Penn State University

Golf Course Water Survey

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Client: Pennsylvania State University, Dr. Mike Fidanza
Docket: 03100302
Report mailed: 12/23/2003 via email
Prepared by: Larry J. Stowell, Ph.D., CPAg
General description of sample group: Water survey

Refer to the enclosed laboratory reports and appraisals for detailed results.

Summary

Before judging the quality of irrigation water sources, it is important to consider the turfgrass-soil system at each golf course. If the course accepts water during irrigation and rainfall without puddling, the first step in course evaluation is complete – hydraulic conductivity and drainage are adequate. With good infiltration and drainage, soils can be amended using a variety of products to provide turfgrasses with a healthy growing medium. If puddling occurs easily during irrigation or rainfall, the turf-soil system may be more difficult to manage and both water and soil testing will be needed to determine the cause of the poor water movement. This water survey provides only a portion of the results needed to evaluate golf course turfgrass systems.

Based upon the results of this survey, the majority of the irrigation waters will benefit from an increase in salinity to improve penetration of the water into the soil. Pure water sources with a total dissolved salt content of less than 320 ppm do not easily infiltrate soils and frequently benefit from injection of gypsum or acid to increase the salt content of the water. The advantage of gypsum injection is the concomitant reduction of the water SAR as a result of calcium delivered in the gypsum. Acid injection is not recommended because there is no residual sodium carbonate in any of the samples and the resulting benefits are not as great as injection of gypusm.

The guidelines and summary data provided below only address water quality issues – consideration of soil chemistry is needed to complete the analysis. Five irrigation water sources were identified:

1. Domestic: Good quality water that is slightly too pure to infiltrate soils effectively. The average domestic water will benefit from gypsum injection to improve the salinity of the water and the cation balance.

2. Recycled: The recycled water is the most problematic due to the elevated level of nitrogen. The 8 ppm nitrate nitrogen will potentially provide excessive nitrogen during the

season that will result in excessive growth and potentially increased susceptibility to diseases such as gray leaf spot.

3. Lake: The lake waters are similar to stream and well water samples. Elevated iron levels at 0.4 ppm suggest that some pipe scaling might occur. The lake water will benefit from injection of gypsum to increase the salinity and to reduce the SAR of the water.

4. Stream: Stream waters are very similar to lake and well waters

5. Well: Well waters are very similar to lake and stream waters

No serious problems were identified for any of the water sources. The most common water quality problem is the modest requirement for gypsum injection to increase the salinity of the water to improve penetration into the soil surface. Further evaluation of soil conditions at each course and rainfall patterns will help provide a complete picture.

Figure 1. Water sample locations.

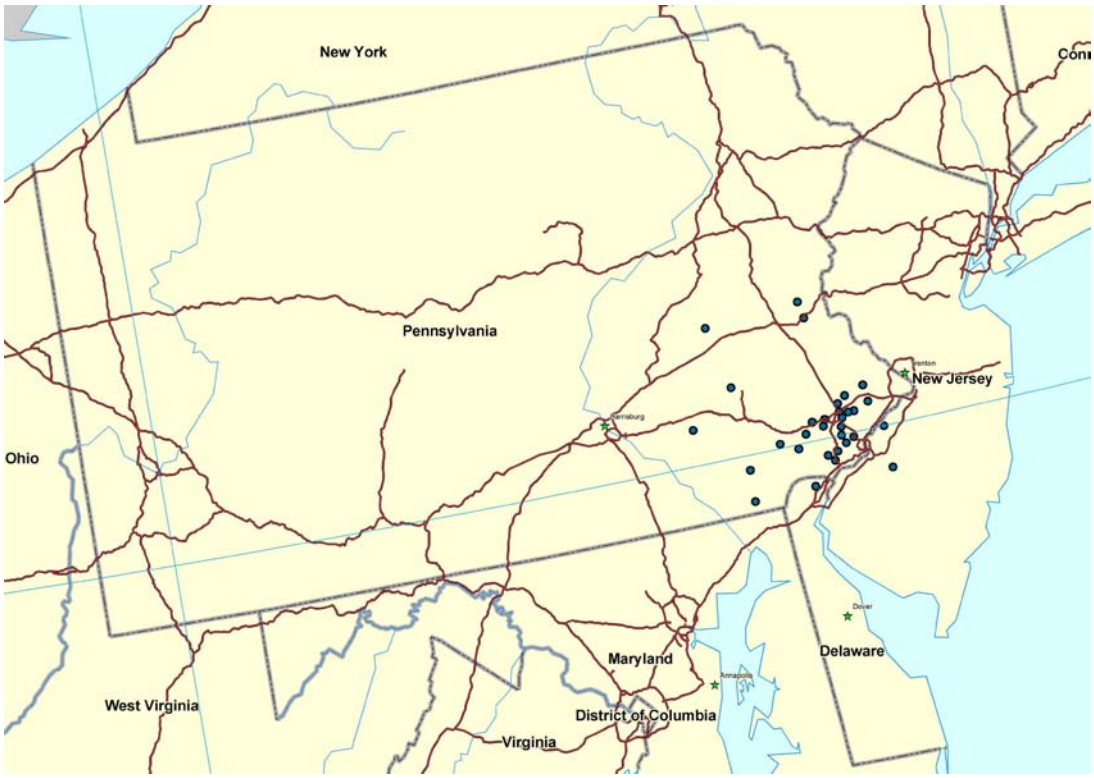


Table 1. Irrigation water - guidelines

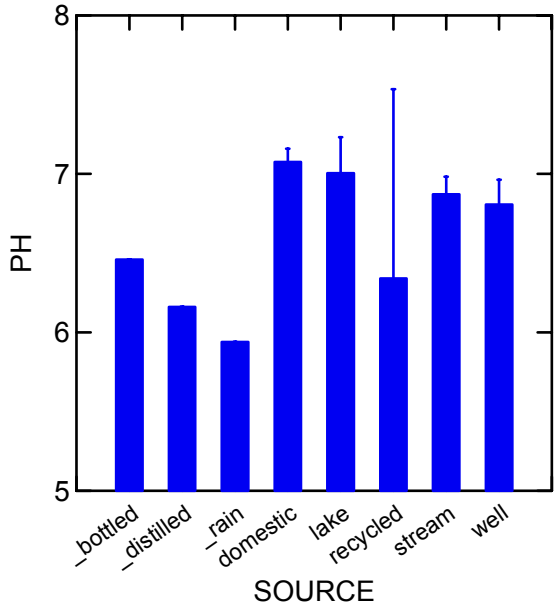
Parameter	Desired range	Bottled	Distilled	Rain
pH	6.5 - 8.4	6.5	6.2	5.9
Electrical Conductivity EC (dS/m)	< 1.2	0.01	0.0	4.4
Sodium Absorption Ratio SAR	< 6.0	0.3	0.1	0.5
Total Dissolved Salts TDS (ppm)	<800	5	1	9
Carbonate CO_3^{-2} (ppm)	<50 (0.8 meq/l)	0	0	0
Bicarbonate HCO_3^{-1} (ppm)	<90 (1.5 meq/l)	7	5.5	10
Residual Sodium Carbonate (meq/l)	0	0.0	0.0	0.1
Ca:Na (meq/l)	>2.0	1.0	1.9	0.5
Ca:Mg (meq/l)	>2.0	1.7	1.6	2.1
Calcium Ca (ppm)	<100 (5.0 meq/l)	1.3	0.9	1.1
Magnesium Mg (ppm)	<40 (3.0 meq/l)	0.5	0.4	0.3
Potassium K (ppm)	<160 (4.1 meq/l)	0.0	0.0	0.0
Sodium Na (ppm)	<160 (7 meq/l)	1.5	0.6	2.2
Boron B (ppm)	<0.50	0.0	0.0	0.0
Chloride Cl (ppm)	<100 (2.8 meq/l)	0.0	0.0	0.0
Copper Cu (ppm)	<0.05	0.0	0.0	0.0
Iron Fe (ppm)	<0.30	0.0	0.0	0.0
Manganese Mn (ppm)	<0.15	0.0	0.0	0.0
Sulfate SO_4^{-2} (ppm)	<200 (4.2 meq/l)	1.7	1.0	1.9
Zinc Zn (ppm)	<2.00	0.0	0.0	0.0
Nitrate NO_3 (ppm)	<8.0	0.1	0.0	0.2
Gypsum (lb/acre ft)		1541	1569	1544
Sulfuric acid (gal/acre ft)		1	1	1

