ABSTRACT

Clean Water Equals Happy Cows!

(A study conducted using GLOBE protocols to analyze various types of drinking water for cattle in NW Arkansas.)

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The types of water locations studied were ponds, creeks, springs, and water tanks. It was predicted that water sample #4, a water tank with well water would be the best quality drinking water for the cattle.

Water samples were collected from 10 locations, and GLOBE procedures were used to test for Dissolved Oxygen, Turbidity, Phosphate, pH, Nitrite, Ammonia, Nitrate, Temperature, Total Dissolved Solids, Electrical Conductivity, bacteria in general, e-coli, & staph.

Not all data could be included in the abstract. **#1:** (DO)-0.6mg/L, (EC)=570uS/cm, Ammonia=6.0ppm, Nitrate=0mg/L, Turbidity=75.6NTU, Phosphate=1.0mg/L, (TDS)=284ppm, staph=2 colonies, e-coli 22.5. **#2:** DO-1.6mg/L, (EC) 238uS/cm, Ammonia 3.0ppm, Turbidity=31.1NTU, Phosphate=2.0mg/L, (TDS)=284ppm, staph=2 colonies, no e-coli. **#3:** DO 0.2mg/L, (EC) 90uS/cm, Ammonia=0.5ppm, Nitrate=0mg/L, Turbidity=57.1NTU, Phosphate =0.25mg/L, (TDS)=45ppm, staph=0.5 colonies, no e-coli. **#4:** DO=0.2mg/L, (EC)=130uS/cm, Turbidity 0.8NTU, (TDS)=65ppm, no staph or e-coli. **#5:** DO=1.0mg/L, (EC)=314uS/cm, Nitrate=10mg/L, Turbidity=100.2NTU, Phosphate=0.25mg/L, (TDS)=157ppm, staph=1.5 colonies, e-coli 25.5. **#6:** DO=2.8mg/L, (EC)=122uS/cm, Ammonia=3.0ppm, Turbidity=371.1NTU, Phosphate=1.0mg/L, (TDS)=63ppm, no staph, e-coli 60.5 colonies. **#7:** DO=0.8mg/L, (EC)=232uS/cm, Ammonia=0.5ppm, Turbidity=8.0NTU, Phosphate=0.5mg/L, (TDS)=116ppm, no staph, e-coli 1.0 colony. **#8:** DO 0.5mg/L, (EC)=518uS/cm, Ammonia=3.0ppm, Turbidity=6.0NTU, Phosphate=0.25mg/L, (TDS)=259ppm, Nitrite=0.25mg/L. no staph, e-coli 4.0 colonies. **#9:** DO=0.4mg/L, (EC)=416uS/cm, Ammonia=1.0ppm, Nitrate=10mg/L, Turbidity=55.1NTU, Phosphate=0.25mg/L, (TDS)=205ppm, Nitrite=0mg/L. staph=22.5 colonies, e-coli 36.0. **#10:** DO=0.4mg/L, (EC)=526uS/cm, Ammonia=1.0ppm, Nitrate=20mg/L, Turbidity=66.2NTU, (TDS)=278ppm, staph=33.5 colonies, no e-coli.

The hypothesis was not supported by the data. Sample #3 (Bobo Creek) was the best. Sample #1 (pond without trees) the worst rating in the chemical tests and sample #9 (spring water) the worst bacteria tests results.

Clean Water Equals Happy Cows !

A study conducted using GLOBE protocols to analyze various types of drinking water for cattle in NW Arkansas.

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May 3, 2019

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RESARCH QUESTIONS AND HYPOTHESIS:

INTRODUCTION

Did you know that the quality of water for cattle is more important than even their food? “Cattle can survive for as long as sixty days with little or no food, but only seven days without water. In extremely hot, humid climates like the Deep South,” where I live “that number maybe even less.” I was riding around with my dad in the field and noticed that there are so many different ways to water our cattle. My dad told me that cows would grow better if they had cleaner water. “Recent research has shown that heifers with access to water pumped form a well or spring gained 23% more weight than heifers drinking pond water.” A cow can drink up to 6-15 gallons of water a day. So it got me to thinking what is the best quality of drinking water for the cattle on our farm. I tested 10 different drinking locations on my dad's and papa's farms. I wanted to see what drinking location had the best quality of water for the cattle.

QUESTION

This project was the result of a study conducted to analyze water quality from several different locations where cattle are raised in Boone and Carroll Counties in Arkansas. The types of water locations studied were ponds (fenced and not fenced, with trees and without trees) creeks, springs, and water tanks (filled with well water and rural water).

HYPOTHESIS

It was predicted that the sample collected from the water tank with well water (Drinking Water Sample #4) would be the best quality drinking water for the cattle. This sample was the most translucent. Also that the sample collected from the pond with no trees (Drinking Water Sample #1) will be the worst quality drinking water for the cattle. This sample was more open for cattle to stand in it.

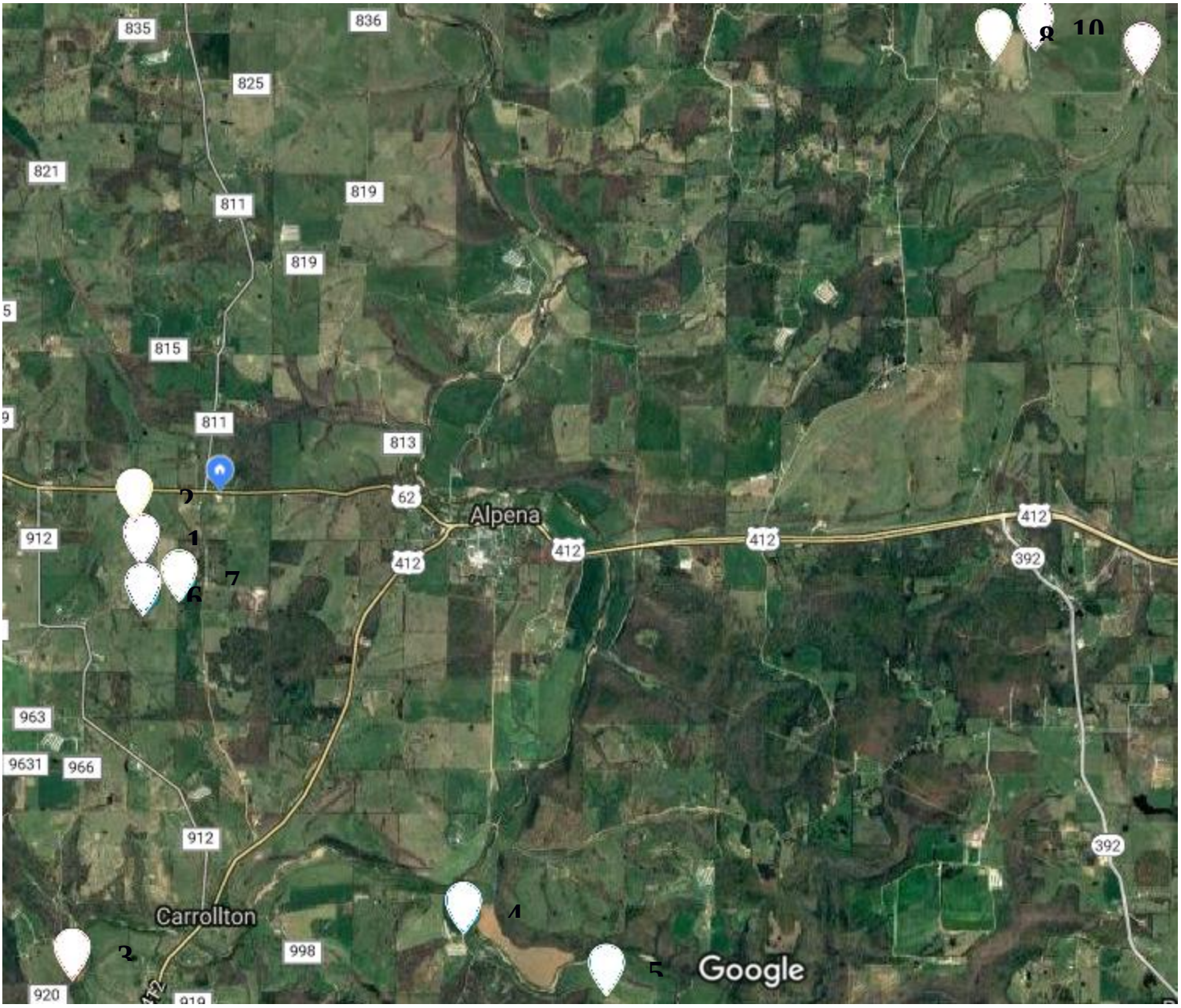
METHODS & MATERIALS:

PROCEDURE

Ten different drinking locations in Boone and Carroll Counties in Arkansas were analyzed by using digital water testing instruments to analyze components of the water at each drinking location. Testing was conducted and samples were collected from 10 drinking locations. GLOBE procedures were used to test the drinking water samples. A LabQuest Digital Water testing system was used to analyze the water on site at each drinking location for Dissolved Oxygen, Turbidity, and Temperature. Then, water samples were collected in sterile water bottles from each drinking location. Next, the samples had a API Water chemical test kit used on them to test Phosphate, pH, Nitrite, Ammonia, and Nitrate. Using a digital water testing meter the samples were also analyzed for Total Dissolved Solids (TDS) and Electrical Conductivity (EC). All of the chemical testing was conducted in home under the direct supervision of the designated supervisor who is trained in appropriate safety procedures and in the collection, testing, and analyzing of the water samples. In the middle school science lab the student researcher used sterile containers to conduct the bacteria testing. Under a designated supervisor the student researcher poured drinking water samples over agar plates. After the drinking water samples were incubated for 48 hours, the student researcher counted the percentage for the bacteria in the general test. Also each drinking water sample was counted for the colonies for e-coli and staph. The student researcher was trained in the safety practices that were needed in completing the analysis of the samples. Testing was conducted on an open bench lab table, and protective clothing, gloves and eye protection was used. The designated supervisor disposed of the water samples once they had been tested. All unused chemical reagents for the water test kits were organized and placed back into the chemical cabinet by the designated supervisor.

