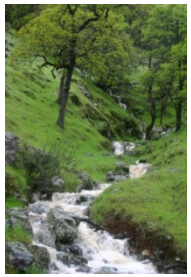
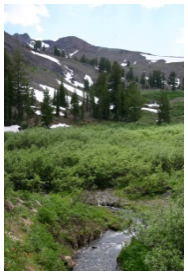
Sustaining Livestock Production and Clean Water on Rangelands

Ken Tate, Rob Atwill, Leslie Roche, Randy Dahlgren

and a lot of colleagues…

UC Davis & UC Cooperative Extension



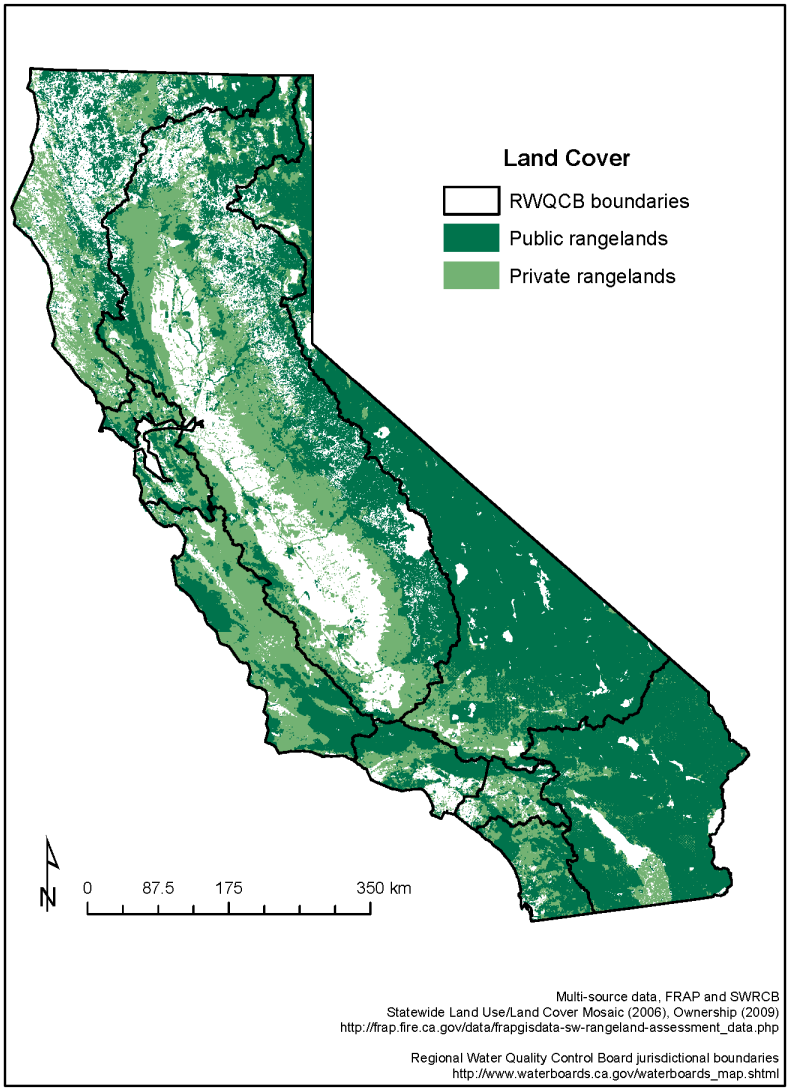
UC RANGELANDS

Supporting Working Landscapes

rangelands.ucdavis.edu

CA Rangelands

- 57 M acres.
- 22 M acres privately owned.
- $3 B annual sheep & cattle industry.
- 1000's of plant and animal species.
- 80% surface waters derived from or stored in.

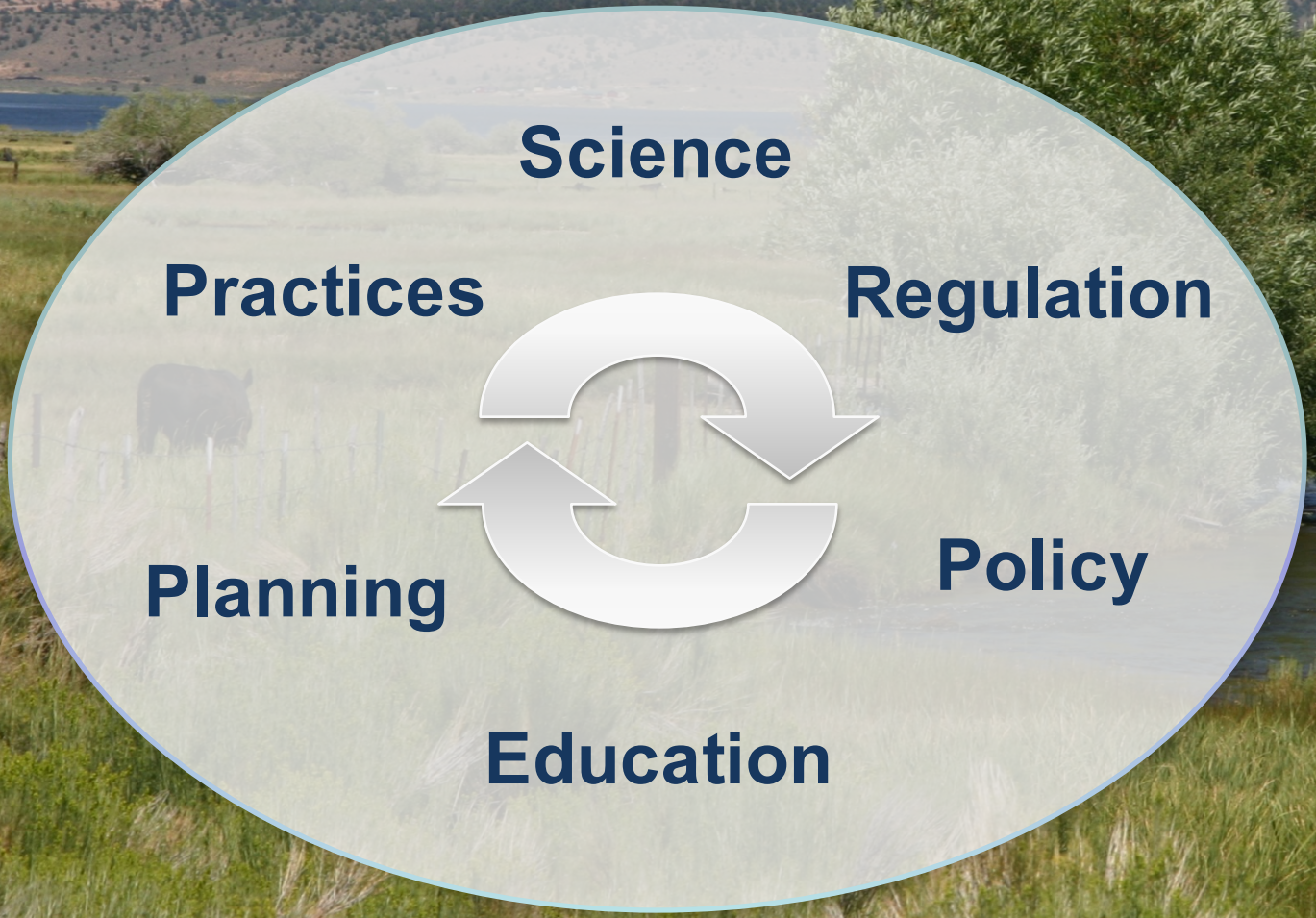


In the 1990's, concerns about…

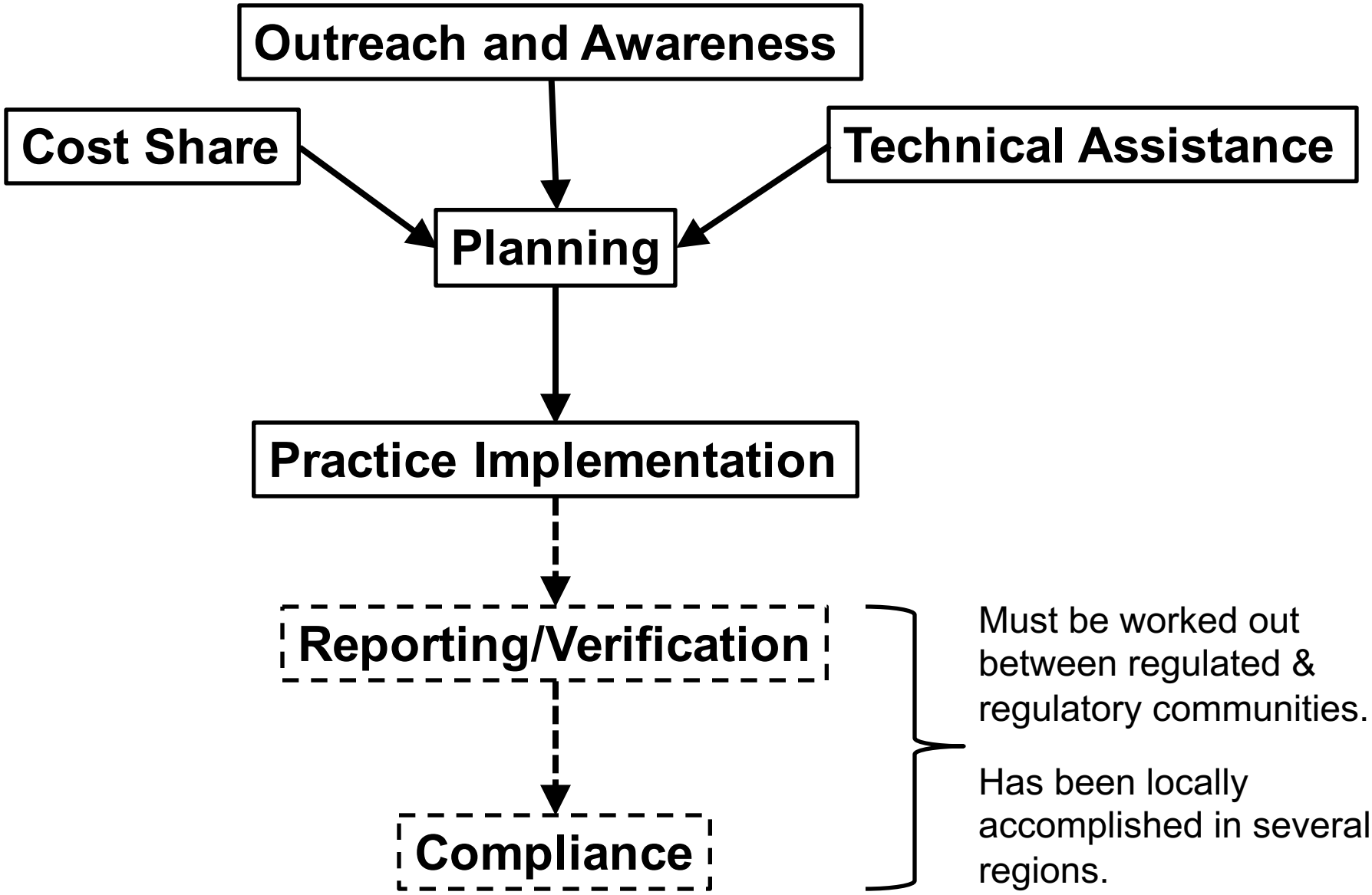
- Microbial pollutants – *Cryptosporidium, E. coli*
- Sediment – erosion
- Stream Temperature – stream shade, tail-water
- Nutrients – nitrogen and phosphorus