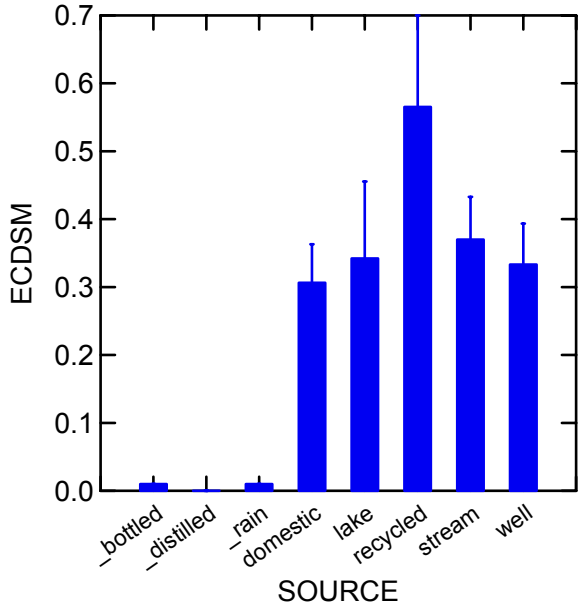
Table 2. Water Survey Summary Table

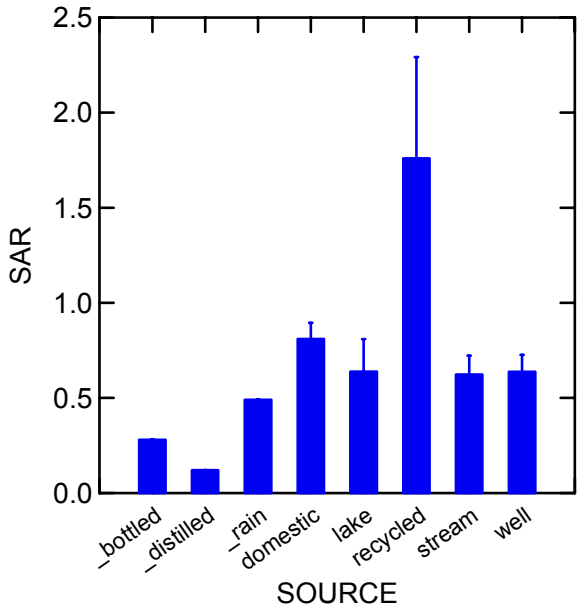
Parameter	Domestic	Recycled	Lake	Stream	Well
pH	7.1	6.3	7.0	6.9	6.8
Electrical Conductivity EC (dS/m)	0.3	0.6	0.3	0.4	0.3
Sodium Absorption Ratio SAR	0.8	1.8	0.6	0.6	0.6
Total Dissolved Salts TDS (ppm)	195	361	218	237	214
Carbonate CO_3^{-2} (ppm)	0.0	0.0	0.0	0.0	0.0
Bicarbonate HCO_3^{-1} (ppm)	75	90	126	95	94
Residual Sodium Carbonate (meq/l)	0.0	0.0	0.0	0.0	0.0
Ca:Na (meq/l)	1.7	0.9	2.5	2.7	2.2
Ca:Mg (meq/l)	1.7	1.7	1.7	1.8	1.6
Calcium Ca (ppm)	25	36	29	33	28
Magnesium Mg (ppm)	10	13	14	13	12
Potassium K (ppm)	3	11	4	3	4
Sodium Na (ppm)	18	49	18	16	15
Boron B (ppm)	0	0.2	0.0	0.0	0.0
Chloride Cl (ppm)	30	77	29	31	28
Copper Cu (ppm)	0.0	0.0	0.0	0.0	0.0
Iron Fe (ppm)	0.2	0.0	0.4	0.0	0.0
Manganese Mn (ppm)	0.0	0.7	0.2	0.0	0.0
Sulfate SO_4^{-2} (ppm)	29	53	20	37	27
Zinc Zn (ppm)	0.1	0.0	0.1	0.1	0.0
Nitrate NO_3 (ppm)	1.9	8	2.0	3.3	3.2
Ammonium NH3 (ppm)	0.0	0.0	0.0	0.6	0.0
Gypsum (lb/acre ft)	684	114	660	528	630
Sulfuric acid (gal/acre ft)	11	13	18	14	13
Number of samples	8	2	5	11	9

Figure 1. pH, EC, SAR and TDS

Desired values are: pH between 6..5 and 8.2, EC less than 1.2, SAR less than 6.0, TDS less than 800. Error bars represent the standard error of the mean.







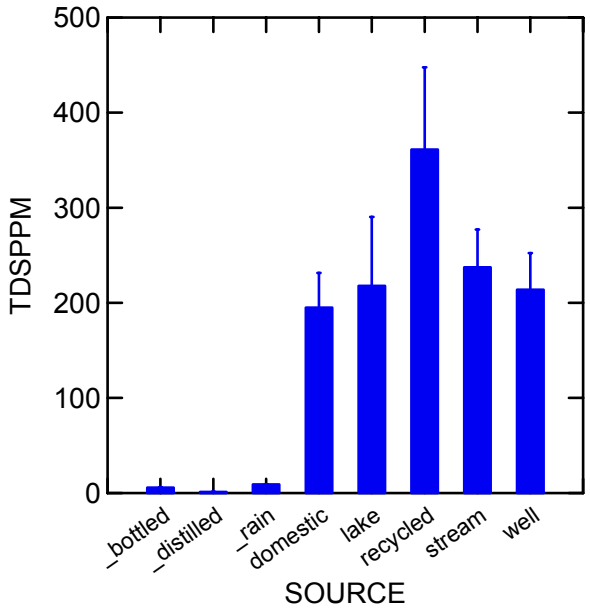


Figure 2, CA, Mg, K, Na

Desired values are: Ca less than 100, Mg less than 40, K less than 160, and Na less than 160. Error bars represent the standard error of the mean.

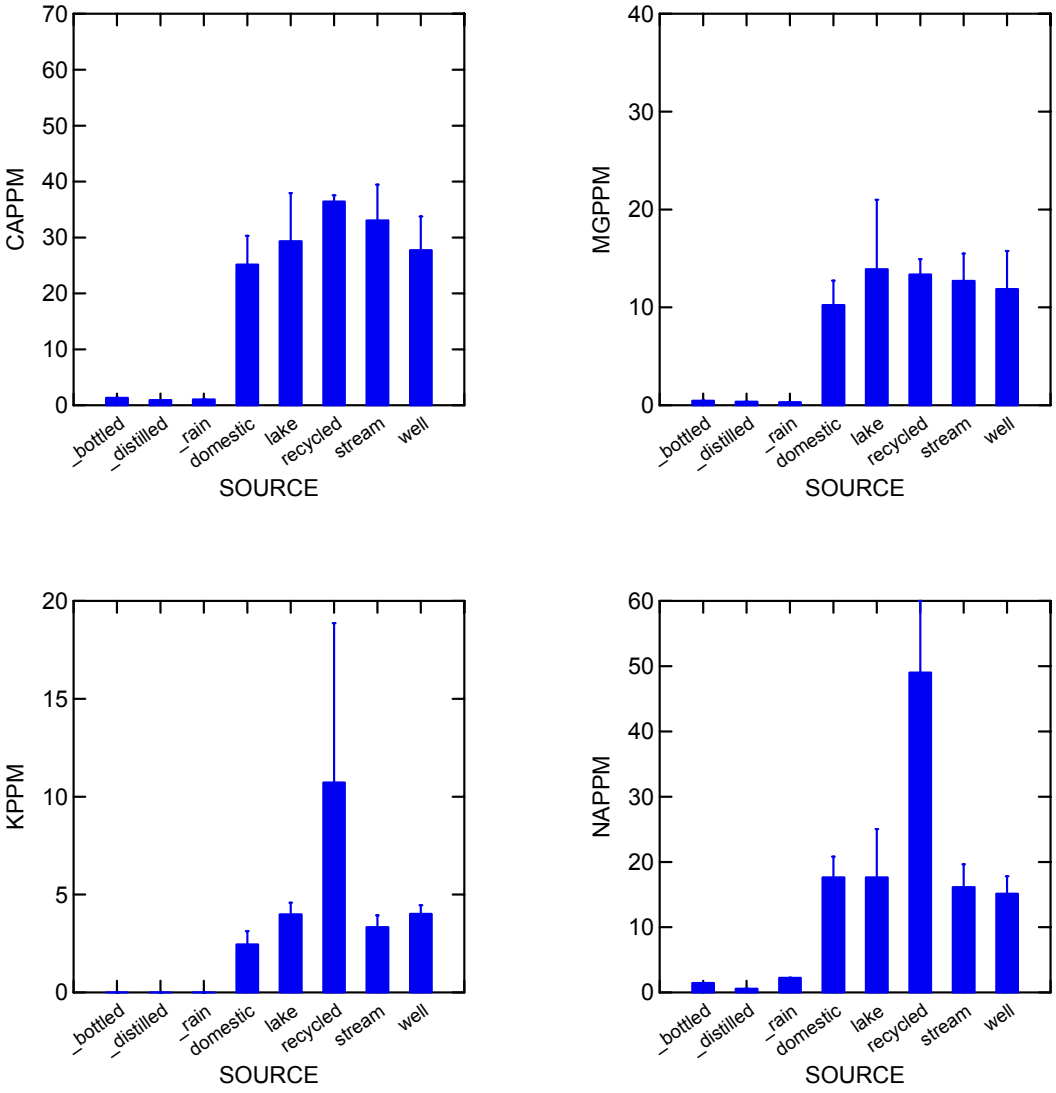


Figure 3. CO3, HCO3, Cl, SO4

Desired values are: Carbonate less than 50, HCO3 less than 90, Cl less than 100, and SO4 less than 200. Error bars represent the standard error of the mean.

