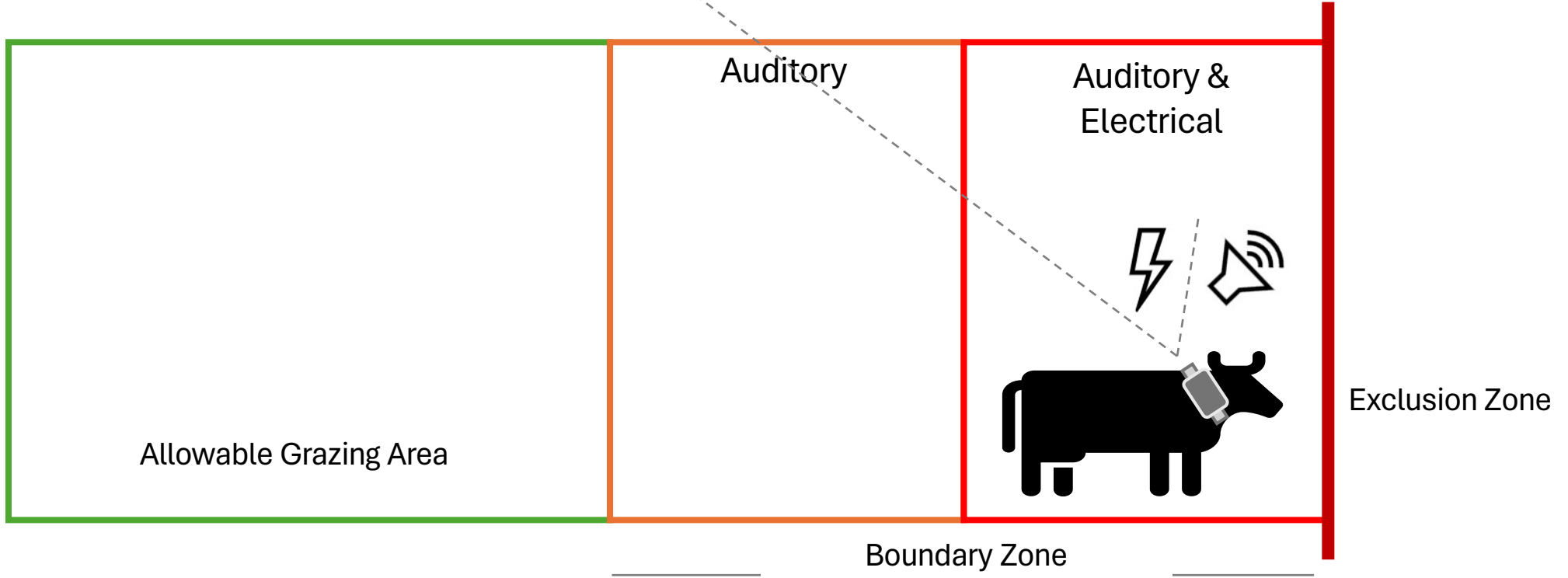
2a



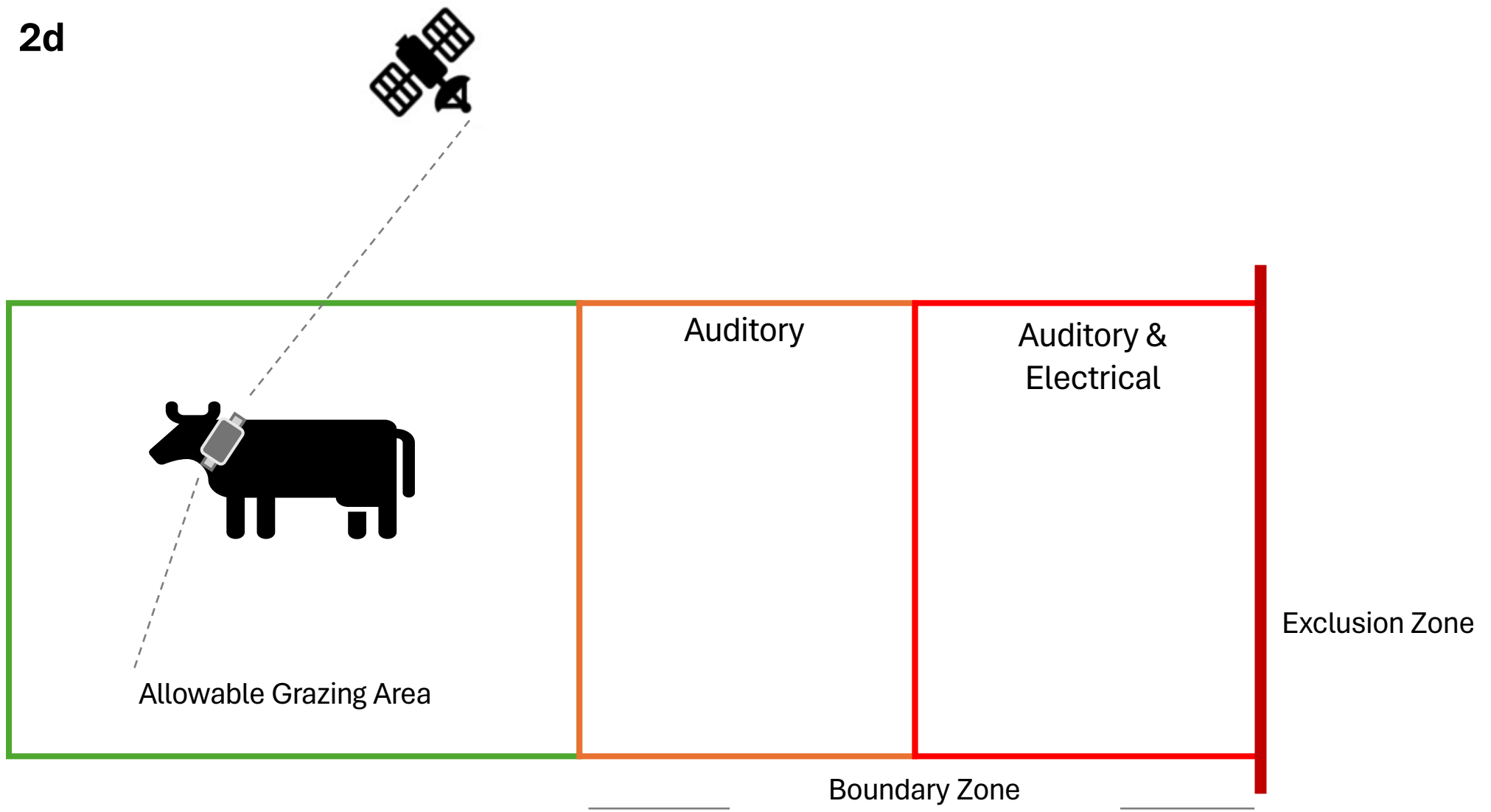
2b



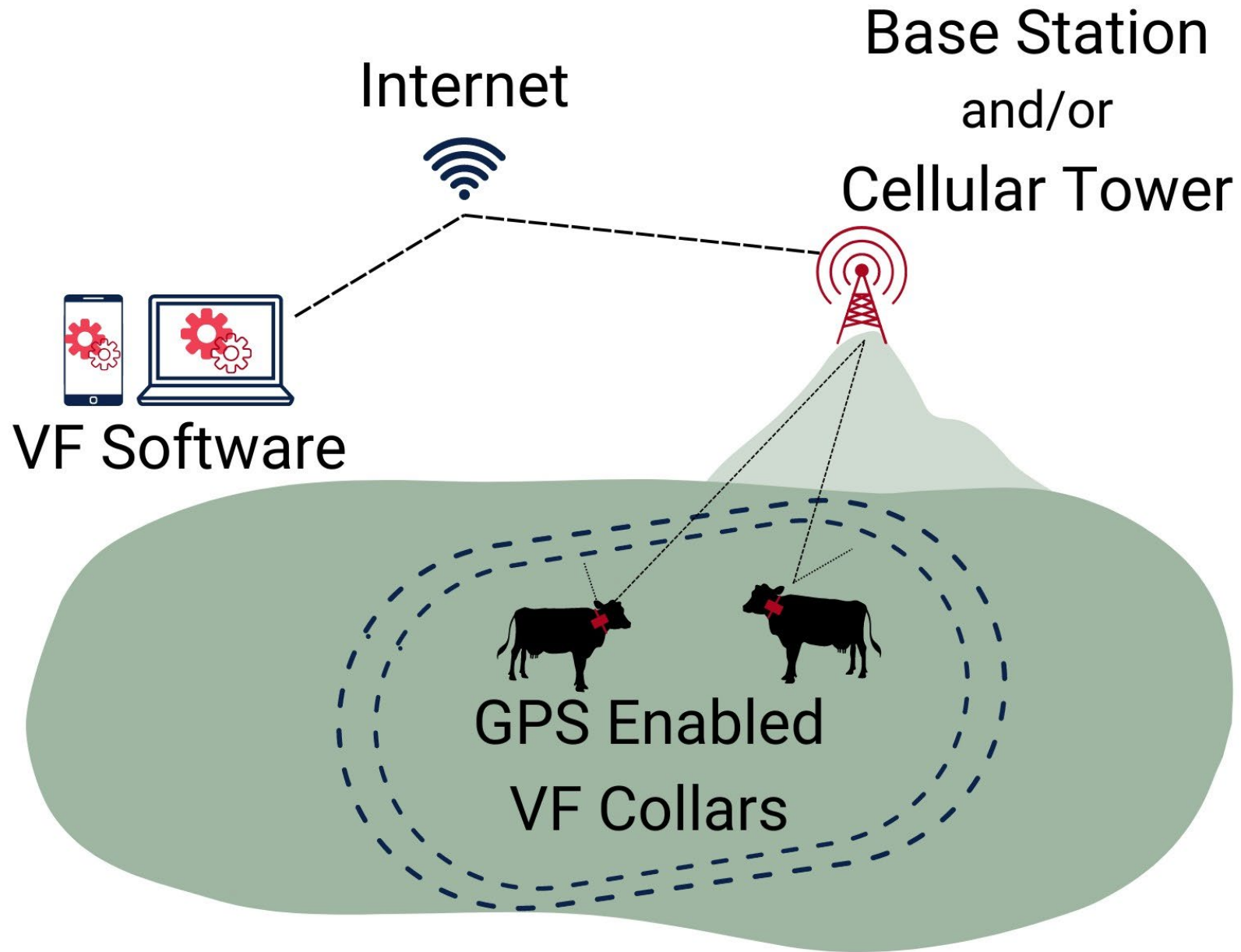
2c



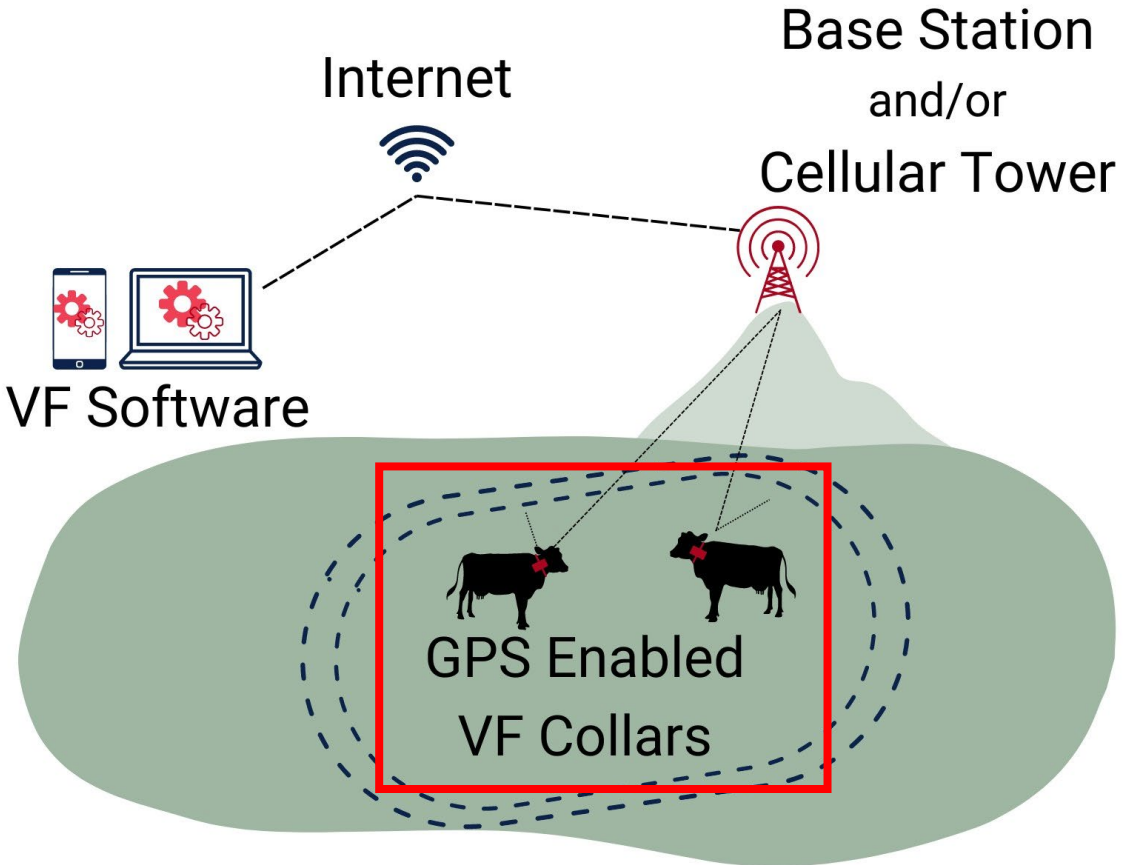
2d



Components of Virtual Fence Systems



Virtual Fence Collars



Cattle Rider V2 Chain Collar – Part Descriptions

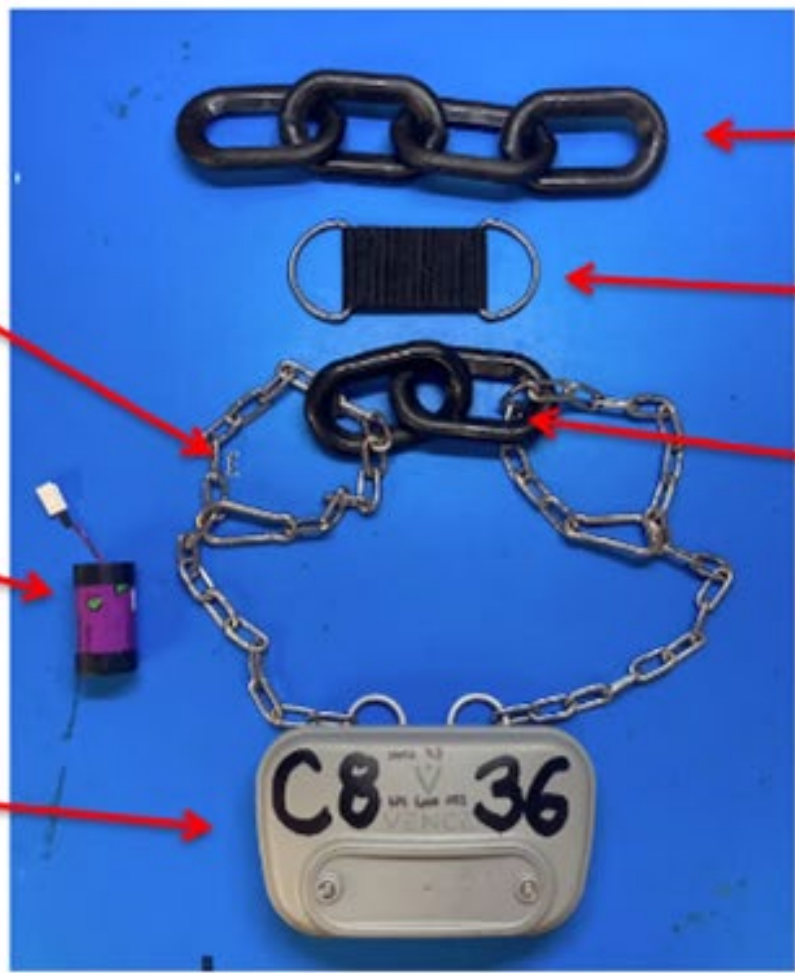


VENCE

Chain Collar