Rangeland Watershed Program

A 25 yr proactive partnership to improve water, range, and ranch enterprises. (Agencies, Ranchers, UC, NGOs).



WQ protection over the past 25 year



USDA – Practice Cost Share (2009-2014)

- $302 M in rangeland WQ practice implementation
- 7,385 contracts with landowners
- 5.7 M acres contracted

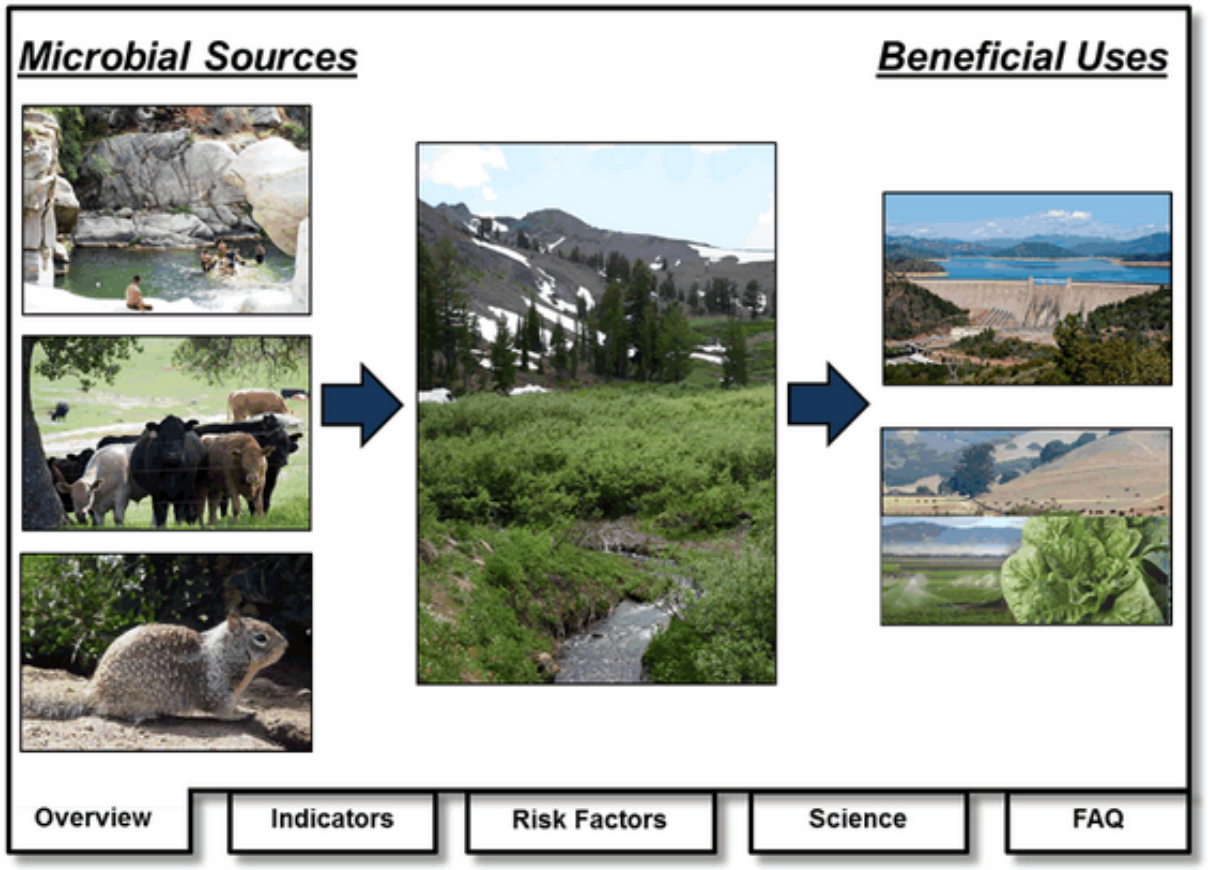
Over 100 research papers

- Pollutant sources on grazing lands
- Transport, fate, mitigation of these pollutants
- WQ conditions on rangelands

Microbial Water Quality In ×

rangelandwatersheds.ucdavis.edu/MWQIC/

Rangeland Watershed Laboratory
Microbial Water Quality Information Center



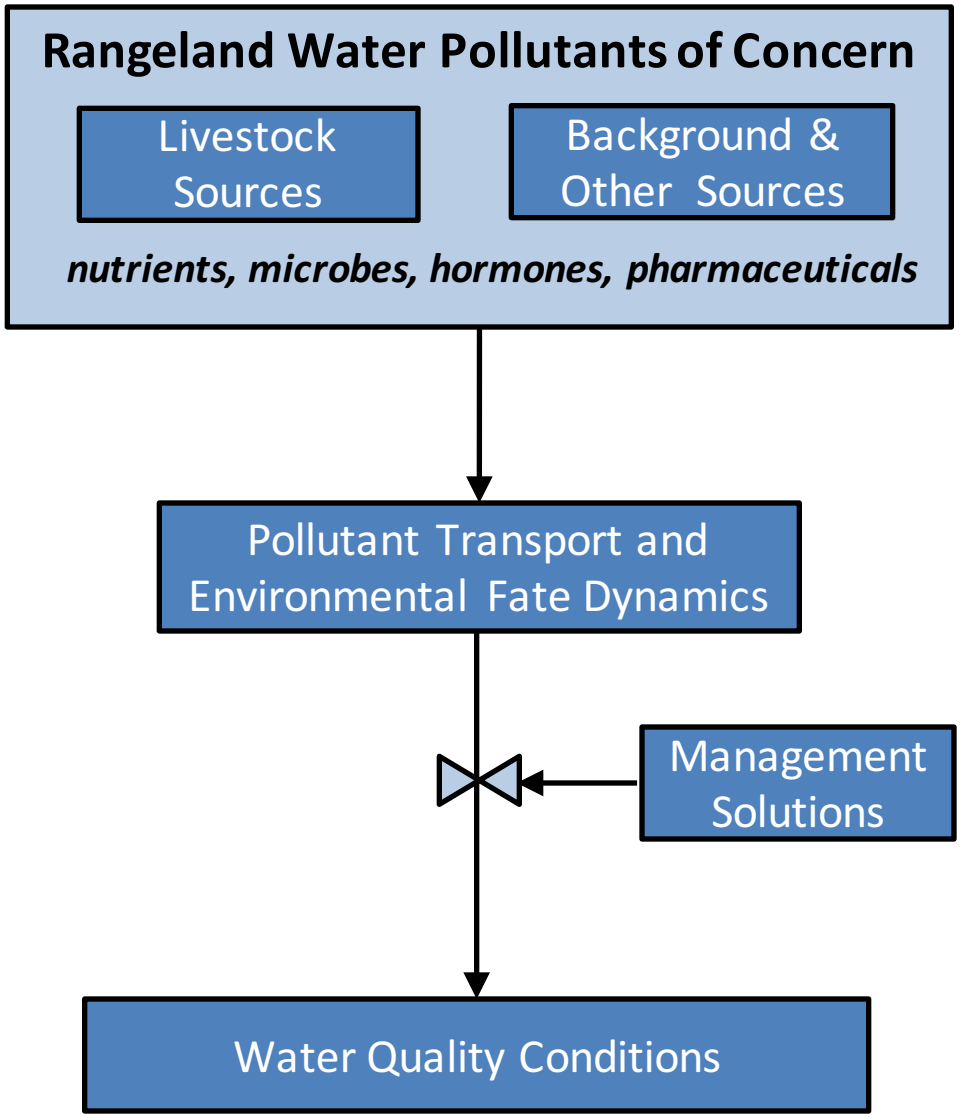
Rangeland Watersheds: Uses and Benefits to Society

Eighty-five percent of the State's surface drinking and irrigation water are generated and stored within California's 30 million acres of rangeland watersheds. These watersheds are often extensively grazed by livestock, predominantly beef cattle. Over the past 2 decades, microbial pollutants have been a primary water quality concern associated with livestock production on California's rangeland watersheds. Drinking water treatment procedures may not be completely effective against some microbial pathogens (especially *Cryptosporidium*), so managing livestock is a vital practice to reduce the prospect of extensive waterborne outbreaks as in **Milwaukee in 1993.**