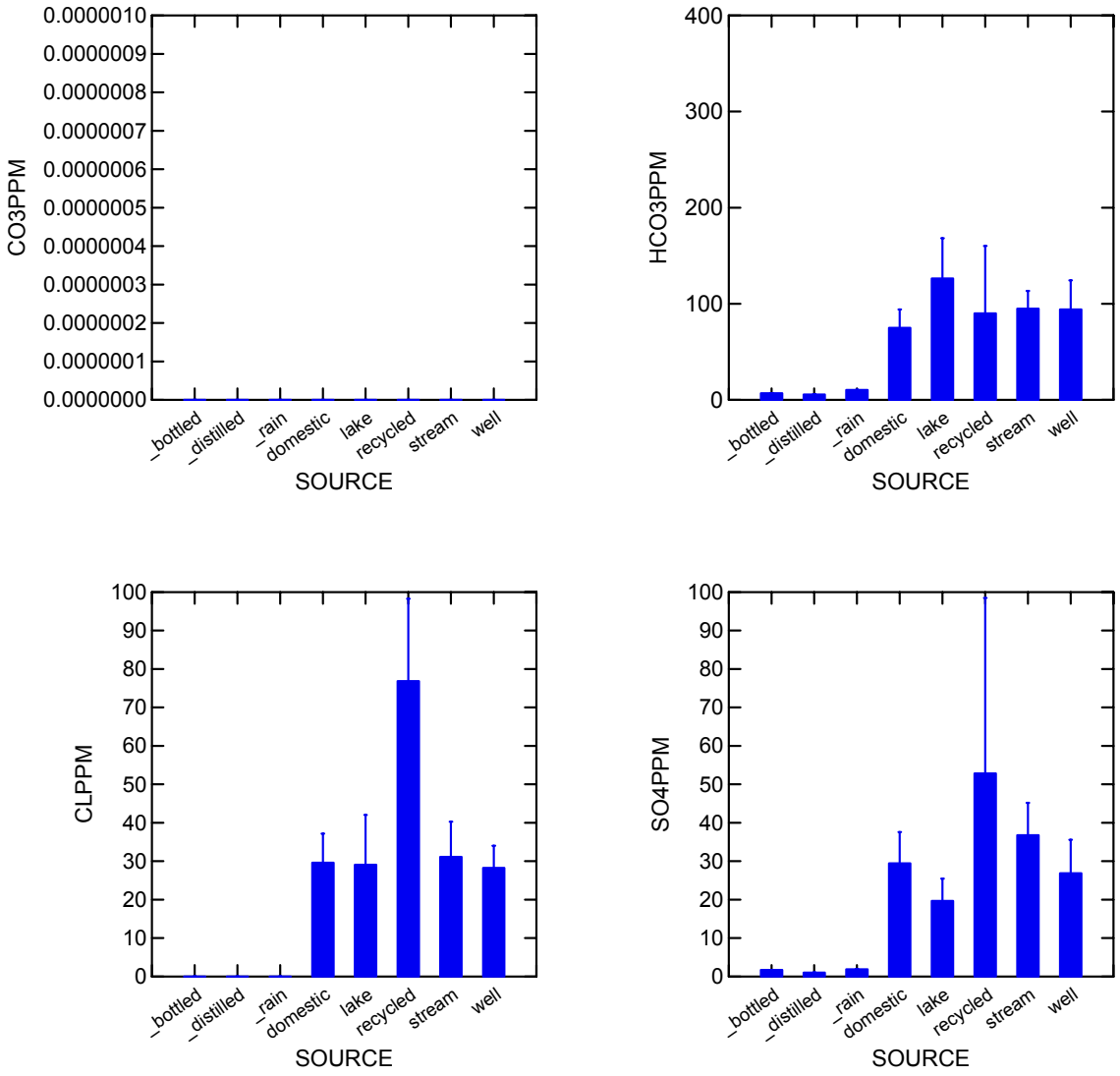


Figure 4. Fe, B, Mn,Cu, Zn

Desired values are: Fe less than 0.3, B less than 0.5, Mn less than 0.15, Cu less than 0.05, Zn less than 2.0. Error bars represent the standard error of the mean.

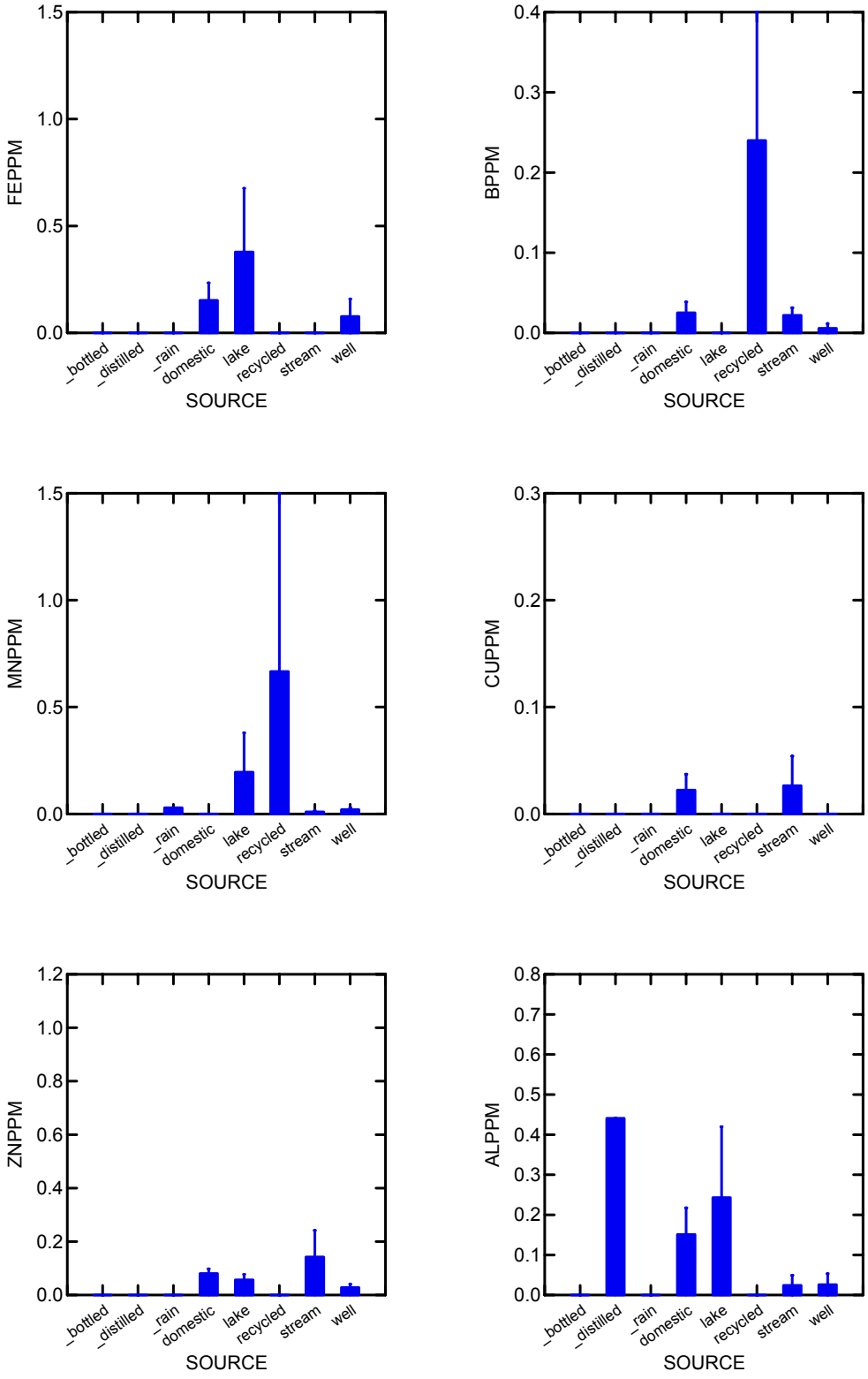
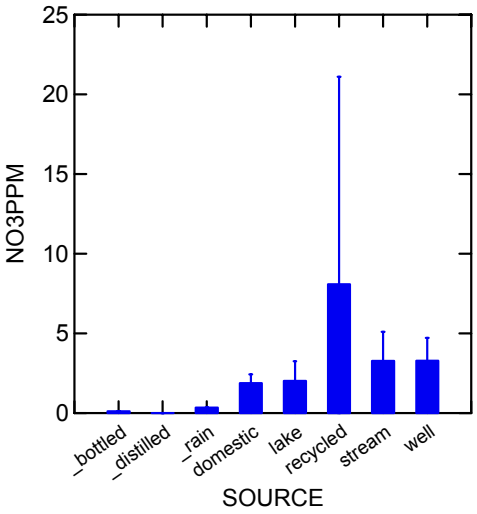


Figure 5. NO3, NH3,

Desired values are: NO3 less than 8, NH3 less than 8, Total N less than 8. Error bars represent the standard error of the mean.



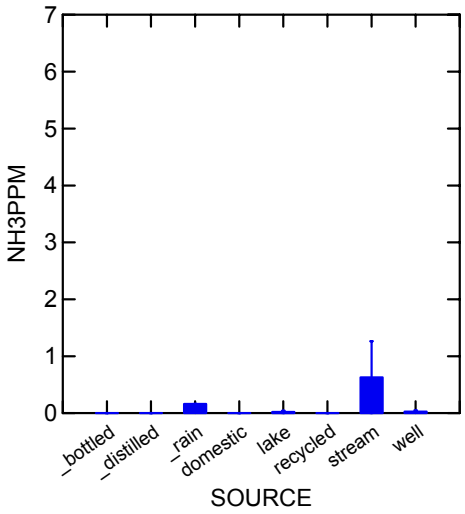
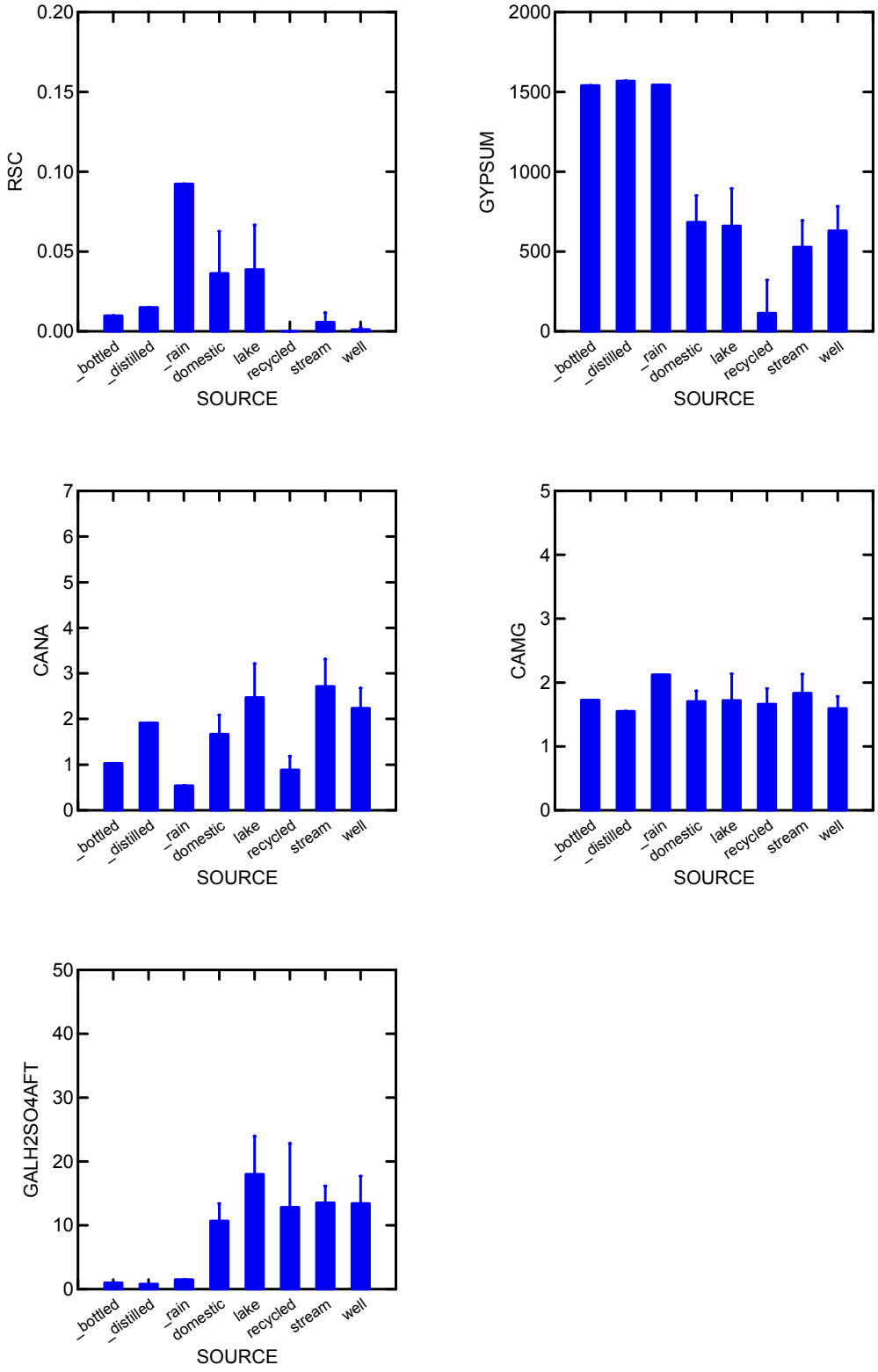


