FREDERICK COUNTY GOVERNMENT
OFFICE OF THE COUNTY EXECUTIVE

Jan H. Gardner
County Executive

Michael G. Marschner, Deputy Chief Administrative Officer

January 30, 2020

Town of Emmitsburg
300 A South Seton Avenue
Emmitsburg, Maryland 21727

Attention: Cathy Willets

Re: Preliminary Results of Review of Discolored Water Problems, Emmitsburg, Maryland

Dear Cathy:

The Town of Emmitsburg asked the County for assistance in reviewing recurring discolored water problems that the Town has been experiencing for the last several months. On Wednesday January 15, 2020, staff from the County Executive's office *(Michael Marschner)* and the County's Division of Utilities and Solid Waste Management (DUSWM) *(Mark Schweitzer and Ken Orndorff)* met with Town staff *(Cathy Willets, Dan Fissel, and Jim Click)* to review the discolored water problems. During this January 15th visit County staff toured the Town's water treatment facilities and collected water samples from the Town's surface water source (Rainbow Lake), one of its ground water sources (Well 3), as well as the water distribution system. Information learned from this visit is summarized below and sample results are shown in Table 1 (Page 3).

It should be noted that this review is of a very limited scope and focusing solely on the discolored water problem and its possible sources. The information contained in this letter should not be used in place of a formal engineering analysis, which may be necessary to develop permanent solutions to address the discolored water problems.

Background

The Town of Emmitsburg's water supply relies on a surface water source (Rainbow Lake) and four (4) deep wells which withdraw groundwater from the Catoctin Metbasalt formation. The wells range in depth from 161 feet to 600 feet. The water treatment plant (WTP) is a direct filtration plant relying on multimedia sand filtration (as a roughing filter) followed by diatomaceous earth (DE) filtration, which is capable of removing opportunistic protozoa *(e.g. Giardia lamblia and Cryptosporidium parva)*. The filtration system is primarily for the surface water source from Rainbow Lake. The treatment plant also provides disinfection (Chlorination) and pH adjustment (Soda Ash feed) for both the surface and ground water sources.

This review was not intended to evaluate the physical water treatment system or its efficacy, although the post filtration pH and alkalinity adjustment chemical feed system's (Soda Ash Feeder) ability to achieve target pH levels is acknowledged in this report.

The Town began receiving an increase in discolored water complaints in October 2019. Complaints continued and increased into December of last year. Initially the discolored water problems were thought to be associated with activities at the National Fire Academy and sudden high flows occurring for short periods of time. Distribution system flushing to resolve the problem was only marginally effective. The higher than usual flows were lower than typical fire flows but were greater than the average flows from the WTP. During a tour of the WTP, Dan Fissel noted that during August 2019, the Town started relying on its well sources to a greater degree due to frequent filter backwashing when using the Rainbow Lake source. Staff also noted that an 8-inch water line between the WTP and distribution system was taken out of service on December 20, 2019, although this old line's condition was poor, it is unlikely that it was contributing to the discolored water problems.

Only well 3 was in operation on the day of the tour of the WTP and, as a result, this was the only well sampled. A sample from the lake was obtained by Dan Fissel, by dipping directly at the lake's release structure. One combined (Lake/Well 3) water sample was also collected, representing the blended water being treated on that day. Two treated water samples (from the WTP) and three water samples from the distribution system were also collected and analyzed.

Results of Water Analysis

Results of the water quality tests, and the calculation of the water's stability, as it relates to corrosivity, indicate that both surface and ground water raw sources are very aggressive (corrosive) to metal pipe typically found in water distribution systems e.g. Cast Iron, Ductile Iron, Galvanized Steel, as well as water service lines made of iron, steel, copper, and lead.[1] Although there is iron and manganese in the source water, the treated water samples (taken at the WTP) indicate that the treatment system is capable of removing iron and manganese from the source water, suggesting that distribution system corrosion may be the primary cause of iron and manganese detected in the water distribution system samples - and by extension discolored water complaints.

Following treatment (pH and alkalinity adjustment) the corrosivity of the water is reduced but not eliminated. Although the WTP operators adjust chemical (soda ash) feed rates to increase the pH from 5.7 to above 8.0, the very low alkalinity and calcium hardness of the source water prevent stabilization of the treated water (so it is not corrosive). The operators focus on elevating the pH and alkalinity of the water but do not routinely calculate the corrosivity or scale forming potential of the water using stability indexes (Langelier or Ryznar Stability Index).

