

# Developing a Grazing Management Plan for Fuels Reduction: Monitoring and Adaptive Management

June 6, 2023

Roxanne Hulme Foss

[Roxanne@vollmarconsulting.com](mailto:Roxanne@vollmarconsulting.com)





# Presentation Objectives

Participants will better understand:

- 1) How to design a monitoring program within the time and budget available;
- 2) Some monitoring approaches for typical metrics; and
- 3) How to tie monitoring to goals and thresholds within an adaptive management framework.

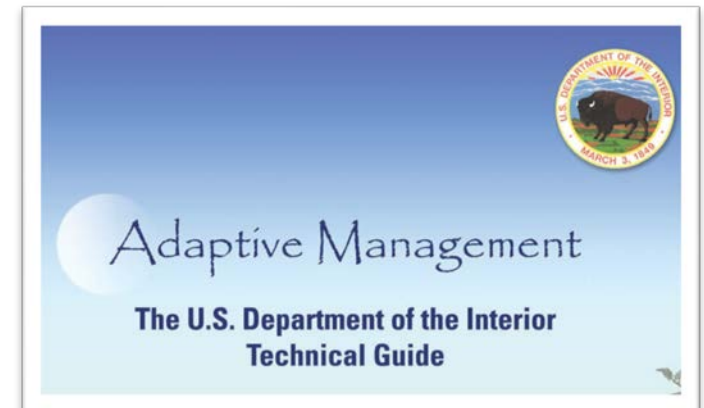
# What is monitoring?

- The collection, evaluation and interpretation of data
- Compliance: Action complies with expectations
  - Examples: RDM levels, lack of pesticides, AU/AUM limits, timing restrictions
- Effectiveness: Action achieves desired results
  - Examples: seasonal grazing maintains native forb cover

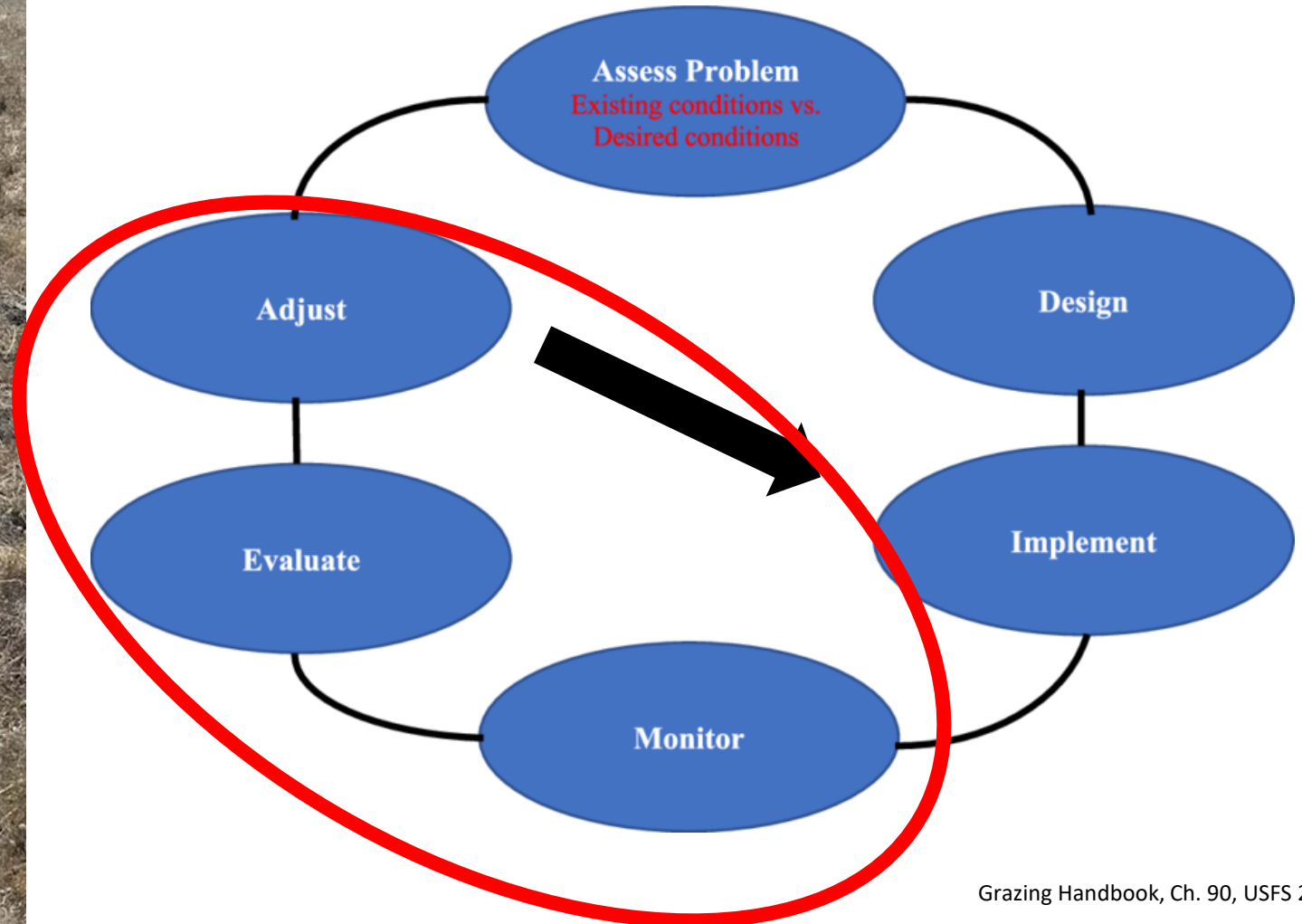


# What is adaptive management?

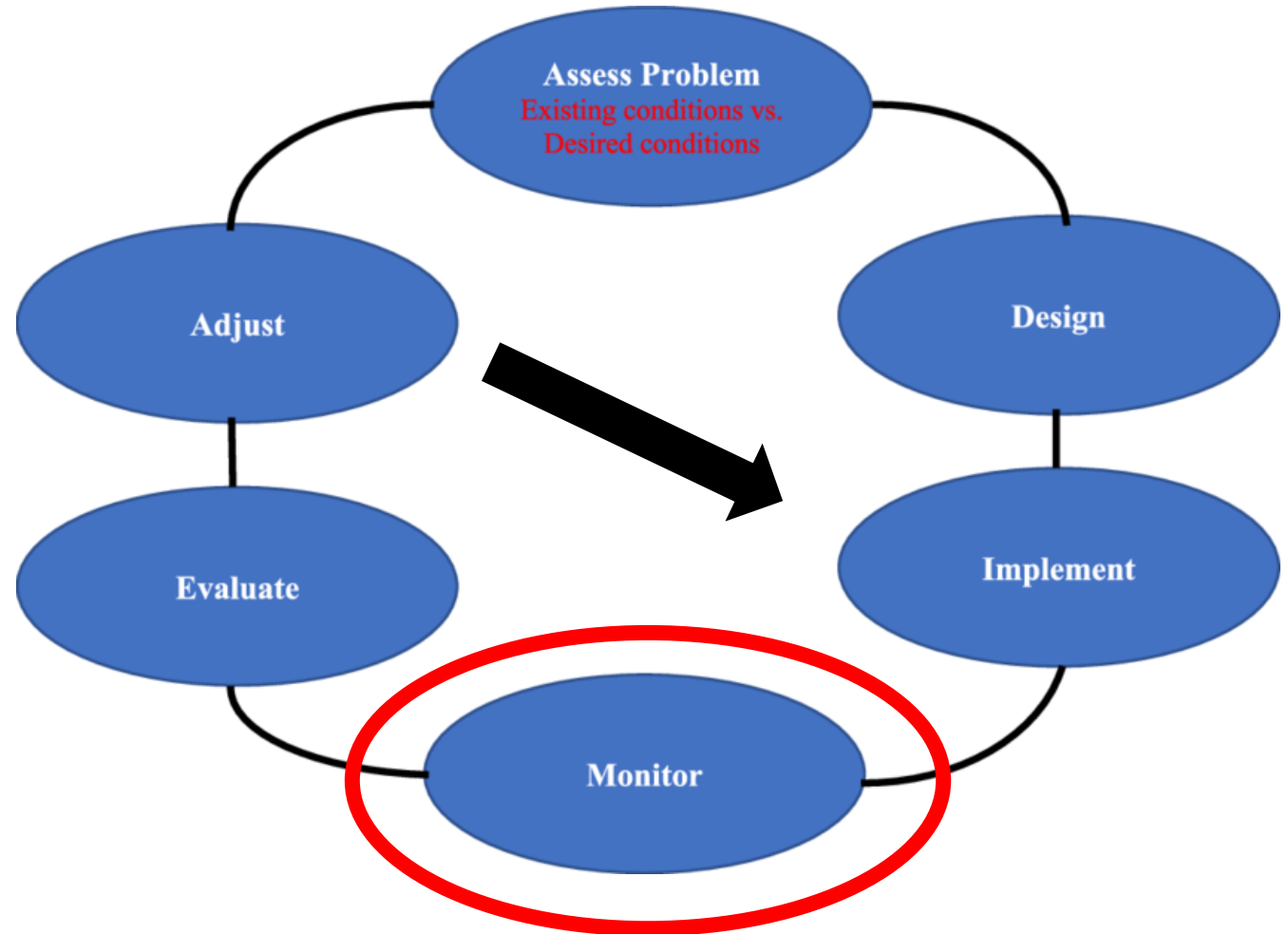
Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.