MATERIALS

Cattle Drinking Water Samples
API Testing Kit
LabQuest Digital Water Testing System
Digital Water Testing System
Agar plates for Unknown Bacteria Test
Lab Coat
Goggles
Lab Gloves
Incubator in the Middle School Science Lab
Camera

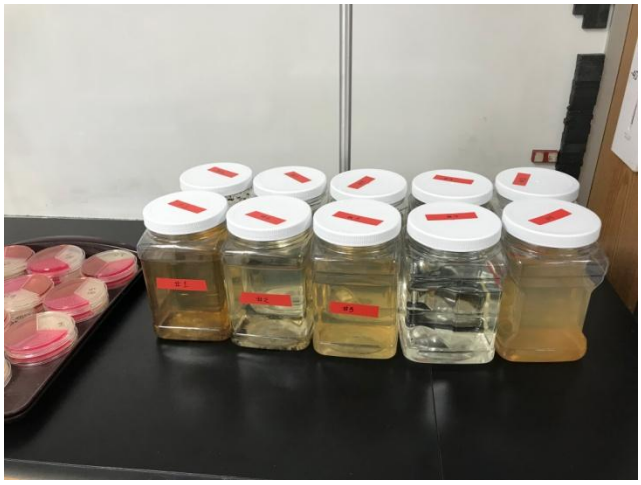


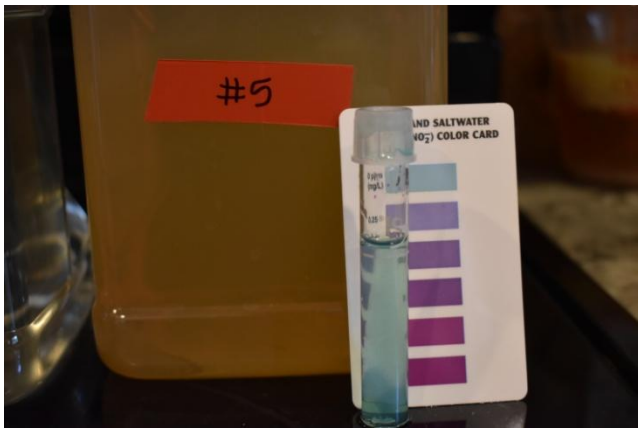
Master Key for Map

#1 Pond without trees
#2 Water tank with city water
#3 Bobo Creek
#4 Water tank with well water
#5 Fenced pond with no trees
#6 Pond with trees
#7 Fenced pond with trees
#8 Water tank with city water Ball tank
#9 Creek water
#10 Spring water

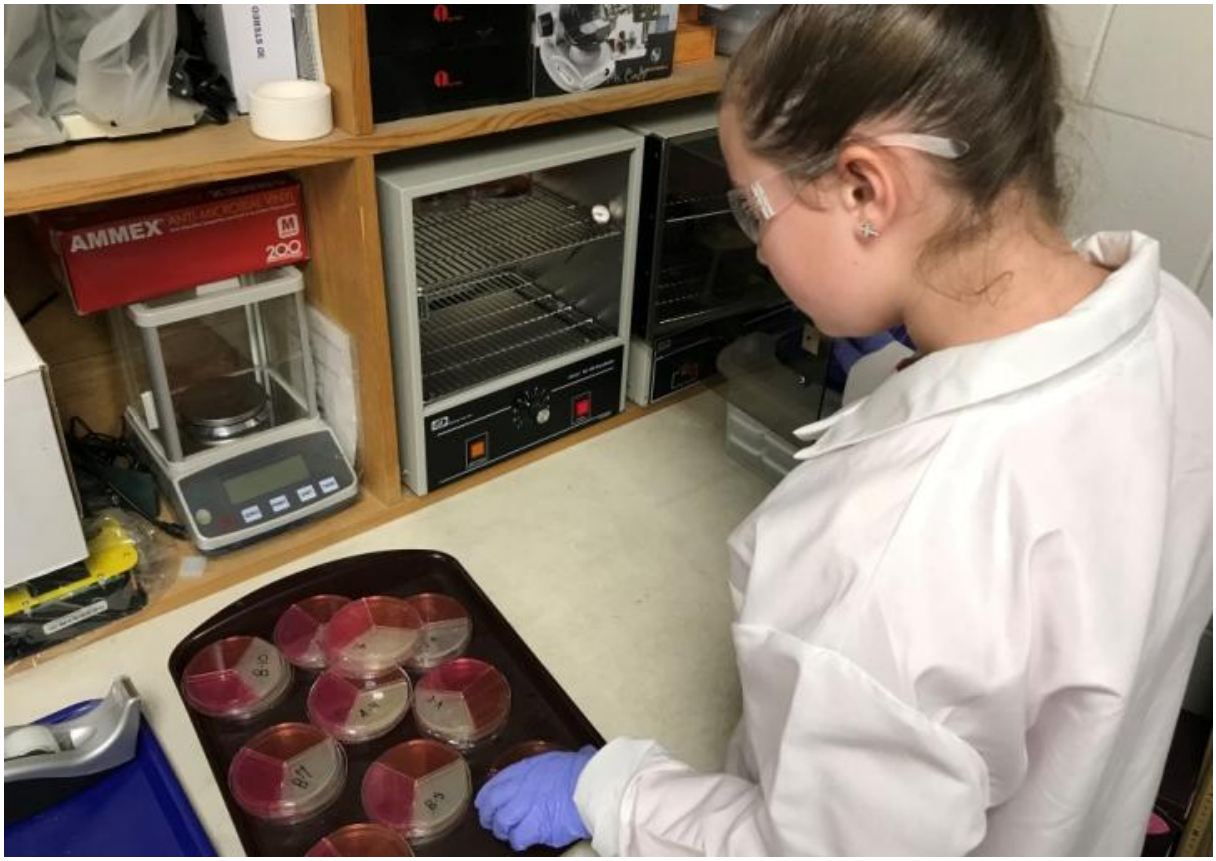
Some of the Water Sample Collection Sites

Analyzing of Water Samples





Testing Water Samples for Bacteria



Analyzing Bacteria Tests

DATA SUMMARY:

Location #1: Dissolved Oxygen -0.6mg/L, Electrical Conductivity (EC) 570uS/cm, Ammonia 6.0ppm, Nitrate 0mg/L, 7.0pH, Temperature 16.6*C, Turbidity 75.6NTU, Phosphate 1.0mg/L, Total Dissolved Solids (TDS) 284ppm, Nitrite 0mg/L, General Bacteria 89.5%, Staph 2 colonies, and e-Coli 22.5 colonies.

Location #2: Dissolved Oxygen -1.6mg/L, Electrical Conductivity (EC) 238uS/cm, Ammonia 3.0ppm, Nitrate 0mg/L, 6.0pH, Temperature 16.4*C, Turbidity 31.1NTU, Phosphate 2.0mg/L, Total Dissolved Solids (TDS) 284ppm, Nitrite 0mg/L, General Bacteria 79.5%, Staph 2 colonies, and e-Coli 0.0 colonies.

Location #3: Dissolved Oxygen 0.2mg/L, Electrical Conductivity (EC) 90uS/cm, Ammonia 0.5ppm, Nitrate 0mg/L, 6.5pH, Temperature 16.1*C, Turbidity 57.1NTU, Phosphate 0.25mg/L, Total Dissolved Solids (TDS) 45ppm, Nitrite 0mg/L, General Bacteria 99%, Staph 0.5 colonies, and e-Coli 0.0 colonies.

Location #4: Dissolved Oxygen 0.2mg/L, Electrical Conductivity (EC) 130uS/cm, Ammonia 0ppm, Nitrate 0mg/L, 6.5pH, Temperature 16.1*C, Turbidity 0.8NTU, Phosphate 0.0mg/L, Total Dissolved Solids (TDS) 65ppm, Nitrite 0mg/L, General Bacteria 893.5%, Staph 0.0 colonies, and e-Coli 0.0 colonies.

Location #5: Dissolved Oxygen 1.0mg/L, Electrical Conductivity (EC) 314uS/cm, Ammonia 0ppm, Nitrate 10mg/L, 7.5pH, Temperature 16.3*C, Turbidity 100.2NTU, Phosphate 0.25mg/L, Total Dissolved Solids (TDS) 157ppm, Nitrite 0mg/L, General Bacteria 51.5%, Staph 1.5 colonies, and e-Coli 25.5 colonies.

