Griffin's Pen Condition Discussion Thoughts & Notes: Using stocking density to help control dust and mud.

In a nut shell: Dust is relatively easy (tighten up the cattle)... mud is tough (lots of months that cattle can't be loosen up/spread out the cattle enough to allow evaporation to get much done.

Dew claw mud will decrease FE 14% (NRC 1996). IF you target your management activities on mud control back in the summer when it is dry you will fair much better the following spring when it is wet. Tightly pack the pen soil (depends on the soil structure ... but generally a composite soil [organic matter + either silicates or colloids ... either turn in samples to the soils lab or wet the soil and play with it ... (the "ribbon test as is taught soils judging] packed to > 80 to 100 lbs density is good. You can drill the surface (4.5 x 0.5 core samples and get a dry weight) to estimate the density ... 16 g ~= 80 lbs and 18 g ~= 100 lbs/sq ft. Caution: Sand (silicates) will be approach or exceed 100 lbs density, yet pours, while clay (colloids) will only approach 55 lbs density, yet be rock hard until it gets wet … when mixed with fresh manure both silicates and colloids are very poor feedlot surface … becoming organic mud. Therefore pound density alone cannot be used to evaluate the ability of a silicate soil to stand up under feeder cattle in the environmental moisture is high. Similarly, pound density alone cannot be used to evaluate the ability of a colloid soil to stand up under feeder cattle in the environmental moisture is high. The wet colloid particles slide past each other which is why wet clay soils become soft and sticky. High silicate and/or high colloid soils should have enough "seasoned" (store in an undisturbed pile for approximately one year) manure added to the top six to eight inches of the pen surface to replace 50% of the volume. In a 100' x 250' pen, that would equal about 700 yards of seasoned manure. Adding seasoned manure provides two things feedlot surface soil needs: oil (from bacterial cell will lipids) and binding to hold soil particles, either silicates or colloids, together. NOTE: "Seasoned" manure (pen surface cleanings stored in a pile for about a year) makes an excellent mound IF PACKED like silage in a trench / pit silo and is in my experience the preferred material for building mounds.

However nothing (soil) will stand up if it does not have a chance to dry ... therefore

1. SLOPE: Having approximately 3 to 5 % pen slope from front to back,

2. TALL MOUNDS: Mounds that come all the way to the bunk (waterer if a center pen) ... (I love it when cattle need oxygen when they get to the top), fence lines that are approximately one to two feet above the center valley between the mound and fence ... (See diagram at the end of these notes)