[1] Cement Lined Ductile Iron Pipe is generally resistant to corrosion and tuberculation associated with mildly aggressive water. Unlined cast iron pipe can corrode and develop tuberculation over time when the water is aggressive. It is not clear from this review to what extent the Town's water mains are Cement Lined Ductile iron pipe or unlined iron pipe.

In reviewing the WTP Monthly Operating Reports (MORs) from October, November, and part of December (until December 11) 2019, it appears that the pH of the water leaving the WTP ranged from 6.0 to 9.7 over a 72 day period.[2] The average pH of the water leaving the WTP during this 72 day period was 8.5. During the same time period the average pH of the distribution system (Town Sample on MOR) was 7.75. These pH values and their variation are shown on Exhibit 1. Based on raw water samples collected from Rainbow Lake and Well 3, the pH of saturation for the raw water is approximately 8.9. Although the pH of the water leaving the WTP averaged 8.5 in the 72-day period of review, pH values of samples taken from the distribution system averaged 7.75, well below the calculated pH where the water would be stable and noncorrosive.

To evaluate the stability of the water supply the Langelier Stability Index (LSI) was calculated using the source and treated water samples. Table 1 shows the results of the sample analysis and calculated LSI.[3] A negative LSI indicates the water is corrosive, the more negative the value the more aggressive or corrosive the water. A zero LSI indicates the water is non-corrosive and positive LSI indicate increased probability of the deposition of calcium carbonate ($CaCO_3$) films or scale in the water distribution system (water mains).

Table 1 - Town of Emmitsburg Water Samples Collected January 15, 2020

Sample Location	Manganese (mg/L)	Iron (mg/L)	Langelier Stability Index (LSI)	Alkalinity (mg/L)	Hardness (mg/L)	TDS (mg/L)	Conductivity (uS/cm)	pH (SU)	Temp (°C)
Rainbow Lake (Source)	0.073	1.20							
Combined Source (Source)	0.026	0.642	-3.44	30	32	65.4	100.1	5.7	9.5
Well #3 (Source)	< 0.001	< 0.025	-3.33	30	40	90.1	134.7	5.7	9.5
Plant Discharge (Treated)	0.019	< 0.025	-0.75	70	30	126.4	191.0	8.1	8.6
Tank Discharge (Treated)	0.020	< 0.025	-0.72	70	30	127.9	194.2	8.1	9.6
Irishtown Road (Distribution)	0.026	< 0.025							
Frailey Road Hydrant First Draw (Distribution)	0.796	2.81							
Frailey Road Hydrant (Distribution)	0.024	0.098							

Calcium carbonate film deposition can be used to reduce or control iron pipe corrosion on a long-term basis as long as it is carefully controlled and monitored. Based on the information gathered from the January 15, 2020, visit, it did not appear that the WTP operators are using water stability indices to refine their alkalinity and pH control strategies to deposit $CaCO_3$ films that could reduce iron pipe corrosion.

[2] A pH of 6.0 was recorded on October 29, 2019 and a pH of 9.7 was recorded on November 1, 2019. Corresponding (Town Distribution System) pH values on these days were 7.9 and 7.6 respectively.

[3] It should be noted that the LSI is not quantitative, it is a guide for estimating water treatment requirements to ensure the stability of water leaving the treatment plant and is a general indicator of the corrosivity of water.

It is important to note that if the water distribution system mains are severely tuberculated the ability to effectively deposit $CaCO_3$ films on the pipe wall to prevent corrosion can be very difficult. In cases where severe tuberculation has occurred, pipe cleaning and relining or replacement of the pipe may be necessary. Figure 1 below shows a severely tuberculated water line that was removed from the Rosemont, Maryland water distribution system during a line replacement project in 2013. Note the heavy iron oxide deposits inside the pipe. These deposits, if present in water mains, can be a primary cause of discolored water complaints.

Figure 1 - Tuberculated Water Line Removed from Rosemont Water Distribution System in 2013

Tuberculation of water mains also reduces hydraulic capacity, impacting the ability to deliver needed fire flows. As the cross sectional area of the pipe is reduced by the tuberculation, velocity through the pipe increases. When high flows occur the higher velocity can scour the deposits, contributing the pipe corrosion by-products into the water. Since condition of pipe interiors cannot always be determined from the exterior of the pipe (note the condition of the pipe in Figure 2 (Page 5) it had similar tuberculation to the pipe shown in Figure 1 above), removing and inspecting coupons from suspect pipe is often necessary. Each time a pipe is tapped for a new connection, where a coupon is removed, its location and condition should be documented, as well as verifying the existence of interior pipe coatings, including the presence of Calcium Carbonate ($CaCO_3$) films.