w/Adjustment
Carabiners

CR Battery

Cattle Rider
Electronics
Housing



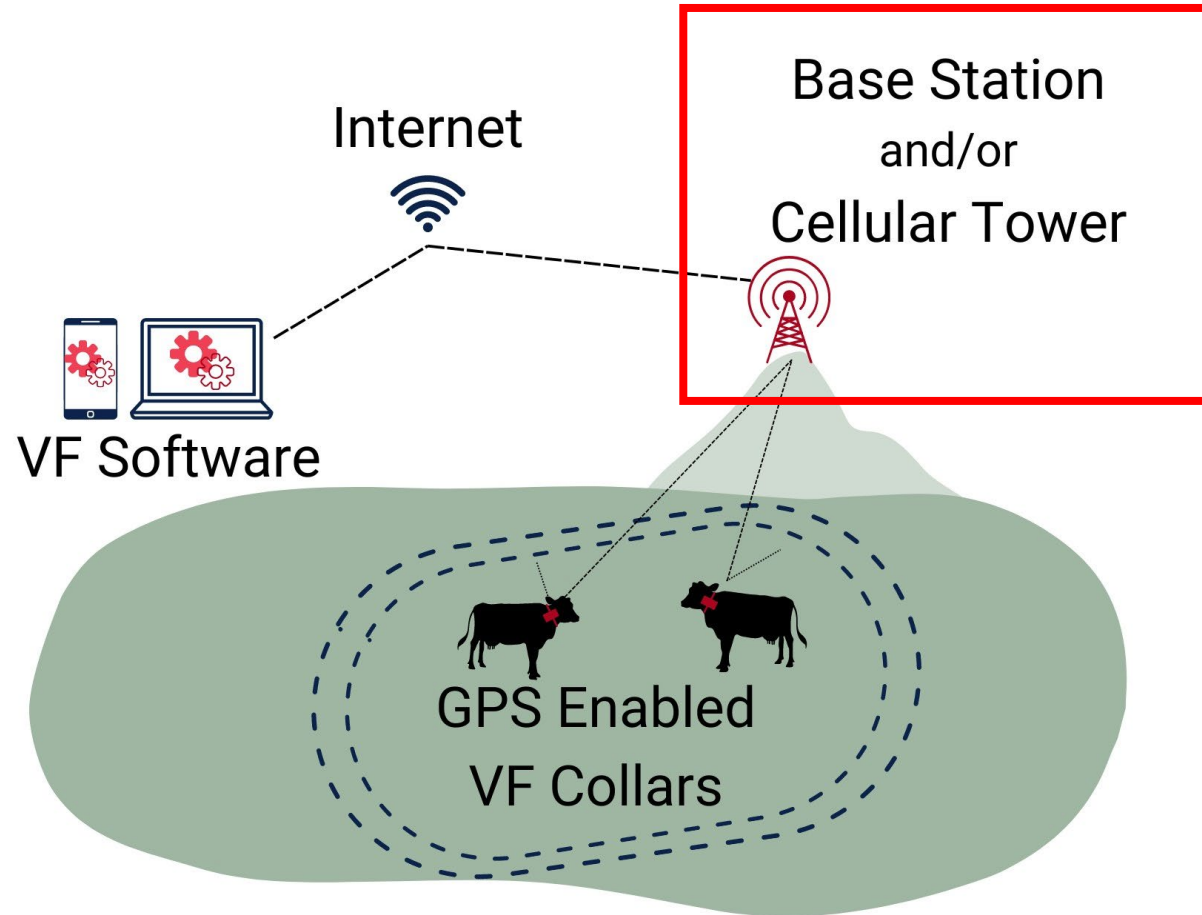
Optional Large
Animal Bridge

Optional Webbing
Bridge

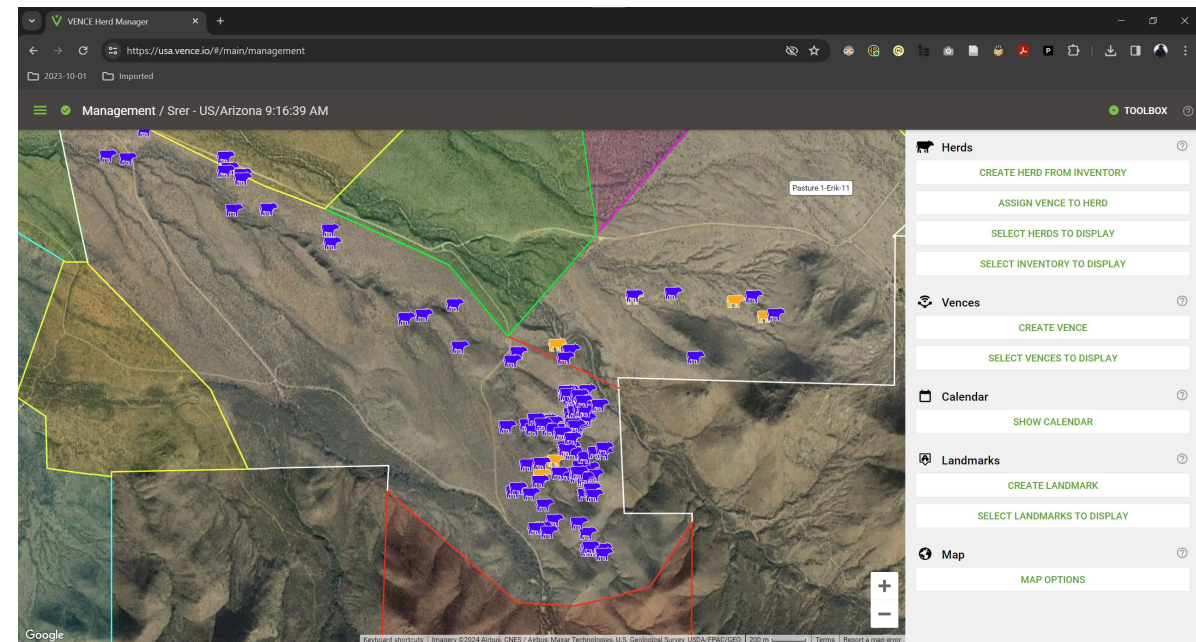
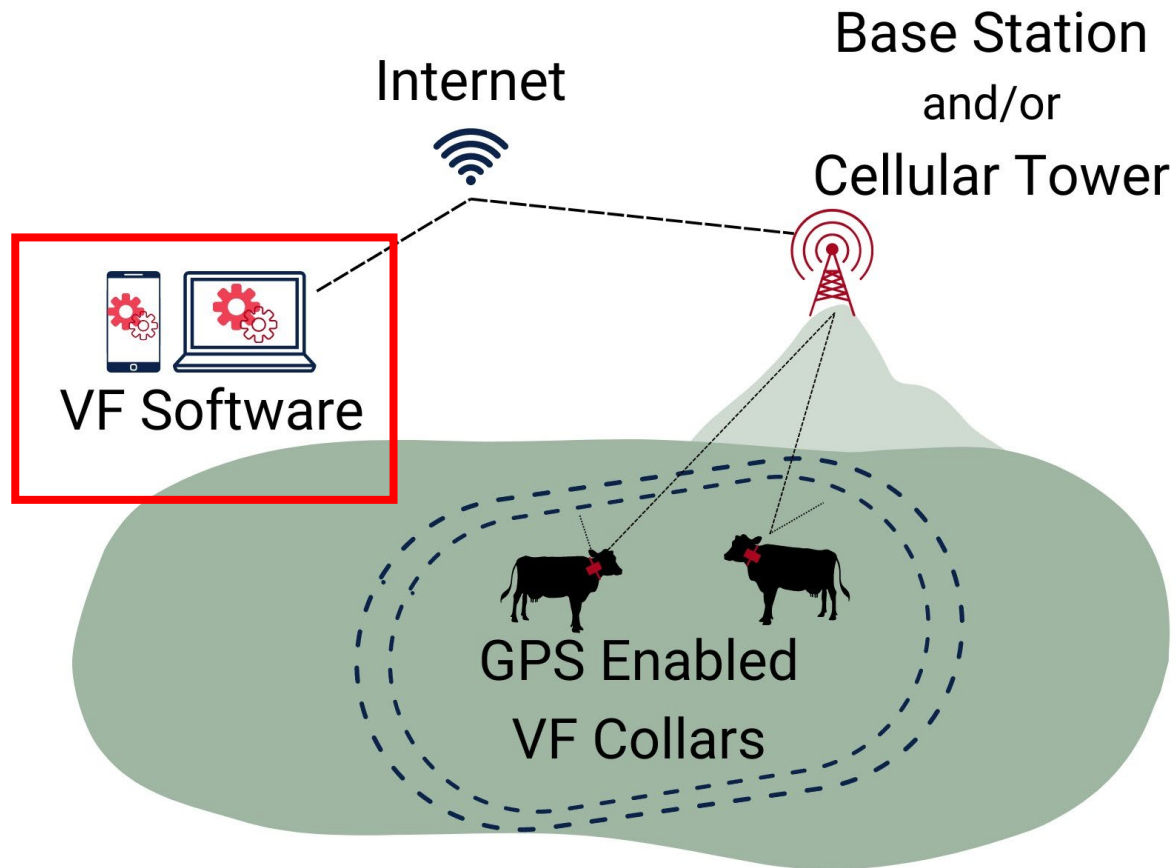
Standard Chain
Bridge

Note: Chain always loops through the bridge and clips back on itself with the carabiner. Do not clip carabiner directly to bridge.

Vence Radio Base Stations



Virtual Fence Software



VENCE Herd Manager

https://usa.vence.io/#/main/management

2023-10-01 Imported

Management / Srer - US/Arizona 9:16:39 AM

TOOLBOX

Pasture 1-Erik-11

Google

Keyboard shortcuts | Imagery ©2024 Airbus, CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO | 200 m | Terms | Report a map error

Herd Management Dashboard

- Herds**
 - CREATE HERD FROM INVENTORY
 - ASSIGN VENCE TO HERD
 - SELECT HERDS TO DISPLAY
 - SELECT INVENTORY TO DISPLAY
- Vences**
 - CREATE VENCE
 - SELECT VENCES TO DISPLAY
- Calendar**
 - SHOW CALENDAR
- Landmarks**
 - CREATE LANDMARK
 - SELECT LANDMARKS TO DISPLAY
- Map**
 - MAP OPTIONS