Figure 6, RSC, Gypsum, Ca:Na, Ca:Mg, H2SO4

Desired values are: RSC less than 125, Gypsum 0, Ca:Na greater than 2:1, Ca:Mg greater than 2:1, GalH2SO4 0. Error bars represent the standard error of the mean.



Water appraisals

PSU Fidanza

03100304

bottled bottled water Lab No: 2662 10/31/2003

pH	6.46		
Hardness ppm	5.70		
Electrical Conductivity (dS/m, mmhos/cm)	0.01	TDS (ppm)	5.8
Sodium Adsorption Ratio (SAR)	0.28		
Bower Adjusted SAR	0.00		
pHc	10.46		
Residual Sodium Carbonate (RSC)	0.01		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	1.31	0.07	3.57
Magnesium Mg	0.46	0.04	1.25
Potassium K	0.00	0.00	0.00
Sodium Na	1.46	0.06	3.97
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	5.65		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	6.89	0.11	18.75
Hydroxide OH	0.00		
Chloride Cl	0.00	0.00	0.00
Sulfur as SO4	1.71	0.04	4.65
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0.11		0.30
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	80
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	15
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	1

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.03
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	14
Reported Calcium:magnesium ratio in meq/l	1.73
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	2

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1541

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

PSU Fidanza

03100314

distilled distilled water Lab No: 2672 10/31/2003

pH	6.16	
Hardness ppm	4.32	
Electrical Conductivity (dS/m, mmhos/cm)	0.00	TDS (ppm) 1.3
Sodium Adsorption Ratio (SAR)	0.12	
Bower Adjusted SAR	0.00	
pHc	10.71	
Residual Sodium Carbonate (RSC)	0.01	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	0.92	0.05	2.50
Magnesium Mg	0.36	0.03	0.98
Potassium K	0.00	0.00	0.00
Sodium Na	0.55	0.02	1.50
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	4.52		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	5.52	0.09	15.02
Hydroxide OH	0.00		
Chloride Cl	0.00	0.00	0.00
Sulfur as SO4	1.00	0.02	2.72
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.44		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0		0.00
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	85
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	12
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	1

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.92
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.55
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	3

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1569

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

St. David's Golf Club

03100310

d municipal Lab No: 2668 10/31/2003

pH	6.82		
Hardness ppm	126.20		
Electrical Conductivity (dS/m, mmhos/cm)	0.40	TDS (ppm)	253.4
Sodium Adsorption Ratio (SAR)	1.08		
Bower Adjusted SAR	1.29		
pHc	8.21		
Residual Sodium Carbonate (RSC)	0.00		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	32.26	1.61	87.81
Magnesium Mg	10.96	0.90	29.83
Potassium K	3.73	0.10	10.15
Sodium Na	27.85	1.21	75.80
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	59.89		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	73.08	1.20	198.91
Hydroxide OH	0.00		
Chloride Cl	44.25	1.25	120.44
Sulfur as SO4	48.89	1.02	133.07
Minors	**ppm**		**lbs/acre ft**
Boron B	0.07		0.19
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.11		
Aluminum Al	0.21		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.38		1.03
NO3	2.27		6.17
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	44
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	160
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	10

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.33
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	190
Reported Calcium:magnesium ratio in meq/l	1.79
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	45

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	439

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Bethlehem Municipal Golf Course

03100309

d municipal Lab No: 2667 10/31/2003

pH	7.02	
Hardness ppm	14.51	
Electrical Conductivity (dS/m, mmhos/cm)	0.07	TDS (ppm) 43.5
Sodium Adsorption Ratio (SAR)	0.84	
Bower Adjusted SAR	0.00	
pHc	9.48	
Residual Sodium Carbonate (RSC)	0.17	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	3.76	0.19	10.23
Magnesium Mg	1.10	0.09	2.99
Potassium K	0.00	0.00	0.00
Sodium Na	7.16	0.31	19.49
Iron Fe	0.33		0.90
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	22.60		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	27.58	0.45	75.07
Hydroxide OH	0.00		
Chloride Cl	3.40	0.10	9.25
Sulfur as SO4	4.21	0.09	11.46
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.10		
Aluminum Al	0.45		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.29		0.79
NO3	0		0.00
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	78
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	60
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	4

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	0.60
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	102
Reported Calcium:magnesium ratio in meq/l	2.07
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1374

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Saucon Valley Country Club

03100307

d municipal Lab No: 2665 10/31/2003

pH	7.12	
Hardness ppm	17.86	
Electrical Conductivity (dS/m, mmhos/cm)	0.07	TDS (ppm) 42.2
Sodium Adsorption Ratio (SAR)	0.79	
Bower Adjusted SAR	0.02	
pHc	9.37	
Residual Sodium Carbonate (RSC)	0.12	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	4.86	0.24	13.23
Magnesium Mg	1.26	0.10	3.43
Potassium K	0.00	0.00	0.00
Sodium Na	7.57	0.33	20.60
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	23.16		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	28.27	0.46	76.95
Hydroxide OH	0.00		
Chloride Cl	3.40	0.10	9.25
Sulfur as SO4	5.07	0.11	13.80
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.06		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0		0.00
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	77
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	62
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	4

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	0.74
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	97
Reported Calcium:magnesium ratio in meq/l	2.34
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1376

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Rolling Green Golf Club

03100311

d municipal Lab No: 2669 10/31/2003

pH	7.07	
Hardness ppm	100.01	
Electrical Conductivity (dS/m, mmhos/cm)	0.32	TDS (ppm) 206.1
Sodium Adsorption Ratio (SAR)	0.92	
Bower Adjusted SAR	0.90	
pHc	8.42	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	22.60	1.13	61.51
Magnesium Mg	10.41	0.86	28.33
Potassium K	2.55	0.07	6.94
Sodium Na	20.98	0.91	57.10
Iron Fe	0.41		1.12
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	51.41		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	62.74	1.03	170.77
Hydroxide OH	0.00		
Chloride Cl	45.45	1.28	123.71
Sulfur as SO4	23.86	0.50	64.94
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.11		
Zinc Zn	0.09		
Aluminum Al	0.29		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.27		0.73
NO3	0.87		2.37
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	48
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	137
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	9

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.24
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	163
Reported Calcium:magnesium ratio in meq/l	1.32
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	137

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	654

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

McCall Golf and Country Club

03100315

d municipal Lab No: 2673 10/31/2003

pH	7.07
Hardness ppm	130.27
Electrical Conductivity (dS/m, mmhos/cm)	0.36 TDS (ppm) 232.3
Sodium Adsorption Ratio (SAR)	0.70
Bower Adjusted SAR	0.90
pHc	8.12
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	34.52	1.72	93.96
Magnesium Mg	10.50	0.86	28.58
Potassium K	3.46	0.09	9.42
Sodium Na	18.38	0.80	50.03
Iron Fe	0.48		1.31
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	68.36		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	83.42	1.37	227.05
Hydroxide OH	0.00		
Chloride Cl	26.04	0.73	70.88
Sulfur as SO4	48.31	1.01	131.49
Minors	**ppm**		**lbs/acre ft**
Boron B	0.08		0.22
Manganese Mn	0.00		0.00
Copper Cu	0.02		
Zinc Zn	0.07		
Aluminum Al	0.27		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.4		1.09
NO3	2.26		6.15
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	53
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	182
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	12

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.15
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.99
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	1

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	518

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Springhaven Club

03100324

d municipal Lab No: 2683 11/3/2003

pH		6.96	
Hardness ppm		134.45	
Electrical Conductivity (dS/m, mmhos/cm)		0.41	TDS (ppm) 260.5
Sodium Adsorption Ratio (SAR)		0.89	
Bower Adjusted SAR		1.01	
pHc		8.26	
Residual Sodium Carbonate (RSC)		0.00	
Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	33.70	1.68	91.73
Magnesium Mg	12.09	0.99	32.91
Potassium K	4.79	0.12	13.04
Sodium Na	23.63	1.03	64.32
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	50.28		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	61.36	1.01	167.01
Hydroxide OH	0.00		
Chloride Cl	46.64	1.32	126.95
Sulfur as SO4	45.50	0.95	123.84
Minors	**ppm**		**lbs/acre ft**
Boron B	0.05		0.14
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.16		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.35		0.95
NO3	4.11		11.18
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	40
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	134
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	9

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.64
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	88
Reported Calcium:magnesium ratio in meq/l	1.69
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	72