# What is adaptive management?



# Designing a Monitoring Program

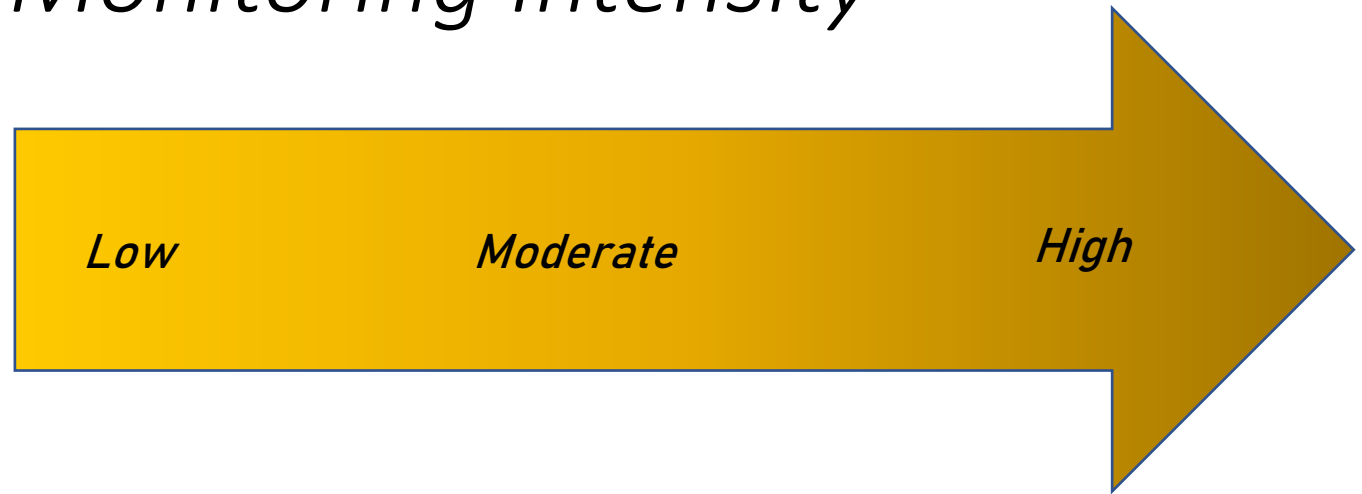


# Designing a Monitoring Program

Why	How	What	When	Where	Who
Rationale	Methods	Metric	Timing, frequency	Location	Surveyor
Tied to specific goal and/or objective	May include high and low intensity options	Quantifiable performance standard: RDM, percent utilization, vegetation height		Map with locations or polygons	Expertise and any permit requirements
Reduce hazardous herbaceous fuels	Photo point and observation	Comparison to standard photo	Annual; after treatment	Established points	Trained individual
	RDM/ biomass sampling or mapping	Pounds/ acre biomass		Established points and throughout	

# Designing a Monitoring Program:

## *Monitoring Intensity*



- Photo points
- Checklists
- Visual assessment

- RDM samples or mapping
- Vegetation structure
- Stubble Height
- Percent utilization
- Rapid invasive plant survey

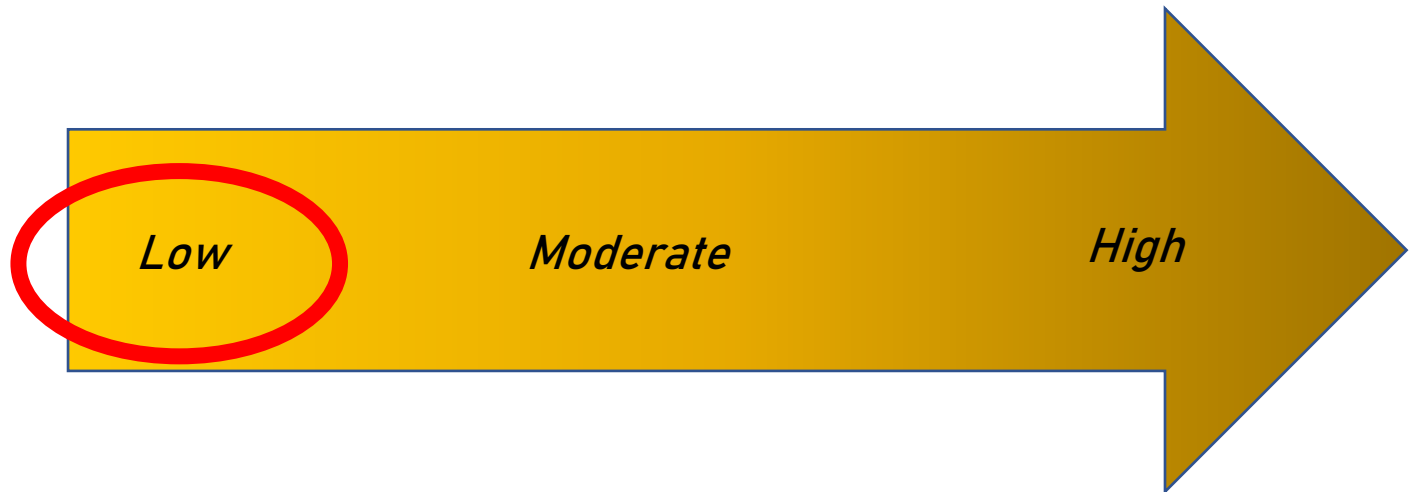
- Soil Health
- Plant or wildlife community
- Plant or wildlife population
- Invasive plant mapping
- Riparian health assessment
- Water quality