Location #6: Dissolved Oxygen 2.8mg/L, Electrical Conductivity (EC) 122uS/cm, Ammonia 3.0ppm, Nitrate 0mg/L, 6.0pH, Temperature 14.9*C, Turbidity 371.1NTU, Phosphate 1.0mg/L, Total Dissolved Solids (TDS) 63ppm, Nitrite 0mg/L, General Bacteria 70%, Staph 0.0 colonies, and e-Coli 60.5 colonies.

DATA SUMMARY CONTINUED:

Location #7: Dissolved Oxygen 0.8mg/L, Electrical Conductivity (EC) 232uS/cm, Ammonia 0.5ppm, Nitrate 0mg/L, 6.5pH, Temperature 15.9*C, Turbidity 8.0NTU, Phosphate 0.5mg/L, Total Dissolved Solids (TDS) 116ppm, Nitrite 0mg/L, General Bacteria 15%, Staph 0.0 colonies, and e-Coli 1.0 colonies.

Location #8: Dissolved Oxygen 0.5mg/L, Electrical Conductivity (EC) 518uS/cm, Ammonia 3.0ppm, Nitrate 0mg/L, 7.0pH, Temperature 15.3*C, Turbidity 6.0NTU, Phosphate 0.25mg/L, Total Dissolved Solids (TDS) 259ppm, Nitrite 0.25mg/L, General Bacteria 94.5%, Staph 0.0 colonies, and e-Coli 4.0 colonies.

Location #9: Dissolved Oxygen 0.4mg/L, Electrical Conductivity (EC) 416uS/cm, Ammonia 1.0ppm, Nitrate 10mg/L, 7.0pH, Temperature 16.8*C, Turbidity 55.1NTU, Phosphate 0.25mg/L, Total Dissolved Solids (TDS) 205ppm, Nitrite 0mg/L, General Bacteria 99.5%, Staph 21.5 colonies, and e-Coli 36 colonies.

Location #10: Dissolved Oxygen 0.4mg/L, Electrical Conductivity (EC) 526uS/cm, Ammonia 1.0ppm, Nitrate 20mg/L, 7.0pH, Temperature 15.9*C, Turbidity 66.2NTU, Phosphate 0.0mg/L, Total Dissolved Solids (TDS) 278ppm, Nitrite 0mg/L, General Bacteria 60%, Staph 33.5 colonies, and e-Coli 0.0 colonies.

RESULTS:

MASTER KEY FOR GRAPHS

Sample Numbers	Sample Names
#1	Pond Below House
#2	Water Tank By Red Barn
#3	Bobo Creek
#4	Papa's Farm Well Water Below Turkey House
#5	Fenced Pond No Trees
#6	Pond With Trees
#7	Fenced Pond With Trees
#8	City Water Ball Tank
#9	Creek Down From Papa's House
#10	Spring Water

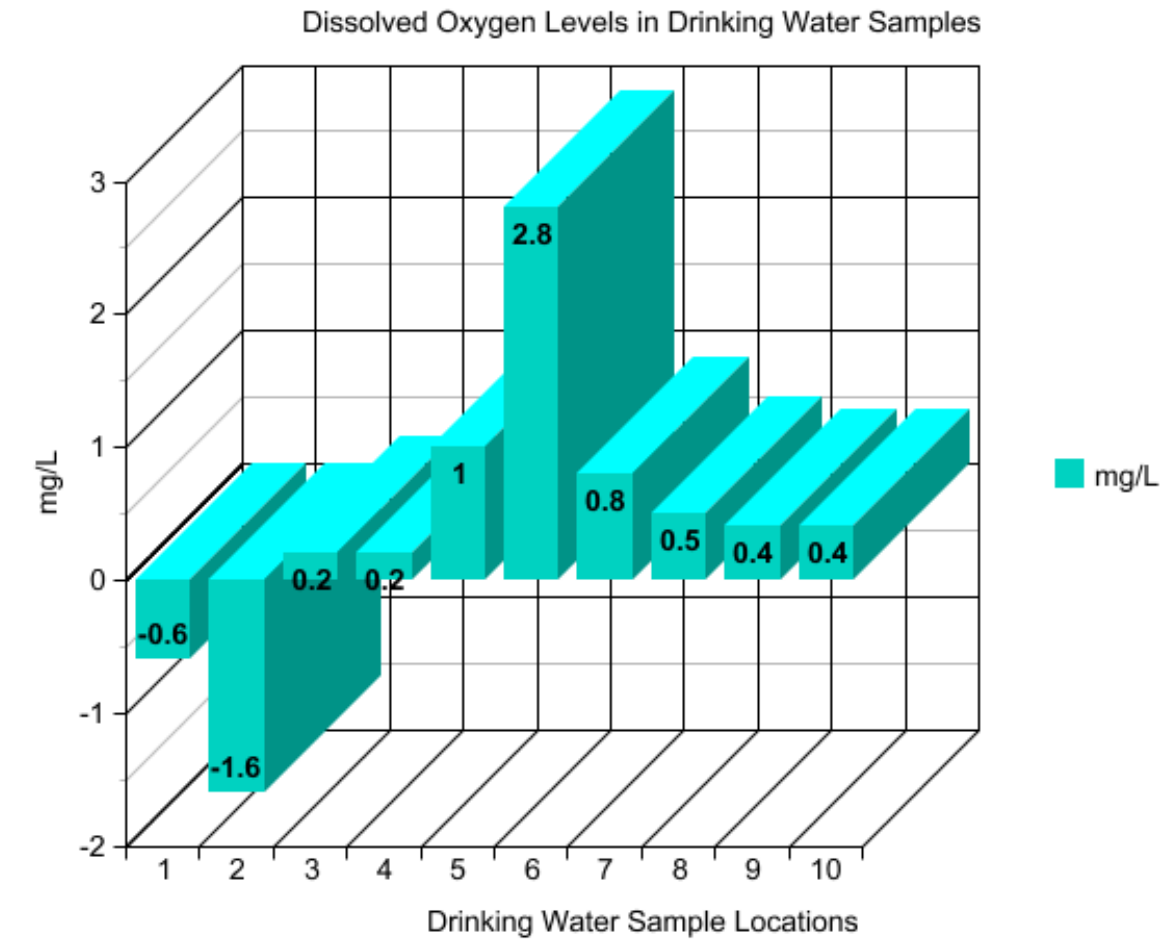
Cattle Drinking Water Test Results for Bacteria						
	General Bacteria		Staphylococci Bacteria		e-Coli Bacteria	
	% of Plate Covered		Number of Colonies		Number of Colonies	
	Data	Mean	Data	Mean	Data	Mean
1A	99%	89.5%	4	2.0	36	22.5
1B	80%		0		9	
2A	80%	79.5%	1	2.0	0	0.0
2B	79%		3		0	
3A	99%	99%	0	0.5	0	0.0
3B	99%		1		0	
4A	99%	93.5%	0	0.0	0	0.0
4B	88%		0		0	
5A	5%	51.5%	2	1.5	33	25.5
5B	98%		1		18	
6A	80%	70%	0	0.0	106	60.5
6B	60%		0		18	
7A	10%	15%	0	0.0	0	1.0
7B	20%		0		2	
8A	90%	94.5%	0	0.0	8	4.0
8B	99%		0		0	
9A	100%	99.5%	0	21.5	0	36.0
9B	99%		43		72	
10A	20%	60%	60	33.5	0	0.0
10B	100%		7		0	

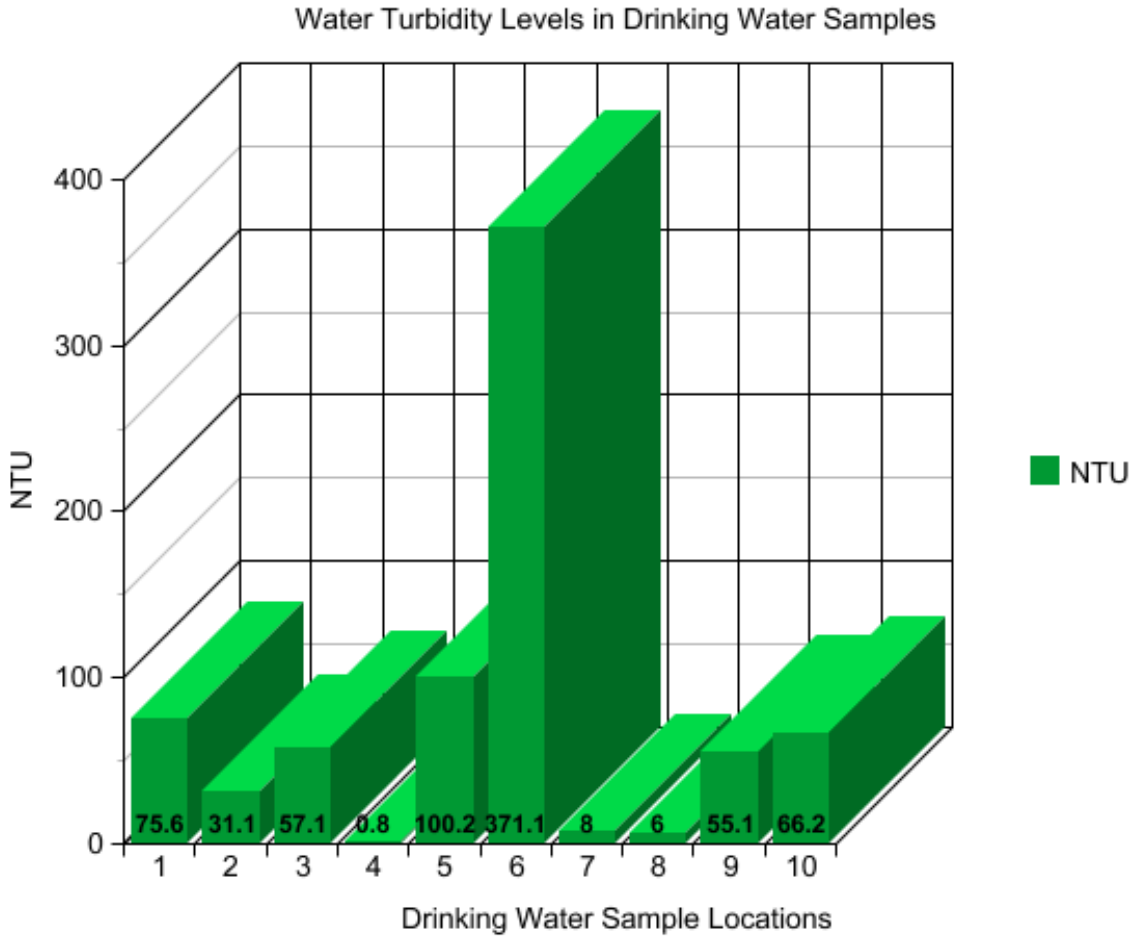
Highest and Lowest Quality of Drinking Water Compared