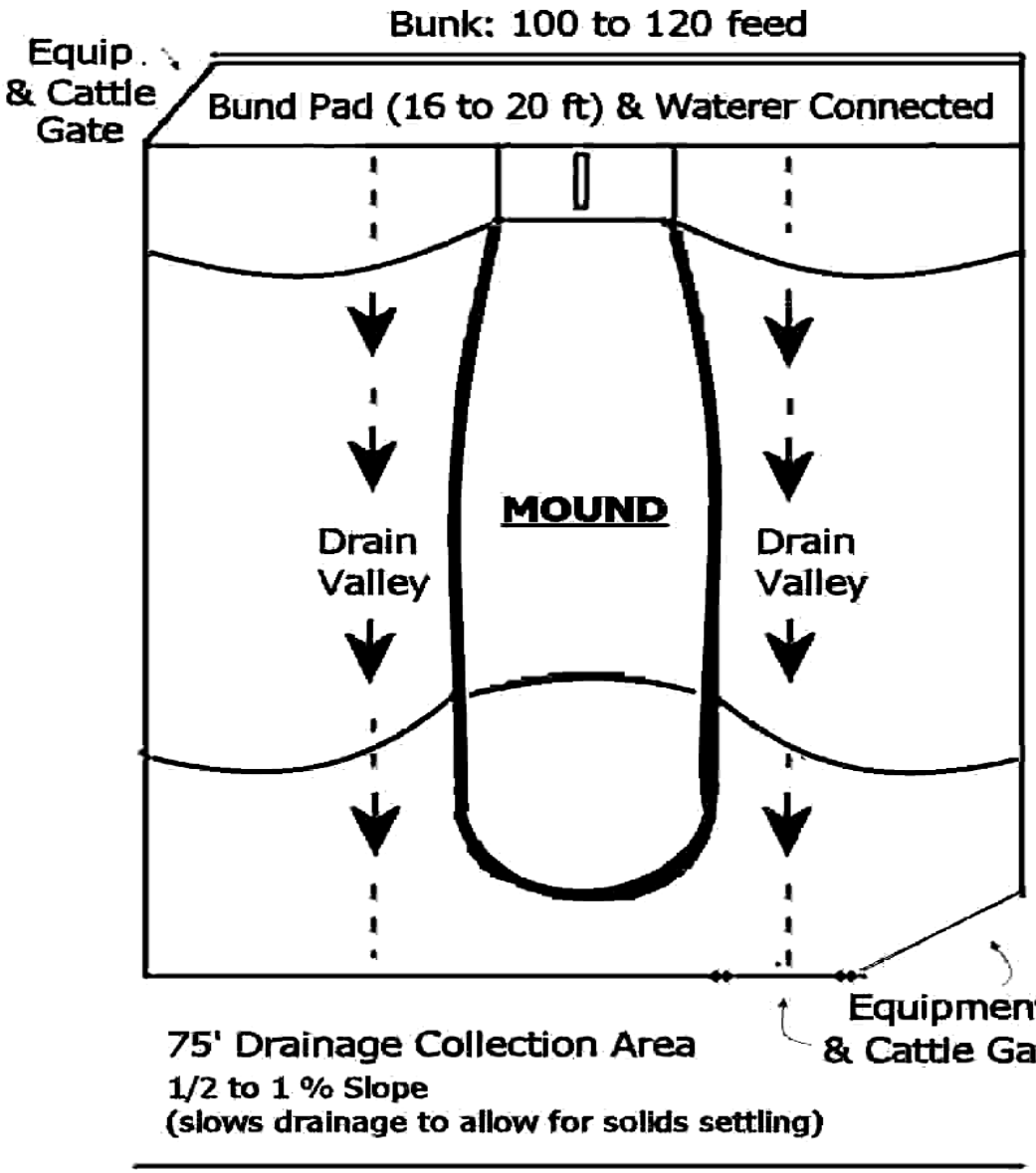
3. REMOVE SPONGE: A fast scrape monthly to pile in the pen the "sponge" (loose manure) ... (IT DOES NOT NEED TO BE REMOVED … can be re-spread in the pen after the season's high moistures period.

I would be surprised if this is not common knowledge to everyone in the industry.

On a personal note ... I think the best feedlot pen dirt is made from MANURE THAT HAS BEEN STORED IN A PILE FOR AT LEAST A YEAR ... not composted, PILED. When this stuff is packed tight as it is laid down every summer (~ 4-6 inches on the floor and make ALL OF THE MOUNDS from this stuff ... it stands up better than anything (including Texas panhandle clay) I have ever used. Sometimes I wonder if a feedyard should ever get rid of their manure ... if handled right I think it may be too good as a pen surface to let go of.

Nothing below on moisture balancing works if the items mentioned above are not first properly completed ... you can't cheat any of the above steps and control mud. "Sort of …" doe not work here. I will give everyone one out ... when there are enough consecutive wet days without any drying pens will fall out from under cattle in even well prepared feedyards. TALL HARD mounds and frequent scraping to pile mud in the pen may allow a measure of relief.

Mud Trouble Spots: Can use plastic snow fence 12 to 18 inches below surface to deal will pot hole or bogs ... dig out 3 feet, 12 to 15 inches sand, snow fence layer, cover with 12 to 15 inches crushed rock and finish covering with dirt (best if composite mix (>25% silicates, >25% colloids).



MOUND
Height: 8-12% pen width
Top: Slightly Rounded
Sides: 3/4 to 4/4 slope
Pack: 100lbs density
(DRY wt = 16/18 gm / (12X120mm core))

Side:
250 feet
with 4%
Slope
(front to back)
4% Slope
(front =>back)

Griffin's Environmental Moisture Balancing Notes:

The yearly moisture load varies greatly across the United States! (See map at the end of these notes) These notes will present a way to think about how moisture inputs can be balanced with evaporation to keep cattle comfortable … dry with minimal dust.

