Baca Grande
Water And Sanitation
District

BACA GRANDE WATER & SANITATION DISTRICT

CORROSION CONTROL STUDY

McLaughlin Water
ENGINEERS LTD.

11-15-01

January 2012

McLaughlin Water
ENGINEERS LTD.

January 13, 2012

Board of Directors
Baca Grande Water & Sanitation District
c/o Mr. Steven Harrell, General Manager
57 Baca Grant Way South
Crestone, Colorado 81131-0520

RE: Corrosion Control Study
Letter of Transmittal/Summary

Dear Mr. Harrell:

Submitted attached is the Corrosion Control Study prepared for the Baca Grande water system.

The primary purpose of this Study is to develop an optimal corrosion control treatment ("OCCT") plan, as required by the Colorado Department of Public Health and Environment (CDPHE).

Principle conclusions/recommendations derived from the study include:

1. The water produced by Well 18 is of uniform, very high quality, having low dissolved solids concentrations – and thus is inherently mildly corrosive. The CDPHE criteria stipulate maximum concentrations of lead and copper at customer taps. Absent the District's corrosion control practices, copper concentrations (from corrosion of customer plumbing) would certainly exceed these limits. Thus, some form of corrosion control by the District is mandatory.

2. Extensive testing has shown no excessive lead concentrations. Early copper exceedences were likely due to inadequate polyphosphate feed rates. During the first half of 2010, 3 samples exceeded permissible levels. For a one year period – last half of 2010 and first half of 2011, all but one sample was within limits.

3. The District's present practices of adding a polyphosphate blend ("Sea Quest") is reasonable and safe. The addition of an adequate amount of Sea Quest has been shown (over a one-year period – 66 samples) to reliably result in compliance with the CDPHE criteria. At this time there is no reason to investigate an alternative polyphosphate product.

4. Our review substantiated a finding by HRS Water Consultants (May, 2010) that there is a very high water loss rate within the District's distribution system. A leakage correction program is recommended – and this will have a much greater economic significance than the optimization of the corrosion control process.

5. The study comparatively evaluates two basic control strategies:

   1) Addition of polyphosphates, and

   2) The addition of alkalinity as needed to result in a non-corrosive water. This approach has sub-alternatives, based on different chemical additions.

   To optimize the plan, both economics and environmental aspects were considered.

   The economic comparison is somewhat synthesized because of the present high loss rate. To develop an optimum long range plan, we assumed reasonable corrections would be accomplished.

6. The decision as to an optimum plan is not "black or white". Both alternatives will meet the CDPHE quality requirements – and cost differences are not of a decision making magnitude.

   The recommended corrosion control plan is to convert to the addition of alkalinity – using granular soda ash, with a magnesium hydroxide option. This alternative is judged marginally superior, primarily because:

   - Cost. The District's wastewater treatment plant now must feed alkalinity (use magnesium hydroxide). With acceptable distribution leakage, most of the alkalinity added to the water system will result in savings at the wastewater plant. The comparative cost of chemical, then, favors Alternate 2, the addition of alkalinity.

   - Performance. Although polyphosphates are adequate for continuous customers, effectiveness diminishes with "stagnant" (long detention time) waters. This is relevant at Baca Grande since there is a relatively high proportion of seasonal or part-time customers. Further, polyphosphates have been shown not effective for protection of iron or steel. Although there is a relatively small area of exposed iron or steel in the Baca Grande system (storage tanks, iron pipe), having a non-corrosive water should be of some benefit.

7. Implementing the transition to alkalinity based treatment will require CDPHE approval and capital improvements, estimated to cost approximately $15,000. Either corrosion control approach would be compatible with the Well 17 addition.

We will be available for discussion or to provide additional information at your direction.

Respectfully submitted,
McLaughlin Water Engineers, Ltd.

Ronald C. McLaughlin, P.E. & L.S.

Terrence P. Kenyon, P.E.

BACA GRANDE WATER & SANITATION DISTRICT
CORROSION CONTROL STUDY

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1. INTRODUCTION

BACKGROUND

The Baca Grande Water & Sanitation District ("District") supplies and distributes water to a relatively large service area. The water source is a deep well. This well produces excellent quality water, having very low dissolved solids. The result is that the water, untreated, is mildly corrosive.

A corrosive water can dissolve metals, e.g. iron, copper, or lead in piping and steel storage tanks. The Colorado Department of Public Health and Environment (CDPHE) regulates the allowable concentrations of lead and copper – and thus regulates the need for corrosion control.

The District has installed a polyphosphate feed system. There is some controversy as to the efficiency of the use of polyphosphates, and the testing program has shown occasions of higher than permitted copper concentrations.

PURPOSE

The purpose of this report is to develop the optimum approach to corrosion control at Baca Grande – and to predesign any recommended improvements. Specifically this study is to comply with the CDPHE directive that the District establish optimal corrosion control treatment ("OCCT") (letter from Sharon Williams, P.E., dated December 15, 2011 – see Attachment A).

The scope does not include any other water supply facilities or treatment processes; however, the raw water is extremely pure and requires no other treatment except for preventative disinfection.

The scope does not include a second, smaller, well/system which supplies, separately, the mobile home development.

2. EXISTING SYSTEM

A description of the existing water system, as is relevant to corrosion control, follows.

WATER SOURCE

The District now has one deep well – "Well 18". This is classified as a deep well (138 ft.), not requiring filtration treatment. The well casing is equipped with two – 10 HP submersible pumps. Each pump has a capacity of 230-250 gpm, or a maximum well production of 450 gpm. The pumps are low head, delivering water through the new treatment/control building to an adjacent ground tank. High pressure pumps supply the distribution system, taking suction from this ground tank.