# Typical Monitoring Approaches

*Monitoring Intensity*



# Low Intensity Monitoring: *Photo Monitoring*

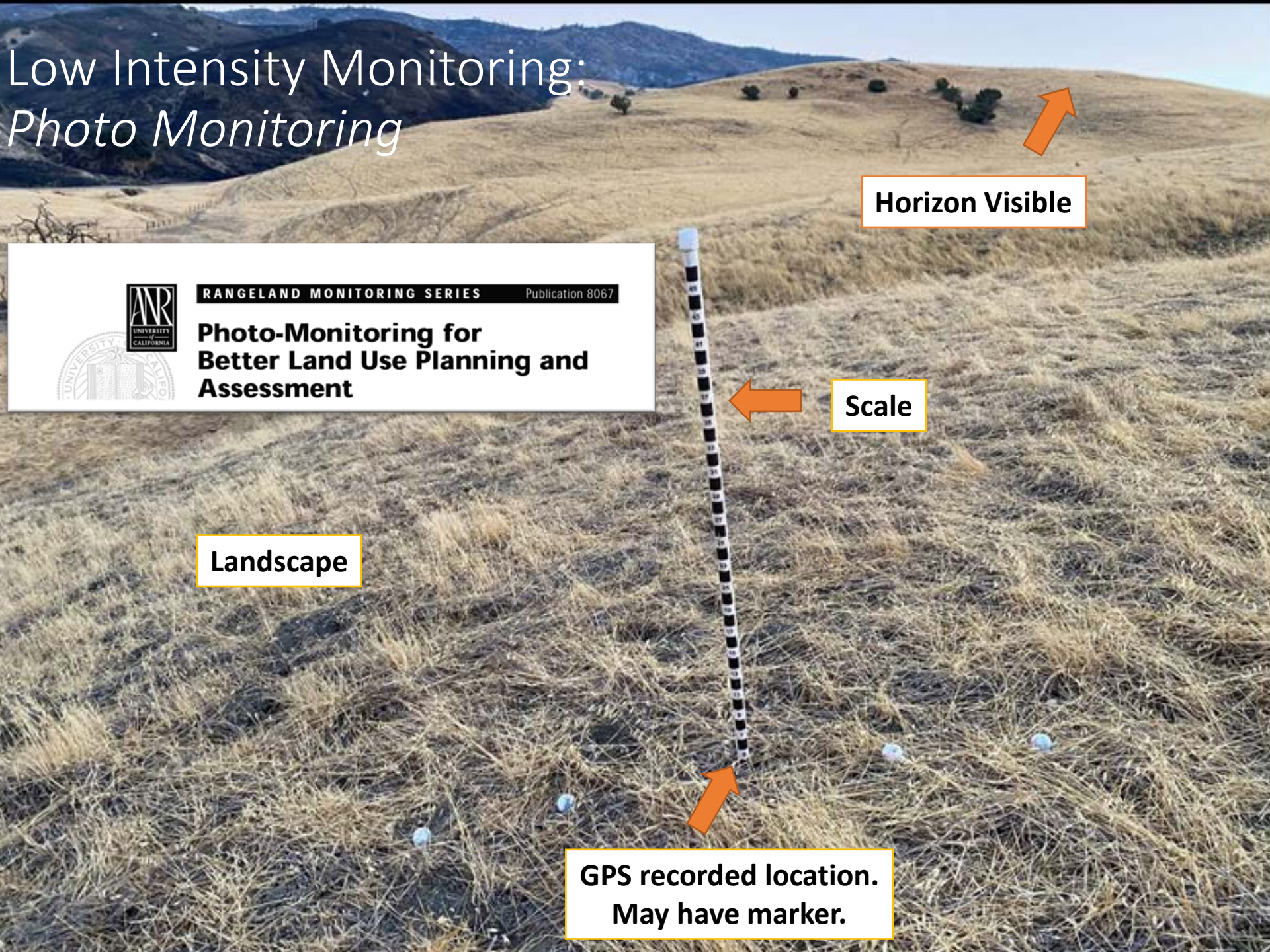
Horizon Visible

 **RANGELAND MONITORING SERIES** Publication 8067  
**Photo-Monitoring for  
Better Land Use Planning and  
Assessment**

Scale

Landscape

GPS recorded location.  
May have marker.



# Low Intensity Monitoring: Checklists

## Checklist Form For Assessing Grazing Operations

Date: \_\_\_\_\_ Weather: \_\_\_\_\_

Name of Person Completing checklist: \_\_\_\_\_

### Facility Information

Facility Name:	Owner Name & Address (if different):
Address:	Nearest Water Body:
Operator Name & Address:	Number of Animals:
Operator Telephone Number:	Type of Animals:
Facility's Assessor's Parcel Number:	

### Erosion and Sediment Sources

Sediment from Sheet, Rill, and Gully Erosion: Sheet and rill erosion generally occurs on crop-fields or overgrazed pastures and corrals. Gullies can occur from these same conditions, or can be caused by natural occurrences, such as from burrowing animals.

Pastures	Yes	No
Upon close inspection, is bare soil visible in pastures?		
At a distance of 20 feet, can you distinguish small objects such as roots and cow pies?		
Are there gullies or headcuts in pastures?		
Crop Fields		
Do crop-fields have rill or other signs of surface erosion?		
Are crop-fields clean cultivated so that all plant residue is tilled under?		
Road Erosion		
Do ranch roads show signs of surface erosion such as rills or gullies?		
Are there any gullies caused by unprotected culverts?		
Are drainage ditches eroding?		
Do road surfaces consist of bare soil?		

### General Inspection

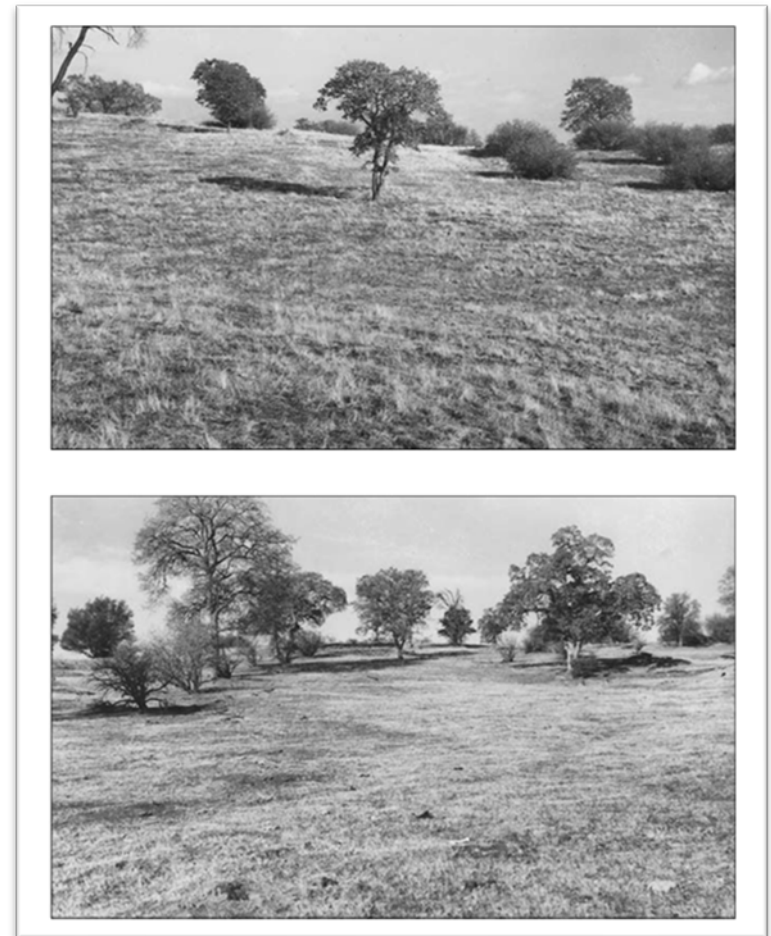
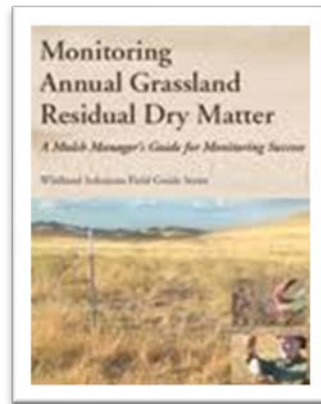
Materials: Digital or hard copy map, camera, pen/pencil, and one datasheet per pasture

Directions: Walk or drive throughout the Preserve to photo-monitoring locations and to assess habitat and infrastructure condition. Walk or drive fence lines and inspect for functionality. Stop and inspect gates as encountered. Navigate to drainages, springs, and ponds to inspect habitat quality, livestock impacts, and presence of sensitive species. Take photographs as needed to support findings. Note areas of concern on a printed or digital map and/or infrastructure tables. This checklist identifies the features to be monitored, the desired condition of that feature, the current rating as observed during monitoring event, and any observations and details to support the rating. The ratings are described as follows: 1 = Does not meet desired condition; 2 = Somewhat meets desired condition; 3 = Fully or nearly meets desired condition.

Date: \_\_\_\_\_ Surveyor: \_\_\_\_\_ Location: \_\_\_\_\_

Feature	Desired Condition	Rating	Observations	Recommendations
Boundary fencing	Any wire fence has at least three tightly stretched barbed wires. Fence posts are firmly set and spaced a post length apart. Fences may be as described or stronger.			
Gates	All gates fully functional. Closing mechanisms function.			
Grazer access	Vehicle gates functional and accessible. Gate is locked appropriately.			
Signage	Educational signs installed at gates entering grazing areas.			
Water developments	All troughs are functional. Wildlife ramps present if installed.			
Listed plant	Present in all known locations. Note cover class within wetland, if possible.			
Ponds and springs	No major erosion issues or other livestock-related damage. Note habitat quality.			
Drainages	No major erosion issues or other livestock-related damage. Note habitat quality.			
Plant Community	Annual photo captures similar conditions or increase in structural and native diversity.			
Other (fire, drought, vandalism, CRLF, oaks etc.)				