Figure 2 - Pipe Removed from Rosemont Water Distribution System in 2013 (Pipe Exterior)

Figure 3 - Section of Water Main Removed from Patrick Street near Court Street in the City of Frederick circa July 2005.

The turberculation of water mains is not uncommon in older water distribution systems. Figure 3 shows a section of pipe removed from the City of Frederick's water distribution system in 2005.

The tuberculation problem shown in Figure 3 was uncovered after deficiencies in the needed fire flow rate were detected at the Frederick County Court House.

Understanding the age of the water distribution system and what the piping material is composed of, in addition to the location of discolored water complaints, is key to identifying pipe segments that should be evaluated for possible tuberculation. If the Town does not already have one, it should develop an asset management database for its entire water distribution system. At a minimum, this database would identify the size, material of construction (including whether it is lined or unlined cast or ductile iron pipe), installation date, and any condition information that may exist (removed coupons, pipe sections) that provide an indication of the pipe condition at a certain point in time. Once assembled, this database can be used to establish the sections of the distribution system that should be evaluated further for tuberculation by removing coupons from the pipe to ascertain actual pipe condition. Once known, these sections of pipe can be programmed for cleaning and relining or replacement, depending on their location and comparative costs between these two options.

Recommendations

Based on the limited information obtained for this review, the County recommends that the Town consider taking a multi layered approach to begin addressing the discolored water problems. First and foremost, it is important to make sure that the discolored water issues are not an indicator of other potential future water quality problems.

The Town completed its last Lead and Copper Rule (LCR) compliance sampling and analysis this past year and based on the current reduced monitoring interval, the Town is not required to complete this type of analysis for another three years. In light of the current discolored water issues the Town should perform additional lead and copper sampling and analysis at least until two consecutive rounds of testing, one of which, occurring during the hottest month of the year, indicate that no increase is occurring in first draw lead and copper samples. If the results indicate that the level of lead and copper are increasing, but are still below Action Levels, testing should continue at least every six months or as directed by the Maryland Department of the Environment (MDE) until there is adequate data to demonstrate that levels will remain below Action Levels.

Before initiating additional lead and copper testing the Town should discuss this action with the MDE to ascertain whether it would recommend any changes to the testing frequency or sample locations. It is possible that with the changes to the WTP's corrosion control methodology, the MDE will also require additional lead and copper testing. They may also require additional data collection on the treated and source water.

The WTP operators should immediately begin daily testing of the raw and treated water for alkalinity, total hardness, Total Dissolved Solids (TDS) and pH to calculate the LSI of the water, which can help establish the target pH and alkalinity needed to produce a stable (non-corrosive)

water. The Town should contact the MDE and ascertain if it can stabilize the treated water above a pH of 8.5, a limit referenced in the Town's website information.[4] Further alkalinity adjustment at or above 8.5 on the water distribution system should be the target. This may require higher pH levels at the WTP, which may need to be approved by the MDE.

Daily stability index values should be used as guide to establish the optimum pH of the treated water going into the distribution system. I have included with this letter report a LSI calculation worksheet, which your operators may find helpful. To ensure that pH and alkalinity control is predictable, chemical feed (soda ash) solutions should be maintained precisely and metering pumps calibrated often. The Town may need to consider modifications to ensure adequate mixing at the soda ash chemical injection location. The difference between pH values at the WTP and in the distribution system may indicate incomplete or inadequate mixing of the treated water and soda ash. To minimize excess deposition of $CaCO_3$ at, or immediately downstream of the soda ash injection point, as a result of the higher LSI target pH value, the use of carrier water for the soda ash solution may be necessary.

In conjunction with the increased lead and copper testing, the Town should immediately consider incorporating the use of a blended polyphosphate corrosion inhibiting chemical, which in conjunction with the alkalinity and pH adjustment (soda ash feed) system can help inhibit corrosion of steel and iron pipe in the water distribution system and potentially, over extended use of the chemical, decrease some iron tuberculation in the water distribution system. The blended polyphosphate may also help reduce discolored water complaints, by sequestering iron and manganese that may be originating from the water distribution system. To realize the maximum benefit, well defined and recurring unidirectional distribution system flushing may be necessary in conjunction with the addition of phosphates corrosion inhibitors.