Moisture Balance Calculation Summary

(Note: adjustments will be required to balance moisture inputs and evaporation to meet the need to control dust or mud during different seasons of the year)

((AMA/Ty) / (MD/Ty)) x 100 = Sq. Feet Needed to Balance Environmental Moisture

AMA (Animal Moisture Added per 100 square ft/unit of time),
MD (Moisture Deficit per unit of time)
T (Time: Tm = month, Ty = year)
Typical: AMA / 1000 lb bovine = 3.0/Tm or 36.0/Ty

Average MD in 7 Midwest cattle feeding states = -2.5 / Tm or -30.0 / Ty
Average MD in 8 Southwest cattle feeding states = -3.3 / Tm or -40.0 / Ty

MW Moisture Balance (Yearly Basis) = (36/30)x100 = 120 sqft / 1000 lbs of cattle
Or 12 sqft / 100 lbs
SW Moisture Balance (Yearly Basis) = (36/40)x100 = 90 sqft / 1000 lbs of cattle
Or 9 sqft / 100 lbs

Balance Environmental Moisture (Example Table)

	Annual Moisture Deficit			
Cattle Weigh	-10"	-20"	-30"	-40"
600	216	108	72	54
800	288	144	96	72
1000	360	180	120	90
1200	432	216	144	108
1400	504	252	168	126

Note: If the annual moisture deficit is greater than or equal to zero, a water removal system (slatted floors, weekly pen cleaning, etc) should be used to meet the space requirements.

Moisture balancing:

Cattle will add water back into their environment (urine and manure) ... in a feedlot on a typical high concentrate diet the equivalent of approximately the amount that would equal a three inch rain per month per 1000 pounds of animal. From the weather service (NOAA) obtain the average and expected precipitation and normal (average) evaporation rate ... need to do a few calculations. Try to match the animal density to match precipitation and evaporation.

Of the top of my head and as a quick response to you I hope I don't think of something else I should have included. Below is a problem I give my students (and my solution to the problem) ... It represents the thought process used when I try to balance the moisture balance in a feedyard.

Example of a problem I give my students: Problems with moisture control in feedlots.
(Use Data Table below and map below (Grif_a5_EnvMap.gif.)

a. CATTLE STOCKING DENSITY: Estimate the yearly average pen space requirements (square feet per head) for 1,000 LB yearlings in WESTERN NE (15" annual precipitation) and EASTERN NE (25" annual precipitation). Note the circled X on the attached moisture deficit map. The moisture load produced by a 1,000 LB steer per 100 square feet is approximately equal to three inches of rain in 30 days. Outline your calculations:

b. Respirable Dust Control: Stocking density can be used to control dust, especially respirable dust (< 2 microns).

To aid in dust control, what STOCKING DENSITY might be used in Western NE for 1,000 LB cattle in months that receive less than 10 percent of annual precipitation?

Stocking density can aid in the control of mud and the 15 to 25% lowered feedlot production associated with mud. Can you think of three other management techniques that can help control mud?

c. Mud Control: To aid in mud control, what STOCKING DENSITY might be used in Eastern NE for 1,000 LB cattle in months that receive MORE THAN 15 percent of annual precipitation?

Data for problem:

NE Moisture Chart by Month

Nebraska	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
% Precip. W=15"	5	5	15	20	10	5	5	0	10	15	5	5
W Evap% E=25"	9	9	9	4	5	9	14	17	9	5	5	5
E Evap%	9	7	6	4	5	9	16	20	9	5	5	5

%Precip = percent precipitation, W=15" = Western NE gets 15"annual rain fall, WEvap% = percent evaporation loss by month in western NE, E=25" = Eastern NE gets 25" annual rain fall. E Evap% = percent evaporation loss by month in eastern NE, Note: This precipitation data may not reflect the yearly moisture distribution in your area, but will serve for this problem.

My solution/explanation to the above problem: (also available Enviro-Mud&DustControl-MoistDeficitCalc.xls)

In PART "a":, "CATTLE STOCKING DENSITY: Estimate the yearly average pen space requirements (square feet per head) for 1,000 LB yearlings in WESTERN NE (15" annual precipitation) and EASTERN NE (25" annual precipitation).

Given: The moisture load produced by a 1,000 LB steer per 100 square feet is approximately equal to three inches of rain in 30 days.

Note the circled X on the Moisture Deficit Map. This is the deficit after evaporation of all precipitation. For Example, Eastern NE gets 15" but has evaporation of 30" … results in a net loss of 15".

Let me work through the calculations for western Kansas with an annual precip of 12" (moisture deficit = -30"). The precipitation has already been included in the moisture deficit calculations. A 1,000 pound yearling will put 36" of water back into a 100 sq foot environment. The yearly average pen space would be: 36"/30=1.2, 1.2x100=120 sq ft.