# Low Intensity Monitoring: *Visual RDM Assessment*

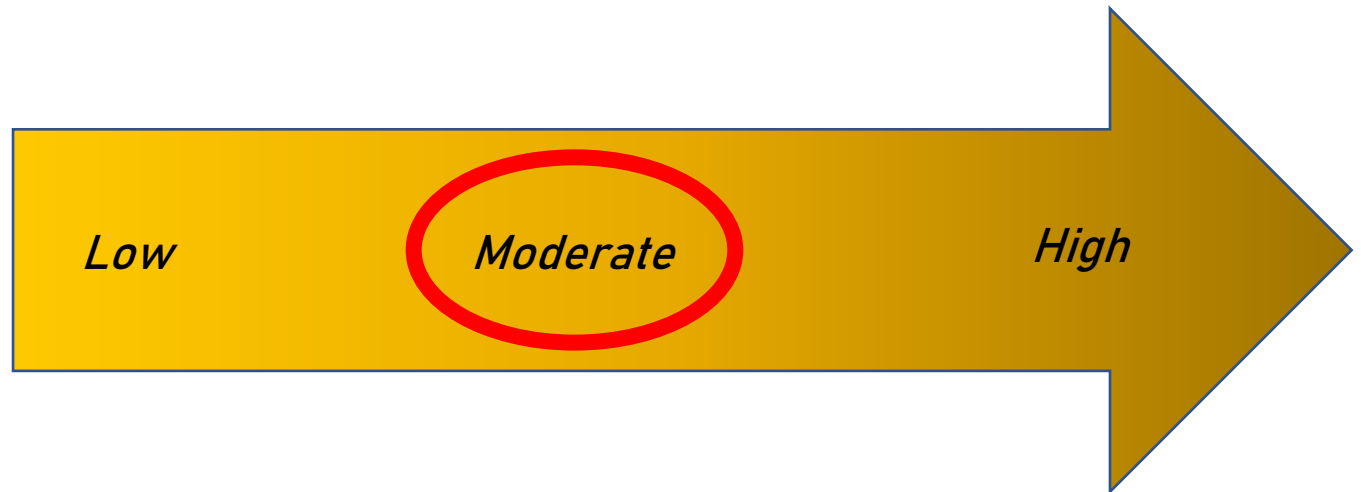


# Low Intensity Monitoring: *Visual Infrastructure Assessment*



# Typical Monitoring Approaches

*Monitoring Intensity*



# Moderate Intensity Monitoring: *RDM Sampling*



## Residual Dry Matter Monitoring

### Materials:

- Digital or hard copy map
- Camera
- One square foot quadrat
- Paper bags
- Clippers, sharp
- Scale
- Compass
- 1 datasheet per monitoring location
- Pen/Pencil
- Photo guides

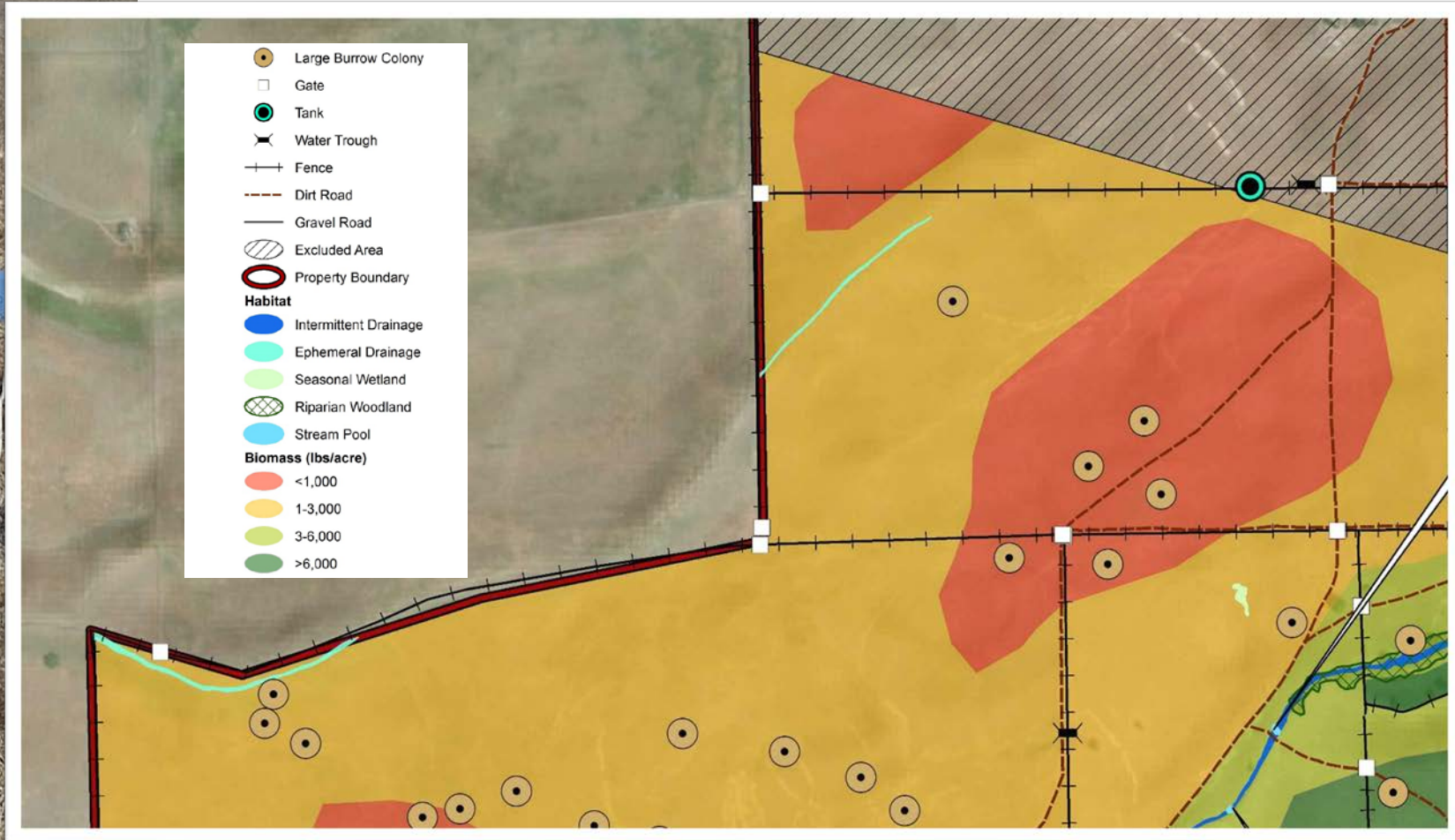
**Directions:** Establish at least one residual dry matter sampling location in each major pasture of the Preserve. The locations will be visited annually in September-October and should be outside of heavy use areas (e.g., near troughs or gates), representative of the grazed area, and respond to management (e.g. in an accessible grazing area). Once at the location, take one photograph of the landscape with sampling location in the foreground. Place a one square foot quadrat on the ground. Remove any summer annuals (e.g., tarweed, thistles, mustards) before clipping the plant material within the quadrat to ground level. Place the plant material in a bag and weigh the contents in the field or office. Make sure the bag weight is omitted. If the RDM is highly variable, take three samples and use an average for the final assessment.

If visual mapping is utilized, conduct a visual assessment of RDM as you traverse the Preserve, noting categories of RDM on a printed or digital map. RDM categories include: below compliance (0 to 1,000 lbs/acre in all cases), in compliance (1,000-1,500 in fire hazard zones, 1,000-3,000 in Upper Preserve, and 1,000-3,600 lbs/acre in Lower Preserve), and above compliance (>1,500 in fire hazard zone, >3,000 in Upper Preserve, and >3,600 lbs/acre in Lower Preserve). Occasional clips taken in representative areas will inform visual estimations and mapping. Location-specific or statewide standard visual guides may be used.

Date: \_\_\_\_\_ Surveyor: \_\_\_\_\_

RDM Monitoring Location ID (e.g., Lower Preserve 1: Umbrella Tree)	
Photo Azimuth (Direction)	
Photo Point #	
Weight of Vegetation (g) (exclude bag weight)	
Describe structural diversity (e.g., bare ground, low stature grasses, high weed patches, coyote brush patches)	
Notes (small mammal burrowing, fire, drought, etc.)	
RDM Mapping Conducted (Y/N)?	
Forage Productivity Monitoring Conducted (Y/N)	
Dominant Species	
List Any Invasive Species of Concern in Vicinity Identify if dominant, co-dominant, common, scattered or rare	