The raw water quality is excellent. Following is a summary of previous inorganic test results (note that the results are relatively consistent – typical of a deep ground water source):

Heavy Metals – sample 04/04.2011

Barium	0.04 mg/l (limit 2.00 mg/l)
All others	Below detectable limit

Iron/Manganese – sample 02/09/2011 and 07/28/2011

Iron	<.005, .011 mg/l
Mn	.0008 mg/l

Nitrates – multiple samples

All very low, in the 0.13 mg/l range

Relative to Corrosion – sample 02/09/2011, 07/28/2011, 08/04/2011

Bicarbonate	65.4 mg/l
Calcium as Ca CO_3	40.2 mg/l
Total Alkalinity	53.5 mg/l
pH	6.6 – 6.9 units
TDS	86 mg/l
Langelier Index	-1.8

DISTRIBUTION SYSTEM

There are presently fewer than 600 equivalent taps total demand.

District supplied information:

There are 65 miles of distribution piping. Most of the pipe is PVC; however, there is some ductile iron, steel and asbestos cement pipe. The far (southerly) end of the service area is over 6 miles from the Well 18 supply.

From 2011 supply meter readings, the yearly average demand rate is about 262,000 gpd (gallons per day) and the maximum month rate is approximately 424,000 gpd. A report Water Supply Analysis – Water Needs Analysis, prepared by HRS Water Consultants, Inc., dated May 10, 2010, opined that the distribution system has a very high ratio of leakage losses. An approximate estimate is that in the range of 50% of the source water pumped is lost.

Relating to corrosion control; the system serves a low density population; any corrosion control chemicals must be stable, that is, have a long effective life.

3. CORROSION CONTROL

GENERAL

Corrosion control has two basic goals:

- Prevent corroded (dissolved) metals from being ingested by customers.

- Increase pipe/tank life by reducing materials loss through corrosion.

Chemical corrosion control is achieved using either of two alternative approaches:

1. Inhibit corrosion by forming a protective film on metal surfaces. Polyphosphates are typically used for this approach.

2. Add alkalinity to raise the pH and result in a non-corrosive water – one which precipitates a calcium carbonate coating.

At Baca Grande, the PVC distribution pipe is not subject to this type of corrosion. Ductile iron pipe and steel tankage only experience corrosion when the protective linings or coatings fail. The primary reason for corrosion control is for the protection of copper service lines and copper plumbing. Older plumbing systems used solder containing lead. Hence, CDPHE regulates lead and copper concentrations.

1. POLYPHOSPHATE ADDITION

There are several forms of ortho/polyphosphates which are used. Baca Grande now uses a proprietary blend from "Sea Quest". This is a reasonable choice - it is safe and NSF approved – and there is no reason to investigate an alternate polyphosphate. (Change can be made at any time since the identical chemical feed equipment can be used.)

Polyphosphates are thought to form a thin film covering surfaces. Polyphosphates are also sequestering agents, which prevent precipitation of iron and manganese. Thus, the addition must also satisfy that need.

The manufacturer's recommended feed rate, for Well 18 water, is 0.5 mg/l. However, literature references cite typical feed rates of 2-6 mg/l. Because of the pure water source, having minimal iron or manganese, it is expected that the design feed rate would be in a low range. However, the long residence time in the distribution system would suggest that a higher feed rate is necessary to maintain a sufficient residual in the south end of the system. The actual feed rate required can best be determined through long-term testing verification.

Monitoring Program Results

Because of previous staff problems, test records prior to 2009 are not available.

There are evidently no tested levels for lead concentration that exceeded the Action Level (0.05 mg/l for lead). The CDPHE notified the District (letter from Bryan Pilson, dated August 17, 2010) that the 90^{th} percentile copper level of 1.645 mg/l exceeded the Action Level (1.3 mg/l for copper).

Copper concentrations at customer taps during the first half of 2010 are shown on Table 3-A. Of the 20 tests, 3 had copper concentrations above the Action Level; the 90^{th} percentile value for this period was 1.645 mg/l. This test period's results are the basis for CDPHE regulatory action.

It is observed that the 3 high copper tests are significantly above the others: the average concentration of the 3 high tests is 1.943 mg/l; the average concentration of the remaining 17 tests is 0.404 mg/l. This suggests the possibility of sampling from low use or dormant customers.

Another test result (June 12, 2011) showed unusually high copper (28.4 mg/l) and lead (0.17 mg/l). This sample was judged to be an anomaly and CDPHE approved its invalidation, so that it was not included in the period's statistical analysis. It was stated that the sample was taken from an outside hose bibb at an uninhabited residence. This instance does conform to the thought that polyphosphates are less effective in stagnant waters. This high variability with time substantiates a time-related explanation for the early 2010 excursions.

Furnished test results for the second half of 2010 and the first half of 2011 were reviewed statistically with regard to copper concentrations at District selected locations. There were 45 samples analyzed in the 6-month 2010 period and 26 samples in the 2011 period. The 90th percentile values were determined per CDPHE Regulations – and are shown on Table 3-A.

In addition, sampling locations were categorized as to location: North group (closest to source); Center group; and Southern group (farthest from the source). The intent was to see if there was a relationship between system detention time and copper levels (i.e. polyphosphate degradation).

Conclusions from these two later period analyses are:

1. The 90th percentile values of copper did not exceed the Action Level for the two test periods (total 1 year). In fact, only one sample exceeded 1.3 mg/l.

2. Some minor corrosion is occurring, over half of the samples showed copper levels above the well test copper level. However, all concentrations were well below regulatory limits.

3. The average copper concentrations, by location, were:

North	-	0.446 mg/l
Central	-	0.393 mg/l
Southern	-	0.564 mg/l

Although the Southern value is about 25% higher than the North area value, the small number of Southern (and Central) samples result in an inconclusive analysis.