Cost Breakdown



Our Cost Breakdown



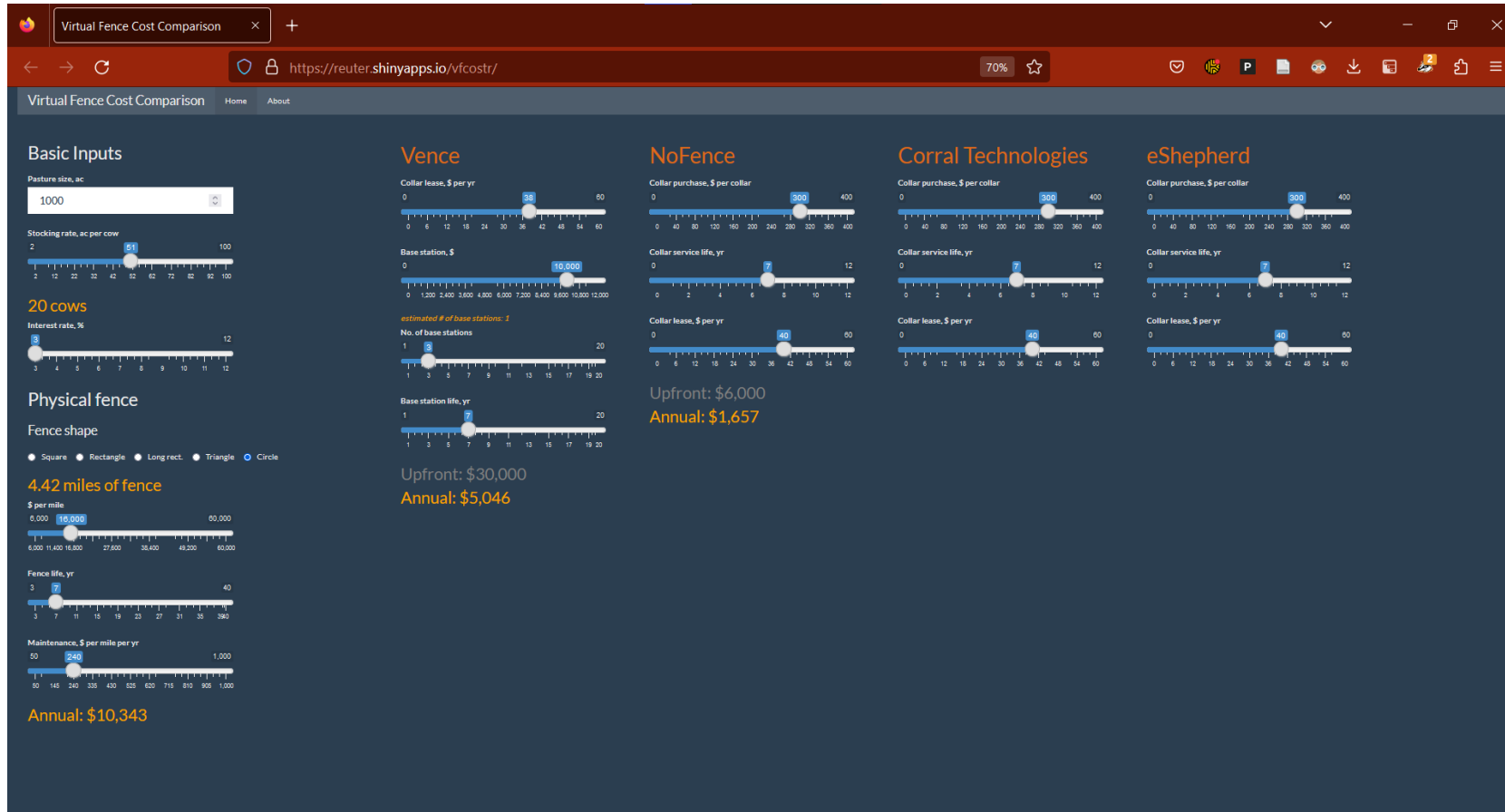
3 base stations & 500 collars

\$36,000 base stations (upfront)

\$20,000 collars (yearly lease)

\$10,000 batteries (yearly)

Cost Comparison Tool



Currently in Beta Testing



Ryan Reuter – Oklahoma State University

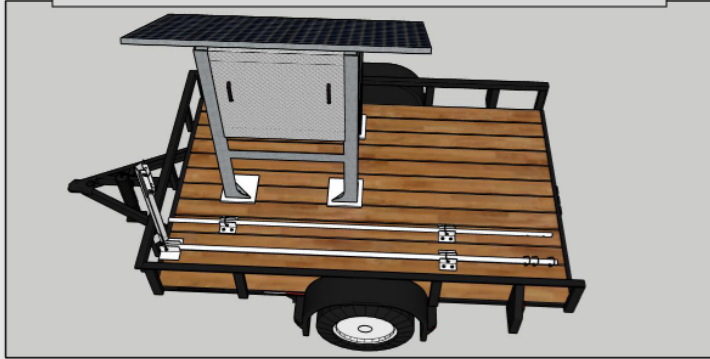
<https://reuter.shinyapps.io/vfcostr/>



Mobile Base Station

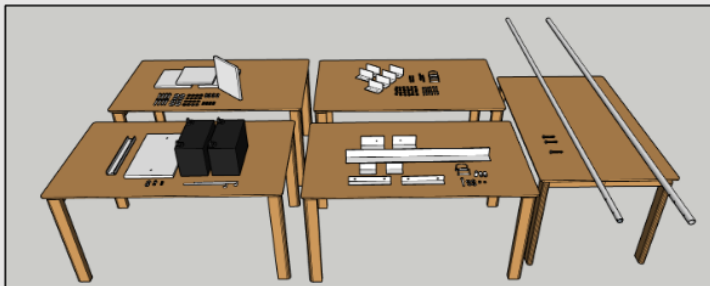
- Not officially supported by Vence Corp.
- Move to new location as herd moves
- Setup in < 1 hour
- Saves \$\$\$

DIY Mobile Base Station Conversion Guide Materials and Step by Step Instructions



How to convert a stationary base station provided by Vence Corp into a mobile base station. Your conversion may look different depending on the type of trailer you use with your conversion.

Disclaimer! The content of this document accurately represents how we have successfully approached increasing the portability of virtual fence base stations, but users should undertake any modification of a base station at their own risk. Vence Corp base stations are not designed to be mounted on a trailer and sensitive equipment could be negatively affected by the consequences of transport. Thus, Vence Corp's product warranty will not cover any damages to the base station resulting from the effects of trailer-mounted transport. Check with your individual equipment supplier for recommendations and concerns.



Written and 3D modeled by – Michael Stauder, Fabrication design by – Tony Runnels
Edited by – Eastern Oregon Agricultural Research Center's Precision Agriculture Tech Group
Questions contact – Rory O'Connor at <https://agsci.oregonstate.edu/eoarc>



Oregon State
University



Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

Step-by-Step Instructions on How to Assemble Your Own Mobile Base Station

Link: <https://agsci.oregonstate.edu/biblio/diy-mobile-base-station-conversion-guide-0>

All resources will be linked here:

<https://rangelandsgateway.org/virtual-fence>

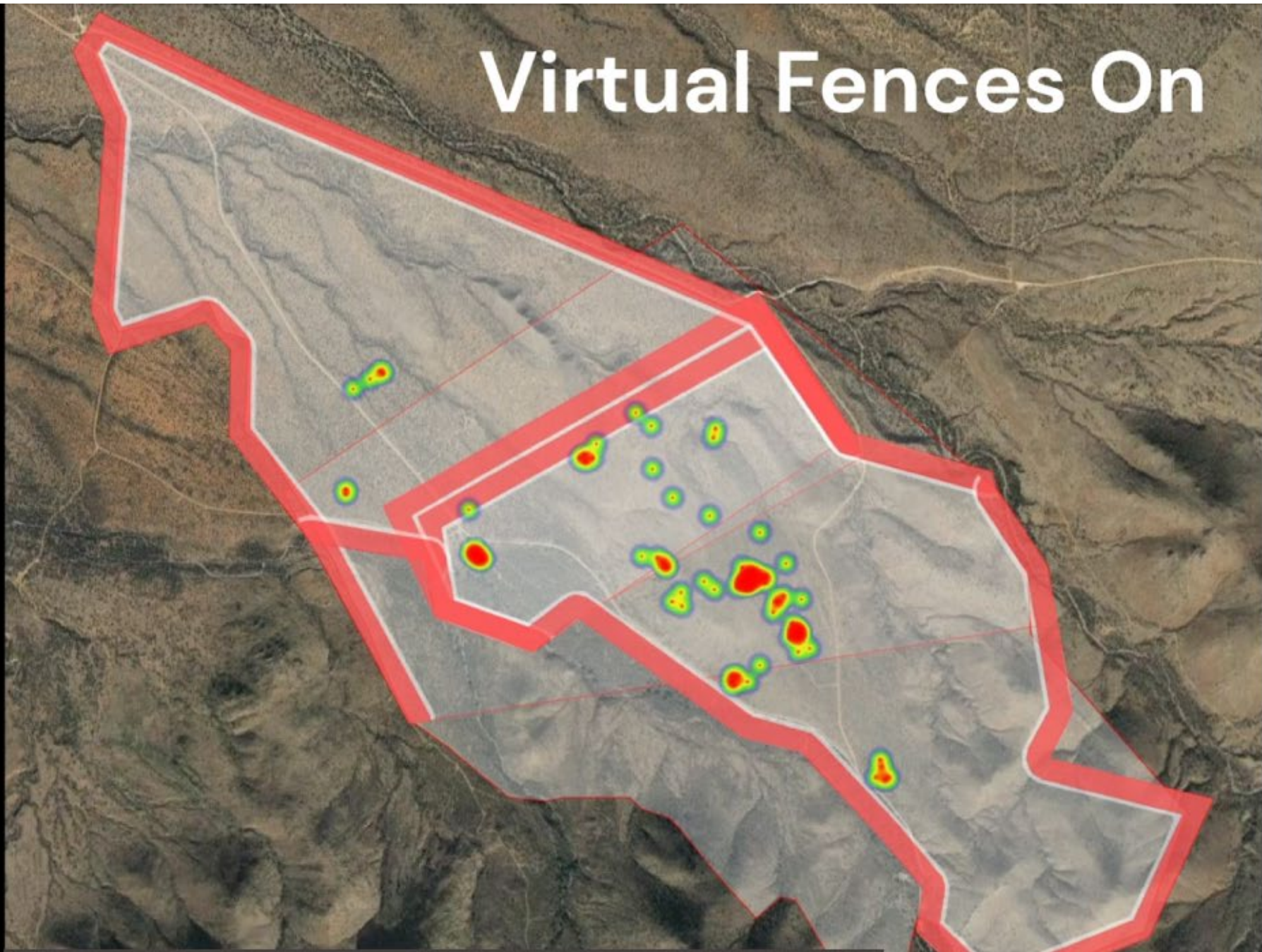
Potential Applications

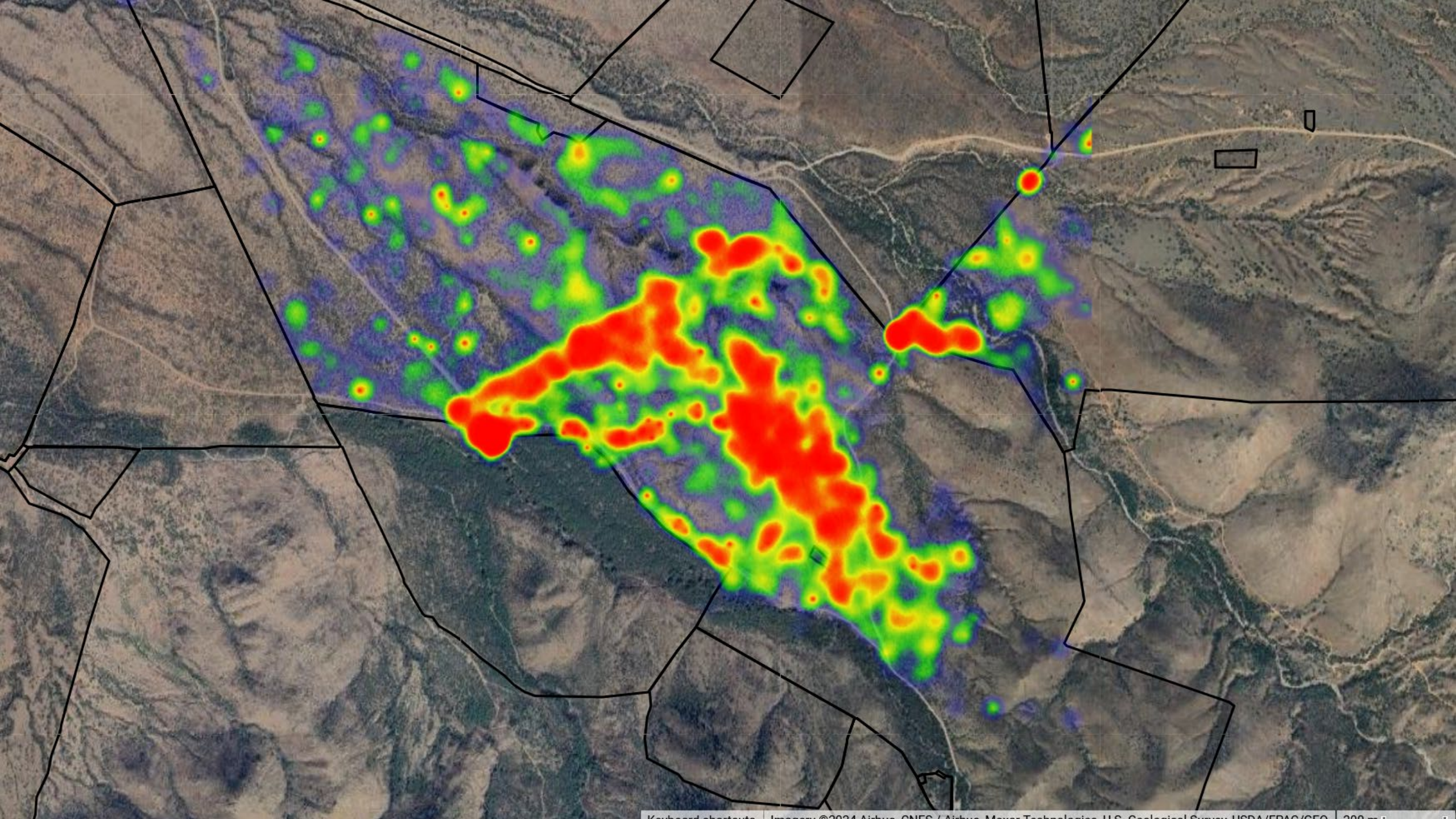


1. Improve Grazing Distribution

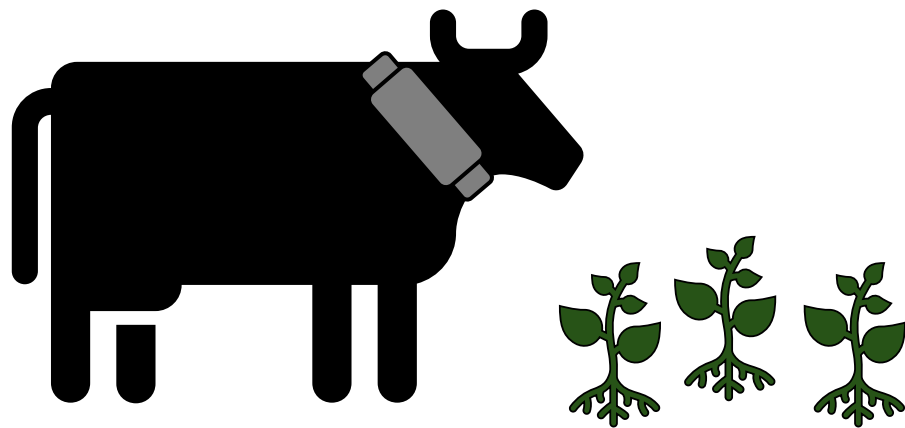


Virtual Fences On

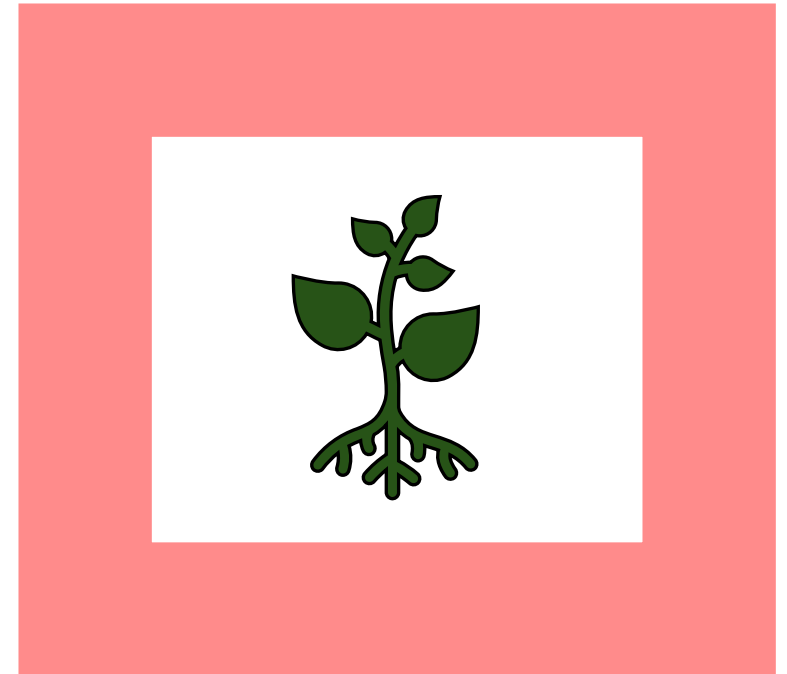
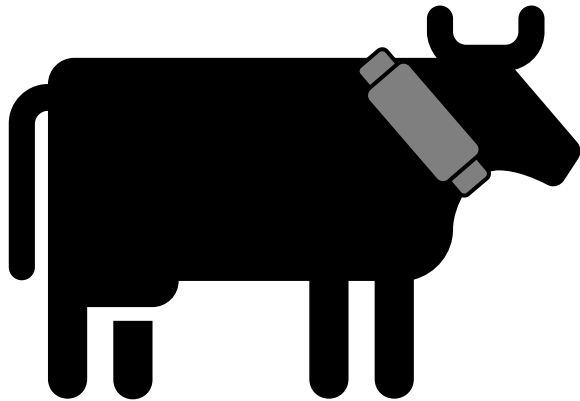




Targeted Grazing



Avoid Toxic/Noxious Weeds



Post-Fire or Disturbance



Supplement Existing Fences

Forest Service authorizes \$2.3 mil x +

← → ↻ https://www.fs.usda.gov/inside-fs/out-and-about/forest-service-authorizes-23-million-replace-range-allotment-infrastructure 🔍 📄 ⚙️ 🌐

Inside the FS

- Delivering the mission
- From the Chief's Desk
- Operation Care and Recovery


Forest Service authorizes \$2.3 million to replace range allotment infrastructure destroyed by Telegraph Fire

ARIZONA - Tonto National Forest received approval for \$2.3 million of Minor Facilities and Infrastructure Rehabilitation Pilot Program funding to repair or replace infrastructure damaged and destroyed as a result of the Telegraph Fire, the largest wildfire in Arizona during the 2021 wildfire season.