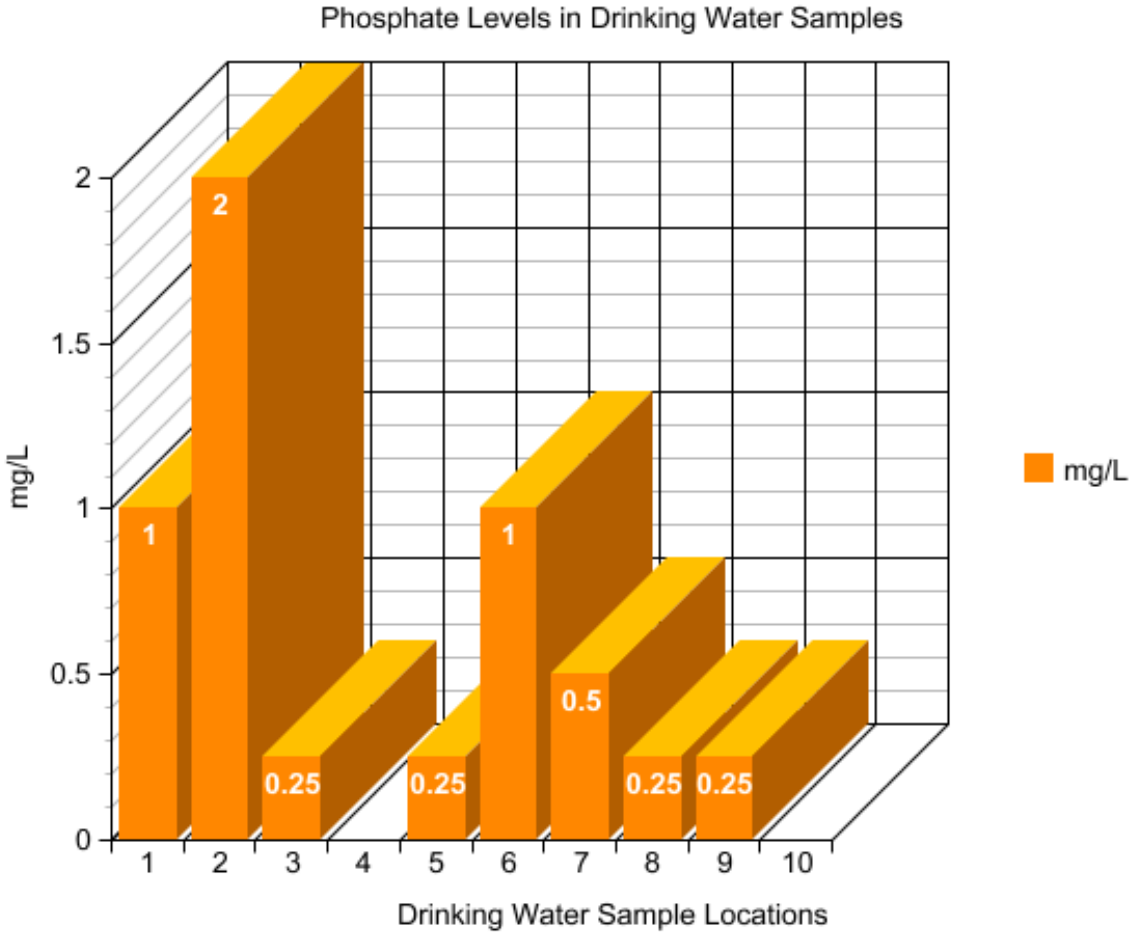
Sample	Dissolved Oxygen	Turbidity	Phosphate	pH	Nitrite	Ammonia	Nitrate	Temp.	TDS	EC	Gen. Bacteria	Staph	e-Coli
Best													
#3 Bobo Creek	**0.2 mg/L**	**57.1 NTU**	**0.25 mg/L**	**6.5**	**0 mg/L**	**0.5**	**0 mg/L**	**16.1 C**	**45 ppm**	**90**	**99%**	**0.5**	**0.0**
Worst													
#1 Pond	**-0.6 mg/L**	**75.6 NTU**	**1.0 mg/L**	**7.0**	**0 mg/L**	**6.0**	**0 mg/L**	**16.6 C**	**284 ppm**	**570**	**89.5%**	**2.0**	**22.5**