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	390

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

PSU Fidanza

03100302

d municipal water (drinking) Lab No: 2660 10/31/2003

pH	7.57
Hardness ppm	175.54
Electrical Conductivity (dS/m, mmhos/cm)	0.41 TDS (ppm) 260.5
Sodium Adsorption Ratio (SAR)	0.33
Bower Adjusted SAR	0.54
pHc	7.76
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	35.70	1.78	97.17
Magnesium Mg	20.86	1.72	56.78
Potassium K	1.52	0.04	4.14
Sodium Na	9.94	0.43	27.05
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	154.81		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	188.90	3.10	514.15
Hydroxide OH	0.00		
Chloride Cl	17.02	0.48	46.33
Sulfur as SO4	7.96	0.17	21.67
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.05		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	2.35		6.39
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	88
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	413
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	27

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	4.12
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.04
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	386

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	325

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Warminster's Five Ponds Golf Course

03100333

r municipal water; effluent Lab No: 2692 11/3/2003

pH	6.99	
Hardness ppm	144.52	
Electrical Conductivity (dS/m, mmhos/cm)	0.49	TDS (ppm) 314.2
Sodium Adsorption Ratio (SAR)	1.47	
Bower Adjusted SAR	2.17	
pHc	7.92	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	37.04	1.85	100.82
Magnesium Mg	12.51	1.03	34.05
Potassium K	6.30	0.16	17.15
Sodium Na	40.58	1.77	110.45
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	105.09		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	128.23	2.10	349.02
Hydroxide OH	0.00		
Chloride Cl	65.19	1.84	177.44
Sulfur as SO4	27.99	0.58	76.18
Minors	**ppm**		**lbs/acre ft**
Boron B	0.12		0.33
Manganese Mn	1.18		3.20
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.37		1.01
NO3	1		2.72
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	58
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	280
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	18

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.05
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	394
Reported Calcium:magnesium ratio in meq/l	1.80
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	49

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	228

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Merion Golf Club East Course

03100329

d municipal/stream; Lab No: 2688 11/3/2003

pH	6.97		
Hardness ppm	146.01		
Electrical Conductivity (dS/m, mmhos/cm)	0.41	TDS (ppm)	261.8
Sodium Adsorption Ratio (SAR)	0.93		
Bower Adjusted SAR	1.12		
pHc	8.19		
Residual Sodium Carbonate (RSC)	0.00		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	33.93	1.69	92.35
Magnesium Mg	14.76	1.21	40.17
Potassium K	3.57	0.09	9.72
Sodium Na	25.69	1.12	69.92
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	61.02		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	74.46	1.22	202.67
Hydroxide OH	0.00		
Chloride Cl	50.72	1.43	138.05
Sulfur as SO4	51.67	1.08	140.64
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.07		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	3.12		8.49
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	42
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	163
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	11

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.52
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	127
Reported Calcium:magnesium ratio in meq/l	1.39
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	172

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	396

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Hershey's Mill Golf Club

03100325

r municipal; effluent water Lab No: 2684 11/3/2003

pH	5.69
Hardness ppm	148.56
Electrical Conductivity (dS/m, mmhos/cm)	0.64 TDS (ppm) 408.3
Sodium Adsorption Ratio (SAR)	2.05
Bower Adjusted SAR	2.16
pHc	8.35
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	35.84	1.79	97.55
Magnesium Mg	14.22	1.17	38.70
Potassium K	15.16	0.39	41.26
Sodium Na	57.45	2.50	156.37
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	42.38		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	51.71	0.85	140.75
Hydroxide OH	0.00		
Chloride Cl	88.51	2.50	240.91
Sulfur as SO4	77.68	1.62	211.43
Minors	**ppm**		**lbs/acre ft**
Boron B	0.36		0.98
Manganese Mn	0.16		0.42
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	6.63		18.03
NO3	15.17		41.26
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	24
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	113
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	7

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	0.72
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	751
Reported Calcium:magnesium ratio in meq/l	1.53
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	129

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Moccasin Run Golf Course

03100308

I pond Lab No: 2666 10/31/2003

pH	6.73		
Hardness ppm	98.93		
Electrical Conductivity (dS/m, mmhos/cm)	0.23	TDS (ppm)	148.5
Sodium Adsorption Ratio (SAR)	0.21		
Bower Adjusted SAR	0.21		
pHc	8.40		
Residual Sodium Carbonate (RSC)	0.00		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	21.24	1.06	57.81
Magnesium Mg	10.57	0.87	28.77
Potassium K	5.63	0.14	15.32
Sodium Na	4.84	0.21	13.17
Iron Fe	1.33		3.62
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	54.24		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	66.18	1.09	180.13
Hydroxide OH	0.00		
Chloride Cl	18.72	0.53	50.95
Sulfur as SO4	20.39	0.42	55.50
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.06		0.15
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.47		
Nutrients	**ppm**		**lbs/acre ft**
NO2	1.08		2.94
NO3	6.07		16.51
NH3	0.1		0.27
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	63
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	145
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	9

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	5.03
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.22
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	159

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	865

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

DuPont Country Club

03100319

I	pond	Lab No:	2678	11/3/2003	
		pH	6.52		
		Hardness ppm	41.65		
		Electrical Conductivity (dS/m, mmhos/cm)	0.13	TDS (ppm)	80.6
		Sodium Adsorption Ratio (SAR)	0.39		
		Bower Adjusted SAR	0.25		
		pHc	8.76		
		Residual Sodium Carbonate (RSC)	0.12		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	10.35	0.52	28.17
Magnesium Mg	3.71	0.31	10.10
Potassium K	3.07	0.08	8.36
Sodium Na	5.81	0.25	15.81
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	46.89		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	57.22	0.94	155.74
Hydroxide OH	0.00		
Chloride Cl	6.30	0.18	17.15
Sulfur as SO4	9.65	0.20	26.27
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.11		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0.81		2.20
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	78
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	125
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	8

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.04
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.69
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	22

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1182

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Schuykill Country Club

03100313

s pond (stream fed) Lab No: 2671 10/31/2003

pH	6.70
Hardness ppm	46.17
Electrical Conductivity (dS/m, mmhos/cm)	0.13 TDS (ppm) 83.2
Sodium Adsorption Ratio (SAR)	0.36
Bower Adjusted SAR	0.25
pHc	8.69
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	13.43	0.67	36.55
Magnesium Mg	2.94	0.24	8.00
Potassium K	1.90	0.05	5.17
Sodium Na	5.55	0.24	15.11
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	41.81		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	51.02	0.84	138.87
Hydroxide OH	0.00		
Chloride Cl	2.55	0.07	6.94
Sulfur as SO4	6.94	0.14	18.89
Minors	**ppm**		**lbs/acre ft**
Boron B	0.06		0.16
Manganese Mn	0.03		0.08
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0.87		2.37
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	84
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	111
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	7

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.78
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	2.77
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1181

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Phoenixville Country Club

03100338

w pond and well; well fills Lab No: 2697 11/3/2003

pH	6.84	
Hardness ppm	96.06	
Electrical Conductivity (dS/m, mmhos/cm)	0.26	TDS (ppm) 169.0
Sodium Adsorption Ratio (SAR)	0.53	
Bower Adjusted SAR	0.54	
pHc	8.38	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	23.22	1.16	63.20
Magnesium Mg	8.95	0.74	24.36
Potassium K	5.75	0.15	15.65
Sodium Na	11.81	0.51	32.14
Iron Fe	0.69		1.88
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	53.11		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	64.80	1.06	176.37
Hydroxide OH	0.00		
Chloride Cl	33.53	0.95	91.26
Sulfur as SO4	18.66	0.39	50.79
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.04		0.11
Copper Cu	0.00		
Zinc Zn	0.07		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.44		1.20
NO3	0.3		0.82
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	55
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	142
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	9

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.26
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.57
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	74

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	800

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Green Valley Country Club

03100336

I pond fed by limestone Lab No: 2695 11/3/2003

pH	7.05		
Hardness ppm	78.68		
Electrical Conductivity (dS/m, mmhos/cm)	0.25	TDS (ppm)	158.1
Sodium Adsorption Ratio (SAR)	0.83		
Bower Adjusted SAR	1.01		
pHc	8.19		
Residual Sodium Carbonate (RSC)	0.08		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	23.53	1.17	64.04
Magnesium Mg	4.71	0.39	12.82
Potassium K	2.90	0.07	7.89
Sodium Na	16.92	0.74	46.05
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	81.92		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	99.96	1.64	272.07
Hydroxide OH	0.00		
Chloride Cl	20.42	0.58	55.58
Sulfur as SO4	7.11	0.15	19.35
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.06		0.16
Copper Cu	0.00		
Zinc Zn	0.05		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0.12		0.33
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	78
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	218
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	14

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.60
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	70
Reported Calcium:magnesium ratio in meq/l	3.03
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	853

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Philadelphia Cricket Club

03100335

I pond fed by limestone Lab No: 2694 11/3/2003

pH	7.70	
Hardness ppm	291.02	
Electrical Conductivity (dS/m, mmhos/cm)	0.70	TDS (ppm) 445.4
Sodium Adsorption Ratio (SAR)	1.04	
Bower Adjusted SAR	1.98	
pHc	7.50	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	54.09	2.70	147.22
Magnesium Mg	37.76	3.11	102.78
Potassium K	3.57	0.09	9.72
Sodium Na	40.70	1.77	110.78
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	210.18		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	256.46	4.20	698.04
Hydroxide OH	0.00		
Chloride Cl	72.34	2.04	196.90
Sulfur as SO4	34.27	0.71	93.28
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.02		0.06
Copper Cu	0.00		
Zinc Zn	0.06		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	2.41		6.56
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	71
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	560
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	36

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.52
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	197
Reported Calcium:magnesium ratio in meq/l	0.87
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	823