# Moderate Intensity Monitoring: *RDM Mapping*

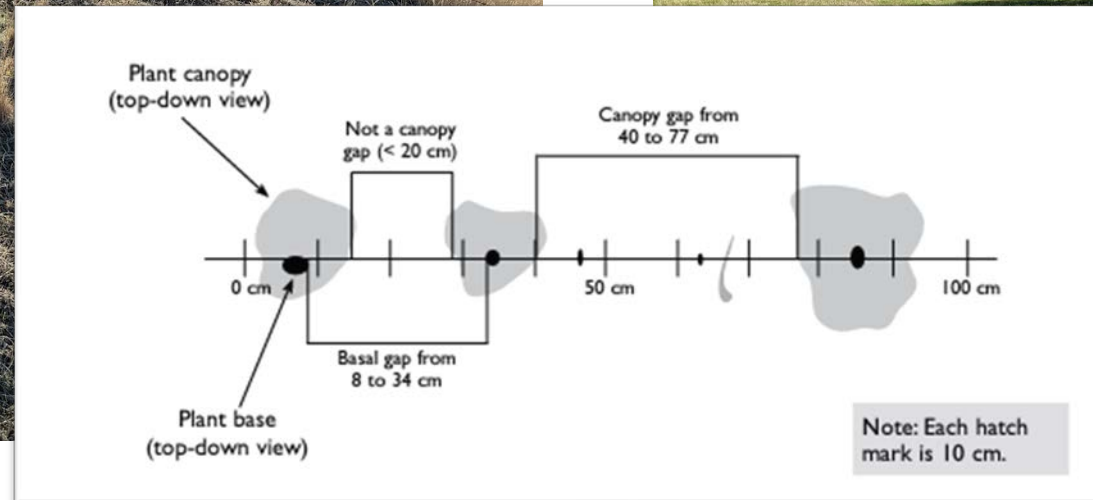
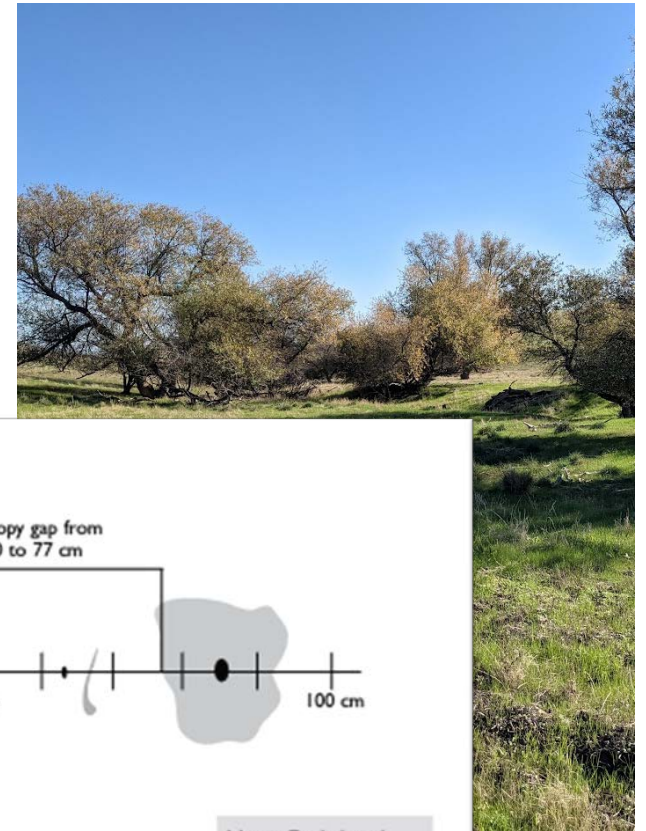
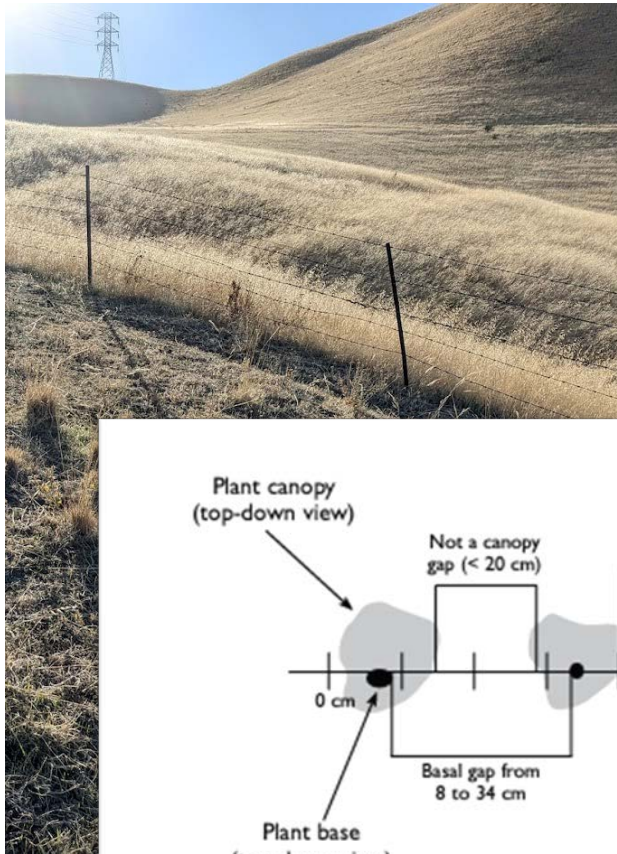




# Moderate Intensity Monitoring: *Percent Utilization/ Comparative Yield*



# Moderate Intensity Monitoring: *Vegetation Structure*



# Moderate Intensity Monitoring: *Stubble Height*

## Utilization Studies and Residual Measurements

Interagency Technical Reference

Cooperative Extension Service

U.S. Department of Agriculture  
—Forest Service—

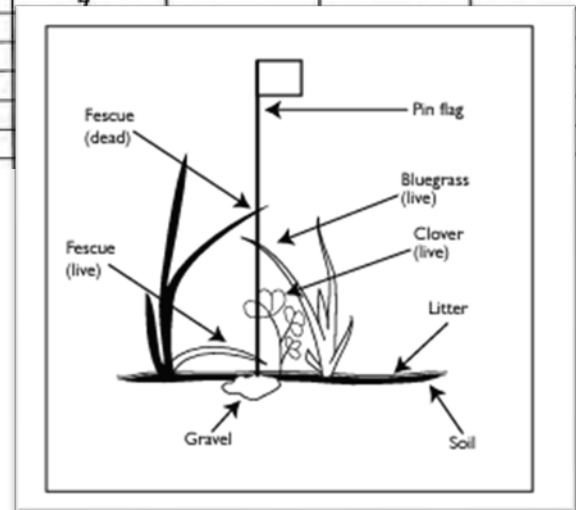
Natural Resource Conservation Service,  
Grazing Land Technology Institute

U.S. Department of the Interior  
—Bureau of Land Management—

1996  
Revised in 1997, 1999

Page 1 of 1

Stubble Height							
Study Number	HDQ 1		Date	8/3/95		Examiner	MJB
Allotment Name & Number			Pasture				
East Fork 46045			Willow Spring				
	1	2	3	4	5	6	
Site (or)	HIMU 2	BOER 4	BOCU				
Species							
1	4	3	2				
2	7	5					
3	6	6	4				
4	8	4					
5	2	2	4				
6	5	1					
7	3	7					
8	6	4					
9	9						
10	4	3					



# Moderate Intensity Monitoring: *Rapid Invasive Plant Survey*



National Park Service  
U.S. Department of the Interior



Natural Resource Program Center

## Early Detection of Invasive Plant Species in the San Francisco Bay Area Network

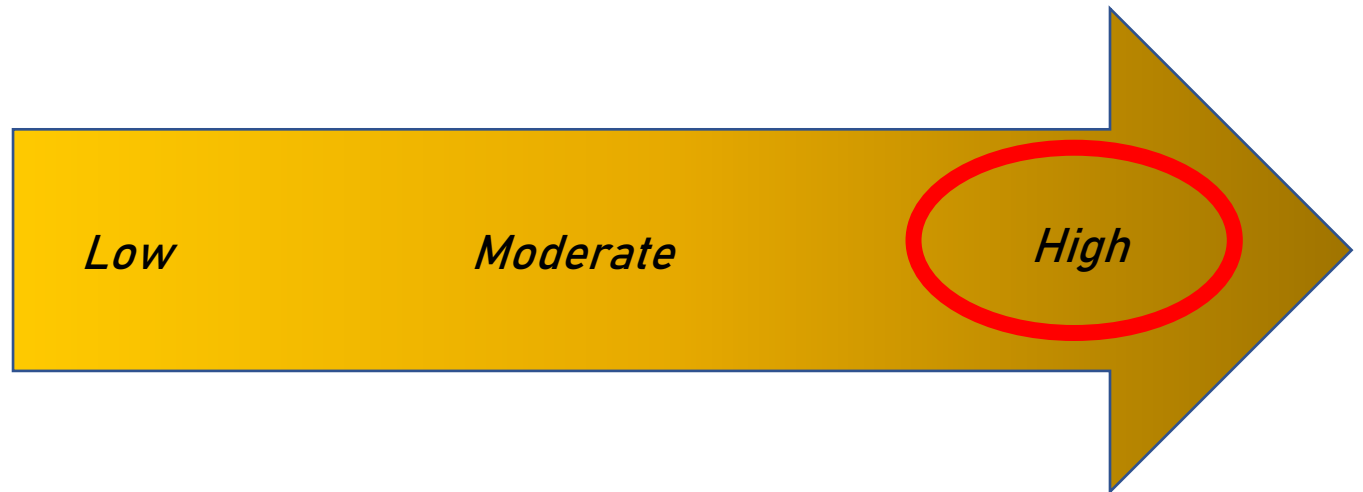
*A Volunteer-Based Approach*

Natural Resource Report NPS/SFAN/NRR—2009/136

Invasive Species	2022 Condition	Rating	Observations	Recommendations
jointed goatgrass ( <i>Aegilops cylindrica</i> )	One population west of the access road.			
false brome ( <i>Brachypodium sylvaticum</i> )	Observed along a dirt road below power lines running north to south through the center of the Preserve			
Italian thistle ( <i>Carduus pycnocephalus</i> )	Common in areas of disturbed soil throughout the Preserve.			
woolly distaff thistle ( <i>Carthamus lanatus</i> )	Observed in the southwestern corner and a small treated population southeast of the park residence in the Lower Preserve.			
toçalote ( <i>Centaurea melitensis</i> )	Occurs in a few scattered locations in disturbed grassland.			