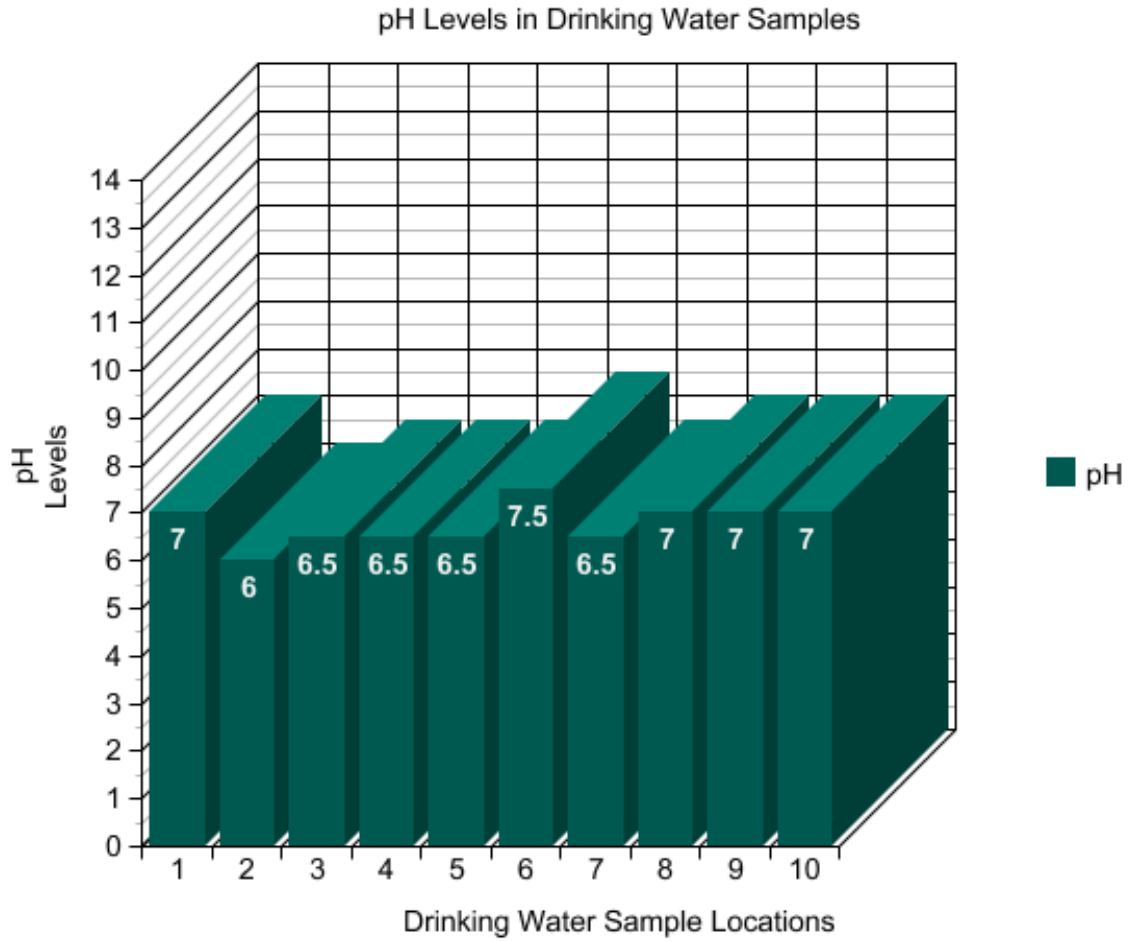
Drinking Water Samples Compared

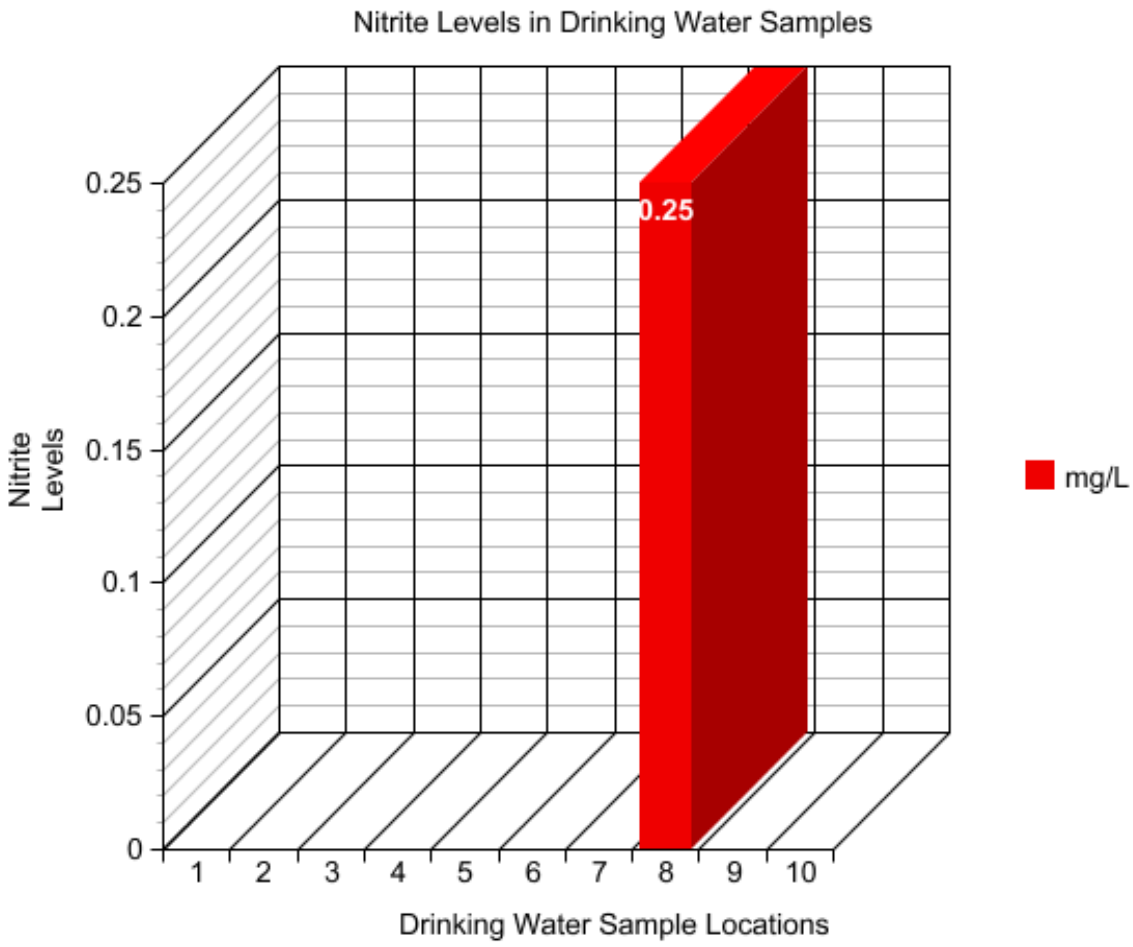
Sample	Dissolved Oxygen	Turbidity	Phos.	pH	Nitrite	Ammonia	Nitrate	Temp.	TDS	EC	Gen. Bacteria	Staph	e-Coli
#1 Pond	**-0.6 mg/L**	**75.6 NTU**	**1.0 mg/L**	**7.0**	**0 mg/L**	**6.0**	**0 mg/L**	**16.6 C**	**284 ppm**	**570**	**89.5%**	**2**	**22.5**
#2 Water tank	**-1.6 mg/L**	**31.1 NTU**	**2.0 mg/L**	**6.0**	**0 mg/L**	**3.0**	**0 mg/L**	**16.4 C**	**119 ppm**	**238**	**79.5%**	**2**	**0**
#3 Bobo Creek	**0.2 mg/L**	**57.1 NTU**	**0.25 mg/L**	**6.5**	**0 mg/L**	**0.5**	**0 mg/L**	**16.1 C**	**45 ppm**	**90**	**99%**	**.5**	**0**
#4 well water	**0.2 mg/L**	**0.8 NTU**	**0.0 mg/L**	**6.5**	**0 mg/L**	**0**	**0 mg/L**	**16.1 C**	**65 ppm**	**130**	**93.5%**	**0**	**0**
#5 Fenced pond No trees	**1.0 mg/L**	**100.2 NTU**	**0.25 mg/L**	**7.5**	**0 mg/L**	**0**	**10 mg/L**	**16.3 C**	**157 ppm**	**314**	**51.5%**	**1.5**	**25.5**
#6 Pond with trees	**2.8 mg/L**	**371.1 NTU**	**1.0 mg/L**	**6.0**	**0 mg/L**	**3.0**	**0 mg/L**	**14.9 C**	**63 ppm**	**122**	**70%**	**0**	**60.5**
#7 Fenced pond	**0.8 mg/L**	**8.0 NTU**	**0.5 mg/L**	**6.5**	**0 mg/L**	**0.5**	**0 mg/L**	**15.9 C**	**116 ppm**	**232**	**15%**	**0**	**1**
#8 City Water	**0.5 mg/L**	**6.0 NTU**	**0.25 mg/L**	**7.0**	**0.25 mg/L**	**3.0**	**0 mg/L**	**15.3 C**	**259 ppm**	**518**	**94.5%**	**0**	**4**
#9 Creek	**0.4 mg/L**	**55.1 NTU**	**0.25 mg/L**	**7.0**	**0 mg/L**	**1.0**	**10 mg/L**	**16.8 C**	**205 ppm**	**416**	**99.5%**	**21.5**	**36**
#10 Spring Water	**0.4 mg/L**	**66.2 NTU**	**0.0 mg/L**	**7.0**	**0 mg/L**	**1.0**	**20 mg/L**	**15.9 C**	**278 ppm**	**526**	**60**	**33.5**	**0**

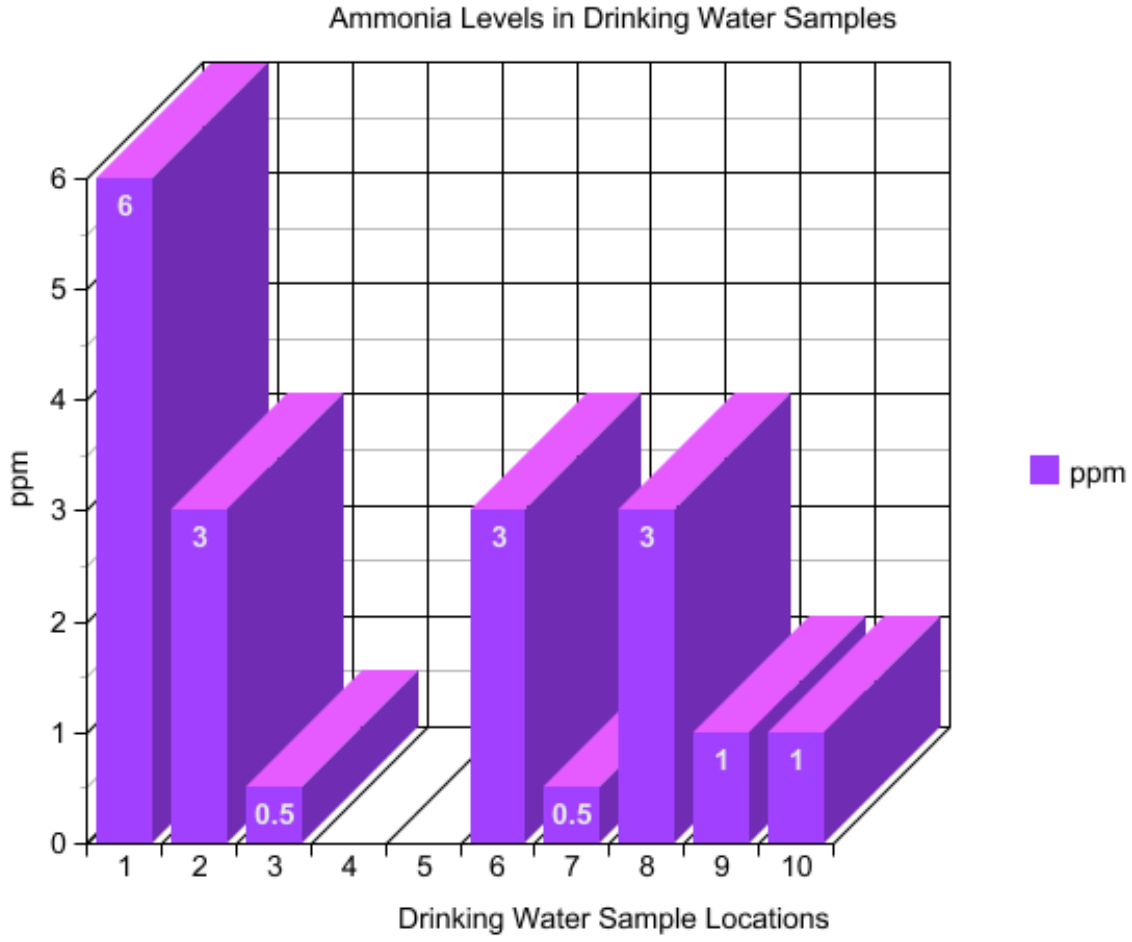

Dissolved Oxygen Levels in Drinking Water Samples
mg/L
3
2
1
0
-1
-2
-0.6
-1.6
0.2
0.2
1
2.8
0.8
0.5
0.4
0.4
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
mg/L