Table 3 A
Statistical Analysis - Copper Concentration

02/2010 - 04/2010	
Rank	Copper Concentration mg/L
1	0.091
2	0.097
3	0.164
4	0.198
5	0.243
6	0.251
7	0.257
8	0.258
9	0.268
10	0.425
11	0.446
12	0.529
13	0.62
14	0.621
15	0.634
16	0.784
17	0.989
18	1.645
19	1.811
20	2.374

90th Percentile
1.645

07/2010 - 12/2010	
Rank	Copper Concentration mg/L
1	0.001
2	0.013
3	0.013
4	0.030
5	0.030
6	0.061
7	0.072
8	0.089
9	0.089
10	0.096
11	0.096
12	0.109
13	0.109
14	0.113
15	0.113
16	0.118
17	0.118
18	0.136
19	0.158
20	0.158
21	0.204
22	0.204
23	0.228
24	0.292
25	0.292
26	0.321
27	0.321
28	0.386
29	0.399
30	0.399
31	0.566
32	0.566
33	0.586
34	0.586
35	0.609
36	0.764
37	0.764
38	0.815
39	0.815
40	0.833
41	0.833
42	0.837
43	1.068
44	1.068
45	1.163

90th Percentile
0.833

01/2011 - 06/2011	
Rank	Copper Concentration mg/L
1	0.048
2	0.064
3	0.093
4	0.163
5	0.184
6	0.219
7	0.222
8	0.346
9	0.400
10	0.445
11	0.538
12	0.566
13	0.666
14	0.671
15	0.701
16	0.832
17	0.897
18	0.963
19	0.964
20	1.071
21	1.096

90th Percentile
0.964

Considerations with the Selection of Polyphosphates

Negative considerations with regard to use of polyphosphates for corrosion control include:

- Not shown effective for all waters. However, recent testing at Baca Grande has indicated probable adequacy when fed at the rate of 0.5 mg/l.

- Although not very significant here, the use of phosphorous is environmentally negative. Phosphorous is considered a nutrient/contaminant in waste waters, with some sewage treatment plants required to remove phosphorous to very low levels (not a requirement now at Baca Grande). Also, phosphorous is a limited national resource, receiving recent publicity as to pending shortages.

- Polyphosphates are thought to be less effective where water is stagnant or slow moving. Because of the present low density of customers, some water has a long detention time before customer use. Also, the seasonal use pattern for some customers in Baca Grande does result in long-term detention in those plumbing systems (when building not occupied).

- A reliable doctoral thesis(1) determined that polyphosphates are less effective in "stagnant" or slow moving waters (which is the case at Baca Grande).

Polyphosphate Dosage

The reported early year's dosage was 0.15 mg/l (although this was indicated to be the target residual). The dosage was reportedly later raised to 0.5 mg/l. Liquid Sea Quest, as supplied, contains 34.5% active polyphosphate.

The February 28, 2011 test results (Colorado Analytical) show a phosphate residual of only 0.01 mg/l. A typical recommended minimum residual is about 0.5 mg/l; and the residual at Baca Grande should not be less than 0.2 mg/l (at the southerly end). It is

(1) "Water Quality Factors Influencing Iron and Lead Corrosion in Drinking Water", Laurie S. McNeill, Virginia Polytechnic Institute, June 2000.

probable that the Sea Quest was under fed, or that system demand/deterioration rate was higher than projected.

2. ALKALINITY ADDITION

Pristine waters having low pH, alkalinity and hardness, are frequently corrosive. Stabilization occurs at the pH and alkalinity values where calcium carbonate is at a saturation–equilibrium value. At this point calcium carbonate does not precipitate or dissolve so that the calcium carbonate protective coating remains on metal surfaces, inhibiting corrosion.

The Langelier Index is commonly used to gauge a water's corrosivity. Water pH and concentrations of hardness, alkalinity, and total dissolved solids are used to calculate this index. A negative index indicates a corrosive water; a positive index indicates that the water will tend to precipitate calcium carbonate, and thus be non corrosive.

Alkaline chemicals which can be added to drinking water to raise pH/alkalinity include:

Lime - Calcium Hydroxide. This is an ideal chemical from cost and environmental standpoints. However, it would be impractical to handle at Baca Grande.

Caustic Soda – Sodium Hydroxide. Can be fed in liquid form. It is hazardous.

Soda Ash – Sodium Carbonate. Purchased in bags – granular form. Reasonable cost and reasonable to use at Baca Grande. Requires solution mixing or dry feeder.

Magnesium Hydroxide. This is the chemical now used to add alkalinity at the waste water treatment plant. It is economical in solution form; however, it is not now available as a liquid, approved for drinking water use. A major supplier indicates that they are now evaluating a liquid, NSF approved, product. The supplier quoted a reasonable cost for an NSF approved, granular, food grade form of magnesium hydroxide.

The design chemical dosage can be determined mathematically and/or by laboratory means. For this analysis, soda ash addition was selected. Varying dosages of soda ash were added to Well 18 raw water – and then were laboratory tested (Accutest – see Appendix B for lab results).

