Water Quality Standards for Livestock Water

revised 1/4/08

			Acceptable Levels or Expected Ranges by Source:										
Water Test Result:	**Comments**	**Sources of Contamination**	Summary Recommendations (Oetzel)	EPA (human standards)	Dairy NRC 2001	Canadian Task Force, 1987	Jim Linn's Review Paper, 1991 Four-State Conf.	John Parsen, UW SPAL Info Sheet, ~1991	Dairyland Labs (10/11/01)	Dairyland Labs (12/05)	Rock River Labs* (6/25/04)	Mike Socha - DHM article (10/01)	Comments, Other Sources
Index Measures:													
pH	Only EPA info available; no cow studies have been done. Low pH (<6) causes corrosiveness and gives water a metallic taste. High pH gives the water a slippery feel, soda taste, and leaves deposits.		6.0 to 9.0	6.5 to 8.5 (secondary)	6.5 to 8.5				<8.3	5.5 to 8.3	<8.5		
Corrosivity	Corrosive water corrodes pipes and fixtures, causes staining, and adds a metallic taste to the water.	Low pH water, other factors? There are specific testing procedures for water corrosivity (EPA).	---	Non-corrosive (secondary)									
Salinity, TDS, TSS	Mostly from NaCl; bicarbonate, sulfate, Ca, Mg, and silica may also contribute. May add color to the water and reduce water intake. Gives water a salty taste.		<1000 ppm	<500 ppm (secondary)	<1000 safe, 1000-2999 can be used	<3000 ppm			<1000 ppm		<960 to 5000 ppm*		
Hardness	Sum of Ca and Mg; reported as equivalent amount of $CaCO_3$; hard water may clog pipes over time. Hard water leaves scaly deposits on plumbing and fixtures. Hard water also decreases the cleaning action of soaps and detergents. Hard waters may be more palatable than soft waters.	Naturally dissolved Ca and Mg from soil and limestone.	---	no EPA limit			0-60 ppm is soft, 61-120 is moderate, 121-180 is hard, and >180 ppm is very hard; 1 grain/gallon equals 17.1 ppm.				<44 ppm		
Alkalinity	Measured as the capacity of water to buffer acid; high alkalinity is associated with high pH. High alkalinity waters may have a distinctly flat, unpleasant taste.	Alkalinity comes from carbonates, bicarbonates, and hydroxides dissolved in the water.	<500 ppm	no EPA limit		>500 ppm has a laxative effect							Buffers low pH waters to reduce corrosion
Nitrate-nitrogen	Toxic to infants less than 6 months of age; causes shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks; sewage; erosion of natural deposits.	<25 ppm	<10 ppm (legal)	<10 ppm		<100 ppm	Public water should not exceed 10 ppm	<50 ppm		<10 to 20 ppm*	<25 ppm	
Nitrite-nitrogen	Same toxicity as nitrate	Runoff from fertilizer use; leaching from septic tanks; sewage; erosion of natural deposits.	<10 ppm	<1 ppm (legal)			<10 ppm						
Ammonia-nitrogen	An indication of pollution		---	no EPA limit				Public water should not exceed .5 ppm					
Sulfates	>150 ppm causes noticeable salty taste. Sulfate salts are laxatives, with Na_2SO_4 the most potent laxative. H_2S is the most toxic form of S (formed on anode rod of hot water heater or by iron bacteria). SO_4 is 33% S.		<250 ppm	<250 ppm (secondary)	<500 ppm calves and <1000 ppm adult cows	<1000 ppm	<500 ppm calves and <1000 ppm adult cows	Public water should be <250 ppm due to taste and laxative effects	<300 ppm	<300 ppm		<125 ppm	>200 ppm may cause odors, taste bitter, and have a temporary laxative effect.
Microminerals:													
Aluminum	May add color to the water; no health effects listed (EPA).		<5 ppm	<.05 to .20 ppm (secondary)	<.5 ppm	<5 ppm	<5 ppm	Rarely >.2 ppm			<5 to 10 ppm*		
Arsenic	Causes skin damage, circulatory system problems, and increased risk of cancer.	Erosion of natural deposits; runoff from orchards; runoff from glass and electronics production wastes.	<.2 ppm	<.05 ppm (legal)	<.05 ppm	<.50 ppm	<.20 ppm	Range of .005 to .34 ppm; median of .06 ppm			<.20 ppm		
Boron			---	no EPA limit	<5 ppm	<5 ppm	<5 ppm				<5 to 1000 ppm*		
Cadmium	Toxicity causes repro problems, possible anemia; EPA lists kidney damage in humans.	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints.	<.05 ppm	<.005 ppm (legal)	<.005 ppm	<.02 ppm	<.05 ppm				<.01 to .05 ppm*		
Chromium	Toxicity causes skin and soft tissue problems; EPA lists allergic dermatitis.	Rarely found in natural waters; indicates industrial pollution (runoff from steel and pulp mills); erosion of natural deposits.	<1 ppm	<.1 ppm (legal)	<.1 ppm	<1 ppm	<1 ppm				<.1 to 1 ppm*		
Cobalt			<1 ppm	no EPA limit	<1 ppm	<1 ppm	<1 ppm						