Before introducing a new treatment process, including the use of feeding a blended phosphate, the Town should discuss this treatment process change with the MDE and verify that a Water System Construction Permit is not needed to begin using this additional chemical.[5] The Town should contact its current chemical supplier and determine if it can provide an appropriate blended polyphosphate product as well as laboratory support and field services that can assist the Town in determining the efficacy of the product used.[6]

Once the initial actions outlined in this letter have been addressed, the Town should begin developing a water distribution system asset management system. This database can then be

[4] The Town's website includes information on the discolored water problem. Under the heading of Daily Logs for 22 East Main St. (October 1, 2019 – Dec. 11, 2019) bullet No. 2 suggests MDE has set a maximum pH of 8.5.
[5] Town staff indicated during the site visit that the WTP, as originally designed, included a phosphate chemical feed system. If this is the case, MDE may not require additional formal plan submission or a construction permit.
[6] If the Town's current treatment chemical supplier cannot offer these services, the Town may want to contact Carus Corporation, which has several polyphosphate chemicals and also provides laboratory support and field service assistance (Carus chemical information attached).

used to target areas of the water distribution system for further evaluation as to whether a tuberculation problem exists. If the results of that analysis indicate that there are areas with serious pipeline tuberculation, the Town can begin programming cleaning and relining or pipe replacement projects in its Capital Improvement Program. Less severe levels of tuberculation in the distribution system may be managed using blended phosphates. If the Town decides to use blended phosphates to reduce tuberculation, it should be done after treatability studies indicate that the product selected should have the desired effect.

To assist the Town with the additional recommended lead and copper analysis, the County's DUSWM laboratory is prepared to offer lead and copper testing services for the additional samples collected by the Town.

As mentioned, this report is not intended to replace a formal engineering analysis of the discolored water problems. The observations in this letter are suggestions only, based on the limited amount of information the County has had the opportunity to review. Should you have any questions about these suggestions, please feel free to call me at 301-600-1133.

Sincerely,

Michael G. Marschner
Deputy Chief Adminstrative Officer

Attachments:
Exhibit 1 – Town of Emmitsburg pH Vlaues
LSI Calculation Work Sheet
Blended Phosphate Information (Carus Corporation)

Pc: Mark Schweitzer (DUSWM)
Ken Orndorff (DUSWM)
Dan Fissel (Town of Emmitsburg)

Exhibit 1

Town of Emmitsburg pH Values
October 1, 2019 thru December 11, 2019[a]

	WTP pH		Distribution (Town) pH	
October 2019				
1	7.7		7.6	
2	7.7		7.7	
3	9.6		7.7	
4	7.8		7.6	
5	7.9		7.7	
6	7.9		7.7	
7	8.1		7.6	
8	8.1		7.6	
9	8.2		7.7	
10	8.9		7.8	
11	8.1		7.8	
12	8.3		7.7	
13	9.2		7.7	
14	7		7.7	
15	8.3		7.6	
16	9.1		7.6	
17	9		7.6	
18	9		7.6	
19	9.1		7.7	
20	9.2		8	
21	7.6		8	
22	7.4		7.6	
23	7.7		7.7	
24	9		7.7	
25	8.2		7.8	
26	9.2		7.8	
27	9		7.8	
28	9.2		8	
29	6		7.9	
30	7.2	Monthly Avg.	7.6	Monthly Avg.
31	8.7	**8.30**	7.6	**7.72**

	WTP pH		Distribution (Town) pH	
November 2019				
1	9.7		7.6	
2	9.2		7.6	
3	8.9		7.8	
4	8.6		7.9	
5	8.5		8	
6	8.5		7.9	
7	8.6		7.9	
8	7.7		7.8	
9	8.6		7.7	
10	8.7		7.7	
11	8.6		7.7	
12	9		7.6	
13	9.6		7.7	
14	9.4		7.7	
15	9.1		7.8	
16	8.2		7.6	
17	9.2		7.6	
18	8.6		7.6	
19	9.4		7.9	
20	8.9		8	
21	7.7		8	
22	7.1		7.8	
23	8.5		7.7	
24	9.4		7.7	
25	9.1		7.8	
26	9		7.8	
27	8.8		7.8	
28	9.1		7.8	
29	9	Monthly Avg.	8	Monthly Avg.
30	8	**8.76**	7.9	**7.78**
December 2019				
1	8		7.7	
2	8.8		7.7	
3	9		7.4	
4	9.3		7.5	
5	9.5		7.8	
6	8.9		7.7	
7	9		8	
8	7.5		8	
9	8		7.9	
10	8.6	11 Day Average	7.9	11 Day Average
11	8.3	**8.63**	7.8	**7.76**