**Use pointer to explore clickable features. Beta Version 1.0

Google™ Custom Search

The Line of Research



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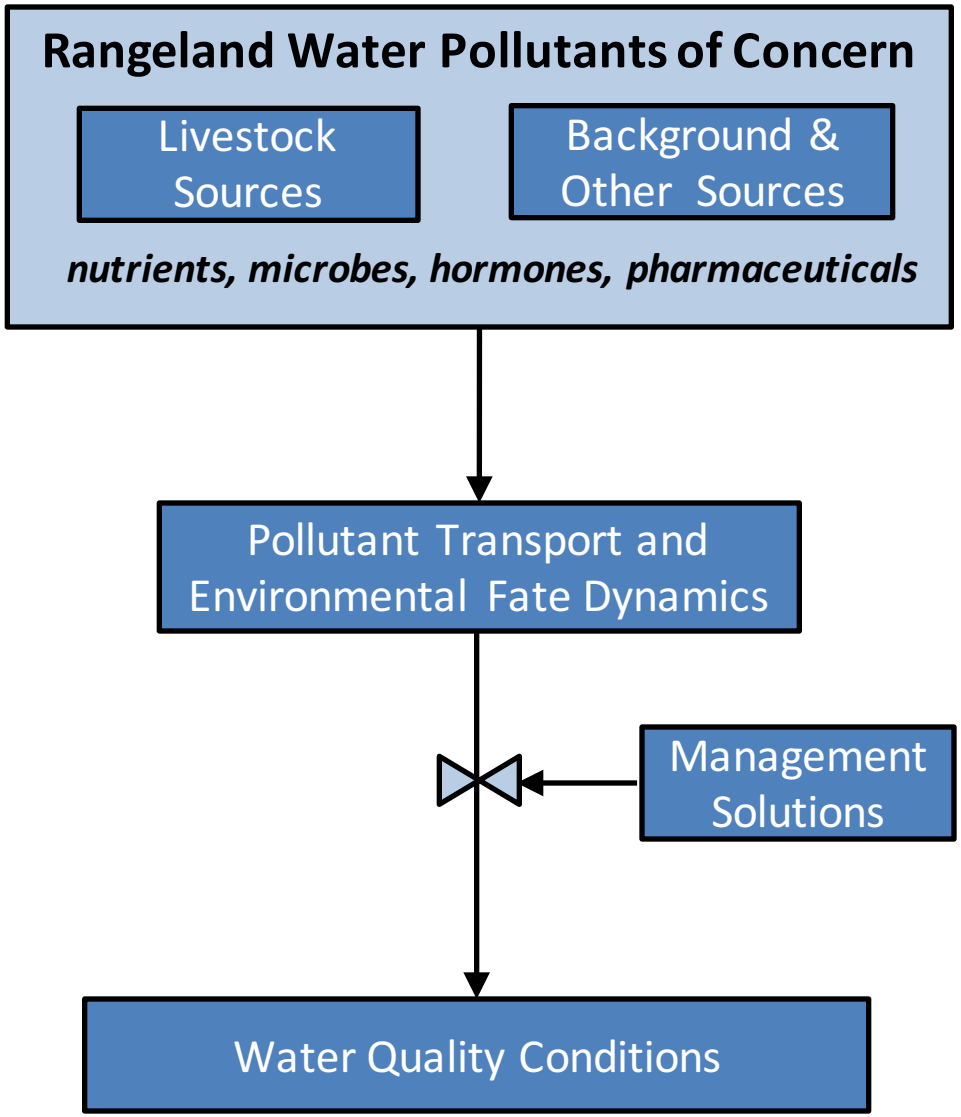

- Livestock can increase microbial concentrations
- *Cryptosporidium* in cattle not infectious to humans

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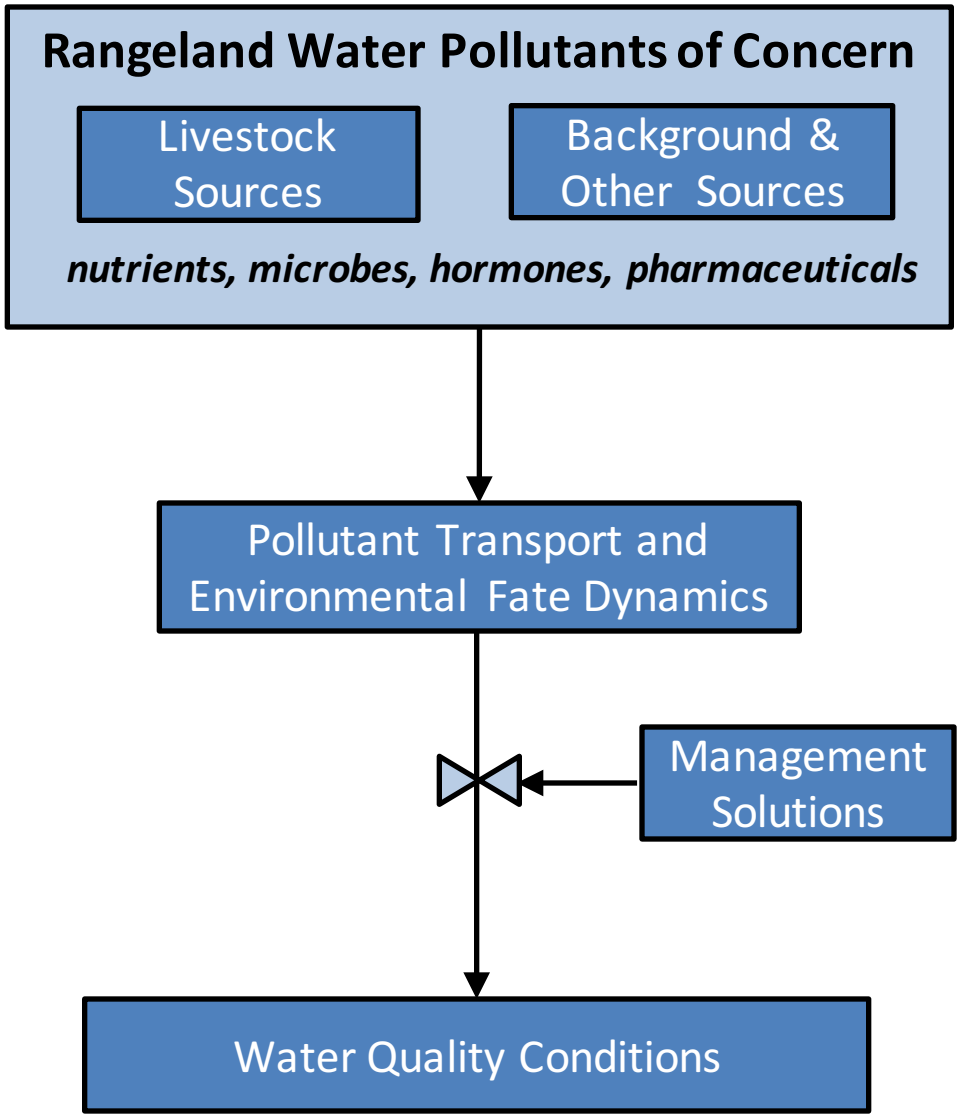

- Livestock can increase microbial concentrations
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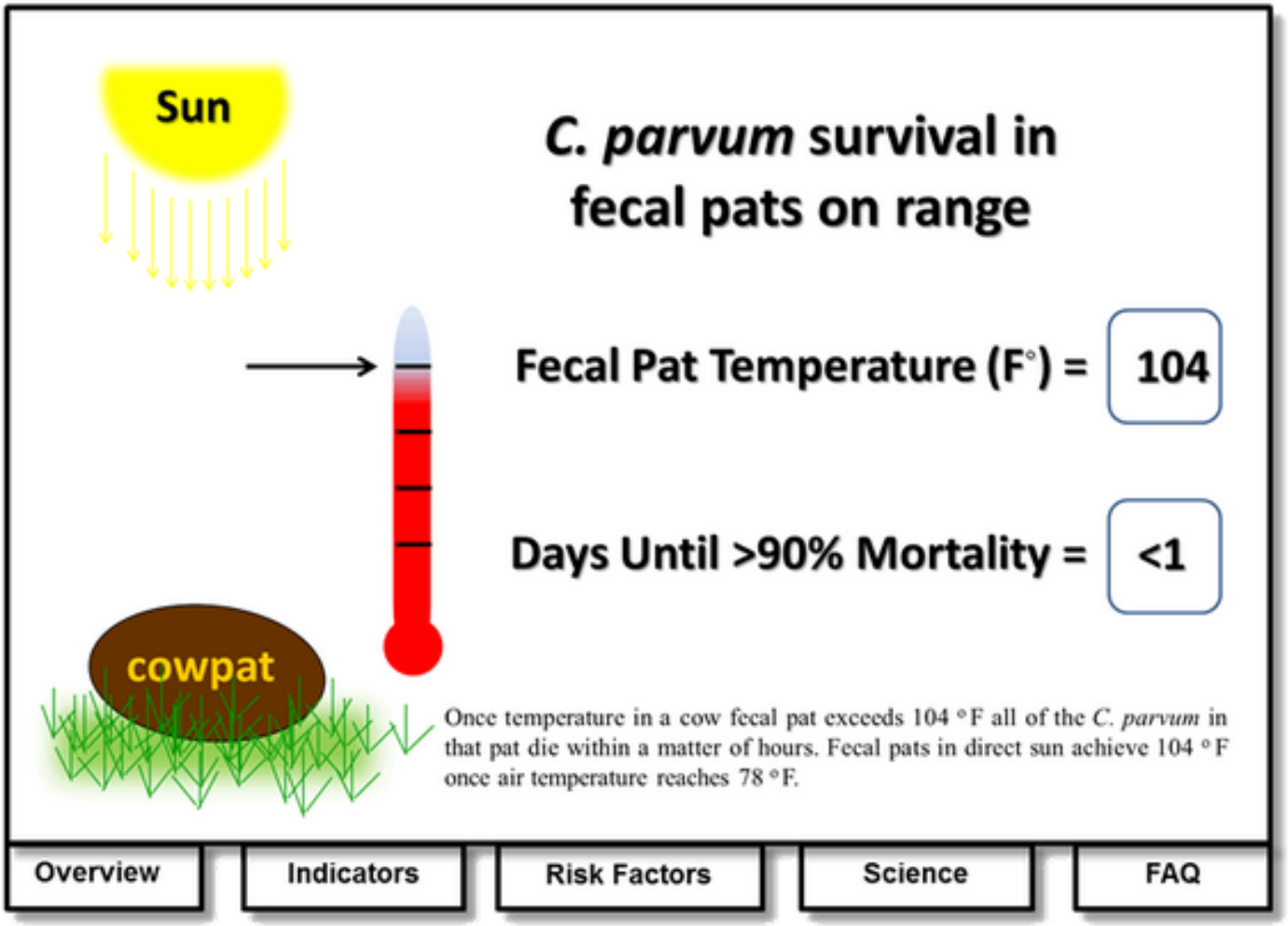
- Can have rapid inactivation of microbes
- <10% of pollutant load mobilizes from fecal deposits