# Typical Monitoring Approaches

*Monitoring Intensity*



# High Intensity Monitoring: *Soil Health*

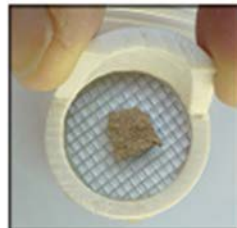
## Interpreting Indicators of Rangeland Health

Technical Reference 1734-6, Version 5

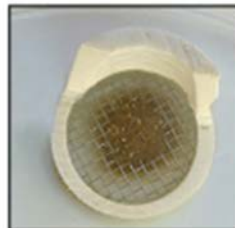


The Rangeland Monitoring Network:  
Handbook of Field Methods

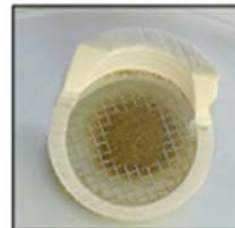
SEQUENCE FOR STABILITY CLASS = 1.



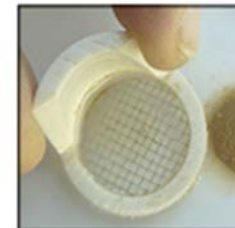
Original sample



After 5 seconds



After 5 minutes



After 5 dips

# High Intensity Monitoring: *Plant or Wildlife Community*

## Combined Vegetation Rapid Assessment and Relevé Field Form

(Revised August 23, 2022)

For Office Use:	Final database #:	Final vegetation type:	Alliance
			Association
I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION			circle: Relevé or RA
Database #:	Date:	Name of recorder:	
		Other surveyors:	
UID:	Location Name:		
GPS name:	For Relevé only: Bearing°, left axis at ID point ___ of Long / Short side		
UTME	UTMN	Zone: 11 NAD83 GPS error: ft./ m./ PDOP	
Decimal degrees: LAT _____ LONG _____			
GPS within stand? Yes / No If No, cite from GPS to stand: distance (m) _____ bearing ° _____ inclination ° _____			
and record: Base point ID _____ Projected UTM: UTME _____ UTMN _____			
Camera Name: _____ Cardinal photos at ID point: _____			
Other photos: _____			
Stand Size (acres): <1, 1-5, >5   Plot Area (m <sup>2</sup> ): 100 / _____   Plot Dimensions _____ x _____ m   RA Radius _____ m			
Exposure, Actual °: _____ NE NW SE SW Flat Variable   Steepness, Actual °: _____ 0° 1-5° > 5-25° >25			
Topography: Macro: top upper mid lower bottom   Micro: convex flat concave undulating			
Geology code: _____ Soil Texture code: _____   Upland or Wetland/Riparian (circle one)			
% Surface cover: (Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) (2mm-7.5cm) (Incl sand, mud)			
H <sub>2</sub> O:	BA Stems:	Litter:	Bedrock: Boulder: Stone: Cobble: Gravel: Fines: =100%
% Current year bioturbation _____ Past bioturbation present? Yes / No   % Hoof punch _____			
Fire evidence: Yes / No (circle one) If yes, describe in Site history			



Site history, stand age, comments:

---



---



---



---



---



---



---



---

### Point Blue Point Count Data Form — Exact Distance version (500m cutoff)

Project  County  Transect  Month  Day  Year  Visit#

First Name \_\_\_\_\_ Last Name \_\_\_\_\_ initials (used in data entry) \_\_\_\_\_

Point	Time	Species	Data	Notes

Disturbance code / Intensity (L,M,H): \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

### II. HABITAT DESCRIPTION

Tree DBH: **T1** (<1" dbh), **T2** (1-6" dbh), **T3** (6-11" dbh), **T4** (11-24" dbh), **T5** (>24" dbh), **T6** multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: **S1** seedling (<3 yr. old), **S2** young (<1% dead), **S3** mature (1-25% dead), **S4** decadent (>25% dead)

Herbaceous: **H1** (<12" plant ht.), **H2** (>12" ht.)

# High Intensity Monitoring: *Plant or Wildlife Population*



U.S. Fish and Wildlife Service

Revised Guidance on Site Assessments and Field Surveys for  
the California Red-legged Frog



August 2005

**RECOMMENDED TIMING AND METHODOLOGY  
FOR SWAINSON'S HAWK NESTING SURVEYS  
IN CALIFORNIA'S CENTRAL VALLEY**  
Swainson's Hawk Technical Advisory Committee  
May 31, 2000

**Protocols for Surveying and Evaluating Impacts to  
Special Status Native Plant Populations and  
Sensitive Natural Communities**

STATE OF CALIFORNIA  
CALIFORNIA NATURAL RESOURCES AGENCY  
DEPARTMENT OF FISH AND WILDLIFE

DATE: March 20, 2018\*

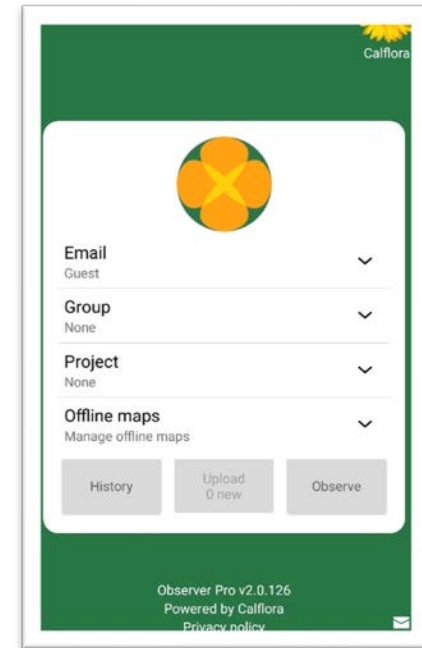
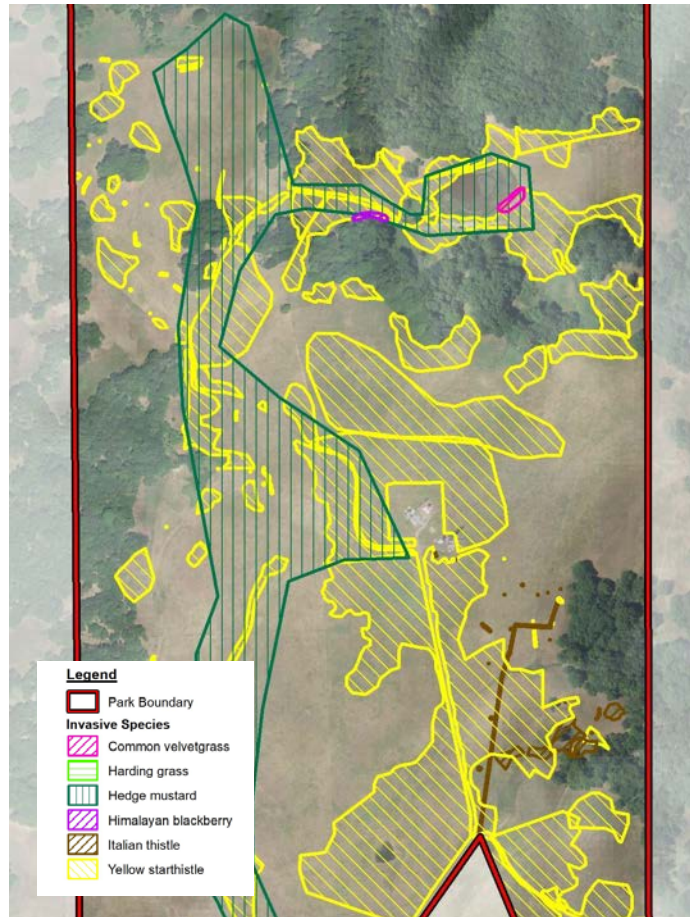
**Guidelines for Describing Grazing Management and Utilization  
when Conducting Botanical Surveys**