Following post-fire assessments, the Tonto submitted a funding request utilizing the Minor Facilities and Infrastructure Rehabilitation Pilot program to the National Burned Area Emergency Response leadership for review and approval. The BAER program is currently administering this pilot program in cooperation with Fire and Aviation Management to address needs beyond the emergency BAER actions. Unlike the BAER program which is specific to mitigating post-fire emergencies on federal lands, this new pilot program authorizes repair of minor national forest land facilities and infrastructure damaged and/or destroyed by wildfires.

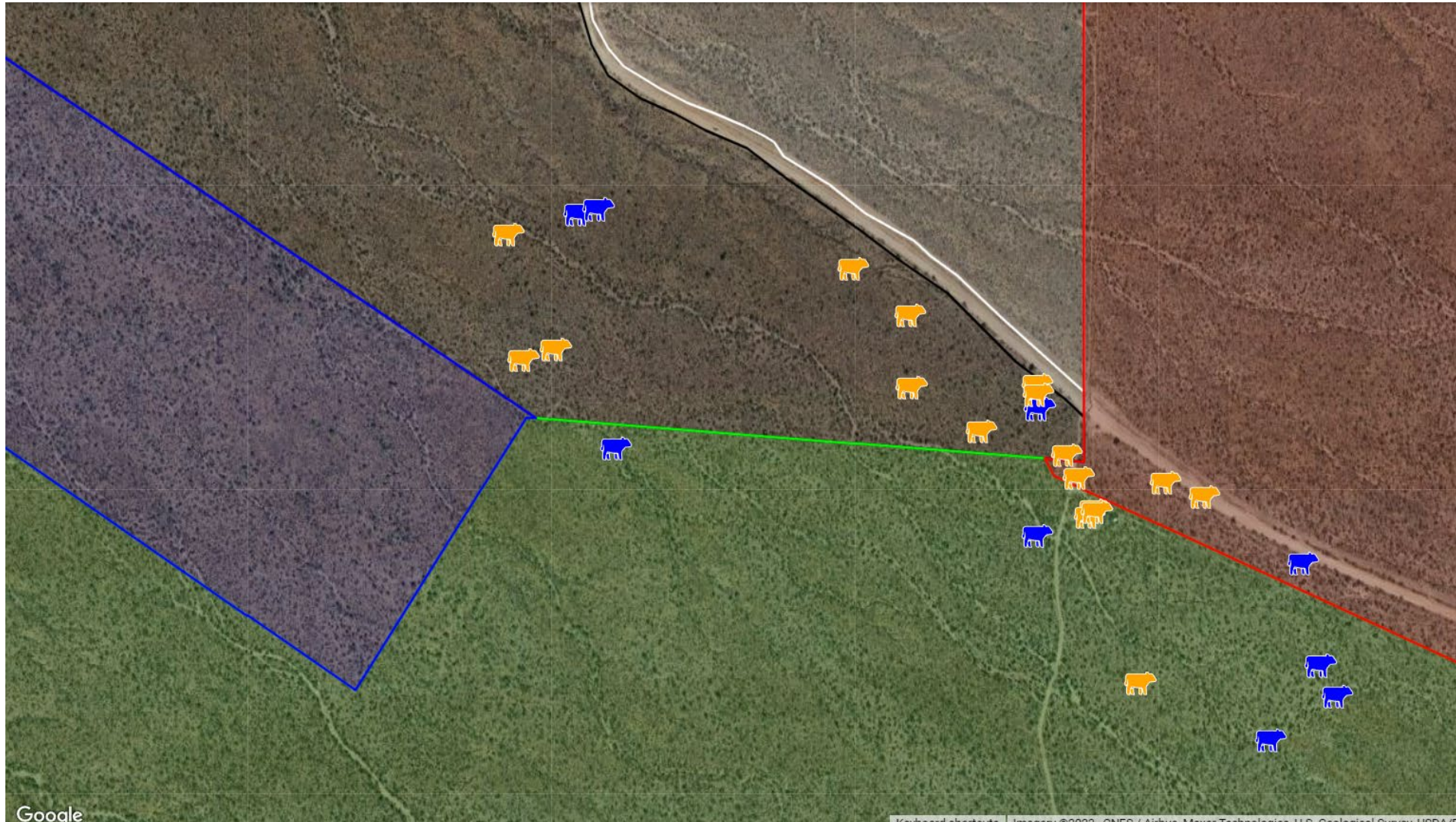
The Telegraph Fire burned or damaged a significant amount of national forest land range infrastructure across nine allotments. Range specialist identified approximately 66 miles of allotment boundary fencing damaged and over 61 miles of interior pasture fencing destroyed.