Key Findings

Cryptosporidium eggs die in one day of 78 F air temperature in direct sun.

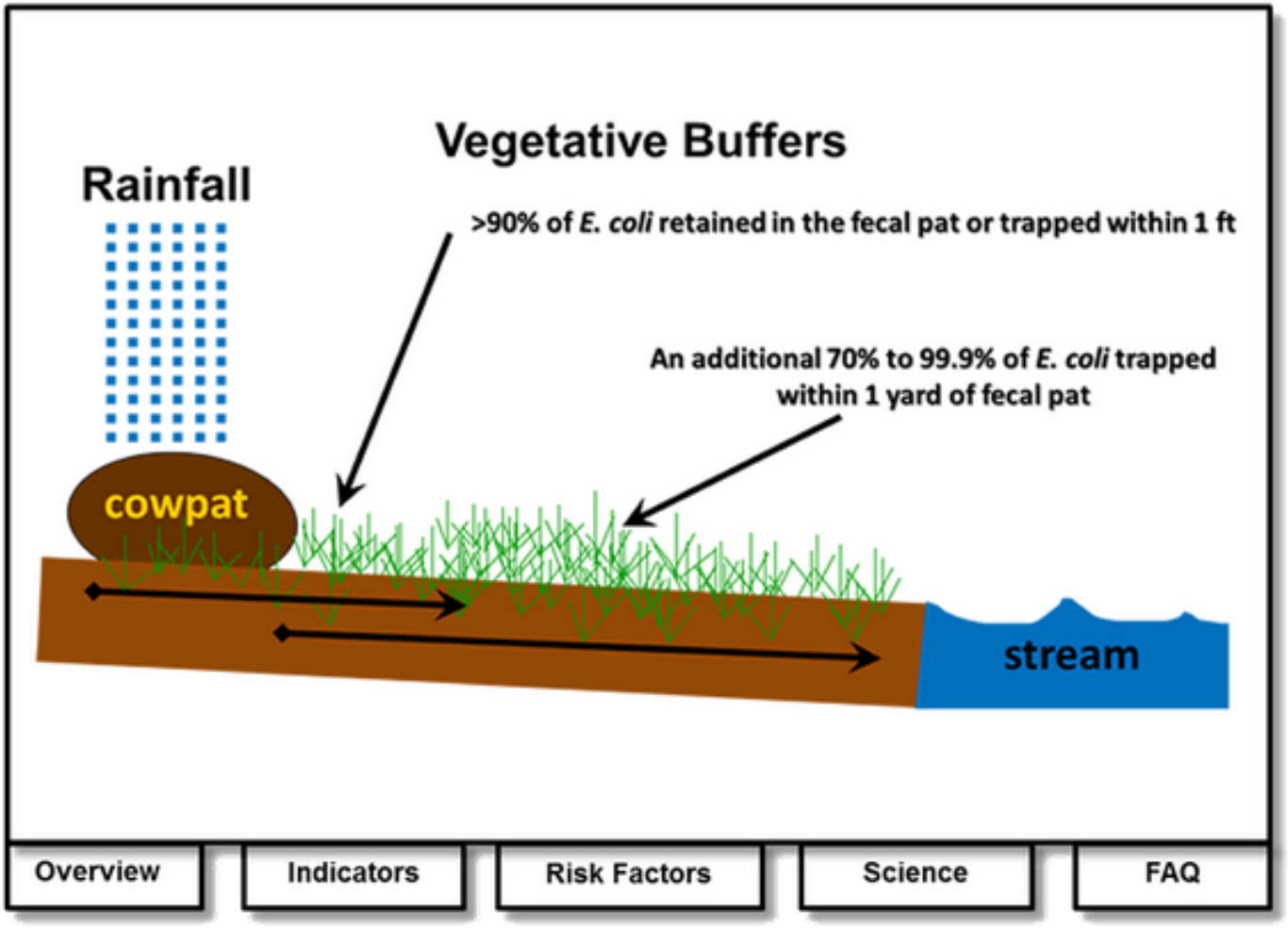


Cryptosporidium parvum
Survival in the Environment

The survival of pathogens in the environment is highly correlated to weather patterns. In hot weather, feces quickly dry out, killing most pathogens that were contained within them. In cooler weather, fecal pats are a more favorable environment for pathogens as the pats remain moist for a much longer period of time. To evaluate and confirm this phenomenon, we measured the ambient temperature and the temperature within fecal pats in two different environments- sun and shade, for a year. More>>

Key Findings

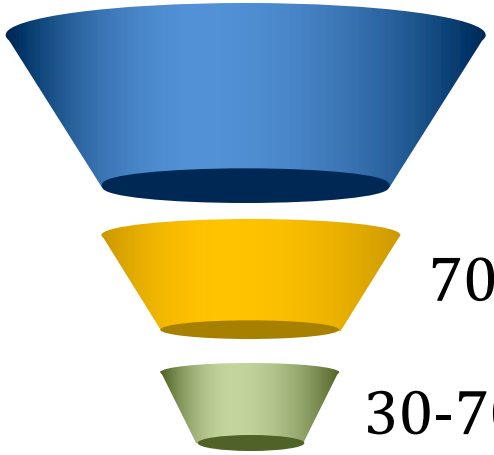
E. Coli are trapped in fecal pat or soil within 1 yard down slope during runoff.



Vegetative Buffer

Non-point source pollution as a result of overland flow during rainfall events is a common transport mechanism for pathogens. Pathogens in fecal material can certainly be directly deposited in a water body by an animal, but livestock and wildlife spend more hours grazing and resting on the surrounding watershed than they do drinking or cooling in a creek or stream. The proximity of contaminated fecal material is a key factor in determining whether or not the pathogen will be able to reach water- Our research has demonstrated that, for indicator *E.coli*, more than 90% of the bacteria was retained within a fecal pat or trapped within 1 foot downslope. More>>