SHEILA BARRY  
University of California Cooperative Extension  
Livestock/Natural Resource Advisor, Tehama, Glenn, and Colusa Counties

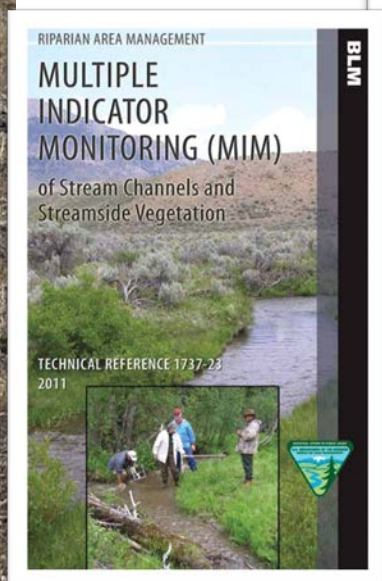




# High Intensity Monitoring: *Invasive Plant Mapping*



# High Intensity Monitoring: *Riparian Health Assessment*



**RANGELAND MANAGEMENT SERIES** Publication 8094



## Guidelines for Monitoring the Establishment of Riparian Grazing Systems

**UNIVERSITY OF  
CALIFORNIA**

Division of Agriculture  
and Natural Resources  
<http://anrcatalog.ucdavis.edu>



**California Rangelands  
Research and  
Information Center**

**T. A. WARD** is University of California Cooperative Extension Livestock and Natural Resource Advisor, San Joaquin and Stanislaus Counties; **K. W. TATE** is UCCE Extension Rangeland Watershed Specialist, Department of Agronomy and Range Science, UC Davis; and **E. R. ATWILL** is Associate Veterinarian and Associate Specialist, Department of Population Health and Reproduction, School of Veterinary Medicine, UC Davis.

**T**his monitoring document outlines methods that will assess current riparian conditions and quantify changes in a riparian area under new management. The monitoring plan outlined here is fairly involved and requires some technical expertise, and for that reason this publication is intended for those with technical experience in rangeland management, specifically UC Cooperative Extension (UCCE) advisors, Natural Resources Conservation Service (NRCS), U.S. Forest Service, and Bureau of Land Management staff, and professional rangeland managers. A secondary audience of land owners and managers can benefit from this information if they are willing to invest time and effort into learning the necessary tools.

Appendices **C1** and **C3** at the end of the publication are blank forms that you can copy and use for your own data collection. We have also provided filled-out samples of these and other useful forms to give you a better idea of how to use them.

# High Intensity Monitoring: *Water Quality*



**TABLE 5. SAMPLE RANGELAND WATER QUALITY AND HYDROLOGIC MONITORING VARIABLES**

<b>Purpose</b>	<b>Variable</b>	<b>Data Collection Methods</b>
Determine if livestock urine and/or manure are entering a stream and causing elevated ammonia levels	Parts per million of un-ionized ammonia	Collect water samples from above and below livestock-affected area and run ammonia tests
Determine if livestock are causing or exacerbating streambank erosion and resultant sedimentation	Observation, volumetric measurements, turbidity	Visit site and record observations; several kinds of turbidity sensors and meters are available; transparency can be measured by the Secchi disk method
Determine if livestock grazing is affecting the length of vernal pool inundation periods	Pool depth	Measure pool depth in grazed and ungrazed control plots with staff gauge at regular intervals in spring

## **GRAZING HANDBOOK**

*A Guide for Resource Managers  
in Coastal California*

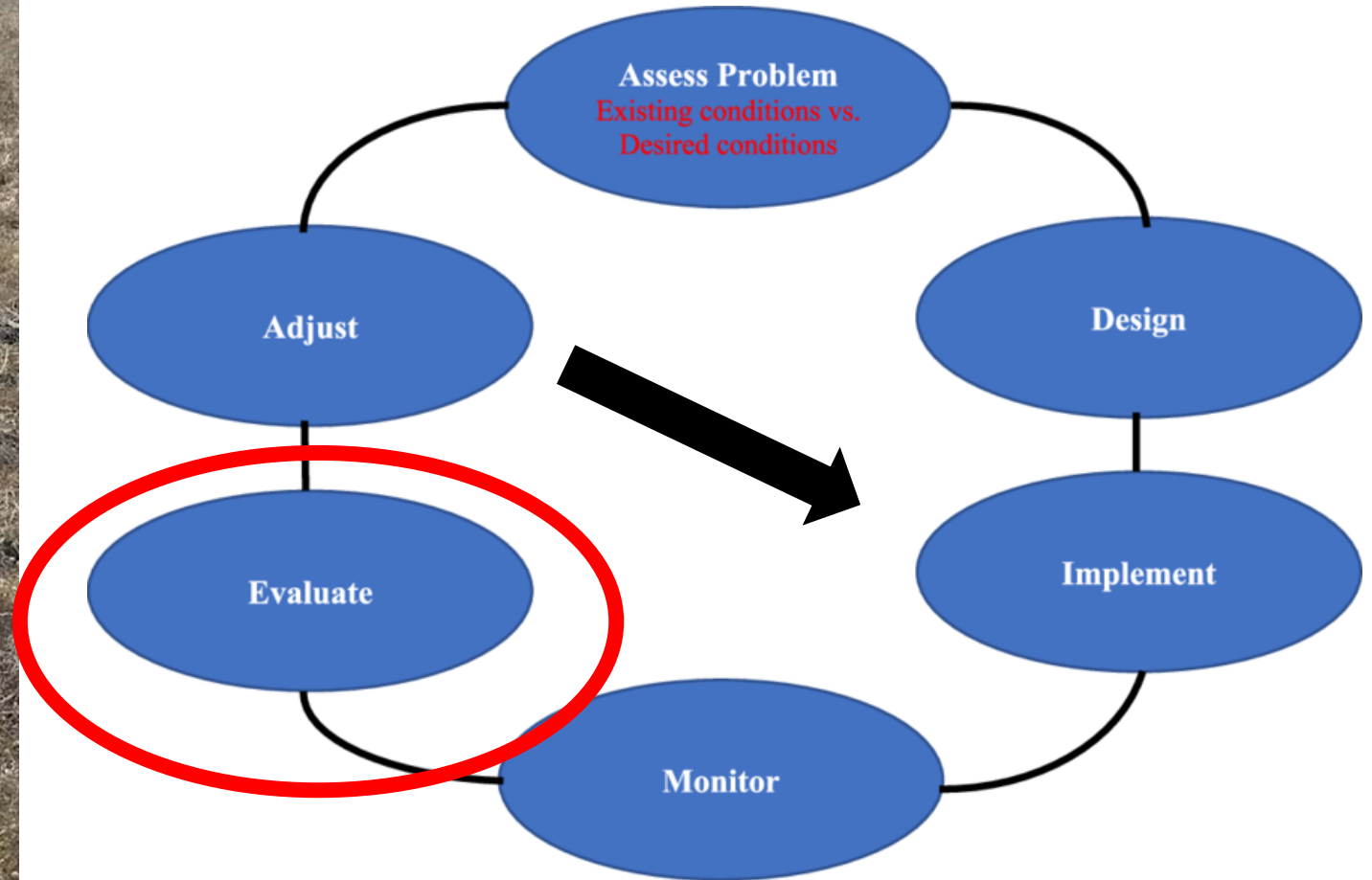


# Designing a Monitoring Program: *Implementation*

- Clearly identify responsibilities (landowner vs. licensee) for monitoring, actions and covering costs
- Identify frequency and timing of monitoring activities
- May include recommended timing for response actions
- Some may include external timelines from agencies, funders etc.



# Annual Meeting & Report



A black cow is grazing in a field of dry, yellowish-brown grass. In the foreground, a blue sign is attached to a white stick. The background shows a line of evergreen trees under a clear blue sky.