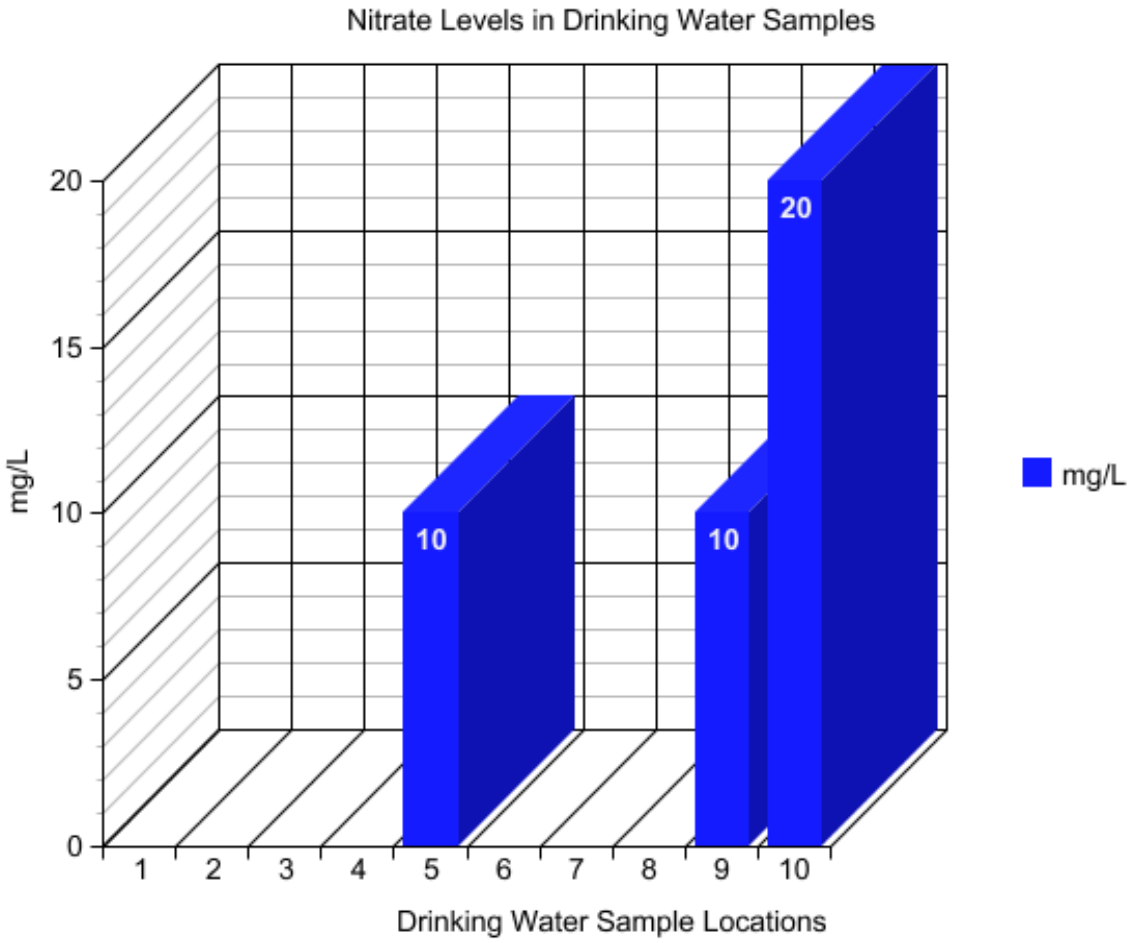

Water Turbidity Levels in Drinking Water Samples
NTU
400
300
200
100
0
75.6
31.1
57.1
0.8
100.2
371.1
8
6
55.1
66.2
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
NTU

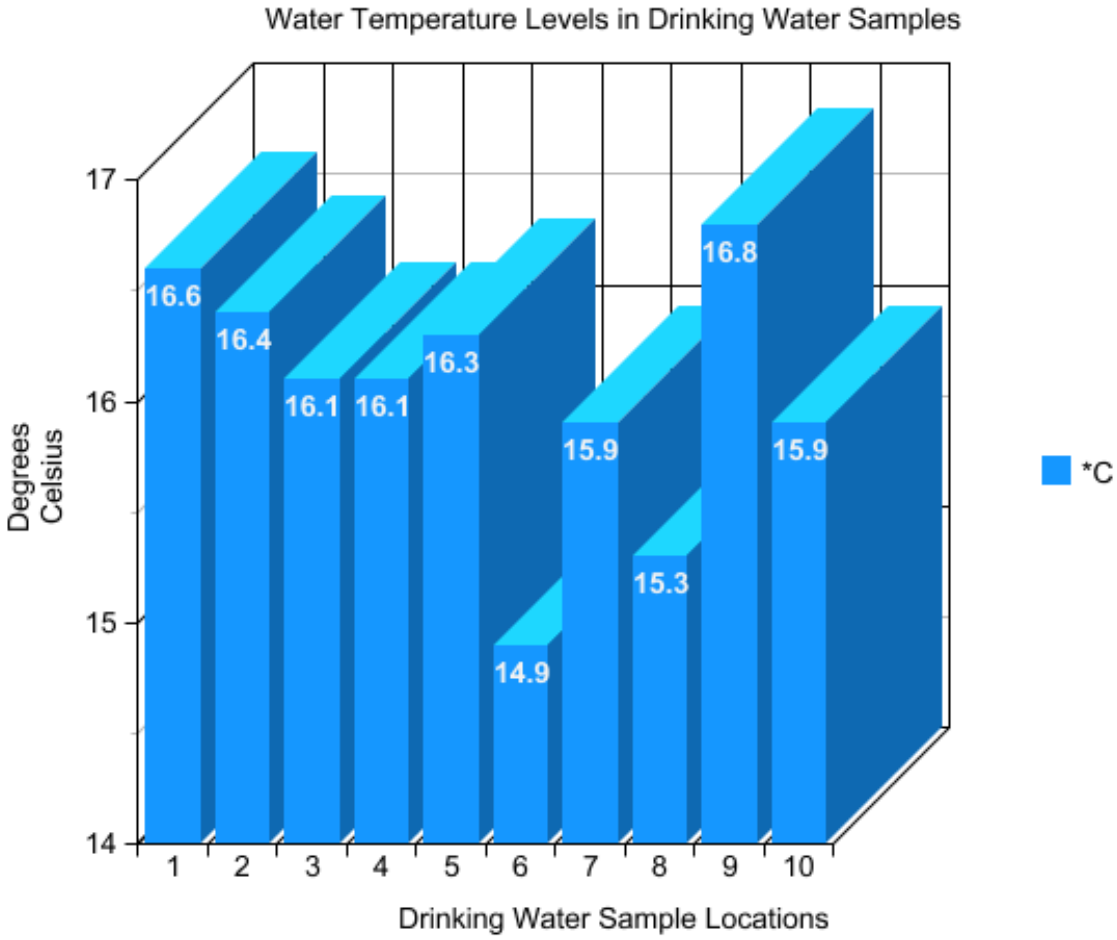

Phosphate Levels in Drinking Water Samples
mg/L
2
1.5
1
0.5
0
1
2
0.25
0.25
1
0.5
0.25
0.25
1 2 3 4 5 6 7 8 9 10
Drinking Water Sample Locations
mg/L