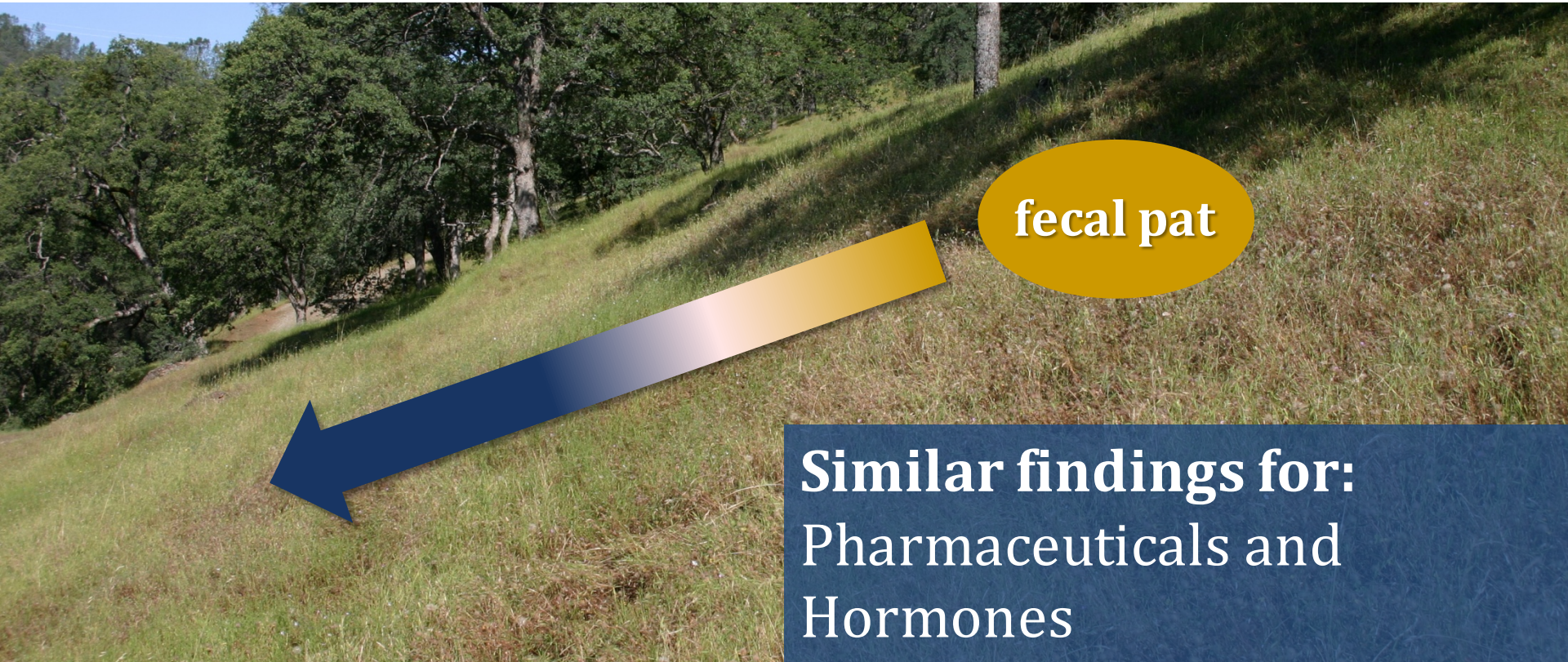
The whole range is a microbial filter…



>90% of pollutants trapped at fecal pat

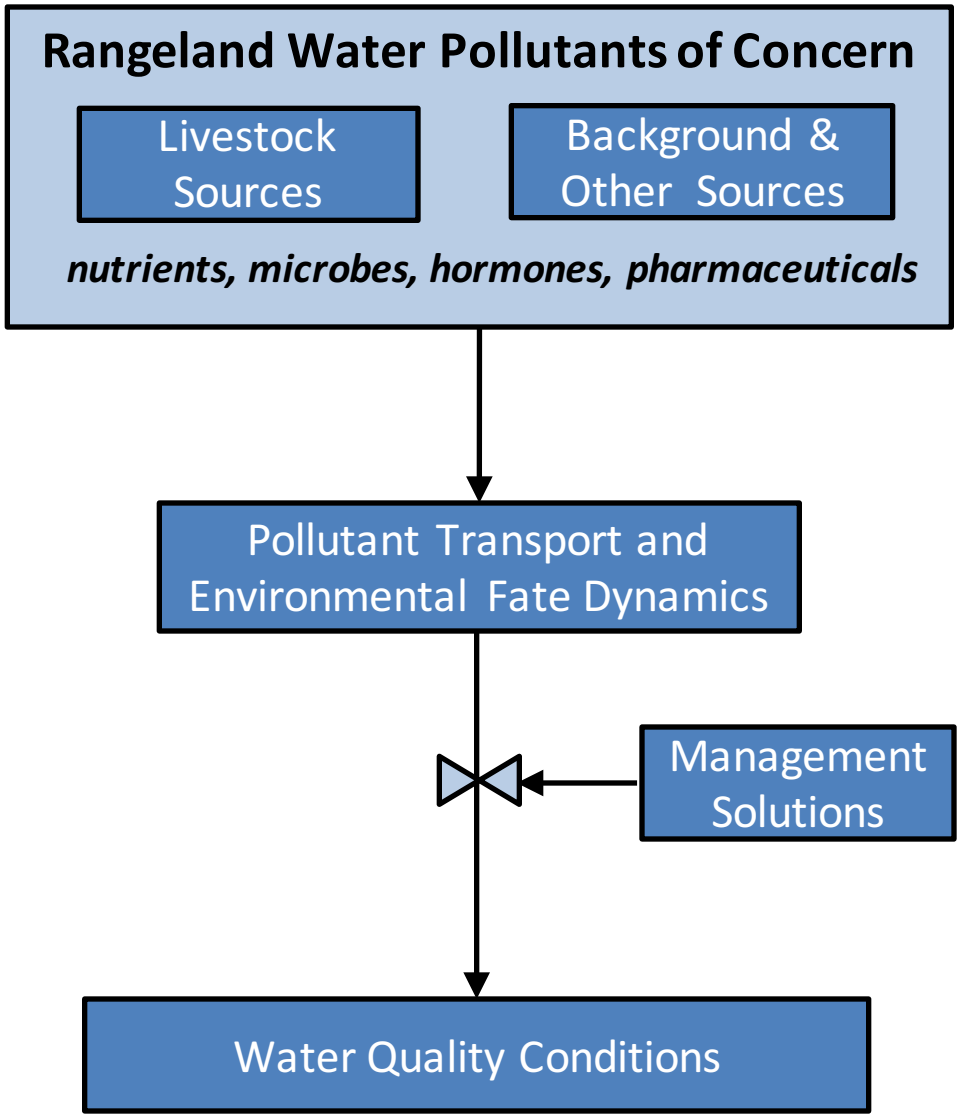
70-99% trapped each additional 1 yard

30-70% trapped in riparian areas



Similar findings for:
Pharmaceuticals and Hormones