PART "b": Aid in dust control in Western NE with a yearly moisture deficit = 15" annual precip - 40" evaporation = -25"

January moisture deficit = 5% annual precip (15"x5%=.75)
.75 - 9%x40" evaporation = .75" - 3.6" = approximately = -3 "
1,000 lb yearling = 3"/100sq ft per month
+3/-3 =, 1x100 = 100 sq ft to balance moisture load.

February moisture deficit = 5% annual precip (15"x5%=.75)
.75 - 9%x40" evaporation = .75" - 3.6" = approximately = -3 "
1,000 lb yearling = 3"/100sq ft per month
3/3 = 1, 1x100 = 100 sq ft to balance moisture load.

March moisture deficit = 15% annual precip (15"x15%=2.25)
2.25 - 9%x40" evaporation = 2.25" - 3.6" = APPROXIMATELY = -1"
1,000 lb yearling = 3"/100sq ft per month
+3/-1 = 3 , 3X100 = 300 sq ft to balance moisture load.

April moisture deficit =20% annual precip (15"x20%=3")
3" - 4%x40" evaporation = 3" - 1.6" = APPROXIMATELY +1"
1,000 lb yearling = 3"/100sq ft per month
NET POSITIVE NUMBER = POSITIVE MOISTURE LOAD THAT CAN'T BE BALANCED.

May moisture deficit = 10% annual precip (15x10%=1.5")
1.5" - (5%x40" evaporation) = 1.5" - 2" = ROUNDS TO APPROXIMATELY 1"
1,000 lb yearling = 3"/100sq ft per month
NET POSITIVE NUMBER = POSITIVE MOISTURE LOAD THAT CAN'T BE BALANCED.

June moisture deficit = 5% annual precip (15"x5%=.75)
.75 - 9%x40" evaporation = .75" - 3.6" = approximately = -3 "
1,000 lb yearling = 3"/100sq ft per month
3/3 = 1, 1x100 = 100 sq ft to balance moisture load.

July moisture deficit = 5% annual precip (15"x5%=.75)
.75 - 14%x40" evaporation = .75" - 5.6" = approximately = -5 "
1,000 lb yearling = 3"/100sq ft per month
3/5 = .6, .6x100 = 60 sq ft to balance moisture load.

August moisture deficit = 0% annual precip - 17%x40" evaporation
0 precip - 6.8"evap = approximately 7"
1,000 lb yearling = 3"/100sq ft per month
3/7=.42, rounds to .5x100=50 sq ft to balance moisture load

September moisture deficit = 10% annual precip (15"x10%= 1.5")
1.5" - 9%x40" evaporation = 1.5" - 3.6" = approximately = -2 "
1,000 lb yearling = 3"/100sq ft per month
3/2 = 1.5, 1.5x100 = 150 sq ft to balance moisture load.

October moisture deficit = 15% annual precip (15x15%= 2.25")
2.25" - (5%x40" evaporation) = 2.25" - 2" = ROUNDS TO APPROXIMATELY 0"
1,000 lb yearling = 3"/100sq ft per month
3/0= ERROR, closest to 3/1 therefore 3x100= 300 sq ft to balance moisture load

November moisture deficit = 5% annual precip (15x5%=.75")
.75" - (5%x40" evaporation) = .75" - 2" = ROUNDS TO APPROXIMATELY -1"
1,000 lb yearling = 3"/100sq ft per month

3/1= 3, 3x100= 300 sq ft to balance moisture load

December moisture deficit = 5% annual precip (15x5%=.75")
.75" - (5%x40" evaporation) = .75" - 2" = ROUNDS TO APPROXIMATELY -1"
1,000 lb yearling = 3"/100sq ft per month
3/1= 3, 3x100= 300 sq ft to balance moisture load

Months less than 10% = Jan, Feb, May, Jun, Jul, Aug, Sep, Nov, Dec
100 + 100 + (net+) + 100 + 60 + 50 + 150 + 300 + 300 = 1160/8 = 145 sq ft

Months more than 10% = Mar, Apr, Oct
200 + (NET +) + 300 = 500/2 = 250+ sq feet

Therefore a good average would be approximately 150 to 300 sq feet in Western NE.

DECREASE PEN SPACE PER ANIMAL TO CONTROL DUST. INCREASE TO HELP CONTROL MUD.