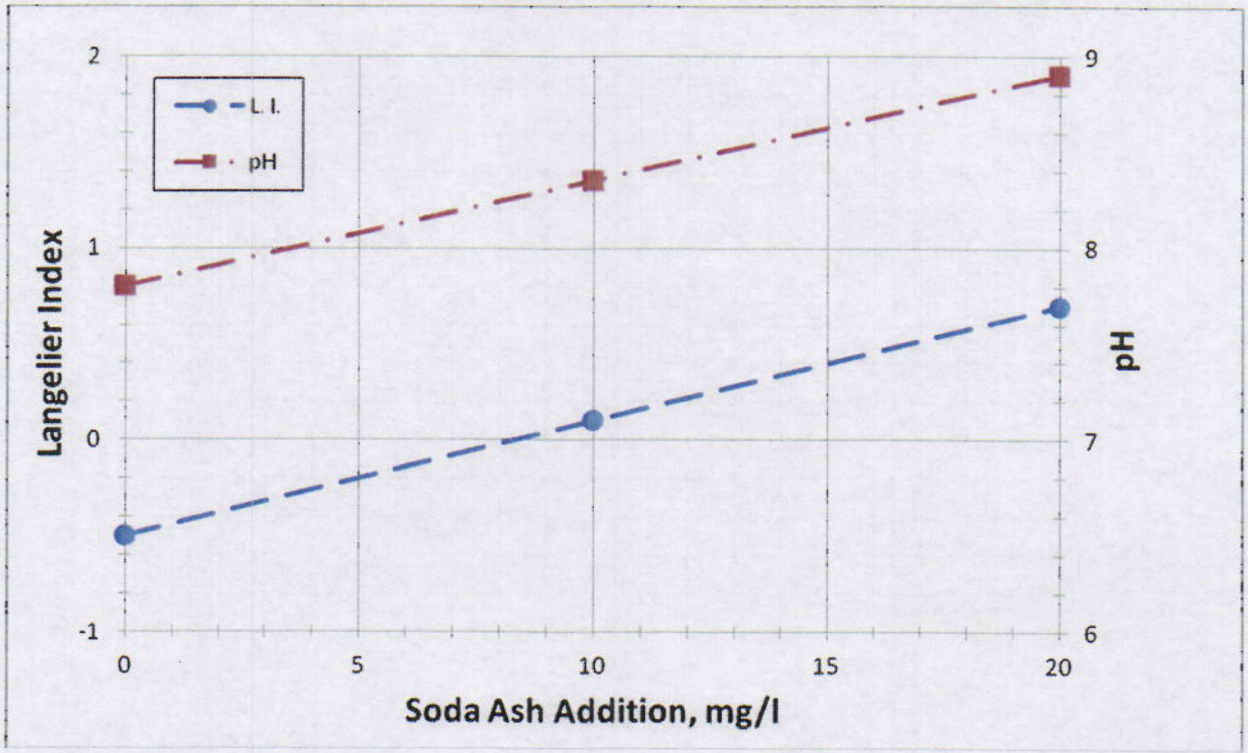
A summary of test values is given in Table 3-B, following.

TABLE 3-B. WATER TEST RESULTS

(Reference Appendix B)

Water	pH	Langelier Index	Date
Raw	6.58	-1.8	07/28/2011
	6.95		02/28/2011
	7.81	-0.5	12/05/2011
Add 10 mg/l (Soda Ash)	8.38/8.30	+0.1	12/05/2011
Add 20 mg/l	8.96/8.91	+0.7	12/05/2011
Add 30 mg/l	9.18	---	12/05/2011
Add 40 mg/l	9.35	---	12/05/2011

From the above values, it is estimated that an appropriate design dosage of soda ash – to attain corrosion control – is approximately 12 mg/l. (L.I. = 0.2)



4. COST COMPARISONS

ALTERNATIVES

The two base alternatives, as discussed in Section III, are:

1. Polyphosphate Addition, and
2. Alkalinity Addition

For Alternate 1, there are several brands/formulations of ortho-polyphosphate mixtures available. For this comparison, the use of Sea Quest is assumed. Sea Quest is now used by the District, and one year's test results demonstrate its general effectiveness.

For Alternate 2, the use of soda ash or magnesium hydroxide is assumed because of the practicality of feeding these chemicals for smaller systems. Actually, magnesium hydroxide (which is now used at the District's wastewater treatment plant) would be the preferred alkaline source; however, it is not now available in liquid form as an NSF approved food grade quality.

COMPARATIVE DESIGN CRITERIA

System Capacity. Facilities design should provide a chemical feed rate adequate for a flow of 500 gpm. This is the rate with two pumps running in Well 18. It is understood that the new replacement Well 17 will be primarily for backup, and thus not increase the design supply rate. Further, at least for the near-future, the supply rate is limited by high service pumping and transmission capacity to approximately 500 gpm.

Information from the HRS report is that District buildout would result in a much higher water supply requirement – in the range of 5 times the present customer demand. The selected facilities design, then, should be amenable to future expansion.

System Usage. HRS used 192 AF/yr as the system demand in 2009. In 2010, Well 18 pumpage increased to 200 AF; and to 293 AF in 2011. A rough estimate of about 50% system losses (leakage) was made; and a report recommendation was to implement a leakage reduction program. It is presumed that a reasonable operating cost comparison for corrosion control should assume some growth and effective leakage reduction. Note that leakage reduction can be justified by both water rights and pumping power costs considerations.

To summarize, the initial chemical cost comparisons are made using the following average flows.

Total Yearly Pumpage – Well 18	200 AF
System Leakage Losses (10% range)	20 AF
Outside/Irrigation Usage	35 AF
Inside Usage – to WWTP	145 AF

CAPITAL COSTS

Alternate 1 – Polyphosphates. The equipment is installed and operating. Required capital cost = $0.

Alternate 2. Soda Ash is purchased in dry form, usually 50 lb. bags. The equipment design feed rate for 500 gpm at 20 mg/l, is 120 lb/day.

A typical design for the feed equipment would include a dry feeder with a mixed dissolving basin and chemical feed pump. For long-term use, this would probably be the operations preferred alternative. The estimated capital cost for such a dry feed system is $24,000.

However, the District now feeds all liquid chemicals, including liquid magnesium hydroxide at the WWTP. We have contacted the primary supplier of magnesium hydroxide; they are planning on introducing liquid, food grade, magnesium hydroxide in the future. Assuming a competitive price, the plan should probably be to convert to liquid magnesium hydroxide when available. Therefore, the proposed preliminary design is to provide a mixed batch tank for conversion of dry soda ash to liquid. The feed rate would then be governed by chemical metering pumps. Although requiring some additional operational labor now, such a system would conveniently be adaptable to liquid magnesium hydroxide feed.

The proposed chemical feed system can be located in the new treatment/pumping station so that no superstructure costs are required. The estimated capital cost of furnishing and installing a new soda ash/magnesium hydroxide feed system is $15,000.

OPERATIONAL COSTS

There will be only minor, insignificant differences to operational labor, power, and maintenance expense. The significant consideration would be as to chemical costs.