The Line of Research



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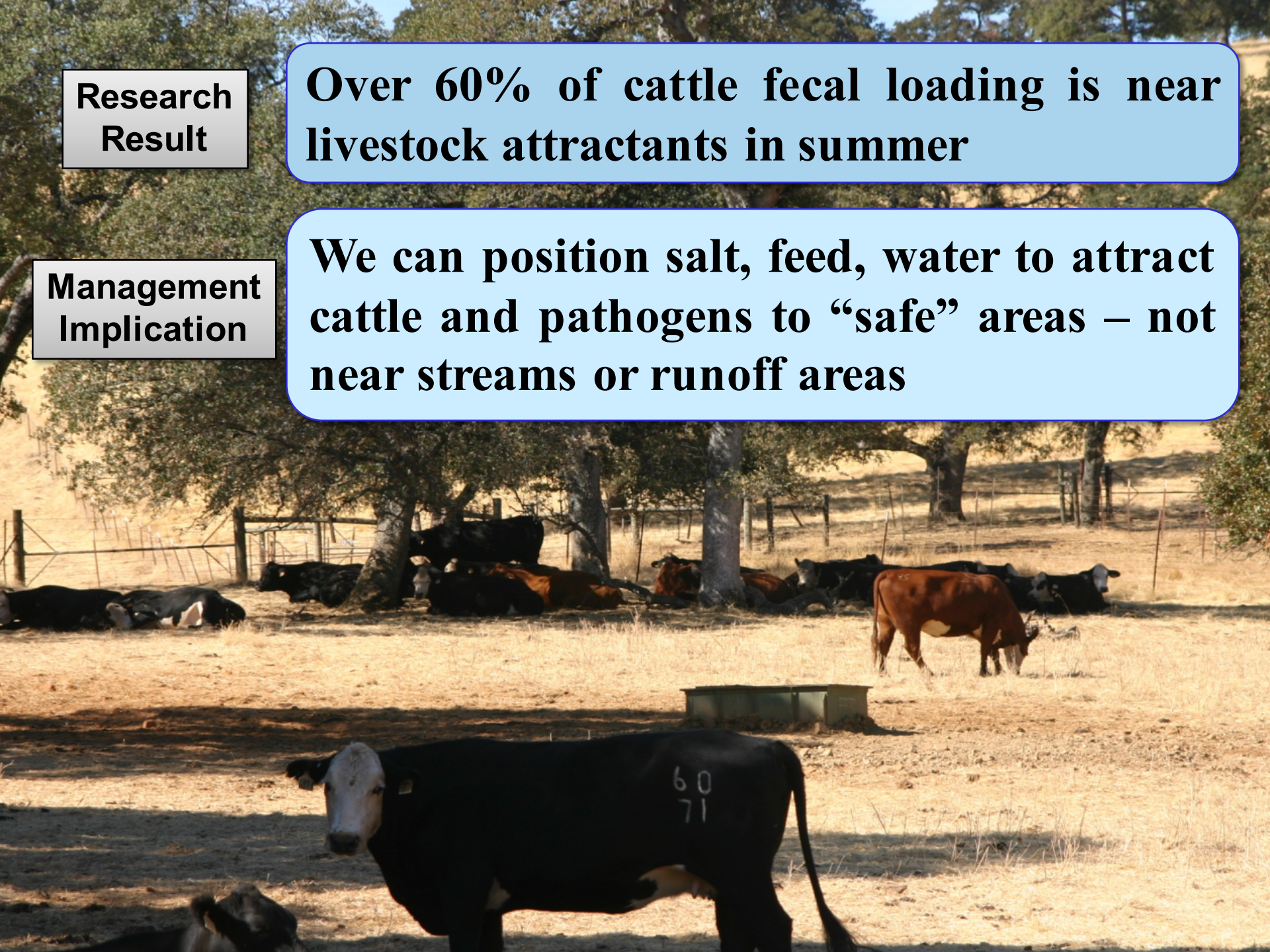
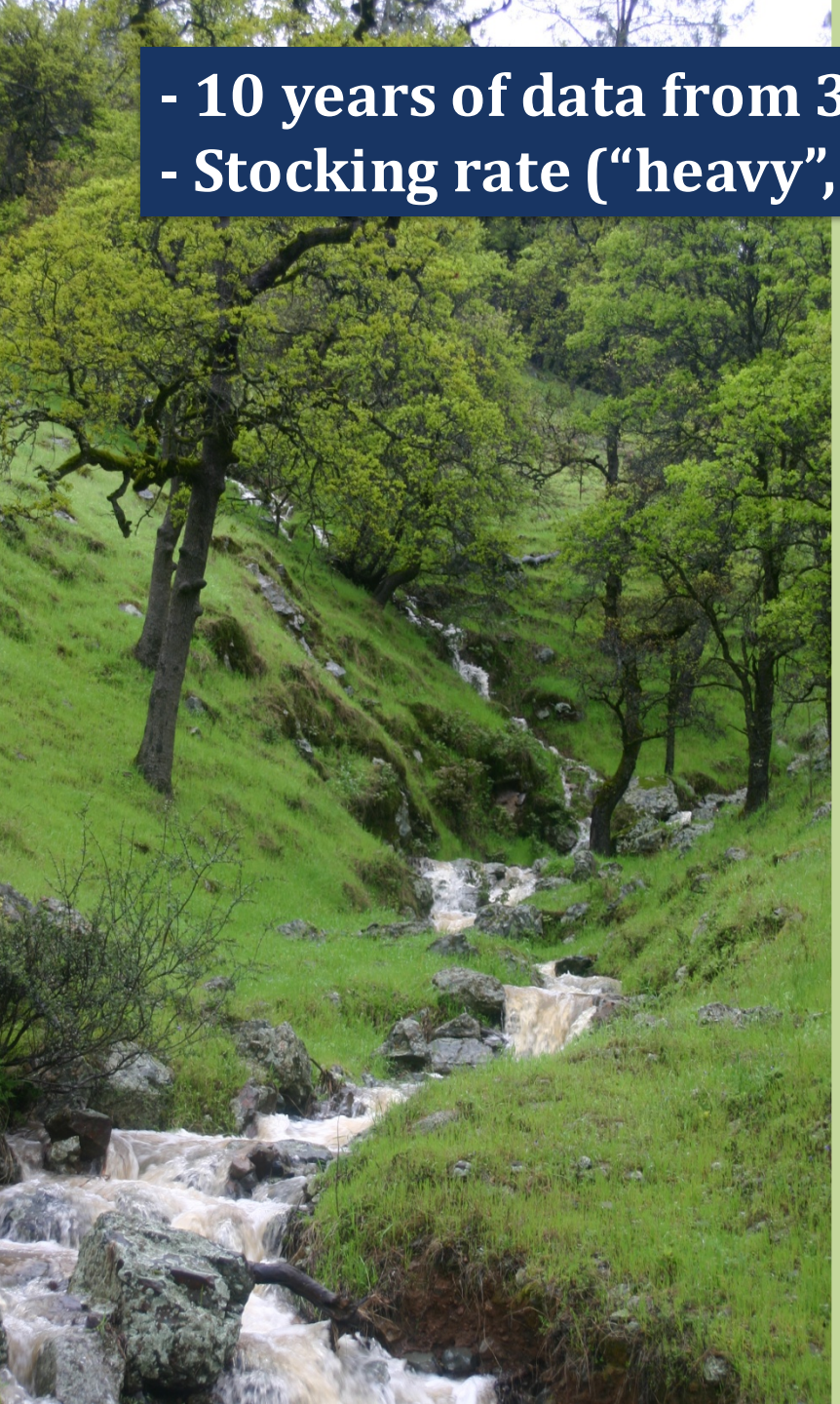
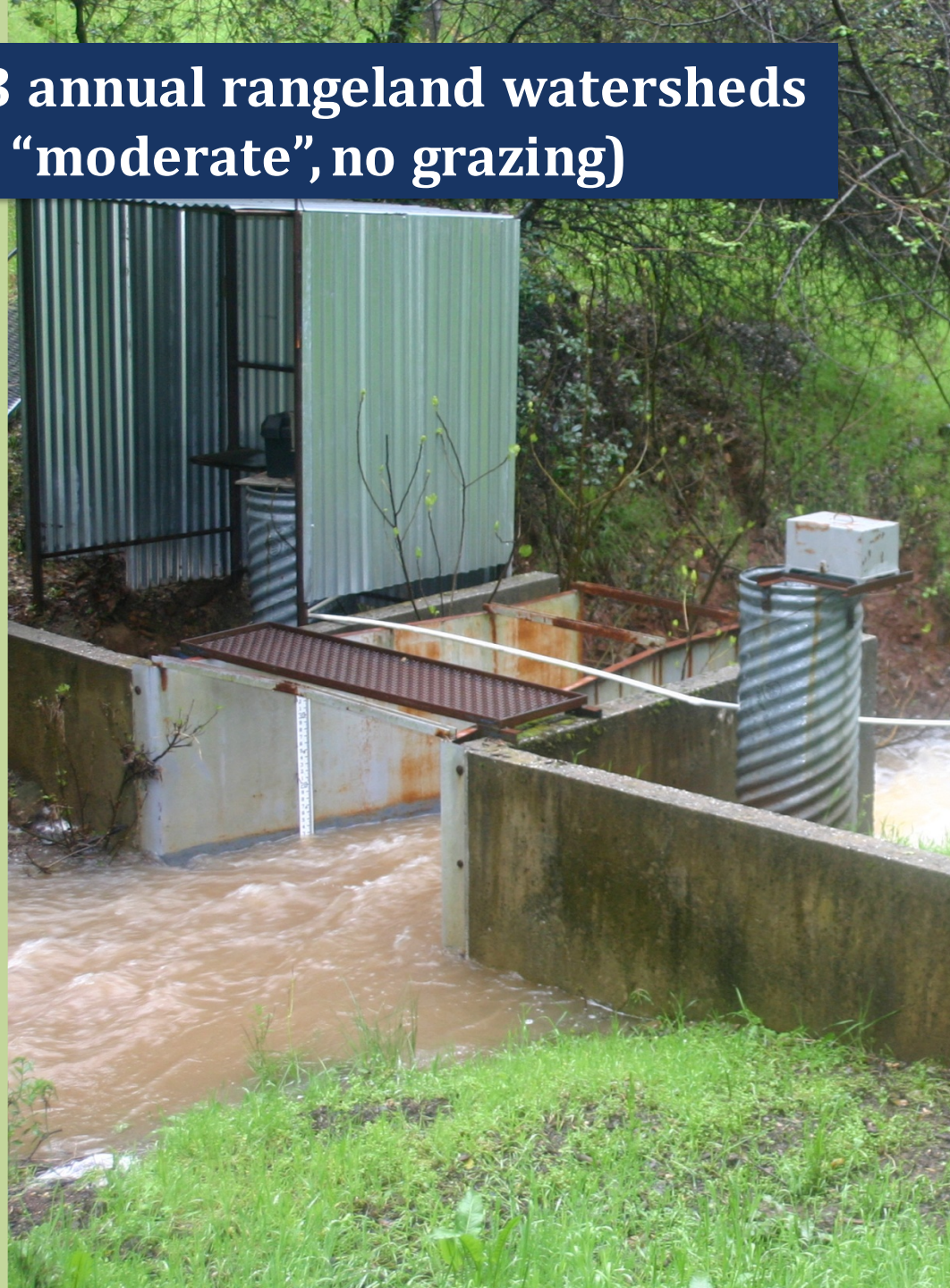
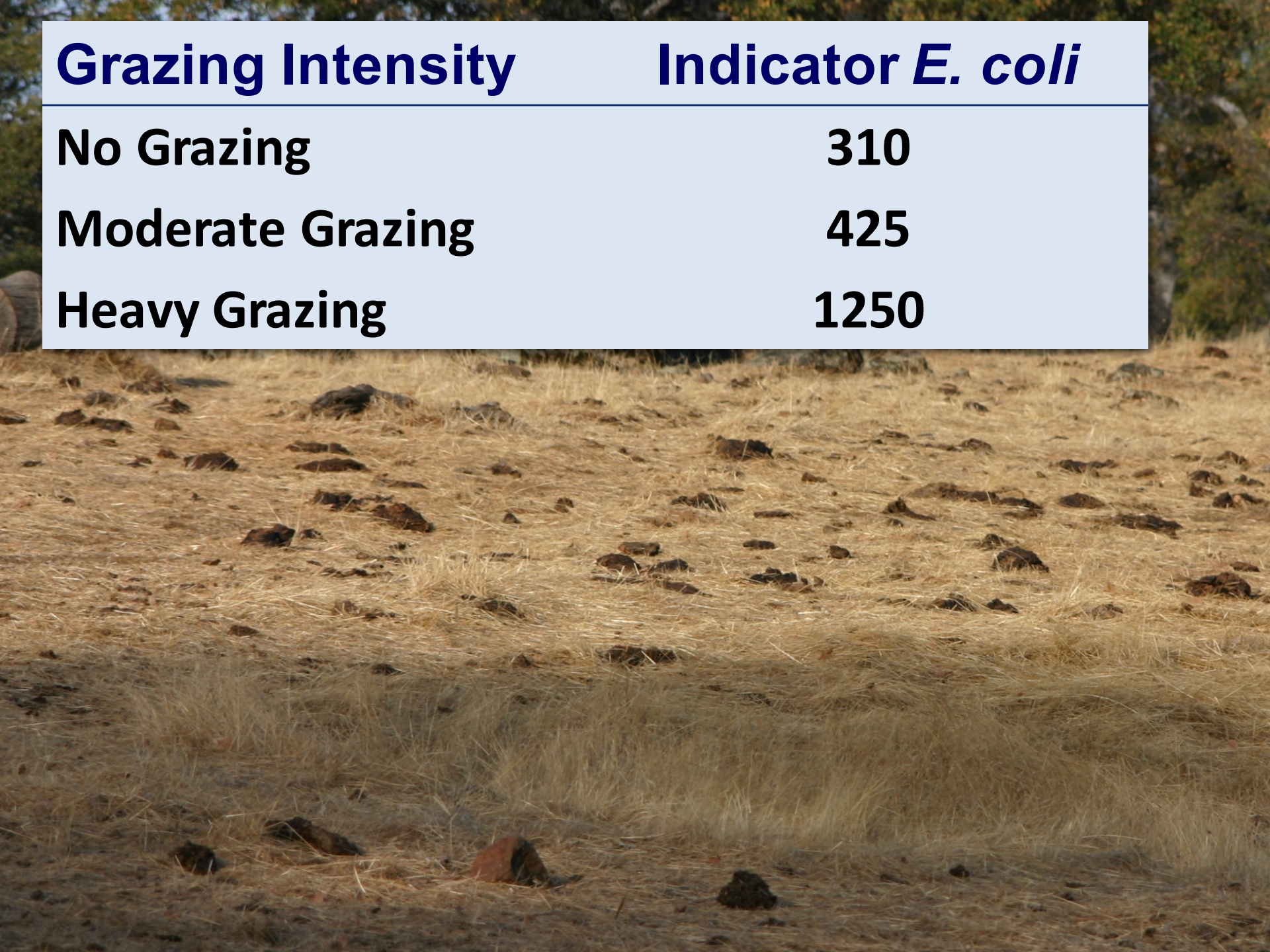
- A toolbox of effective WQ protection practices