Repeat the process for Eastern Nebraska. YOU DO NOT NEED TO MAKE THE SAME CALCULATIONS I HAVE MADE. ESTIMATES ARE CLOSE ENOUGH. I just wanted you to get an idea of how pen space requirements were estimated.

PART "c": Aid in mud control in Eastern NE with a yearly moisture deficit =
= 25" annual precip - 40" evaporation = -15"

January moisture deficit = 5% annual precip (25"x5%=1.25)
1.25 - 9%x40" evaporation = 1.25" - 3.6" = approximately = -2 "
1,000 lb yearling = 3"/100sq ft per month
3/2 = 1.5, 1.5x100 = 150 sq ft to balance moisture load.

February moisture deficit = 5% annual precip (25"x5%=1.25)
1.25 - 7%x40" evaporation = 1.25" - 2.8" = approximately = -2 "
1,000 lb yearling = 3"/100sq ft per month
3/2 = 1.5, 1.5x100 = 150 sq ft to balance moisture load.

March moisture deficit = 15% annual precip (25"x15%=3.75)
3.75 - 6%x40" evaporation = 3.75" - 2.4" = APPROXIMATELY = +1"
1,000 lb yearling = 3"/100sq ft per month
NET POSITIVE NUMBER = POSITIVE MOISTURE LOAD THAT CAN'T BE BALANCED.

April moisture deficit =20% annual precip (25"x20%=5")
5" - 4%x40" evaporation = 5" - 1.6" = APPROXIMATELY = +3"
1,000 lb yearling = 3"/100sq ft per month
NET POSITIVE NUMBER = POSITIVE MOISTURE LOAD THAT CAN'T BE BALANCED.

May moisture deficit = 10% annual precip (25x10%=2.5")
2.5" - (5%x40" evaporation) = 2.5" - 2" = ROUNDS TO APPROXIMATELY +1"
1,000 lb yearling = 3"/100sq ft per month
NET POSITIVE NUMBER = POSITIVE MOISTURE LOAD THAT CAN'T BE BALANCED.

June moisture deficit = 5% annual precip (25"x5%=1.25)
1.25 - 9%x40" evaporation = 1.25" - 3.6" = approximately = -2 "
1,000 lb yearling = 3"/100sq ft per month
3/2 = 1.5, 1.5x100 = 150 sq ft to balance moisture load.

July moisture deficit = 5% annual precip (25"x5%=1.25)
1.25 - 16%x40" evaporation = 1.25" - 6.4" = approximately = -5 "
1,000 lb yearling = 3"/100sq ft per month
3/5 = .6, .6x100 = 60 sq ft to balance moisture load.

August moisture deficit = 0% annual precip - 20%x40" evaporation
0 precip - 8"evap = approximately -8"
1,000 lb yearling = 3"/100sq ft per month
3/8 =.38, rounds to .5x100=50 sq ft to balance moisture load

September moisture deficit = 10% annual precip (25"x10%= 2.5")
2.5" - 9%x40" evaporation = 2.5" - 3.6" = approximately = -1 "
1,000 lb yearling = 3"/100sq ft per month
3/1 = 1, 1x100 = 100 sq ft to balance moisture load.

October moisture deficit = 15% annual precip (25x15%= 3.75")
3.75" - (5%x40" evaporation) = 3.75" - 2" = APPROXIMATELY +2"
1,000 lb yearling = 3"/100sq ft per month
NET POSITIVE NUMBER = POSITIVE MOISTURE LOAD THAT CAN'T BE BALANCED.

November moisture deficit = 5% annual precip (25x5%=1.25")
1.25" - (5%x40" evaporation) = 1.25" - 2" = ROUNDS TO APPROXIMATELY -1"
1,000 lb yearling = 3"/100sq ft per month
3/1= 3, 3x100= 300 sq ft to balance moisture load

December moisture deficit = 5% annual precip (25x5%=1.25")
1.25" - (5%x40" evaporation) = 1.25" - 2" = ROUNDS TO APPROXIMATELY 1"
1,000 lb yearling = 3"/100sq ft per month
3/1= 3, 3x100= 300 sq ft to balance moisture load

MUD CONTROL NEEDED (Mar, Apr, May, Oct) WHEN NET POSITIVE NUMBER = POSITIVE MOISTURE LOAD THAT CAN'T BE BALANCED. USE: Slope, pack, mounds, and frequent removal of "sponge" (SPONGE is the loose dried manure on the top of the pen that soaks up moisture and softens the pen surface ...) would be the management practices to help balance environmental conditions to the needs of the feedlot cattle.