Water Quality Standards for Livestock Water

revised 1/4/08

			Acceptable Levels or Expected Ranges by Source:										
Water Test Result:	**Comments**	**Sources of Contamination**	Summary Recommendations (Oetzel)	EPA (human standards)	Dairy NRC 2001	Canadian Task Force, 1987	Jim Linn's Review Paper, 1991 Four-State Conf.	John Parsen, UW SPAL Info Sheet, ~1991	Dairyland Labs (10/11/01)	Dairyland Labs (12/05)	Rock River Labs* (6/25/04)	Mike Socha - DHM article (10/01)	Comments, Other Sources
Copper	>.1 ppm causes milk oxidative flavor; >.6 ppm may cause dairy liver damage. Copper gives water a bad taste / odor if >1.0 ppm (EPA). May also add color to the water. Short-term exposure causes GI distress; long-term exposure causes liver and/or kidney failure.	Corrosion of household plumbing systems; erosion of natural deposits. May see blue-green staining of plumbing with high copper water.	<.5 ppm	<1.3 ppm (legal), and <1.0 ppm (secondary)	<1.0 ppm	<5.0 ppm (swine); <.6 ppm (dairy)	<.5 ppm	<1.0 ppm for public drinking: usually .01 to .28 ppm	<.3 ppm	<.5 ppm	<.2 to .5 ppm*	<.2 ppm	
Flourine	Excess causes loss of tooth enamel, bone disease (pain and tenderness of the bones); children may get mottled teeth.	Water additives which promote strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories.	<2 ppm	<4 ppm (legal), and <2 ppm (secondary). Added at .7 to 1.2 ppm for prevention of tooth decay.	<2 ppm	<2 ppm	<2 ppm				<2 ppm		
Iron	>.3 ppm can stain clothes, support growth of iron bacteria (foul smell), and potentially reduce water intake. May add a rusty color to the water and cause reddish to orange staining of plumbing and fixtures. May tie up zinc, other microminerals? Also a pro-oxidant, which might interfere with anti-oxidants? No health problems listed (EPA).	Iron leaches out of high iron rocks into the aquifer. Deep wells with low dissolved oxygen content and/or high carbonate content will have higher dissolved iron content. Iron may also come from pipes carrying corrosive water.	<.3 ppm	<.3 ppm (secondary)		<.3 ppm	not defined	Taste detection begins at .1 ppm; public water should be <.3 ppm	<.3 ppm	<.3 ppm	<.2 to .4 ppm*	<.2 ppm	Water softeners can remove up to about 3 ppm iron from water. Taste problems are the main issue with high iron water
Lead	Toxicity may cause abortion (goats). Children show delays in physical and mental development; adults may show kidney problems and high blood pressure.	Acidic soft water standing in lead pipes can dissolve excessive lead. Also erosion of natural deposits.	<.10 ppm	<.015 ppm (legal)	<.015 ppm	<.10 ppm	<.10 ppm	Range of .002 to .64 ppm expected.			<.05 to .10 ppm*		
Manganese	Ties up zinc (see Zinpro?, although milligram amounts are very small), maybe other minerals? Gives water a bitter, metal taste and bad odor if >.05 ppm. Turns water black or brown and causes black staining of plumbing and fixtures. Mn bacteria may clog pipes with black "sludge." No health problems listed (EPA).	Deep wells with low dissolved oxygen content; also wells with high carbonate content.	<.05 ppm	<.05 ppm (secondary)	<.05 ppm	no guideline	not defined	Public water should be <.05 ppm to prevent black stains; >.15 ppm causes brownish laundry stains and objectional taste; rarely >1 ppm	<.05 ppm	<.05 ppm	<.05 to .50 ppm*	<.05 ppm	
Mercury	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands.	<.01 ppm	<.002 ppm (legal)	<.01 ppm	<.003 ppm	<.01 ppm	Public water should not exceed .002 ppm.			<.01 ppm		
Molybdenum			---	no EPA limit		<.5 ppm	not defined				<.03 to .06 ppm*		
Nickel			<1 ppm	no EPA limit	<.25 ppm	<1 ppm	<1 ppm	Irrigation waters should contain less than .2 ppm.			<.25 to 1.00 ppm*		
Selenium	"Blind staggers" or "bob-tailed disease" if excessive. Human toxicity signs include hair or fingernail loss; numbness in fingernails or toes; circulatory problems.	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines.	<.05 ppm	<.05 ppm (legal)	<.05 ppm	<.05 ppm	<.05 ppm				<.05 to .10 ppm*		
Uranium			<.2 ppm	no EPA limit		<.2 ppm							
Vanadium			<.1 ppm	no EPA limit	<.1 ppm	<.1 ppm	<.1 ppm				<.1 ppm		
Zinc	Gives water a metallic taste. No health problems listed (EPA).	From galvanized pipes carrying corrosive water.	<25 ppm	<5 ppm (secondary)	<5 ppm	<50 ppm	<25 ppm	Public water should be <5 ppm (based on bitter taste); usually .06 to 7.0 ppm.	<25 ppm	<25 ppm	<25 ppm	<25 ppm	
Macrominerals:													
Calcium	Public water should be below about 200 ppm; related to water hardness. No health problems listed (EPA).	Naturally dissolved Ca from soil and limestone.	<200 ppm	no EPA limit		<1000 ppm		usually 50 to 200 ppm	<200 ppm	<200 ppm	<100 to 200 ppm*	<100 ppm	
Chloride	Important anion - contributes to acidosis. May cause bad odor or taste (salty taste) if >250 ppm (EPA). May also increase corrosiveness of the water. No health problems listed (EPA).		<250 ppm	<250 ppm (secondary)				Usually 0 to 540 ppm (median of 13 ppm). High Cl / low pH harms metallic pipes and growing plants.	<200 ppm		<100 to 300 ppm*	<100 ppm	Estimated dairy cow rejection threshold of about 5,000 ppm; Use 2 to 3 ounces bleach/50 gallons water to kill bacteria and algae in tanks.