72 Day Average	**8.54**	**7.75**
72 Day Maximum	**9.70**	**8.00**
72 Day Minimum	**6.00**	**7.40**

[a] Source Emmitsburg WTP Monthly Operating Reports

Frederick County Division of Utilities & Solid Waste Management

Langelier Index Calculation Work Sheet

Water System: _____ Water Source: _____ Date: _____

Calcium Hardness (mg/l): _____ Total Alkalinity (mg/l): _____ Temperature (Deg. C): _____

Total Dissolved Solids (mg/l): _____ pH (Raw Water): _____ pH (Treated Water): _____

$$pHs = A + B - C - D$$

Where:

"A" = Temperature Constant obtained from Table 1 based on measured temperature of water sample.

"B" = Ionic Strength Correction Constant obtained from Table 2 based on the TDS of the water sample.

"C" = Calcium Hardness in mg/l $CaCO_3$. (Use Table 3 for $CaCO_3$ equivalence determination)

"D" = Total Alkalinity expressed in mg/l $CaCO_3$. (Use Table 3 for $CaCO_3$ equivalence determination)

Therefore:

$$pHs = \underset{(A)}{\_\_\_\_} + \underset{(B)}{\_\_\_\_} - \underset{(C)}{\_\_\_\_} - \underset{(D)}{\_\_\_\_}$$

$$LI = \underset{(pH)}{\_\_\_\_} - \underset{(pHs)}{\_\_\_\_}$$

$$LI = \_\_\_\_$$

Note: Use Instructions and Tables on the back of this form to calculate the Langelier Index (LI) of treated water supplies.

Interpretation:
The Langelier Index (LI) is a gauge of whether a water will precipitate or dissolve calcium carbonate. If the pHs is equal to the actual pH, the water is considered "balanced." This means that calcium carbonate will not be dissolved or precipitated. If the pHs is less than the actual pH (the LI is a positive number), the water will tend to deposit calcium carbonate and is scale forming and is considered nonaggressive. If the pHs is greater than the actual pH (the LI is a negative number), the water is not saturated and will dissolved calcium carbonate and is therefore considered aggressive. **Operators should strive to maintain a LI of zero which indicates a chemically balanced water supply.**

Table 1

Temp. Deg. C	Constant A
0	2.60
4	2.50
8	2.40
12	2.30
16	2.20
20	2.10
25	2.00
30	1.90
40	1.70
50	1.55
60	1.40
70	1.25
80	1.15

Table 2

TDS mg/l	Constant B
0	9.70
100	9.77
200	9.83
400	9.86
600	9.89
1000	9.90

Table 3

Ca Hardness & Total Alkalinity mg/l CaCO3	Constant C and D
10	1.00
20	1.30
30	1.48
40	1.60
50	1.70
60	1.78
70	1.84
80	1.90
100	2.00
200	2.30
300	2.48
400	2.60
500	2.70
600	2.78
700	2.84
800	2.90
900	2.95
1000	3.00

NOTE: Factor C is the logarithm (base 10) of the calcium hardness expressed in mg/l.

NOTE: Factor D is the logarithm (base 10) of the total alkalinity expressed in mg/l.

Instructions:

Prepare form 805 by collecting treated water quality data for Calcium Hardness, Total Alkalinity, Temperature, Total Dissolved Solids, and pH. Document this water quality data in the spaces provided on this form.

Calculate the pHs using the formula shown on the front of the form (Use Tables 1 through 3 to obtain necessary constants).

Calculate Langelier Index (LI) of treated water. If "LI" is positive number reduce alkali chemical feed dosage to obtain Calcium Carbonate equilibrium. If "LI" is negative number increase alkali chemical feed to obtain Calcium Carbonate equilibrium.

Treated water pH should be as close to pHs as possible to maintain a nonaggressive water supply.

CARUS
WATER



Municipal Drinking Water

AQUA MAG® BLENDED PHOSPHATE
DATA SHEET

SHIPPING CONTAINERS

5-gallon (57-lb) Jerrican
Made of high density polyethylene (HDPE). Weighs 3.0 lb (1.36 kg).
The net weight is 57 lb (25.85 kg).

15-gallon (171-lb) Drum
Made of high density polyethylene (HDPE). Weighs 6.5 lb (3.0 kg).
The net weight is 171 lb (77.6 kg).

30-gallon (342-lb) Drum
Made of high density polyethylene (HDPE). Weighs 14 lb (6.35 kg).
The net weight is 342 lb (155 kg).

