Highlights of Investigation of Sodium and Chloride in the Water Supply, Redding Elementary School, prepared by WSP USA

Investigation undertaken to

- Attempt to identify the source of excessive sodium and chloride concentrations in Well 2 at Redding Elementary School
- Provide potential options to improve the quality of the water supplied to the school

Existing System:

- The existing water-supply system consists of two bedrock water-supply wells (Well 1 and Well 2), a 10,000-gallon atmospheric storage tank and two re-pressurization transfer pumps.
- Water treatment includes the injection of sodium hypochlorite for disinfection and iron filtration to reduce the iron concentration in the water supply. The sodium hypochlorite is injected prior to the atmospheric storage tank and the iron filtration is located after the atmospheric storage tank.
- The iron filtration consists of two 20 cubic-foot mixed bed iron filters with one iron filter being located in a pit on the exterior of the school and the other iron filter being located in the boiler room. The iron filters utilize a backwash feature to allow for media regeneration and the backwash water is directed to the onsite septic system that serves the school
- The school currently uses bottled water to meet the consumptive demand for the school (drinking and food preparation) and utilizes the onsite bedrock water-supply system for sanitary purposes.
- Maintenance activities for the water-supply system include quarterly cleaning of the 10,000-gallon storage tank to remove sediment/particles that have settled in the bottom of the storage tank.
- With regard to the iron filters, the media within the vessels has not been changed-out within the last 10 years. Typically, in many situations the recommended media change-out frequency is five to seven years.
- Well 2 was deactivated during November 2016 due to elevated chloride levels and Well 1 is the sole source that is supplying potable water to the school.
- The water quality concerns that were evaluated as part of this investigation include sodium, chloride, lead, copper, turbidity, iron and manganese.
- The sodium and chloride were investigated because elevated concentrations were detected in Well 2. Elevated concentrations of sodium and chloride in a water supply can result in corrosion of the plumbing system.

- Lead and copper were investigated to determine if the sodium and chloride in the water supply have had a corrosive effect on the plumbing system within the school.
- The turbidity, iron and manganese were evaluated because these parameters have been detected at concentrations that exceed regulatory limits in raw water samples from Well 1 and Well 2. The focus of the turbidity, iron and manganese evaluation was to determine if the existing iron filtration system is effective at improving the water quality and to make recommendations for improvement.

Water Quality

- Water-quality samples have been collected from Well 1 and Well 2 and from sampling points within the school, and then analyzed for physical parameters and inorganic compounds; of particular interest being sodium, chloride, lead, copper, turbidity, iron and manganese:

TABLE 1

REDDING ELEMENTARY SCHOOL
REDDING, CONNECTICUT

Summary of Groundwater Quality Results

Location	Sample Date	Sodium (mg/l)	Chloride (mg/l)	Manganese (mg/l)	Iron (mg/l)	Turbidity (NTUs)
RES - Well 1	9/6/2016	23	124	0.88	4.38	42.20
	11/8/2016	25.3	127	NS	NS	NS
	1/5/2017	29.1	145	NS	NS	NS
	1/9/2017	29.7	NS	NS	NS	NS
	1/27/2017	30.2	NS	NS	NS	NS
	3/1/2017	31.8	173.6	NS	NS	NS
	3/27/2017	34.3	171.0	NS	NS	NS
	3/12/2018	36.0	124	0.9	4.90	13.10
RES - Well 2	9/6/2016	63.9	319	0.49	5.81	73.50
	11/8/2016	56.9	239	NS	NS	NS
	1/5/2017	81.1	238	NS	NS	NS
	1/9/2017	72.6	NS	NS	NS	NS
	1/27/2017	94.1	NS	NS	NS	NS
	3/1/2017	123.6	441.5	NS	NS	NS
	3/27/2017	157	535	NS	NS	NS
	3/12/2018	117	393	0.04	3.90	41.30
	US EPA MCL	NE	250	NA	NA	5.00
	US EPA SMCL	NA	NA	0.05	0.30	NA
	CTDPH Notification Level	28	NA	NA	NA	NA
	CTDPH Guidance Level	100	NE	0.05	0.20	NE

*	No established MCL for Copper and Lead. Action Levels represented.
NTU	Nephelometric Turbidity Unit
mg/l	Milligrams per liter
US EPA	United States Environmental Protection Agency
CTDPH	Connecticut Department of Public Health
MCL	Maximum Contaminant Level
SMCL	Secondary Maximum Contaminant Level
NS	Not Sampled
NE	Not regulated under this criteria.
NA	Not Applicable

H:\Redding Elementary School\RES - Well Summary - Table 1.docx

- The sodium concentrations that have been detected in Well 1 are less than the CTDPH Guidance level but exceed the Notification Level.