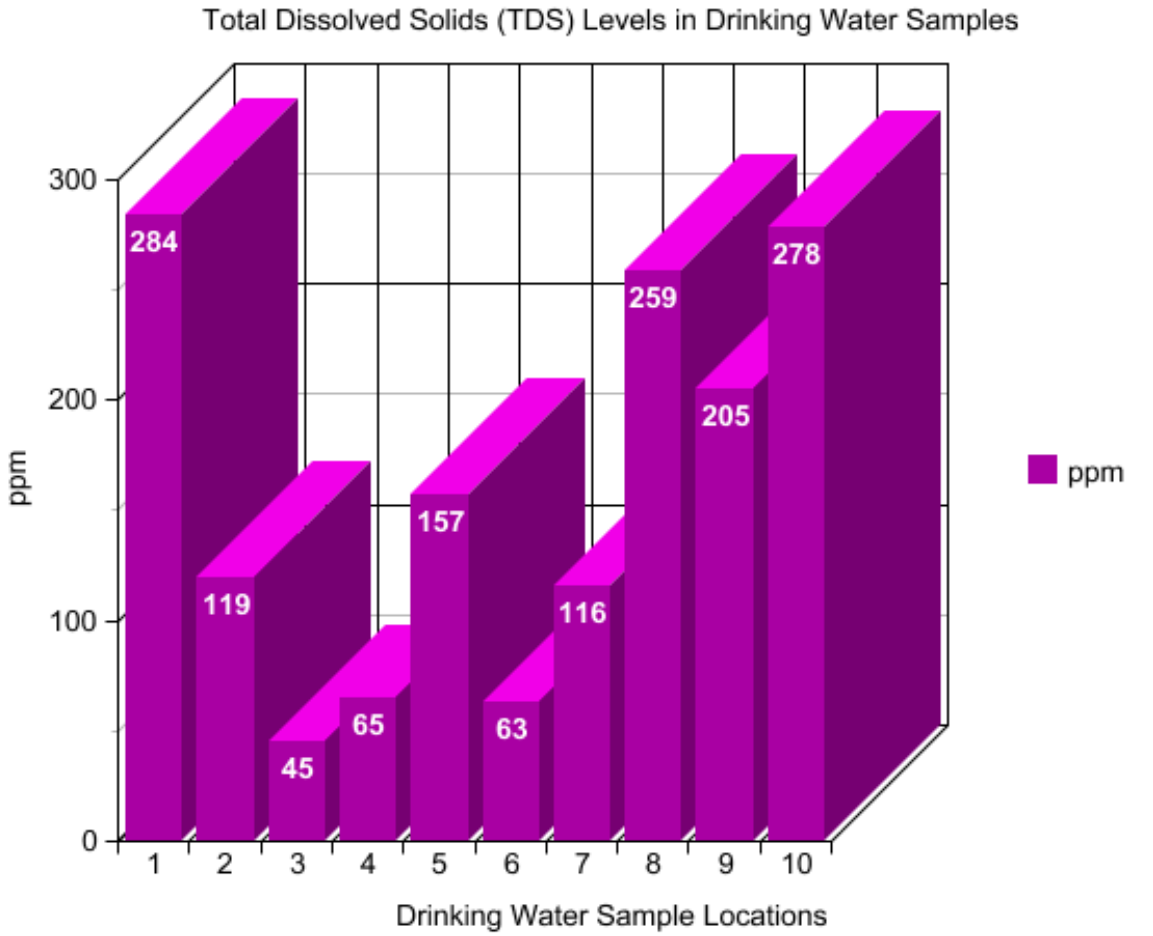

pH Levels in Drinking Water Samples
pH Levels
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
7
6
6.5
6.5
6.5
7.5
6.5
7
7
7
1 2 3 4 5 6 7 8 9 10
Drinking Water Sample Locations
pH

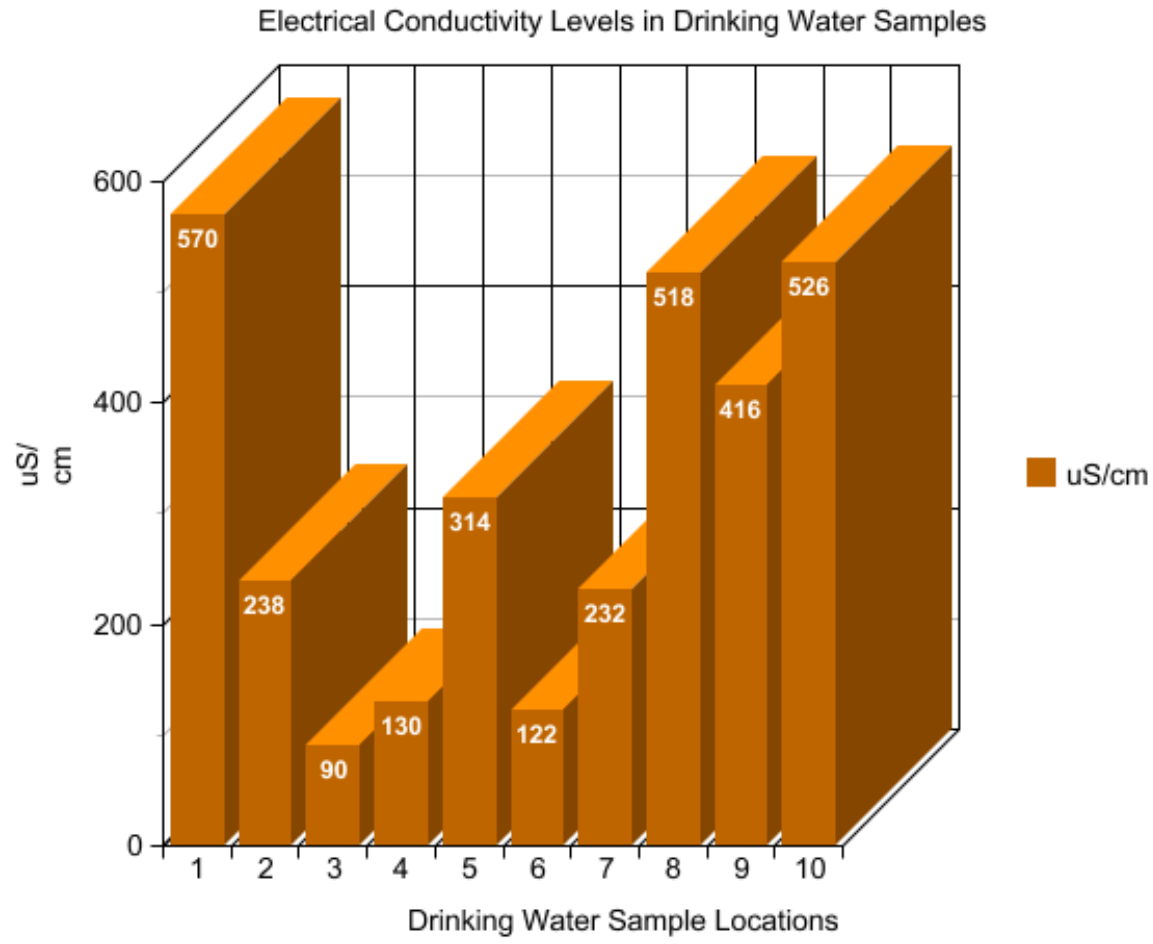

Nitrite Levels in Drinking Water Samples
Nitrite Levels
0.25
0.2
0.15
0.1
0.05
0
0.25
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
mg/L

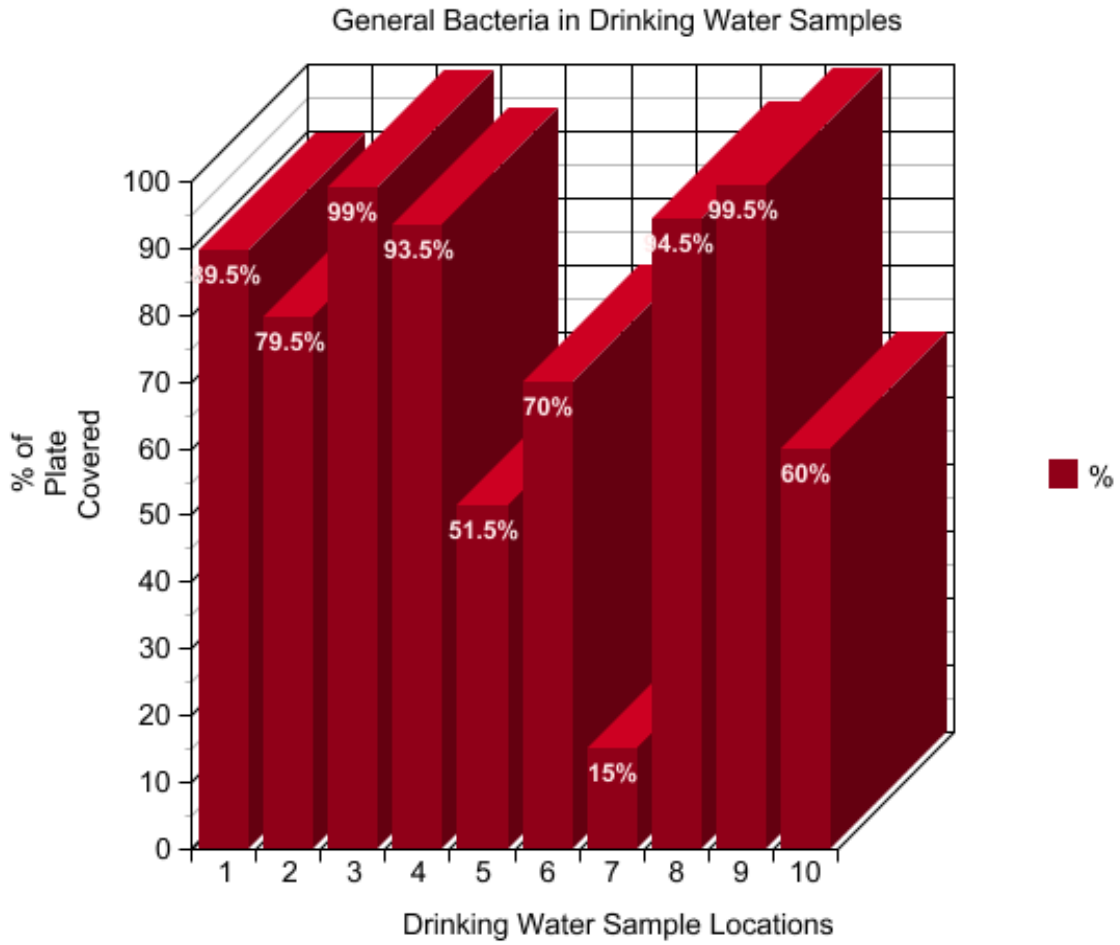

Ammonia Levels in Drinking Water Samples
ppm
6
5
4
3
2
1
0
6
3
0.5
3
0.5
3
1
1
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
ppm