55-gallon (627-lb) Drum
Made of high density polyethylene (HDPE). Weighs 21 lb (9.5 kg).
The net weight is 627 lb (284 kg).

SHIPPING CONTAINERS CONT.

275-gallon IBC (Intermediate Bulk Container)
Weighs 129 lb (58.5 kg). The net weight is 3135 lb (1,422 kg). The IBC has a 2 in. butterfly valve with NPT threads in bottom sump.

Bulk quantities up to 4150 gallons are available.

Other containers may be available, contact Carus Corporation at 800-435-6856 for details.

CARUS VALUE ADDED

LABORATORY SUPPORT
Carus Corporation has technical assistance available to answer questions, evaluate treatment alternatives, and perform laboratory testing. Our laboratory capabilities include: Consulting, Treatability Studies, Feasibility Studies, and Analytical Services.

FIELD SERVICES
As an integral part of our technical support, Carus provides extensive on-site treatment assistance. We offer full application services, including technical expertise, supervision, testing, and feed equipment design and installation in order to accomplish a successful evaluation and/or application.

CARUS CORPORATION
During its more than 97-year history, Carus' ongoing emphasis on research and development, technical support, and customer service has enabled the company to become the world leader in permanganate, manganese, oxidation, and base-metal catalyst technologies.

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WATER



Municipal Drinking Water

AQUA MAG® BLENDED PHOSPHATE
DATA SHEET

AQUA MAG® blended phosphate is the premier corrosion inhibitor and sequesterant for use in potable and industrial water systems. The product is a liquid concentrate of exceptional purity, clarity, and stability utilizing a broad spectrum of phosphates for better sequestering and corrosion control.

BENEFITS OF AQUA MAG

• Inhibits corrosion of steel distribution system water lines, iron and galvanized piping, and lead and copper plumbing

• Decreases iron tuberculation to extend the life of the distribution system

• Inhibits lead and copper leaching resulting in lower lead and copper levels in the delivered potable water

• Minimizes the occurrence of microbial-influenced corrosion providing longer life system

• Controls iron and manganese minimizing rusty and dirty water in the system

• Reduces discoloration, staining, and mineral build-up resulting in fewer customer complaints

• Diminishes calcium scale deposits typically seen in hot water lines and heaters

• Saves money by reducing corrosion and scale; lowering chlorine demand and decreasing hydrant flushing, leaks, and failures

PROPERTIES AND CERTIFICATIONS

Description:	Clear homogenous liquid
Viscosity:	< 2 cps at 70° F
Freezing Point:	< 38° F
Specific Gravity:	1.34-1.40
pH (1% w:w):	6.0 ± 0.5

NSF

Certified U Kosher Pareve

NSF/ANSI Standard 60, Kosher Approved
Conforms to 21 CFR, Section 182 and 184 (USDA)

HANDLING AND STORAGE

AQUA MAG blended phosphate should be handled with care. Wear proper protective equipment including goggles, face shield, apron, respirator and proper gloves when handling this product.

Protect containers from physical damage. Store in a cool, dry area in closed containers. In case of accidental release: contain spill by collecting the liquid in a pit or holding behind a dam (sand or soil). Absorb with inert media and dispose of properly. Disposal of all materials shall be in full and strict compliance with federal, state, and local regulations. Consult the MSDS for additional safety and handling information.

SHIPPING

AQUA MAG blended phosphate is generally considered to be safe and is not classified as hazardous according the US Department of Transportation, Canada TDG, UN, IMDG, or IATA regulations.

COMPATIBILITY INFORMATION

AQUA MAG blended phosphate can be stored in high-medium density polyethylene, cross-linked polyethylene, fiberglass reinforced plastic, 316 stainless steel, and glass lined/epoxy lined steel tanks. Piping materials may include schedule 80 PVC/CPVC piping, clear PVC, and white polyethylene tubing. Pump materials may include ceramic, Teflon, viton, hypalon and PVC liquid end pump materials.

Metering equipment can include diaphragm and peristaltic type metering pumps and other pumps meeting compatibility requirements.

It is not compatible with black iron, mild steel, galvanized metals, aluminum, zinc, copper, lead, brass, bronze, tin, and other base metals.