Alternate 1

Using the assumed comparative flows and current Sea Quest pricing, the comparative yearly chemical costs would be:

(200 AF)(0.3259 MG/AF)(8.34 lbs/gal)(0.5 mg/l)
($4.12/lb) = <u>$1,120/yr</u>

Alternate 2

The yearly cost of feeding Soda Ash at a 12.0 mg/l dosage is calculated as follows:

(200 AF)(0.3259 MG/AF)(8.34 lbs/gal)(12 mg/l)
(30¢/lb) = <u>$1,957/yr</u>

Of the above amount, some of the cost would be recoverable at the wastewater treatment plant – since this would result in added alkalinity, thus reducing the required magnesium hydroxide dosage. The recoverable cost, using the stated assumed flows, would be:

(145 AF/yr)(0.3259 MG/AF)(8.34 lbs/gal)
(12 mg/l)(0.55 $Mg(OH)_2$ equiv)(55.8¢/lb)
=$1,451/yr

The net chemical cost then, would be <u>$505</u>/year.

At present quoted pricing, the use of magnesium hydroxide is slightly more costly than soda ash – although its use is slightly preferable. The predesigned chemical feed system could utilize either dry chemical – as well as liquid magnesium hydroxide, if ever available.

Discussion

The District does need – for multiple reasons – to reduce its water distribution leakage to say, not over 10% (around 5% is generally considered a system goal).

The comparative economic analysis indicates that operating and capital cost differences are not large. The relative costs for Alternate 2 improve (lower) with reduced system leakage, i.e. increased amount of added alkalinity to wastewater treatment; and with a low irrigation ratio. The amount of water used for outside irrigation at Baca Grande is thought relatively low, but has not been estimated precisely with confidence.

Dry food grade magnesium hydroxide is available. It is now priced at 46¢/lb., plus shipping. At an estimated cost of 55¢/lb., the magnesium hydroxide chemical cost would be: (Note that 7 mg/l of magnesium hydroxide is approximately equivalent to 12 mg/l of soda ash.)

(200 AF/yr)(0.3259 MG/AF)(8.34 lbs/gal)
(7 mg/l)(55¢/lb.) = $2,093

The net savings would be the same as for soda ash, resulting in a net comparative cost of $642/yr.

ATTACHMENT A

CORRESPONDENCE FROM THE CDPHE

STATE OF COLORADO

John W. Hickenlooper, Governor
Christopher E. Urbina, MD, MPH
Executive Director and Chief Medical Officer

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Colorado Department
of Public Health
and Environment

December 15, 2011

Mr. Steven Harrell
Baca Grande WSD
PO Box 520
Crestone, CO 81131

RE: Baca Grande Water & Sanitation District,
Public Water System Identification Number #CO0155200

Dear Mr. Harrell:

The purpose of this letter is to address matters related to corrosion control and lead and copper levels at the Baca Grande Water and Sanitation District public water system (the "District") and to communicate the relevant provisions of the *Colorado Primary Drinking Water Regulations* (the "Regulations") regarding compliance with the Lead and Copper Rule (Article 8).

This correspondence follows a recent discussion between the Division and the District, the purpose of which was to establish a plan to resolve the technical and regulatory issues related to corrosion control. In addition, the Division has received correspondence from customers of the District who have requested that the District be required to re-evaluate its corrosion control treatment, discontinue use of current treatment processes, and properly complete a corrosion control study (a "study"). The Division understands that the District is actively pursuing a study in order to establish optimal corrosion control treatment ("OCCT").

The Division agrees with the District that a study is needed; this correspondence provides the regulatory basis for the decision, discusses the study requirements and establishes deadlines for completing the steps in the study.

In addition to establishing the expectations for the study, this letter also specifies additional requirements related to proper lead and copper sampling locations and the District's most recent Consumer Confidence Report.

Regulatory Basis and Background

We have conducted a thorough review of our records and the regulatory requirements which apply. The District and Division have a long history of communications related to lead and copper control and on the following occasions the District was in communication with the Division regarding its intent to comply with the corrosion control study requirements, in accordance with the Regulations:

- In March 2008, Mr. Steve McDowell communicated the District's request to install SeaQuest, a corrosion control inhibitor. In April and May 2008, the Division responded in letters to the District requiring a corrosion control study and monitoring.
- In June 2009, Mr. Stephen Rogers communicated the District's status update on the required study. The Division replied and corresponded by email and in a letter, also in June 2009.
- In 2010, the Division communicated with District representatives Mr. AJ Beckman and Mr. Thomas Rossillon as part of a design review and approval process. In a letter dated May 2010, the Division approved the District's design plans and specifications, including those related to SeaQuest, an NSF certified polyphosphate corrosion control inhibitor.

Division records also indicate that, while the District and Division have been in regular communication regarding corrosion control treatment, and specifically the use of SeaQuest, the Division has not, to date, designated OCCT. Furthermore, in accordance with Article 8.5(b)(6), the system cannot be deemed to have optimized corrosion control because the copper action level has been exceeded.

According to Division records, the District serves a residential population of 885 persons. For a system of this size, the requirement to conduct a study may be triggered by an exceedance of an action level {§8.6(b)}, and the study may be interrupted whenever the system meets both action levels during each of two consecutive six-month monitoring periods {§8.5(c)}. In December 2009, the District had already completed one six-month monitoring period with results below the copper action level. Based on the original April 2008 start date of a study, the District was required to complete a study within 18 months, and the Division was required to designate OCCT within 24 months, i.e. by April 2010 {§8.5(d)}. Due primarily to limited available resources, the Division did not respond immediately to the District's failure to complete a study within 18 months. However, before the response to the missed deadline could occur, the Division's compliance determination was interrupted by an exceedance of the copper action level in the first six-month monitoring period of 2010.

When the system exceeded the copper action level in the first six months of 2010, the Division should have required the District to complete the study commenced in 2008. The Division was in error when that determination did not occur and the Division instead required treatment recommendations only, as stated in our letter dated August 2010. The Division should have notified the District of the requirement to restart the study by June 30, 2011 {§8.5(d)(2)}.