Water Quality Standards for Livestock Water

revised 1/4/08

			Acceptable Levels or Expected Ranges by Source:										
Water Test Result:	**Comments**	**Sources of Contamination**	Summary Recommendations (Oetzel)	EPA (human standards)	Dairy NRC 2001	Canadian Task Force, 1987	Jim Linn's Review Paper, 1991 Four-State Conf.	John Parsen, UW SPAL Info Sheet, ~1991	Dairyland Labs (10/11/01)	Dairyland Labs (12/05)	Rock River Labs* (6/25/04)	Mike Socha - DHM article (10/01)	Comments, Other Sources
Magnesium	Epsom's salts ($MgSO_4$) is a laxative. Water >125 ppm Mg may cause diarrhea in some people; try to keep public water <30 ppm. No health problems listed (EPA).	Naturally dissolved Mg from soil and limestone.	<80 ppm	no EPA limit		<300 to 400 ppm		usually 25 to 150 ppm; >125 ppm may be cathartic and diuretic	<80 ppm	<80 ppm	<50 to 100 ppm*	<50 ppm	
Phosphorus		Run-off from cropland, other sources?	<1 ppm	no EPA limit				most water is <.03 ppm	<.7 ppm	<.7 ppm	<.7 ppm		
Potassium	Excessive intakes might cause diarrhea? No health problems listed (EPA).		<20 ppm	no EPA limit				most water is <5 ppm; only rarely >20 ppm	<20 ppm	<20 ppm	<10 to 20 ppm*	<10 ppm	
Sodium	Glauber's salts (Na_2SO_4) is a laxative. Sodium contributes to extracellular fluid volume and controls blood pressure. No health problems listed (EPA).	Softening water by ion exchange increases Na by about 8 ppm for each grain/gallon of hardness removed (1 grain/gallon equals 17.1 ppm). Sodium is the main contributor to high salinity (TDS, TSS) water.	<100 ppm	no EPA limit. The National Academy of Sciences suggests that public water should be <100 ppm Na; this keeps water Na below 10% of total Na intake. Heart and kidney patients should not drink water >20 ppm sodium.		>800 ppm may cause diarrhea		usually 1 to 175 ppm; should be <20 ppm if on a Na-restricted diet	<150 ppm	<150 ppm	<50 to 300 ppm*	<50 ppm	
Sulfur	Usually expressed as sulfates instead (SO_4 is 33% S). Important anion - contributes to acidosis if soluble. No health problems listed (EPA).		<100 ppm	no EPA limit				usually from 0 to 600 ppm (mean of 25 ppm).			<50 to 300 ppm*	<50 ppm	
EPA Notes: (www.epa/gov/safewater)	Corrosion control (pH, etc.) in public water systems reduces iron, copper, and zinc concentrations. This extends the life of water mains and service lines; decreases energy costs because water is pumped through smooth, uncorroded lines; and reduces water losses through leaking or broken plumbing. Corrosion control also reduces water colors and metallic flavors.			Comments on iron and manganese removal (from various extension bulletins):		Chlorination can kill iron bacteria, thus reducing the foul smell and orange film formation from high iron waters. Water softeners can reduce iron if it is 3 to 10 ppm in the natural water (depending on the softener type and manufacturer). Most softeners cannot handle very high Fe or Mn and will become plugged. Chlorination and filtration work better with very high Fe and Mn.				*Rock River Lab - the lower value is the level at which water intake for livestock might start to be impaired, and the higher value is the level at which both water intake and animal health might start to be impaired. They attribute their upper levels to ZinPro.	