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DRINKING WATER

DATA SHEET

SHIPPING CONTAINERS

5-gallon (58-lb) Jerrican
(UN Specification: UN3H1/Y1.8/100) Made of high density polyethylene (HDPE). Weighs 3.0 lb (1.36 kg). **The net weight is 58 lb (26.3 kg).**

15-gallon (174-lb) Drum
(UN Specification: UN1H1/Y1.8/100) Made of high density polyethylene (HDPE). Weighs 6.5 lb (3.0 kg). **The net weight is 174 lb (78.9 kg).**

30-gallon (348-lb) Drum
(UN Specification: UN1H1/Y1.8/100) Made of high density polyethylene (HDPE). Weighs 14 lb (6.35 kg). **The net weight is 348 lb (157.8 kg).**

55-gallon (638-lb) Drum
(UN Specification: UN1H1/Y1.8/100) Made of high density polyethylene (HDPE). Weighs 21 lb (9.5 kg). **The net weight is 638 lb (289.4 kg).**

SHIPPING CONTAINERS CONT.

275-gallon IBC (Intermediate Bulk Container)
(UN Specification: UN31HA1/Y1.9/100) Weighs 129 lb (58.5 kg). The net weight is 3190 lb (1447 kg). The IBC has a 2 in. butterfly valve with NPT threads in bottom sump.

Bulk Quantities up to 3500 gallons are available.

Other containers may be available, contact Carus Corporation at 800-435-6856 for details.

CARUS VALUE ADDED

LABORATORY SUPPORT

Carus Corporation has technical assistance available to answer questions, evaluate treatment alternatives, and perform laboratory testing. Our laboratory capabilities include: Consulting, Treatability Studies, Feasibility Studies, and Analytical Services.

FIELD SERVICES

As an integral part of our technical support, Carus provides extensive on-site treatment assistance. We offer full application services, including technical expertise, supervision, testing, and feed equipment design and installation in order to accomplish a successful evaluation and/or application.

CARUS CORPORATION

During its more than 90-year history Carus' ongoing emphasis on research and development, technical support, and customer service has enabled the company to become the world leader in permanganate, manganese, oxidation, and base-metal catalyst technologies.

CARUS

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Responsible Care® Good Chemistry at Work

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Form PH 12471

CARUS™ 1000 Water Treatment Chemical

DATA SHEET

CARUS™ 1000 water treatment chemical is an effective sequesterant for use in potable and industrial water systems. The product is a liquid concentrate of exceptional purity, clarity, and stability.

BENEFITS OF CARUS™ 1000

•Controls iron and manganese minimizing rusty and dirty water in the system

•Inhibits corrosion of steel distribution system water lines, iron and galvanized piping, and lead and copper plumbing

•Diminshes calcium scale deposits typically seen in hot water lines and heaters

•Reduces discoloration, staining, and mineral build-up resulting in fewer customer complaints

•Lowers chlorine demand and improves disinfection within the distribution system

•Saves money by reducing corrosion and decreasing hydrant flushing, leaks, and failures.

PROPERTIES AND CERTIFICATIONS

Description:	Clear homogenous liquid
Specific Gravity:	1.36-1.42
pH:	6.4 ± 0.5
NSF Maximum Feed Rate:	28 mg/L
NSF/ANSI Standard 60	

Certified
Kosher Pareve

HANDLING AND STORAGE

CARUS™ 1000 water treatment chemical should be handled with care. Wear proper protective equipment including goggles, face shield, apron, respirator and proper gloves when handling this product.

Protect containers from physical damage. Store in a cool, dry area in closed containers. In case of accidental release: contain spill by collecting the liquid in a pit or holding behind a dam (sand or soil). Absorb with inert media and dispose of properly. Disposal of all materials shall be in full and strict compliance with federal, state, and local regulations Consult the MSDS for additional safety information.

SHIPPING

CARUS™ 1000 water treatment chemical is generally considered to be safe and is not classified as hazardous according the US Department of Transportation, Canada TDG, UN, IMDG, or IATA regulations.

COMPATIBILITY INFORMATION

CARUS™ 1000 water treatment chemical can be stored in high-medium density polyethylene, cross-linked polyethylene, fiberglass reinforced plastic, 316 stainless steel, glass lined /epoxy lined steel tanks. Piping materials may include schedule 80 PVC/CPVC piping, clear PVC, and white polyethylene tubing. Pump materials may include ceramic, Teflon, viton, hypalon and PVC liquid end pump materials.

Metering equipment can include diaphragm and peristaltic type metering pumps and other pumps meeting compatibility requirements.

It is not compatible with black iron, mild steel, galvanized metals, aluminum, zinc, copper, lead. brass, bronze, tin, and other base metals.