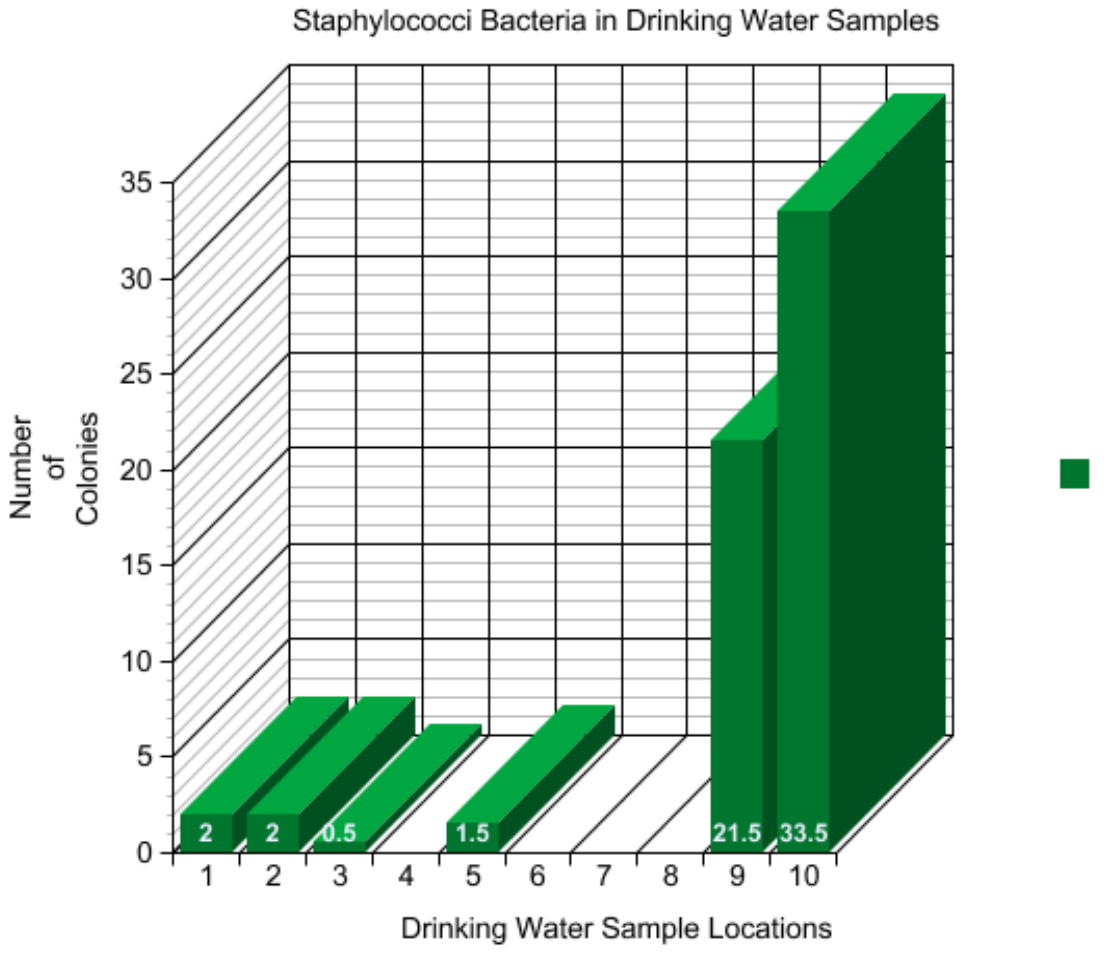

Nitrate Levels in Drinking Water Samples
mg/L
0
5
10
15
20
10
10
20
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
mg/L

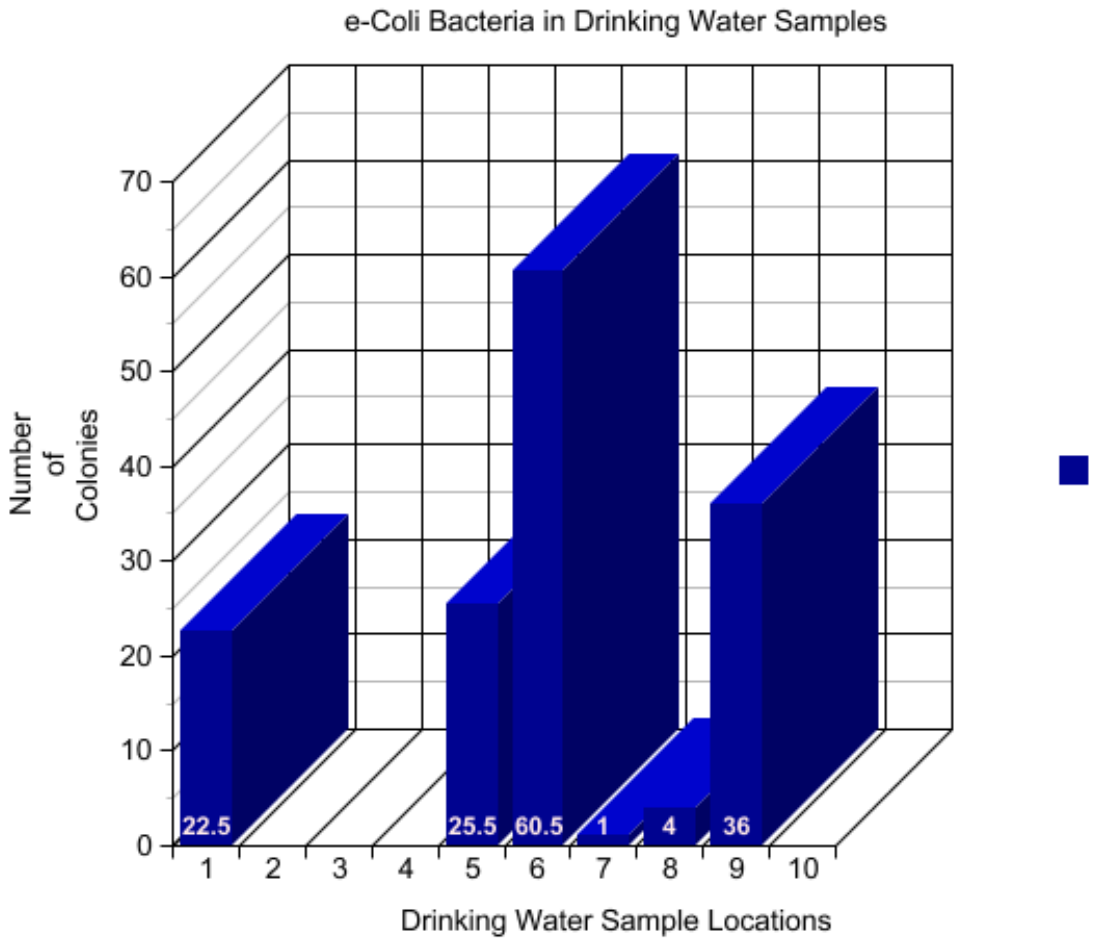

Water Temperature Levels in Drinking Water Samples
Degrees Celsius
14
15
16
17
16.6
16.4
16.1
16.1
16.3
14.9
15.9
15.3
16.8
15.9
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
*C


Total Dissolved Solids (TDS) Levels in Drinking Water Samples
ppm
300
200
100
0
284
119
45
65
157
63
116
259
205
278
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
ppm


Electrical Conductivity Levels in Drinking Water Samples
uS/cm
600
400
200
0
570
238
90
130
314
122
232
518
416
526
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
uS/cm


General Bacteria in Drinking Water Samples
% of Plate Covered
100
90
80
70
60
50
40
30
20
10
0
99%
93.5%
79.5%
70%
51.5%
15%
99.5%
60%
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations
%


Staphylococci Bacteria in Drinking Water Samples
Number of Colonies
35
30
25
20
15
10
5
0
2
2
0.5
1.5
21.5
33.5
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations


e-Coli Bacteria in Drinking Water Samples
Number of Colonies
0
10
20
30
40
50
60
70
22.5
25.5
60.5
1
4
36
1
2
3
4
5
6
7
8
9
10
Drinking Water Sample Locations

CONCLUSION:

The first part of the hypothesis was not supported by the data. It had been predicted that water sample #4 (water tank with well water) would have the best overall water quality test results. However water sample #3 (Bobo Creek) had the best results for water quality. The second part of the hypothesis was supported by the data, with water sample #1 (pond without trees) receiving the worst scores as predicted. Although water sample #9 (spring water) was the worst for the bacteria testing, water sample #1 (pond without trees) numbers of all other testing out weighed water sample #9 (spring water).

DISCUSSION:

One reason that water sample #3 for Bobo Creek might have had the best water quality readings is because it is spring fed and the water sample was collected on the upper end of the creek. In the future it might be interesting to collect water samples at different locations along Bobo Creek to determine if the water quality remains constant.

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