# Annual Meeting

- Review previous season's grazing operation
- Effectiveness monitoring results
- Compliance checklist
- Issues
- Accomplishments and projects completed
- Develop annual plan with next steps



Management Recommendation	Previous Compliance	Current Compliance	Next Steps
Tank, trough, and supplemental nutrients (e.g., salt blocks) should avoid sensitive areas: buffered at least 33 feet (beyond 100 feet where feasible; SFBRWQCB 2004) from riparian corridors, wetlands, native grass stands, and sensitive plant populations.			
Maintain at least 800 lbs/acre (Bartolome et al. 2006).			
Any supplemental feeding should be certified weed-free.			
Quarantine off-site livestock in holding corral 24 hours before release.			
Avoid using chemical treatment where possible. If chemical treatment is necessary, follow regulatory guidance and other label requirements to avoid impacts sensitive resources.			
If appropriate, apply prescribed grazing and/or prescribed burning.			
All boundary fencing should consist of at least 5-strand barbed wire fence with steel and/or wood posts that meets the legal definition of a fence (NALC n.d.).			

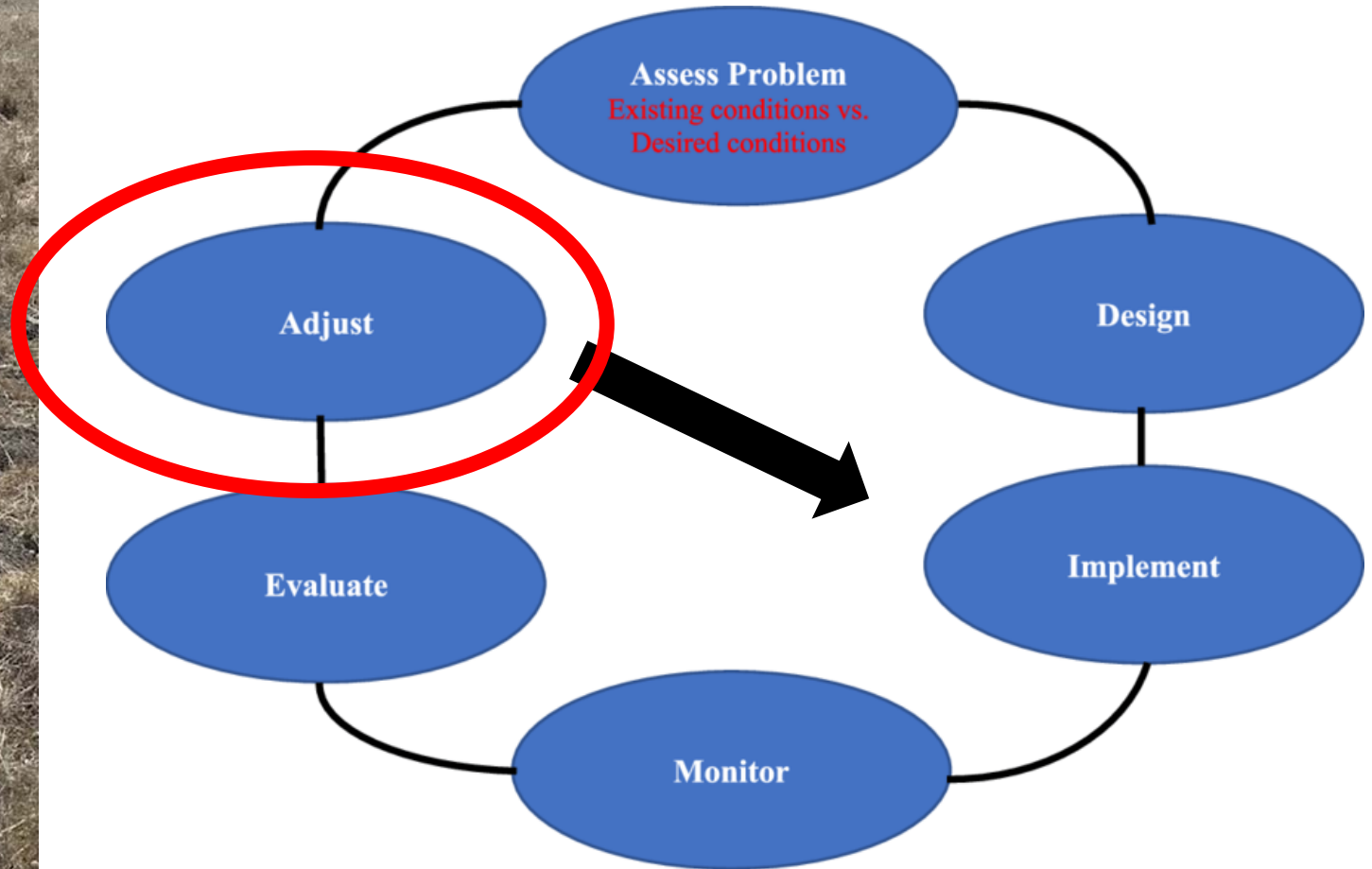
A black cow is grazing in a field of dry, yellowish-brown grass. A blue marker is attached to a white stake in the ground. The background shows a line of evergreen trees under a clear blue sky.

# Annual Report

- Summarize monitoring in context of goals
- Describe previous years' climate and operational context
- Provide recommendations based on monitoring results
- Lay out next years management approach (Annual Plan)



# Adaptive Management



# Adaptive Management

- Recommend immediate, short and long term actions based on monitoring results based on management “triggers”
- Include emergency contingency plan

Goal	Performance Standard	Monitoring	Remedial Actions For a Result Below Standard		
			Immediate Action	Short-term Action	Long-term Action
Maintain soil integrity	RDM levels greater than 1,000 lbs/acre	RDM sampling or visual mapping	- Move livestock out of non-compliant pastures as soon as possible	- Move nutrients - Adjust stocking rates	- Develop infrastructure to improve distribution -Identify sacrifice areas or fields

A black cow is grazing in a field of dry, yellowish-brown grass. In the foreground, a blue marker is stuck in the ground, connected to a white string. The background shows a line of trees under a clear blue sky.

# Questions?

Roxanne Hulme Foss

[Roxanne@vollmarconsulting.com](mailto:Roxanne@vollmarconsulting.com)



# Resources

- ANR Photo Monitoring: <https://ucanr.edu/sites/BayAreaRangeland/files/253126.pdf>
- WQCB Minimum Requirements: [https://www.waterboards.ca.gov/rwqcb2/water\\_issues/programs/agriculture/CAF/WDR%20Attach%20E%20GMP.pdf](https://www.waterboards.ca.gov/rwqcb2/water_issues/programs/agriculture/CAF/WDR%20Attach%20E%20GMP.pdf)
- ANR 8092 (RDM): <http://www.elkhornsloughctp.org/uploads/files/1230939961Bartolome%202006%20RDM.pdf>
- Wildland Solutions: <http://www.wildlandsolutions.com/products/>
- NPS Invasive Species Early Detection Rapid Response: <https://irma.nps.gov/DataStore/Reference/Profile/662369>
- PointBlue RMN Handbook: [http://pointblue.org/wp-content/uploads/2018/06/RMN\\_Handbook\\_v2.pdf](http://pointblue.org/wp-content/uploads/2018/06/RMN_Handbook_v2.pdf)
- NRCS NRI: [https://www.nrcs.usda.gov/sites/default/files/2022-06/Interpreting\\_Indicators\\_1734-6\\_ver5\\_08272020%20%281%29.pdf](https://www.nrcs.usda.gov/sites/default/files/2022-06/Interpreting_Indicators_1734-6_ver5_08272020%20%281%29.pdf)
- CNPS Rare Plant, Mapping, Releve Methods: <https://www.cnps.org/plant-science/field-protocols-guidelines>
- Calflora Weed Manager: <https://www.calflora.org//entry/weed-mgr.html>
- CDFW Survey Protocols and Guidelines: <https://wildlife.ca.gov/Conservation/Survey-Protocols>
- Grazing/ Botanical Surveys (Barry): <https://ucanr.edu/sites/BayAreaRangeland/files/253125.pdf>
- BLM MIM Riparian monitoring: [https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/fseprd558332.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd558332.pdf)
- ANR 8094 (Riparian): <https://rangelandarchive.ucdavis.edu/files/187432.pdf>
- DOI Adaptive Management Guide: <https://www.doi.gov/sites/doi.gov/files/uploads/TechGuide-WebOptimized-2.pdf>
- Grazing Handbook (Bush): <https://carangeland.org/images/GrazingHandbook.pdf>
- Interagency Utilization Tech. Reference: <https://www.nrcs.usda.gov/sites/default/files/2022-09/stelprdb1044249.pdf>
- USDA-ARS Monitoring Manual: [https://jornada.nmsu.edu/files/Core\\_Methods.pdf](https://jornada.nmsu.edu/files/Core_Methods.pdf)

# Lease/ License Implications

- Annual report and meeting may inform operator review during lease renewal process
- Key goals and performance standards may be in lease
- Ensure monitoring or management expectations and responsibilities are clear and consistent across documents