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Downingtown Country Club

03100337

s pond filled by runoff;also Lab No: 2696 11/3/2003

pH	7.54	
Hardness ppm	256.79	
Electrical Conductivity (dS/m, mmhos/cm)	0.57	TDS (ppm) 362.9
Sodium Adsorption Ratio (SAR)	0.44	
Bower Adjusted SAR	0.77	
pHc	7.62	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	51.16	2.55	139.25
Magnesium Mg	31.22	2.57	84.98
Potassium K	2.44	0.06	6.64
Sodium Na	16.04	0.70	43.66
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	158.20		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	193.04	3.17	525.42
Hydroxide OH	0.00		
Chloride Cl	30.47	0.86	82.93
Sulfur as SO4	83.33	1.73	226.81
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	3.02		8.21
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	63
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	422
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	27

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	3.66
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	0.99
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	605

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Plymouth Country Club

03100316

w pond fillled by wells and Lab No: 2674 10/31/2003

pH	6.68	
Hardness ppm	86.09	
Electrical Conductivity (dS/m, mmhos/cm)	0.29	TDS (ppm) 186.9
Sodium Adsorption Ratio (SAR)	0.95	
Bower Adjusted SAR	0.92	
pHc	8.44	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	19.97	1.00	54.35
Magnesium Mg	8.67	0.71	23.60
Potassium K	4.41	0.11	12.00
Sodium Na	20.30	0.88	55.25
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	54.24		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	66.18	1.09	180.13
Hydroxide OH	0.00		
Chloride Cl	40.34	1.14	109.80
Sulfur as SO4	15.01	0.31	40.85
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.05		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	2.11		5.74
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	54
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	145
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	9

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.13
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	180
Reported Calcium:magnesium ratio in meq/l	1.40
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	101

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	744

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Huntington Valley Country Club

03100330

s pond that is stream fed Lab No: 2689 11/3/2003

pH	6.71	
Hardness ppm	107.89	
Electrical Conductivity (dS/m, mmhos/cm)	0.35	TDS (ppm) 222.7
Sodium Adsorption Ratio (SAR)	0.78	
Bower Adjusted SAR	0.77	
pHc	8.41	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	26.36	1.32	71.75
Magnesium Mg	10.09	0.83	27.46
Potassium K	4.41	0.11	12.00
Sodium Na	18.47	0.80	50.27
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	45.20		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	55.15	0.90	150.11
Hydroxide OH	0.00		
Chloride Cl	46.81	1.32	127.41
Sulfur as SO4	25.51	0.53	69.43
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	1.8		4.90
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	43
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	120
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	8

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.64
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	68
Reported Calcium:magnesium ratio in meq/l	1.58
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	81

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	552

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Blue Bell Country Club

03100334

I pond; having problems Lab No: 2693 11/3/2003

pH	7.02	
Hardness ppm	146.97	
Electrical Conductivity (dS/m, mmhos/cm)	0.40	TDS (ppm) 257.3
Sodium Adsorption Ratio (SAR)	0.72	
Bower Adjusted SAR	1.12	
pHc	7.83	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	37.44	1.87	101.91
Magnesium Mg	12.75	1.05	34.70
Potassium K	4.79	0.12	13.04
Sodium Na	19.89	0.87	54.14
Iron Fe	0.56		1.52
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	124.86		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	152.36	2.50	414.70
Hydroxide OH	0.00		
Chloride Cl	27.57	0.78	75.04
Sulfur as SO4	26.79	0.56	72.92
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.84		2.28
Copper Cu	0.00		
Zinc Zn	0.06		
Aluminum Al	0.74		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.52		1.41
NO3	0.71		1.93
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	74
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	333
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	22

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.16
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.78
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	54

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	401

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

White Manor Country Club

03100326

w pond; pond filled by well Lab No: 2685 11/3/2003

pH	6.79		
Hardness ppm	71.40		
Electrical Conductivity (dS/m, mmhos/cm)	0.21	TDS (ppm)	131.8
Sodium Adsorption Ratio (SAR)	0.35		
Bower Adjusted SAR	0.35		
pHc	8.41		
Residual Sodium Carbonate (RSC)	0.00		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	19.38	0.97	52.75
Magnesium Mg	5.46	0.45	14.86
Potassium K	3.45	0.09	9.39
Sodium Na	6.84	0.30	18.62
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	56.50		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	68.94	1.13	187.64
Hydroxide OH	0.00		
Chloride Cl	5.11	0.14	13.91
Sulfur as SO4	21.45	0.45	58.38
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	1.39		3.78
NO3	1.17		3.18
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	72
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	151
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	10

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	3.25
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	2.15
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	936

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Philmont Country Club

03100317

s pond; pond is fed by a Lab No: 2675 10/31/2003

pH	6.97		
Hardness ppm	98.81		
Electrical Conductivity (dS/m, mmhos/cm)	0.29	TDS (ppm)	183.7
Sodium Adsorption Ratio (SAR)	0.55		
Bower Adjusted SAR	0.63		
pHc	8.25		
Residual Sodium Carbonate (RSC)	0.00		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	25.69	1.28	69.92
Magnesium Mg	8.29	0.68	22.56
Potassium K	1.98	0.05	5.39
Sodium Na	12.44	0.54	33.86
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	64.41		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	78.59	1.29	213.91
Hydroxide OH	0.00		
Chloride Cl	20.25	0.57	55.12
Sulfur as SO4	21.23	0.44	57.78
Minors	**ppm**		**lbs/acre ft**
Boron B	0.05		0.14
Manganese Mn	0.02		0.06
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	2.93		7.97
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	65
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	172
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	11

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.37
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.88
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	19

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	710

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Paxon Hollow Country Club

03100321

s pond; pond is fed by a Lab No: 2680 11/3/2003

pH	6.95	
Hardness ppm	114.79	
Electrical Conductivity (dS/m, mmhos/cm)	0.31	TDS (ppm) 200.3
Sodium Adsorption Ratio (SAR)	0.65	
Bower Adjusted SAR	0.68	
pHc	8.36	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	19.71	0.98	53.65
Magnesium Mg	15.80	1.30	43.00
Potassium K	3.07	0.08	8.36
Sodium Na	16.01	0.70	43.58
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	66.67		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	81.35	1.33	221.42
Hydroxide OH	0.00		
Chloride Cl	34.04	0.96	92.65
Sulfur as SO4	28.59	0.60	77.82
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.11		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	2		5.44
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	57
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	178
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	12

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.41
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	96
Reported Calcium:magnesium ratio in meq/l	0.76
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	378

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	662

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Gulph Mills Golf Club

03100323

s pond; pond is fed by Lab No: 2682 11/3/2003

pH	6.37
Hardness ppm	209.03
Electrical Conductivity (dS/m, mmhos/cm)	0.62 TDS (ppm) 394.2
Sodium Adsorption Ratio (SAR)	0.34
Bower Adjusted SAR	0.54
pHc	7.83
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	67.41	3.36	183.48
Magnesium Mg	9.76	0.80	26.57
Potassium K	8.06	0.21	21.94
Sodium Na	11.42	0.50	31.08
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	71.19		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	86.87	1.42	236.45
Hydroxide OH	0.00		
Chloride Cl	30.47	0.86	82.93
Sulfur as SO4	80.66	1.68	219.54
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.05		0.14
Copper Cu	0.29		
Zinc Zn	0.14		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.36		0.98
NO3	20.43		55.57
NH3	6.66		18.12
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	44
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	190
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	12

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	6.77
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	4.19
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Pine Valley Golf Club

03100327

s pond; pond is spring fed Lab No: 2686 11/3/2003

pH	6.35	
Hardness ppm	19.46	
Electrical Conductivity (dS/m, mmhos/cm)	0.07	TDS (ppm) 48.0
Sodium Adsorption Ratio (SAR)	0.64	
Bower Adjusted SAR	0.00	
pHc	9.42	
Residual Sodium Carbonate (RSC)	0.06	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	4.53	0.23	12.33
Magnesium Mg	1.85	0.15	5.04
Potassium K	1.56	0.04	4.25
Sodium Na	6.40	0.28	17.42
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	22.04		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	26.89	0.44	73.19
Hydroxide OH	0.00		
Chloride Cl	0.00	0.00	0.00
Sulfur as SO4	7.83	0.16	21.31
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0.51		1.39
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	77
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	59
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	4

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	0.81
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	77
Reported Calcium:magnesium ratio in meq/l	1.48
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	18

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1371

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Bala Golf Club

03100328

s pond; pond is stream fed Lab No: 2687 11/3/2003

pH	6.92		
Hardness ppm	178.25		
Electrical Conductivity (dS/m, mmhos/cm)	0.58	TDS (ppm)	372.5
Sodium Adsorption Ratio (SAR)	1.34		
Bower Adjusted SAR	1.65		
pHc	8.17		
Residual Sodium Carbonate (RSC)	0.00		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	40.43	2.02	110.04
Magnesium Mg	18.65	1.53	50.76
Potassium K	5.00	0.13	13.61
Sodium Na	40.92	1.78	111.38
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	55.93		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	68.25	1.12	185.76
Hydroxide OH	0.00		
Chloride Cl	99.23	2.80	270.09
Sulfur as SO4	47.06	0.98	128.09
Minors	**ppm**		**lbs/acre ft**
Boron B	0.07		0.19
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.06		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	1.45		3.94
NH3	0.14		0.38
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	32
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	149
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	10

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.13
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	361
Reported Calcium:magnesium ratio in meq/l	1.31
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	246

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Philadelphia Country Club

03100320

w ponds filled with runoff, Lab No: 2679 11/3/2003

pH	6.82	
Hardness ppm	85.29	
Electrical Conductivity (dS/m, mmhos/cm)	0.30	TDS (ppm) 192.6
Sodium Adsorption Ratio (SAR)	0.82	
Bower Adjusted SAR	0.91	
pHc	8.29	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	22.14	1.10	60.26
Magnesium Mg	7.16	0.59	19.49
Potassium K	3.78	0.10	10.29
Sodium Na	17.38	0.76	47.31
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	68.93		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	84.11	1.38	228.93
Hydroxide OH	0.00		
Chloride Cl	28.77	0.81	78.31
Sulfur as SO4	20.30	0.42	55.25
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.06		
Aluminum Al	0.23		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	1.36		3.70
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	63
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	184
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	12