Thus, the corrosion control treatment study which commenced in 2008 must proceed at this time as outlined in Article 8.6(c) and (d) of the Regulations. The Division understands that the District has already engaged a consultant to design and implement the study. The study must be completed in its entirety so that OCCT can be designated and optimal water quality control parameters established by the Division.

The Division recognizes that the District has sought guidance in 2011 on completing this study, and that District representatives Mr. AJ Beckman, Mr. Steve Harrell, and Mr. Brad Simons have expressed a commitment to completing a properly formulated study as soon as possible. The Division is requiring that the study be completed no later than December 31, 2012, which is 18 months following the June 30, 2011 determination date, and that the study follow all applicable provisions of the Regulations, as outlined below.

Actions Related to a Corrosion Control Study

As Division staff members have discussed with District representatives at meetings in August and November of this year, the study must be designed and completed in accordance with Article 8.6(c) of the Regulations, including an evaluation of all of the following corrosion control treatment options:

- alkalinity and pH adjustment,
- calcium hardness adjustment, and
- phosphate or silicate based corrosion inhibitor addition.

The District shall evaluate each of the corrosion control treatments using either pipe rig/loop tests, metal coupon tests, or an alternative Division-approved method. In addition, the study shall measure water quality parameters in accordance with Article 8.6(c)(3), identify and document chemical and physical constraints of particular treatments, and evaluate the effects of chemicals used for corrosion control on other water quality treatment processes.

As described in Article 8.6(c)(6) of the Regulations, the District must recommend to the Division in writing the treatment option that the study indicates constitutes OCCT for the system. The findings of the study along with all corresponding lead and copper and water quality parameter sample results must be submitted within three months of completing the study, and no later than March 31, 2013. The Division will designate OCCT within six months of the completion of the study, and no later than June 30, 2013, in accordance with Articles 8.5(d) and 8.6(d) of the Regulations. At that time, the Division will also designate optimal water quality parameters in accordance with Article 8.6(f).

The District shall submit quarterly reports to the Division demonstrating that the corrosion control treatment study is being conducted thoroughly and in accordance with the Regulations. The first report is due March 31, 2012 and should include parameters of the study and a time table for completion.

If a new treatment process is recommended as a result of the study, a Plan Submittal must be submitted in accordance with Part 1.1 of the *Design Criteria for Potable Water Systems* ("Design Criteria") which must include details on chemical additions, feed rates, optimal water quality parameter ranges, and any associated equipment required to operate the treatment. The Division will review the Plan Submittal for completeness and approval. Construction of any new treatment required in accordance with the Division's OCCT designation must be completed no later than 24 months after the Division designates OCCT, and no later than June 30, 2015. Copies of the Design Criteria and the Regulations can be found on the Internet at the following web addresses, respectively:
http://www.cdphe.state.co.us/wq/engineering/pdf/DesignCriteriaPotableWaterSystem.pdf
http://www.cdphe.state.co.us/regulations/wqccregs/100301primarydrinkingwaternew.pdf

Actions Related to Lead and Copper Sampling Locations

Division records do not include a complete materials survey, as required by Article 8.2(a) of the Regulations. A materials survey is necessary to verify the pool of targeted sampling sites that meets the lead and copper sampling requirements, and which is sufficiently large to ensure that the water system can collect the number of lead and copper tap samples.

If the District has performed this survey, please submit the information to the Division. If the survey has not been completed, or needs to be updated, please complete the survey and submit it to the Division.

along with an updated monitoring plan for Division review, no later than June 30, 2012, listing the District's 20 standard lead and copper sites along with at least 10 alternative sites.

Actions Related to the District's Consumer Confidence Report

Pursuant to Article 9.1.3(d)(4)(vi) of the Regulations, systems with detected levels of lead and copper must show the last round of lead and copper sampling in their Consumer Confidence Report (CCR). The District met this requirement in their most recent CCR which reported 2010 water quality data. Article 9.1.3(d)(3) of the Regulations requires results of detected contaminants be derived from data collected during the calendar year. The District collected lead and copper samples earlier in the calendar year (before the last round of lead and copper sampling), however this information was not included in the District's most recent CCR.

In the interest of ensuring proper public notification of drinking water quality, the Division requests the District send an amendment to its most recent CCR to all customers displaying the District's lead and copper 90th percentile for both first and second half 2010. The CCR amendment must clearly indicate that the District exceeded the copper action level in the first half of 2010. The District must detail the actions undertaken since the exceedance and the planned corrosion control study. The CCR amendment should be delivered to all water customers as soon as practical but no later than January 31, 2012. Please submit a copy of the CCR amendment along with a Certificate of Delivery by February 10, 2012.

Summary of Deadlines

The milestones for the activities discussed in this letter are summarized in the table, below:

Summary of Deadlines	
Action	**Due Date**
Corrosion Control Treatment Study	
Quarterly Report #1	3/31/2012
Quarterly Report #2	6/30/2012
Quarterly Report #3	9/30/2012
Complete the Study	12/31/2012
Quarterly Report #4	12/31/2012
Final Report of Study Findings, including OCCT recommendation	3/31/2013
CCR amendment delivered to District customers	1/31/2012
Copy of CCR amendment and Certificate of Delivery delivered to Division	2/10/2012
Materials Evaluation and Revised Monitoring Plan	6/30/2012
OCCT Designated by the Division	6/30/2013
Corrosion Control Treatment Installation (if new treatment)	6/30/2015

All reports and data submittals in response to this requirement letter should be sent to Bryan Pilson. You may also submit via electronic mail to bryan.pilson@state.co.us. If electronic submission is not possible, you may either fax these submittals to (303) 758-1398 or mail to the following address:

CDPHE - WQCD
ATTN: CAME-Bryan Pilson
4300 Cherry Creek Drive South
Denver, CO 80246-1530

Thank you for your continuing efforts to communicate with the Division on these important matters related to lead and copper control in your public water system.

If you have any questions regarding the requirements for the District, please contact Bryan at 303-692-3318.