Tonto National Forest officials worked directly with permittees, the Natural Resource Conservation Service, Natural Resource Conservation Districts, Farm Service



One of several boundary allotment fences destroyed by the Telegraph Fire, June 6, 2021. Over 66 miles of allotment boundary fencing will be replaced with funding received by the BAER pilot program. USDA Forest Service photo by Bain Grantham.

Easier to Locate and Gather Cattle



Reduce Use in Sensitive Areas



Image Credit: <https://www.gettingmoreontheground.com/2019/06/09/livestock-exclusion-is-it-time-for-the-big-r/>

Additional Resources



The Virtual Fence User Guide

<https://rangelandsgateway.org/virtual-fence>



A screenshot of the Rangelands Gateway website. The top left features a dark blue navigation menu with the text 'RANGELANDS GATEWAY' and a list of categories: LIBRARY, PARTNER STATES, TOPICS, PROJECTS, TOOLS, HIGHLIGHTS, and GLOBAL. Below the menu are social media icons for Instagram, YouTube, Twitter, and Facebook. The main content area has a header image of a herd of brown cows in a field with the title 'Virtual Fencing' overlaid. Below the image is a paragraph of text explaining the technology and its benefits. At the bottom, there is a grid of six article cards, each with a red arrow pointing to it from the left. The cards are: 'FOUNDATIONS OF VF', 'The Basics of a Virtual Fencing System', 'The Vital Role of High-Quality Data', 'Livestock Conditioning for Animal Welfare', 'Create the Conditions Success', 'The Financial Implications of Adopting a Virtual Fence: A Cost-Benefit Analysis', 'Collar Management', and 'Collar Fit'. Each card contains a brief description and a small diagram.

RANGELANDS GATEWAY

- LIBRARY
- PARTNER STATES
- TOPICS
- PROJECTS
- TOOLS
- HIGHLIGHTS
- GLOBAL



Virtual Fencing

Photo by Andrew Ardava

Ranchers and land managers rely on thousands of miles of physical fence to manage livestock on rangelands. While permanent wire fence has led to improved rangeland condition in many places, wire fence provides little to no flexibility to rapidly change pasture size, manipulate grazing distribution, or avoid areas of high use or sensitive habitat within a pasture. As a result, there are constraints on the use of permanent fences as a tool for managing riparian health, post-fire vegetation recovery, or improving livestock distribution.

Virtual fencing (VF) is an emerging precision livestock management technology that can be used to increase management flexibility. The system uses invisible barriers, established by Global Positioning System (GPS) coordinates, to influence livestock movement with a combination of auditory and electrical cues.

FOUNDATIONS OF VF

The Basics of a Virtual Fencing System

Virtual fencing (VF) is an emerging precision livestock management tool with multiple interconnected components.



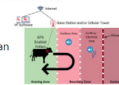
The Vital Role of High-Quality Data

[in review] Virtual fence lines are created in VF software, which requires a digital map of an entire ranch or land management area.



Livestock Conditioning for Animal Welfare

[in review] Understanding how livestock recognize and interpret the auditory and electrical cues can limit potential risks for animal health and welfare.



Create the Conditions Success

[coming soon] Special consideration is needed when training livestock, designing fences, managing incentives, and moving livestock.



The Financial Implications of Adopting a Virtual Fence: A Cost-Benefit Analysis

[in progress] Economic pros and cons of VF implementation to better understand the financial benefits and risks of the technology compared to tradition fencing.

Collar Management

[in progress] Battery life, collar disposal, strategies for collection in the field, and data organization.

Collar Fit

[up next] Equipment needed, strategies for proper fit, and safety when placing virtual fence collars on livestock.

The Virtual Fence User Guide

<https://rangelandsgateway.org/virtual-fence>

A screenshot of a web page titled 'TOOLS' is shown. It contains five tool cards with titles and brief descriptions. The 'Virtual fence cost comparison' card is highlighted with a red arrow.

TOOLS


- Optimal base station location** [↗](#)
Plot the best location for a single base station. Requires ArcGIS Pro with the Spatial Analyst extension enabled.
- Geospatial data collections and resources** [↗](#)
The Arizona Geographic Information Council curates GIS data resources for Arizona and other western states.
- BLM data** [↗](#)
The Bureau of Land Management shares geographic data and content that can be downloaded.
- Virtual fence cost comparison** [↗](#)
Compare the cost of VF systems and physical fence in different scenarios.
- Forest Service geodata clearinghouse** [↗](#)
The U.S. Forest Service maintains digital rangeland data, including boundaries and ownership, natural resources, roads and trails, and other datasets.

The Virtual Fence User Guide

<https://rangelandsgateway.org/virtual-fence>




WORKSHOPS

A photograph of a green and white utility trailer with a solar panel mounted on top, parked in a grassy field under a cloudy sky.


Exploring the boundaries of virtual fencing

Workshop 1

A photograph of a woman in a plaid shirt standing next to a brown cow in a barn, looking at a piece of equipment.

Exploring the boundaries of VF: Comparing vendors & rancher insights


Workshop 2

A close-up photograph of a brown cow's head in a field, with dust or dirt kicked up around its face.

Soil Health & Virtual Fencing

April 16, 2024 | Ranching Heritage Alliance | Eagar, AZ

Workshop 3

A large red arrow with a black outline points from the bottom right towards the 'Workshop 3' button.

Project Team

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The University of Arizona

Virtual Fence Program

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Livestock Extension



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