Research Result
Over 60% of cattle fecal loading is near livestock attractants in summer
Management Implication
We can position salt, feed, water to attract cattle and pathogens to “safe” areas – not near streams or runoff areas

- 10 years of data from 3 annual rangeland watersheds
- Stocking rate ("heavy", "moderate", no grazing)







Grazing Intensity	Indicator *E. coli*
No Grazing	310
Moderate Grazing	425
Heavy Grazing	1250

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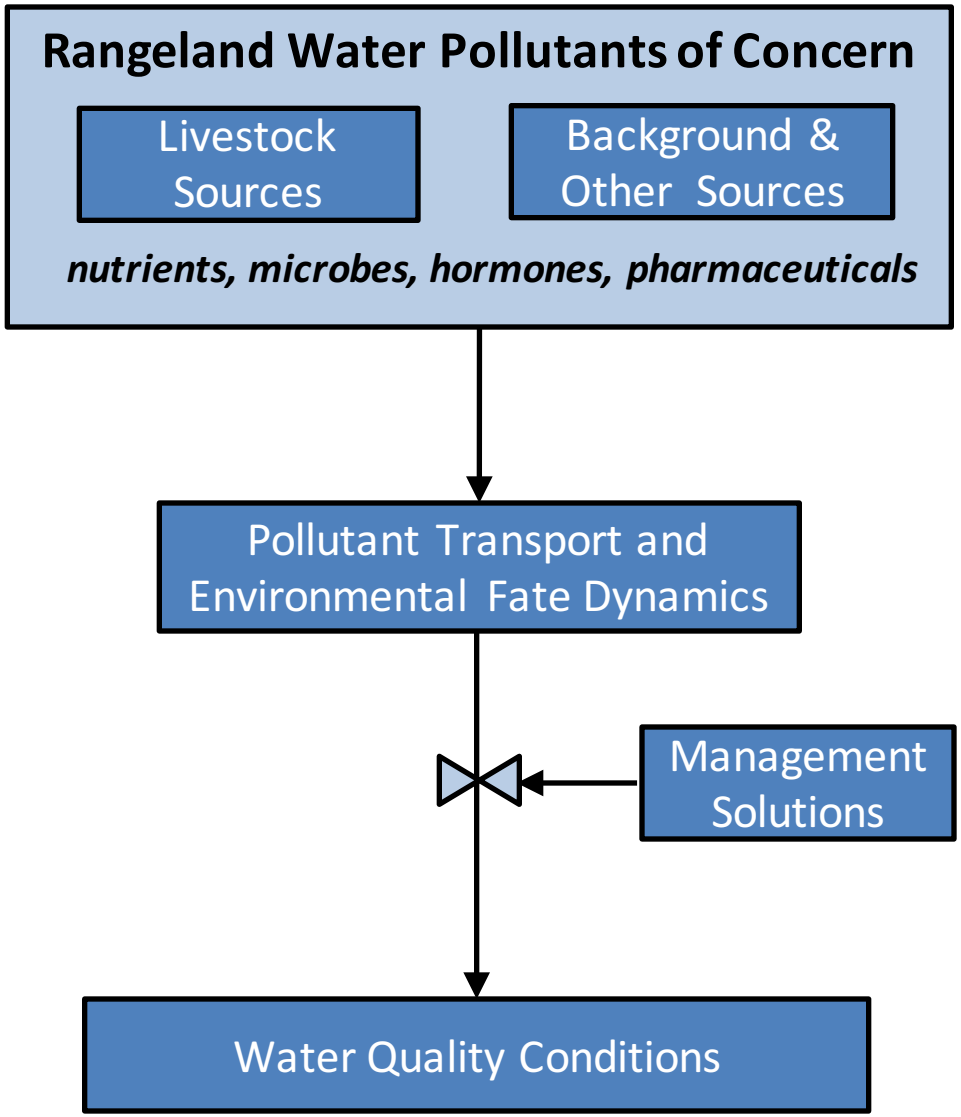
1. Background is not 0!
2. EPA Standards are not always attainable (100, 126, 235).

Range management that reduces water pollution risk

Moderate stocking	Manage livestock distribution	Manage wet season
Set stocking rate in balance with forage production and site resiliency to reduce impacts to soil and vegetation.	Distribute grazing and waste across the landscape, and actively manage grazing intensity in critical hydrologic zones.	Distribute livestock to resilient soils and non-critical hydrologic zones during saturated conditions.

Prescribed grazing, cross fencing, off-stream drinking water, targeted supplemental feeding, riparian pastures, herding, vegetative buffer strips

The Line of Research



- Livestock can increase microbial concentrations
- *Cryptosporidium* in cattle not infectious to humans

- <10% of pollutant load mobilizes from fecal deposits
- <70% transported more than 1 yard

- A toolbox of effective WQ protection practices

- With good management – clean water, recreation, grazing are very compatible

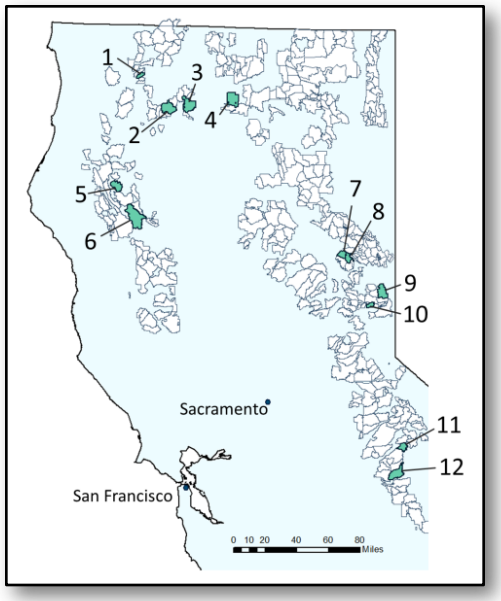
Public Lands Grazing & Water Quality

Comprehensive Water Quality Survey

- 12 USFS public lands grazing allotments, 5 National Forests.
  - 320,000 acres

- 155 stream collection sites, monitored monthly during grazing-recreation period (Jun-Nov, 2011).
  - Key Grazing Areas
  - Recreation Areas
  - Areas with No Concentrated Use Activities

- Total of 743 water samples collected
  - Fecal Indicator Bacteria: Fecal coliform, *E. coli*
  - TN, NO_3-N, NH_4-N, TP, PO_4-P



Water Quality Benchmarks

Percentage of 743 stream *water samples* exceeding benchmarks

Regulatory Benchmarks

Benchmark	Overall (% of 743)	Key Grazing Area (% of 462)	Recreation Area (% of 125)	No Concentrated Use Activities (% of 156)
FC > 20 cfu/100ml	50	48	46	58
FC > 200 cfu/100ml	10	10	6	13
E. coli > 100 cfu/100ml	9	8	7	11
E. coli > 235 cfu/100ml	3	3	3	4
NO_3-N > 300 µg/L	0	0	0	0
TP > 100 µg/L	2	2	2	<1
PO_4-P > 50 µg/L	<1	1	0	0

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Roche *et al.* 2013. PLOS ONE.

Mean FIB Concentrations

Benchmark	Key Grazing Area (n = 462)	Recreation Area (n = 125)	No Concentrated Use Activities (n = 156)
FC (cfu 100/ml)	87 ± 12 a	55 ± 9 b	90 ± 12 a
E. coli (cfu 100/ml)	42 ± 6 a	29 ± 7 b	43 ± 8 a

No significant differences in FIB concentrations between key grazing areas and areas of no concentrated use activities.

Roche *et al.* 2013. PLOS ONE.

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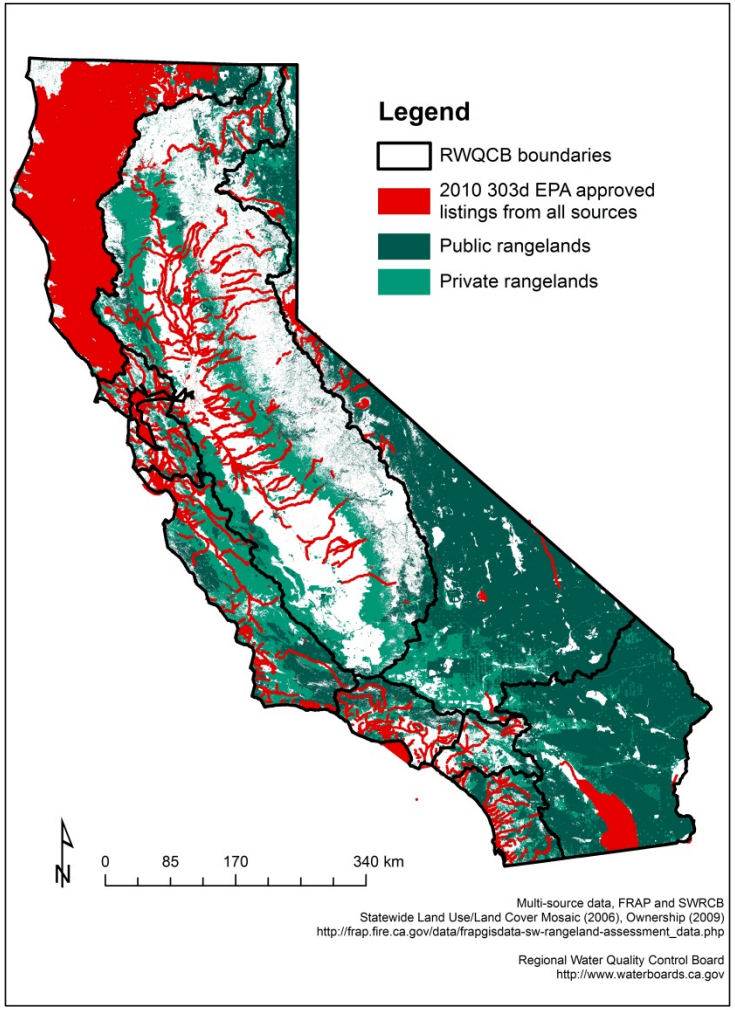
FIB concentrations significantly lower at recreation areas.