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.46
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	95
Reported Calcium:magnesium ratio in meq/l	1.88
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	17

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	702

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

PSU Fidanza

03100301

rain rain water Lab No: 2659 10/31/2003

pH	5.94		
Hardness ppm	4.39		
Electrical Conductivity (dS/m, mmhos/cm)	0.01	TDS (ppm)	9.0
Sodium Adsorption Ratio (SAR)	0.49		
Bower Adjusted SAR	0.00		
pHc	10.38		
Residual Sodium Carbonate (RSC)	0.09		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	1.05	0.05	2.86
Magnesium Mg	0.30	0.02	0.82
Potassium K	0.00	0.00	0.00
Sodium Na	2.23	0.10	6.07
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	8.47		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	10.34	0.17	28.14
Hydroxide OH	0.00		
Chloride Cl	0.00	0.00	0.00
Sulfur as SO4	1.89	0.04	5.14
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.03		0.08
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.21		0.57
NO3	0.35		0.95
NH3	0.16		0.44
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	85
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	23
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	1

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	0.54
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	33
Reported Calcium:magnesium ratio in meq/l	2.12
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1544

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Saucon Valley Country Club

03100306

s stream Lab No: 2664 10/31/2003

pH	7.31
Hardness ppm	202.02
Electrical Conductivity (dS/m, mmhos/cm)	0.45 TDS (ppm) 288.6
Sodium Adsorption Ratio (SAR)	0.33
Bower Adjusted SAR	0.58
pHc	7.65
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	51.66	2.58	140.61
Magnesium Mg	17.61	1.45	47.93
Potassium K	2.21	0.06	6.02
Sodium Na	10.79	0.47	29.37
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	142.38		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	173.73	2.85	472.86
Hydroxide OH	0.00		
Chloride Cl	16.51	0.47	44.94
Sulfur as SO4	38.18	0.79	103.92
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	1.07		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	1.97		5.36
NH3	0.1		0.27
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	76
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	379
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	25

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	5.49
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.78
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	75

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	204

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Horsham Valley Golf Club

03100318

s stream Lab No: 2677 11/3/2003

pH	6.94	
Hardness ppm	204.32	
Electrical Conductivity (dS/m, mmhos/cm)	0.55	TDS (ppm) 354.6
Sodium Adsorption Ratio (SAR)	0.98	
Bower Adjusted SAR	1.70	
pHc	7.66	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	49.88	2.49	135.76
Magnesium Mg	19.25	1.58	52.40
Potassium K	3.07	0.08	8.36
Sodium Na	32.03	1.39	87.18
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	146.90		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	179.25	2.94	487.89
Hydroxide OH	0.00		
Chloride Cl	56.68	1.60	154.27
Sulfur as SO4	50.43	1.05	137.26
Minors	**ppm**		**lbs/acre ft**
Boron B	0.06		0.16
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.27		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0.8		2.18
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	63
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	392
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	26

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.79
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	70
Reported Calcium:magnesium ratio in meq/l	1.57
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	159

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Wyncote Golf Course

03100312

w well Lab No: 2670 10/31/2003

pH	6.84		
Hardness ppm	46.93		
Electrical Conductivity (dS/m, mmhos/cm)	0.14	TDS (ppm)	90.2
Sodium Adsorption Ratio (SAR)	0.35		
Bower Adjusted SAR	0.20		
pHc	8.81		
Residual Sodium Carbonate (RSC)	0.01		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	9.07	0.45	24.69
Magnesium Mg	5.77	0.47	15.70
Potassium K	2.97	0.08	8.08
Sodium Na	5.42	0.24	14.75
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	46.89		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	57.22	0.94	155.74
Hydroxide OH	0.00		
Chloride Cl	6.47	0.18	17.61
Sulfur as SO4	6.75	0.14	18.37
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.05		0.14
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	1.35		3.67
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	81
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	125
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	8

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.92
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	4
Reported Calcium:magnesium ratio in meq/l	0.95
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	116

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1149

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

North Hills Country Club

03100322

w well Lab No: 2681 11/3/2003

pH	7.63
Hardness ppm	309.03
Electrical Conductivity (dS/m, mmhos/cm)	0.62 TDS (ppm) 399.4
Sodium Adsorption Ratio (SAR)	0.33
Bower Adjusted SAR	0.66
pHc	7.38
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	58.55	2.92	159.36
Magnesium Mg	39.43	3.24	107.32
Potassium K	2.77	0.07	7.54
Sodium Na	13.25	0.58	36.06
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	248.03		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	302.65	4.96	823.76
Hydroxide OH	0.00		
Chloride Cl	33.70	0.95	91.73
Sulfur as SO4	23.04	0.48	62.71
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	5.37		14.61
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	84
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	661
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	43

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	5.07
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	0.90
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	835

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Riverton Country Club

03100332

w well Lab No: 2691 11/3/2003

pH	5.93		
Hardness ppm	43.66		
Electrical Conductivity (dS/m, mmhos/cm)	0.18	TDS (ppm)	118.4
Sodium Adsorption Ratio (SAR)	0.67		
Bower Adjusted SAR	0.00		
pHc	9.47		
Residual Sodium Carbonate (RSC)	0.00		

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	9.82	0.49	26.73
Magnesium Mg	4.52	0.37	12.30
Potassium K	2.69	0.07	7.32
Sodium Na	10.05	0.44	27.35
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	9.61		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	11.72	0.19	31.90
Hydroxide OH	0.00		
Chloride Cl	13.62	0.38	37.07
Sulfur as SO4	28.01	0.58	76.24
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.07		0.18
Copper Cu	0.00		
Zinc Zn	0.08		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	2.97		8.08
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	22
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	26
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	2

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.12
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	90
Reported Calcium:magnesium ratio in meq/l	1.32
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	59

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1043

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Bent Creek Country Club

03100305

w well (stored in pond) Lab No: 2663 10/31/2003

pH	7.06
Hardness ppm	147.13
Electrical Conductivity (dS/m, mmhos/cm)	0.44
TDS (ppm)	282.2
Sodium Adsorption Ratio (SAR)	0.85
Bower Adjusted SAR	1.34
pHc	7.82
Residual Sodium Carbonate (RSC)	0.00

Cations	ppm	meq/l	lbs/acre ft
Calcium Ca	42.11	2.10	114.62
Magnesium Mg	10.07	0.83	27.41
Potassium K	4.14	0.11	11.27
Sodium Na	23.61	1.03	64.26
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	113.56		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	138.57	2.27	377.16
Hydroxide OH	0.00		
Chloride Cl	41.53	1.17	113.04
Sulfur as SO4	18.00	0.37	48.99
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.03		0.07
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0.23		0.63
NO3	1.46		3.97
NH3	0.1		0.27
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	70
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	303
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	20

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.05
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	2.54
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	0

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	298

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Brideman Golf Club

03100331

s well and spring-fed water Lab No: 2690 11/3/2003

pH	6.82	
Hardness ppm	52.22	
Electrical Conductivity (dS/m, mmhos/cm)	0.15	TDS (ppm) 99.2
Sodium Adsorption Ratio (SAR)	0.45	
Bower Adjusted SAR	0.32	
pHc	8.70	
Residual Sodium Carbonate (RSC)	0.00	

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	13.43	0.67	36.55
Magnesium Mg	4.41	0.36	12.00
Potassium K	3.07	0.08	8.36
Sodium Na	7.52	0.33	20.47
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	41.24		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	50.33	0.83	136.99
Hydroxide OH	0.00		
Chloride Cl	5.11	0.14	13.91
Sulfur as SO4	14.41	0.30	39.22
Minors	**ppm**		**lbs/acre ft**
Boron B	0.00		0.00
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.19		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	0.22		0.60
NH3	0		0.00
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	72
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	110
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	7

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	2.05
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	0
Reported Calcium:magnesium ratio in meq/l	1.85
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	13

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	1126

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

PSU Fidanza

03100303

w well water (drinking) Lab No: 2661 10/31/2003

pH	6.67
Hardness ppm	182.78
Electrical Conductivity (dS/m, mmhos/cm)	0.56 TDS (ppm) 355.2
Sodium Adsorption Ratio (SAR)	0.88
Bower Adjusted SAR	1.05
pHc	8.21
Residual Sodium Carbonate (RSC)	0.00

Cations	**ppm**	**meq/l**	**lbs/acre ft**
Calcium Ca	45.26	2.26	123.19
Magnesium Mg	16.82	1.38	45.78
Potassium K	6.16	0.16	16.77
Sodium Na	27.43	1.19	74.66
Iron Fe	0.00		0.00
Anions	**ppm**	**meq/l**	**lbs/acre ft**
Total Alkalinity	44.07		
Carbonate CO3	0.00	0.00	0.00
Bicarbonate HCO3	53.77	0.88	146.35
Hydroxide OH	0.00		
Chloride Cl	51.06	1.44	138.98
Sulfur as SO4	90.35	1.88	245.92
Minors	**ppm**		**lbs/acre ft**
Boron B	0.05		0.14
Manganese Mn	0.00		0.00
Copper Cu	0.00		
Zinc Zn	0.00		
Aluminum Al	0.00		
Nutrients	**ppm**		**lbs/acre ft**
NO2	0		0.00
NO3	13.4		36.45
NH3	0.15		0.41
Total P	0		0.00

Acid injection is frequently used to amend waters that are high in carbonates and bicarbonates. However, acid amendment is only recommended when carbonates and bicarbonates together comprise more than 50% of the total anions and ideally when the water EC is less than 0.5 dS/m.

Reported Carbonates and bicarbonates as a percent of the total anions	28
Estimated pounds of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	117
Estimated Gallons of H2SO4 needed per acre ft of water to neutralize CO3 and HCO3	8

Gypsum injection is an alternative method of amending water to deliver additional calcium to soils. In this case, the target is two times more calcium than sodium or magnesium (a 2:1 ratio) measured in milliequivalents per liter (meq/l).