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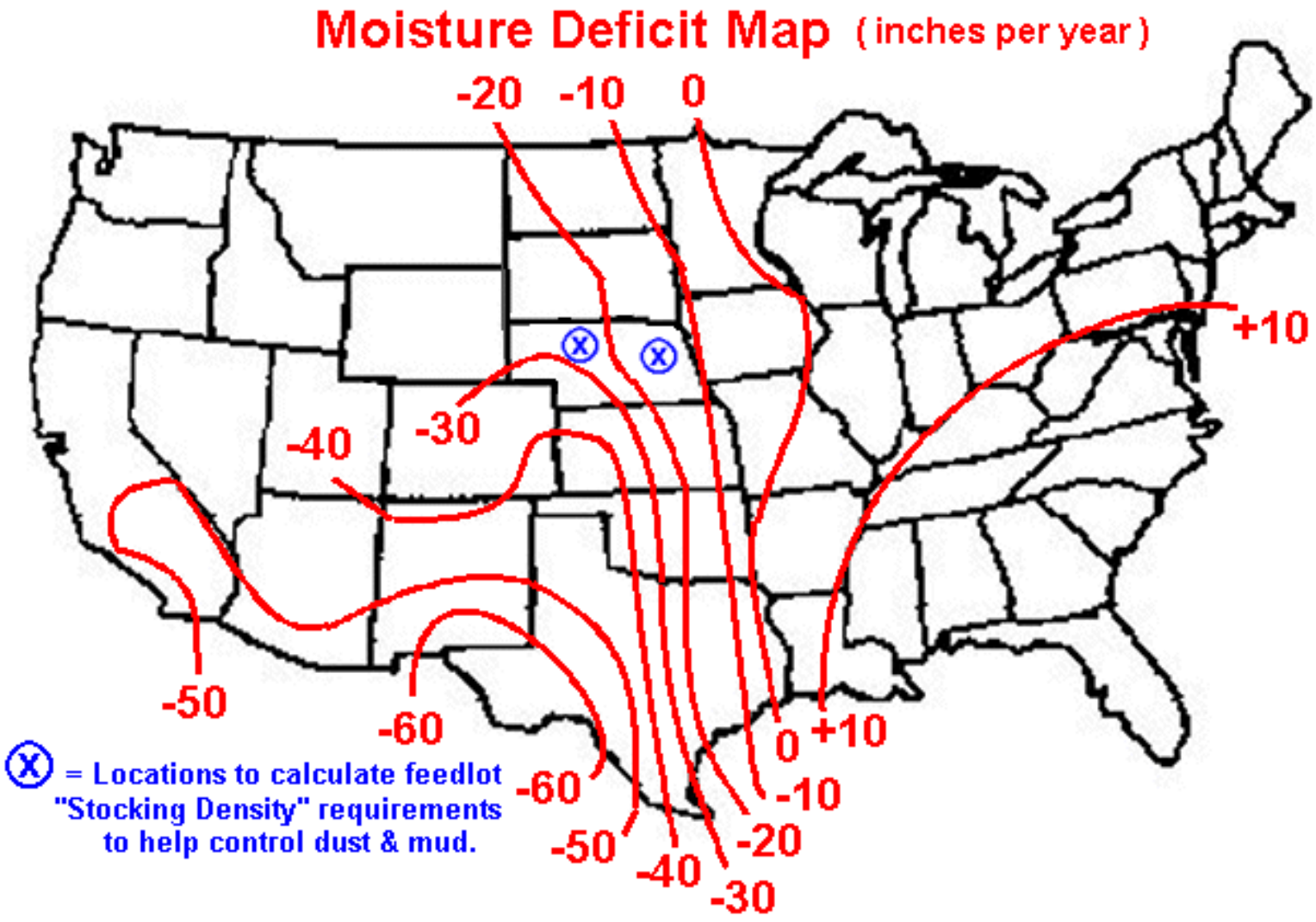
Moisture Deficit Map (inches per year)
-20
-10
0
+10
-30
-40
-50
-60
0
+10
-10
-20
-30
-40
-50
-60
= Locations to calculate feedlot "Stocking Density" requirements to help control dust & mud.