Roche *et al.* 2013. PLOS ONE.

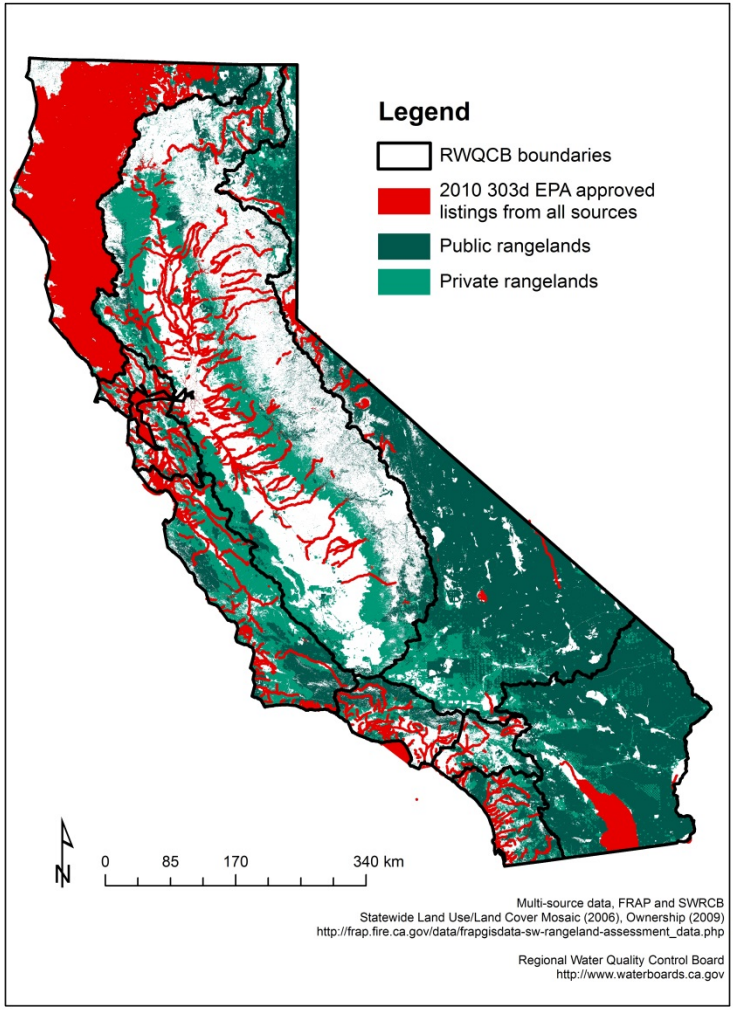
CA 2010 CWA Sec 303d List of all impaired waterbodies – all sources

All WQ Impairments (n=7,294)

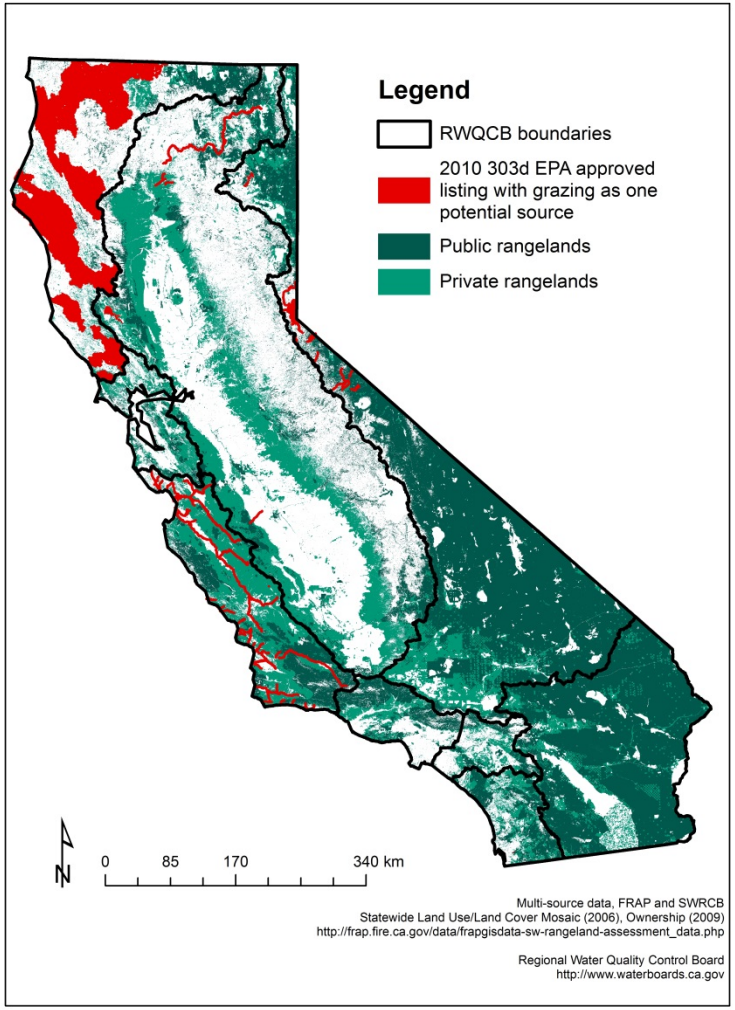


Grazing = 4% of listed WQ impairments in CA

All WQ Impairments (n=7,294)

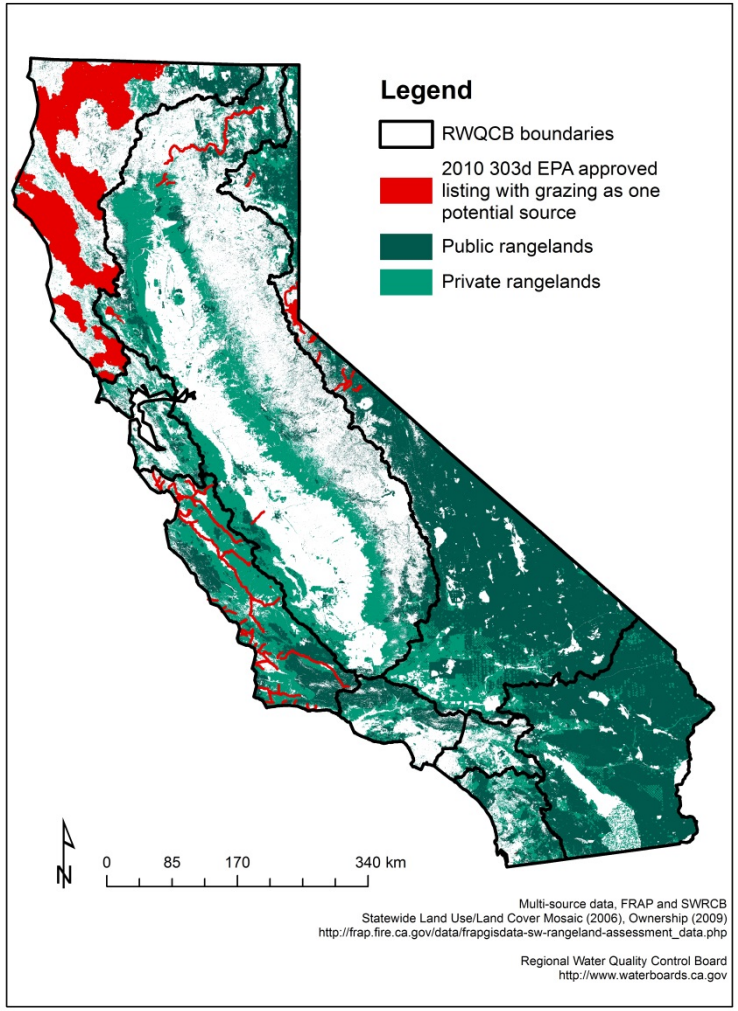


Grazing a *Potential* Source (n=324)



What are the pollutants of concern?

Grazing as a *potential* source (n=324)



Pollutant of concern	% of 324 303d listings
Microbial	29
Nutrients	23
Sediments	16

2010 303d Impairments

WQ Summary

- Water quality on extensively grazed rangelands and forests is often high.
- Management can certainly create risk to water quality, or it can protect water quality.
- Rangelands have great capacity to attenuate pollutants from livestock and other ranch activities – work with that potential.
- A large toolbox of tested, feasible practices exists.

UC Next Steps

- **Synthesis of Current Science**
  - ***Peer-reviewed synthesis papers***
  - ***Series of 1-2 page policy/informational briefs***
  - ***One-stop-shopping online information page***

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- **Scope of grazing as WQ impairment**
  - ***Analysis of SWRCB 303d listings***
  - ***Online reporting of analysis and results***
  - ***Peer reviewed policy paper***

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  - *Peer reviewed policy papers*
- **Participate in grass-roots "ranch water quality partnership"**
  - ***Review and renewal of the 25 year partnership***
  - ***Build on existing successes and plan for the next 25 years***

Rangeland Watershed Laboratory

http://rangelandwatersheds.ucdavis.edu