Sincerely,

Sharon I. Williams, P.E.
Unit Manager
Safe Drinking Water Compliance Assurance
Water Quality Control Division

cc: Drinking Water File, CO0155200
Christine Canaly, Baca Grande Water & Sanitation District
AJ Beckman, Baca Grande Water & Sanitation District
Jennifer Gruber Tanaka, Esq., White, Bear & Ankele, P.C.

cc: Shawn McCaffrey, EPA, Region 8
Jerry Goad, Office of the Attorney General
Tyson Ingels, P.E. Engineering Section
Bret Icenogle, P.E., Engineering Section

ATTACHMENT B

LABORATORY TEST RESULTS

Mountain States
ACCUTEST
LABORATORIES

01/04/12

Technical Report for

McLaughlin Water Engineers

Baca Grande W&S Dist.

Accutest Job Number: D30579

Sampling Date: 12/23/11

Report to:

McLaughlin Water Engineers
2420 Alcott Street
Denver, CO 80211

ATTN: Ron McLaughlin

Total number of pages in report: **13**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

Brad Madadian
Laboratory Director

Client Service contact: Shea Greiner 303-425-6021

Certifications: CO, ID, NE, NM, ND (R-027) (PW) UT (NELAP CO00049)

Test results relate only to samples analyzed.

Table of Contents

-1-

Sample Summary

McLaughlin Water Engineers

Baca Grande W&S Dist.

Job No: D30579

Sample Number	Collected Date	Time By	Received	Matrix Code	Type	Client Sample ID
D30579-1	12/23/11	09:00	12/23/11	AQ	Water	RAW
D30579-2	12/23/11	09:00	12/23/11	AQ	Water	10MG/L
D30579-3	12/23/11	09:00	12/23/11	AQ	Water	20MG/L

Mountain States ACCUTEST LABORATORIES

Sample Results

Report of Analysis

Accutest Laboratories

Report of Analysis

Client Sample ID:	RAW		
Lab Sample ID:	D30579-1	**Date Sampled:**	12/23/11
Matrix:	AQ - Water	**Date Received:**	12/23/11
		Percent Solids:	n/a
Project:	Baca Grande W&S Dist.		

Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Calcium	19700	400	ug/l	1	12/27/11	12/27/11	JB	EPA 200.7 [1]	EPA 200.7 [2]

(1) Instrument QC Batch: MA2077
(2) Prep QC Batch: MP6547

RL = Reporting Limit

Accutest Laboratories

Report of Analysis

Client Sample ID:	RAW		
Lab Sample ID:	D30579-1	Date Sampled:	12/23/11
Matrix:	AQ - Water	Date Received:	12/23/11
		Percent Solids:	n/a
Project:	Baca Grande W&S Dist.		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Total as CaCO3	62.3	5.0	mg/l	1	12/30/11	JD	SM20 2320B
Corrosivity, Langlier Index	-0.5			1	12/30/11	JD	SM16 203
Hardness, Calcium [a]	49.2	1.0	mg/l	1	12/27/11 14:39	JB	SM20 2340B
Solids, Total Dissolved	74.0	10	mg/l	1	12/27/11	JK	SM20 2540C
pH	7.81		su	1	12/23/11 14:50	JD	SM20 4500H

Field Parameters

Temperature (Field)	20		Deg. C	1	12/23/11	SUB	EPA 170.1

(a) Calculated as: (Calcium * 2.497) to convert to Calcium Carbonate

RL = Reporting Limit

Accutest Laboratories

Report of Analysis

Client Sample ID:	10MG/L			
Lab Sample ID:	D30579-2		**Date Sampled:**	12/23/11
Matrix:	AQ - Water		**Date Received:**	12/23/11
			Percent Solids:	n/a
Project:	Baca Grande W&S Dist.			

Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Calcium	19800	400	ug/l	1	12/27/11	12/27/11	JB	EPA 200.7 [1]	EPA 200.7 [2]

(1) Instrument QC Batch: MA2077
(2) Prep QC Batch: MP6547

RL = Reporting Limit

Accutest Laboratories

Report of Analysis

Client Sample ID:	10MG/L		
Lab Sample ID:	D30579-2	**Date Sampled:**	12/23/11
Matrix:	AQ - Water	**Date Received:**	12/23/11
		Percent Solids:	n/a
Project:	Baca Grande W&S Dist.		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Total as CaCO3	67.4	5.0	mg/l	1	12/30/11	JD	SM20 2320B
Corrosivity, Langlier Index	0.1			1	12/30/11	JD	SM16 203
Hardness, Calcium [a]	49.4	1.0	mg/l	1	12/27/11 14:46	JB	SM20 2340B
Solids, Total Dissolved	85.0	10	mg/l	1	12/27/11	JK	SM20 2540C
pH	8.30		su	1	12/23/11 14:50	JD	SM20 4500H

Field Parameters

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Temperature (Field)	20		Deg. C	1	12/23/11	SUB	EPA 170.1

(a) Calculated as: (Calcium * 2.497) to convert to Calcium Carbonate

RL = Reporting Limit

Accutest Laboratories

Report of Analysis

Client Sample ID:	20MG/L		
Lab Sample ID:	D30579-3	**Date Sampled:**	12/23/11
Matrix:	AQ - Water	**Date Received:**	12/23/11
		Percent Solids:	n/a
Project:	Baca Grande W&S Dist.		

Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Calcium	19600	400	ug/l	1	12/27/11	12/27/11	JB	EPA 200.7 [1]	EPA 200.7 [2]

(1) Instrument QC Batch: MA2077
(2) Prep QC Batch: MP6547

RL = Reporting Limit

Accutest Laboratories

Report of Analysis

Client Sample ID:	20MG/L			
Lab Sample ID:	D30579-3		**Date Sampled:**	12/23/11
Matrix:	AQ - Water		**Date Received:**	12/23/11
			Percent Solids:	n/a
Project:	Baca Grande W&S Dist.			