Reported Calcium:sodium ratio in meq/l	1.89
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Na ratio	30
Reported Calcium:magnesium ratio in meq/l	1.63
Pounds of gypsum per acre ft of water to deliver 2:1 Ca:Mg ratio	119

In addition to waters that require modification to balance the cations or for removal of carbonates, some waters have a low EC and moderate SAR that requires amendment to increase the EC of the water to improve water infiltration. Gypsum injection has been the product of choice for this amendment because it increases the EC and drops the SAR at the same

Pounds of gypsum needed per acre foot of water to balance the EC/SAR relationship. If the value is zero, no gypsum is needed.	0

Note: Values reported as 0 (zero) indicate that the element is present below minimum levels of detection. Minimum detection levels for selected elements and compounds are listed below in parts per million (ppm):
NO2 < 0.01; NO3 < 0.10; NH4 < 0.10; Al <0.20; Cu <0.02; Fe <0.10; Zn <0.04, K<0.60

Descriptive Statistical analyses

The following results are for:
SOURCE$ = domestic

	PH	ECDSM	SAR	CAPPM	MGPPM
N of cases	8	8	8	8	8
Minimum	6.820	0.070	0.330	3.760	1.100
Maximum	7.570	0.410	1.080	35.700	20.860
Mean	7.075	0.306	0.810	25.166	10.243
Std. Error	0.078	0.053	0.079	4.773	2.320

	KPPM	NAPPM	FEPPM	CO3PPM	HCO3PPM
N of cases	8	8	8	8	8
Minimum	0.000	7.160	0.000	0.000	27.580
Maximum	4.790	27.850	0.480	0.000	188.900
Mean	2.453	17.650	0.153	0.000	74.976
Std. Error	0.631	2.949	0.076	0.000	17.837

	CLPPM	SO4PPM	TDSPPM	BPPM	MNPPM
N of cases	8	8	8	8	8
Minimum	3.400	4.210	42.240	0.000	0.000
Maximum	50.720	51.670	261.760	0.080	0.000
Mean	29.615	29.434	195.040	0.025	0.000
Std. Error	7.003	7.570	33.871	0.013	0.000

	CUPPM	ZNPPM	ALPPM	NO3PPM	NH3PPM
N of cases	8	8	8	8	8
Minimum	0.000	0.000	0.000	0.000	0.000
Maximum	0.107	0.159	0.446	4.110	0.000
Mean	0.022	0.081	0.151	1.872	0.000
Std. Error	0.014	0.016	0.062	0.520	0.000

	GYPSUM	RSC	GALH2SO4AFT	CAMG	CANA
N of cases	8	8	8	8	8
Minimum	325.000	0.000	3.925	1.038	0.602
Maximum	1376.000	0.174	26.881	2.339	4.120
Mean	684.000	0.036	10.669	1.704	1.666
Std. Error	154.787	0.024	2.538	0.154	0.391

The following results are for:
SOURCE$ = lake

	PH	ECDSM	SAR	CAPPM	MGPPM
N of cases	5	5	5	5	5
Minimum	6.520	0.130	0.210	10.350	3.710
Maximum	7.700	0.700	1.040	54.090	37.760
Mean	7.004	0.342	0.638	29.330	13.900
Std. Error	0.200	0.099	0.150	7.544	6.205

	KPPM	NAPPM	FEPPM	CO3PPM	HCO3PPM
N of cases	5	5	5	5	5
Minimum	2.900	4.840	0.000	0.000	57.220
Maximum	5.630	40.700	1.330	0.000	256.460
Mean	3.992	17.632	0.378	0.000	126.436
Std. Error	0.526	6.485	0.262	0.000	36.538

	CLPPM	SO4PPM	TDSPPM	BPPM	MNPPM
N of cases	5	5	5	5	5
Minimum	6.300	7.110	80.640	0.000	0.000
Maximum	72.340	34.270	445.440	0.000	0.839
Mean	29.070	19.642	217.984	0.000	0.195
Std. Error	11.347	5.111	63.468	0.000	0.161

	CUPPM	ZNPPM	ALPPM	NO3PPM	NH3PPM
N of cases	5	5	5	5	5
Minimum	0.000	0.000	0.000	0.120	0.000
Maximum	0.000	0.113	0.744	6.070	0.100
Mean	0.000	0.057	0.243	2.024	0.020
Std. Error	0.000	0.018	0.155	1.080	0.020

	GYPSUM	RSC	GALH2SO4AFT	CAMG	CANA
N of cases	5	5	5	5	5
Minimum	0.000	0.000	8.143	0.869	1.525
Maximum	1182.000	0.116	36.495	3.030	5.035
Mean	660.200	0.039	17.992	1.718	2.472
Std. Error	206.693	0.025	5.200	0.367	0.652

The following results are for:
SOURCE$ = recycled

	PH	ECDSM	SAR	CAPPM	MGPPM
N of cases	2	2	2	2	2
Minimum	5.690	0.490	1.470	35.840	12.510
Maximum	6.990	0.640	2.050	37.040	14.220
Mean	6.340	0.565	1.760	36.440	13.365
Std. Error	0.650	0.075	0.290	0.600	0.855

	KPPM	NAPPM	FEPPM	CO3PPM	HCO3PPM
N of cases	2	2	2	2	2
Minimum	6.300	40.580	0.000	0.000	51.710
Maximum	15.160	57.450	0.000	0.000	128.230
Mean	10.730	49.015	0.000	0.000	89.970
Std. Error	4.430	8.435	0.000	0.000	38.260

	CLPPM	SO4PPM	TDSPPM	BPPM	MNPPM
N of cases	2	2	2	2	2
Minimum	65.190	27.990	314.240	0.120	0.156
Maximum	88.510	77.680	408.320	0.360	1.177
Mean	76.850	52.835	361.280	0.240	0.666
Std. Error	11.660	24.845	47.040	0.120	0.510

	CUPPM	ZNPPM	ALPPM	NO3PPM	NH3PPM
N of cases	2	2	2	2	2
Minimum	0.000	0.000	0.000	1.000	0.000
Maximum	0.000	0.000	0.000	15.170	0.000
Mean	0.000	0.000	0.000	8.085	0.000
Std. Error	0.000	0.000	0.000	7.085	0.000

	GYPSUM	RSC	GALH2SO4AFT	CAMG	CANA
N of cases	2	2	2	2	2
Minimum	0.000	0.000	7.359	1.528	0.716
Maximum	228.000	0.000	18.248	1.796	1.047
Mean	114.000	0.000	12.803	1.662	0.881
Std. Error	114.000	0.000	5.445	0.134	0.166

The following results are for:
SOURCE$ = stream

	PH	ECDSM	SAR	CAPPM	MGPPM
N of cases	11	11	11	11	11
Minimum	6.350	0.070	0.330	4.530	1.850
Maximum	7.540	0.620	1.340	67.410	31.220
Mean	6.871	0.370	0.624	33.063	12.715
Std. Error	0.106	0.060	0.094	6.070	2.649

	KPPM	NAPPM	FEPPM	CO3PPM	HCO3PPM
N of cases	11	11	11	11	11
Minimum	1.560	5.550	0.000	0.000	26.890
Maximum	8.060	40.920	0.000	0.000	193.040
Mean	3.343	16.145	0.000	0.000	94.952
Std. Error	0.569	3.327	0.000	0.000	17.659

	CLPPM	SO4PPM	TDSPPM	BPPM	MNPPM
N of cases	11	11	11	11	11
Minimum	0.000	6.940	48.000	0.000	0.000
Maximum	99.230	83.330	394.240	0.070	0.051
Mean	31.102	36.743	237.265	0.022	0.009
Std. Error	8.708	8.006	37.920	0.009	0.005

	CUPPM	ZNPPM	ALPPM	NO3PPM	NH3PPM
N of cases	11	11	11	11	11
Minimum	0.000	0.000	0.000	0.220	0.000
Maximum	0.291	1.065	0.265	20.430	6.660
Mean	0.026	0.143	0.024	3.273	0.627
Std. Error	0.026	0.095	0.024	1.738	0.603

	GYPSUM	RSC	GALH2SO4AFT	CAMG	CANA
N of cases	11	11	11	11	11
Minimum	0.000	0.000	3.827	0.757	0.812
Maximum	1371.000	0.063	27.470	4.189	6.772
Mean	527.818	0.006	13.512	1.834	2.718
Std. Error	158.585	0.006	2.513	0.283	0.568

The following results are for:
SOURCE$ = well

	PH	ECDSM	SAR	CAPPM	MGPPM
N of cases	9	9	9	9	9
Minimum	5.930	0.140	0.330	9.070	4.520
Maximum	7.630	0.620	0.950	58.550	39.430
Mean	6.807	0.333	0.637	27.724	11.872
Std. Error	0.147	0.056	0.084	5.670	3.653

	KPPM	NAPPM	FEPPM	CO3PPM	HCO3PPM
N of cases	9	9	9	9	9
Minimum	2.690	5.420	0.000	0.000	11.720
Maximum	6.160	27.430	0.690	0.000	302.650
Mean	4.013	15.121	0.077	0.000	94.218
Std. Error	0.418	2.523	0.077	0.000	28.288

	CLPPM	SO4PPM	TDSPPM	BPPM	MNPPM
N of cases	9	9	9	9	9
Minimum	5.110	6.750	90.240	0.000	0.000
Maximum	51.060	90.350	399.360	0.050	0.066
Mean	28.237	26.841	213.973	0.006	0.021
Std. Error	5.432	8.173	36.013	0.006	0.009

	CUPPM	ZNPPM	ALPPM	NO3PPM	NH3PPM
N of cases	9	9	9	9	9
Minimum	0.000	0.000	0.000	0.300	0.000
Maximum	0.000	0.079	0.233	13.400	0.150
Mean	0.000	0.028	0.026	3.277	0.028
Std. Error	0.000	0.012	0.026	1.356	0.019

	GYPSUM	RSC	GALH2SO4AFT	CAMG	CANA
N of cases	9	9	9	9	9
Minimum	0.000	0.000	1.668	0.901	1.121
Maximum	1149.000	0.011	43.068	2.536	5.070
Mean	630.222	0.001	13.408	1.593	2.238
Std. Error	143.598	0.001	4.025	0.178	0.415