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Certified Company

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CARUS WATER



Municipal Drinking Water

AQUA MAG® BLENDED PHOSPHATE
DATA SHEET

AQUA MAG® blended phosphate is the premier corrosion inhibitor and sequesterant for use in potable and industrial water systems. The product is a liquid concentrate of exceptional purity, clarity, and stability utilizing a broad spectrum of phosphates for better sequestering and corrosion control.

BENEFITS OF AQUA MAG

• Inhibits corrosion of steel distribution system water lines, iron and galvanized piping, and lead and copper plumbing

• Decreases iron tuberculation to extend the life of the distribution system

• Inhibits lead and copper leaching resulting in lower lead and copper levels in the delivered potable water

• Minimizes the occurrence of microbial-influenced corrosion providing longer life system

• Controls iron and manganese minimizing rusty and dirty water in the system

• Reduces discoloration, staining, and mineral build-up resulting in fewer customer complaints

• Diminishes calcium scale deposits typically seen in hot water lines and heaters

• Saves money by reducing corrosion and scale; lowering chlorine demand and decreasing hydrant flushing, leaks, and failures

PROPERTIES AND CERTIFICATIONS

Description:	Clear homogenous liquid
Viscosity:	< 2 cps at 70° F
Freezing Point:	< 38° F
Specific Gravity:	1.34-1.40
pH (1% w:w):	6.0 ± 0.5

NSF Certified U Kosher Parve

NSF/ANSI Standard 60, Kosher Approved
Conforms to 21 CFR, Section 182 and 184 (USDA)

HANDLING AND STORAGE

AQUA MAG blended phosphate should be handled with care. Wear proper protective equipment including goggles, face shield, apron, respirator and proper gloves when handling this product.

Protect containers from physical damage. Store in a cool, dry area in closed containers. In case of accidental release: contain spill by collecting the liquid in a pit or holding behind a dam (sand or soil). Absorb with inert media and dispose of properly. Disposal of all materials shall be in full and strict compliance with federal, state, and local regulations. Consult the MSDS for additional safety and handling information.

SHIPPING

AQUA MAG blended phosphate is generally considered to be safe and is not classified as hazardous according the US Department of Transportation, Canada TDG, UN, IMDG, or IATA regulations.

COMPATIBILITY INFORMATION

AQUA MAG blended phosphate can be stored in high-medium density polyethylene, cross-linked polyethylene, fiberglass reinforced plastic, 316 stainless steel, and glass lined/epoxy lined steel tanks. Piping materials may include schedule 80 PVC/CPVC piping, clear PVC, and white polyethylene tubing. Pump materials may include ceramic, Teflon, viton, hypalon and PVC liquid end pump materials.

Metering equipment can include diaphragm and peristaltic type metering pumps and other pumps meeting compatibility requirements.

It is not compatible with black iron, mild steel, galvanized metals, aluminum, zinc, copper, lead, brass, bronze, tin, and other base metals.

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form PH 15100

CARUS
WATER



Municipal Drinking Water

AQUA MAG® BLENDED PHOSPHATE
DATA SHEET

SHIPPING CONTAINERS

5-gallon (57-lb) Jerrican
Made of high density polyethylene (HDPE). Weighs 3.0 lb (1.36 kg).
The net weight is 57 lb (25.85 kg).

15-gallon (171-lb) Drum
Made of high density polyethylene (HDPE). Weighs 6.5 lb (3.0 kg).
The net weight is 171 lb (77.6 kg).

30-gallon (342-lb) Drum
Made of high density polyethylene (HDPE). Weighs 14 lb (6.35 kg).
The net weight is 342 lb (155 kg).

55-gallon (627-lb) Drum
Made of high density polyethylene (HDPE). Weighs 21 lb (9.5 kg).
The net weight is 627 lb (284 kg).

SHIPPING CONTAINERS CONT.

275-gallon IBC (Intermediate Bulk Container)
Weighs 129 lb (58.5 kg). The net weight is 3135 lb (1,422 kg). The IBC has a 2 in. butterfly valve with NPT threads in bottom sump.

Bulk quantities up to 4150 gallons are available.

Other containers may be available, contact Carus Corporation at 800-435-6856 for details.

CARUS VALUE ADDED

LABORATORY SUPPORT

Carus Corporation has technical assistance available to answer questions, evaluate treatment alternatives, and perform laboratory testing. Our laboratory capabilities include: Consulting, Treatability Studies, Feasibility Studies, and Analytical Services.

FIELD SERVICES

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