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Total as CaCO3	78.3	5.0	mg/l	1	12/30/11	JD	SM20 2320B
Corrosivity, Langlier Index	0.7			1	12/30/11	JD	SM16 203
Hardness, Calcium [a]	48.9	1.0	mg/l	1	12/27/11 15:36	JB	SM20 2340B
Solids, Total Dissolved	106	10	mg/l	1	12/27/11	JK	SM20 2540C
pH	8.91		su	1	12/23/11 14:50	JD	SM20 4500H

Field Parameters

Temperature (Field)	20		Deg. C	1	12/23/11	SUB	EPA 170.1

(a) Calculated as: (Calcium * 2.497) to convert to Calcium Carbonate

RL = Reporting Limit

Mountain States ACCUTEST LABORATORIES

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

ACCUTEST LABORATORIES

CHAIN OF CUSTODY

PAGE ___ OF ___

Accutest Laboratories Mountain States
4036 Youngfield Street Wheat Ridge, Co 80033
TEL. 303-425-6021 877-737-4521
FAX 303-425-6021

FED-EX Tracking #:
Bottle Order Control #: D30579
Accutest Quote #:
Accutest Job #:

Client / Reporting Information

- Company Name: McLaughlin Water Eng
- Street Address: 2420 Blatt St
- City: Denver State: Co Zip:
- Project Contact: Ron McLaughlin E-mail: ronmc@mwe HR.com
- Phone #: 303 964 3333 Fax #:
- Sampler(s) Name(s): Phone #:

Project Information

- Project Name: Baca Grande W&S Dist
- Street:
- City:
- Project #:
- Client PO#:
- Project Manager:

Billing Information (If different from Report to)

- Company Name:
- Street Address:
- City: State: Zip:
- Attention: PO#:

Requested Analysis (see TEST CODE sheet): Langelier Index

Matrix Codes: DW - Drinking Water, GW - Ground Water, WW - Water, SW - Surface Water, SO - Soil, SL - Sludge, SED - Sediment, OI - Oil, LIQ - Other Liquid, AIR - Air, SOL - Other Solid, WP - Wipe, FB - Field Blank, EB - Equipment Blank, RB - Rinse Blank, TB - Trip Blank

Accutest Sample #	Field ID / Point of Collection	MEOH/DI Vial #	Collection Date	Collection Time	Sampled by	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	NONE	DI Water	MEOH	ENCORE	Bisulfate	Langelier Index	LAB USE ONLY
	Raw		12-23	9^00		W											✓	01
	10 mg/l		12-23	9^00		W											✓	02
	20 mg/l		12-23	9^00		W											✓	03
	30 mg/l } Add - CaCl before running		12-23	9^00		W												04
	40 mg/l }		12-23	9^00		W												05

AD 12/23/11

Turnaround Time (Business days)

- [x] Std. 10 Business Days
- [ ] Std. 5 Business Days (By Contract only)
- [ ] 5 Day RUSH
- [ ] 3 Day EMERGENCY
- [ ] 2 Day EMERGENCY
- [ ] 1 Day EMERGENCY

Emergency & Rush T/A data available VIA Lablink

Approved By (Accutest PM): / Date:

Data Deliverable Information

- [ ] Commercial "A" (Level 1)
- [ ] Commercial "B" (Level 2)
- [ ] Commercial "B" +Narrative
- [ ] FULLT1 (Level 3+4)
- [ ] State Forms
- [ ] EDD Format ______
- [ ] PDF

Commercial "A" = Results Only
Commercial "B" = Results + QC Summary

Comments / Special Instructions

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received By:	Relinquished By:	Date Time:	Received By:
1 R McLaughlin	12-23-11 9:05 AM	1 Daniel J R... 12/23 9:35	2		2
Relinquished by Sampler:	**Date Time:**	**Received By:**	**Relinquished By:**	**Date Time:**	**Received By:**
3		3	4		4
Relinquished by:	**Date Time:**	**Received By:**	**Custody Seal #** AD	☑ Intact ☐ Not Intact	Preserved where applicable ☐ On Ice ☐ Cooler Temp. 5.7
5		5			

D30579: Chain of Custody
Page 1 of 2

Accutest Laboratories Sample Receipt Summary

ACCUTEST LABORATORIES

3.1 | 3

Accutest Job Number: D30579 **Client:** MCLAUGHLIN WATER ENGINEERING **Immediate Client Services Action Required:** No

Date / Time Received: 12/23/2011 9:35:00 AM **No. Coolers:** 1 **Client Service Action Required at Login:** No

Project: BALK GRANDE W&S DIST **Airbill #'s:** HD

Cooler Security	Y	N		Y	N
1. Custody Seals Present:	☑	☐	3. COC Present:	☑	☐
2. Custody Seals Intact:	☑	☐	4. Smpl Dates/Time OK	☑	☐

Cooler Temperature	Y	N
1. Temp criteria achieved:	☑	☐
2. Cooler temp verification:	Infared gun	
3. Cooler media:	Ice (bag)	

Quality Control Preservation	Y	N	N/A
1. Trip Blank present / cooler:	☐	☐	
2. Trip Blank listed on COC:	☐	☐	
3. Samples preserved properly:	☑	☐	
4. VOCs headspace free:	☐	☐	☑

Sample Integrity - Documentation	Y	N
1. Sample labels present on bottles:	☑	☐
2. Container labeling complete:	☑	☐
3. Sample container label / COC agree:	☑	☐

Sample Integrity - Condition	Y	N
1. Sample recvd within HT:	☑	☐
2. All containers accounted for:	☑	☐
3. Condition of sample:	Intact	

Sample Integrity - Instructions	Y	N	N/A
1. Analysis requested is clear:	☑	☐	
2. Bottles received for unspecified tests	☐	☑	
3. Sufficient volume rec'd for analysis:	☑	☐	
4. Compositing instructions clear:	☐	☐	☑
5. Filtering instructions clear:	☐	☐	☑

Comments

Accutest Laboratories
V:(303) 425-6021

4036 Youngfield Street
F: (303) 425-6854

Wheat Ridge, CO
www/accutest.com

D30579: Chain of Custody

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