- The chloride concentrations that have been detected in Well 1 have been gradually increasing since 2016 but do not exceed the maximum contaminant level (MCL) for chloride (250 mg/l).
- The sodium concentrations that have been detected in Well 2 have been gradually increasing since September, 2016 from 63.9 mg/l to a high of 157 mg/l (March, 2017), 2017, with the most recent detection of being 117 mg/l (March, 2018), exceeding the CTDPH Notification Level, and at times, the CTDPH Guidance Level.
- The chloride concentrations in Well 2 have been detected at concentrations ranging between 238 mg/l to 535 mg/l, which exceeds the MCL.
- Within the building, sodium levels are less than the CTDPH Guidance level but exceed the Notification Level. Chloride levels have varied and have occasionally exceeded the MCL.
- Turbidity, iron, and manganese levels exceed the MCL in both wells. Within the building, iron and manganese levels do not exceed the MCL, but they exceed the Secondary Maximum Contaminant level (SMCL)
- MCLs relate to potential adverse health effects. SMCLs relate to aesthetic issues (such as color and odor).
- A sample from the Redding Department of Public Works (800 feet to the southwest of the school) has sodium and chloride concentrations that are less than the CTDPH Notification and Guidance levels. Turbidity, iron, and manganese levels exceed the MCL.

Potential Sources of Sodium and Chloride

- Sodium and chloride occur naturally in groundwater.
- Sources of elevated concentrations can include salt storage, road salting, and backwash water from water softeners
- There is a salt storage facility approximately 800 feet to the southwest
- Road salt is applied to parking areas and Route 107 (approximately 500 feet to the east)
- No awareness of water softeners in the area but it cannot be ruled out
- Based on the site inspection and review of the available data, it is not possible to identify any of the sources as the primary source
- Based on experience with other properties, salt storage facilities are typically significant sources of excessive sodium and chloride in groundwater

Options to Improve Water Quality

- Install water treatment equipment to reduce the sodium and chloride
    - Estimated cost to install: minimum of $50,000
    - Estimated operational costs: $2,250 to $4,500 daily for offsite disposal

- Install water treatment equipment to mitigate potential corrosive effects to the distribution system from the groundwater
    - Intended to prevent leaks and potential leaching of lead and copper
    - Estimated cost to install: $10,000 to $20,000
- Install water treatment equipment to reduce turbidity, iron and manganese
    - Estimated cost to install new filter: $7,500 to $12,500
    - Estimated cost to install leaching system: TBD (plans and specifications are complete)
- Locate and drill a new water-supply well
    - Estimated cost to install and connect new well: $87,500+ to $130,000+
    - Caveats: new well may not have sufficient yield or acceptable water quality. Water quality may also degrade over time.
    - Minimum cost to assess yield and quality: $17,500 to $25,000
- Connect to a public water supply system
    - Construction costs estimated at $1,320,000 to $2,640,000 per mile to connect
- Reduce the level of salt application to the parking lots, walkways, and Lonetown Road

Conclusions

1. RES currently provides bottled water for consumptive purposes. This action is voluntary.
2. The water supplied from Well 1 meets all MCLs with the exception of turbidity; however, iron and manganese have been detected at concentrations that exceed the SMCL and sodium has been detected at a concentration that exceeds the CTDPH Notification Level.
3. The water supplied from Well 2 exceeds the MCLs for chloride and turbidity, the CTDPH Guidance Level and Notification Level for sodium and the SMCLs for iron and manganese.
4. The concentrations of sodium and chloride in Well 1 have been increasing since 2016.
5. Water samples collected from the distribution system within the school verify that the water in the distribution system is potable; however, exceedances of the SMCL for iron and manganese have been recently detected.
6. Installation of a water treatment system to reduce sodium and chloride is considered less desirable because of the potential to cost and impact to offsite water-supply wells from any backwash.
7. Extension of the water main from a public water supplier is considered less desirable because of the cost associated with extending a water main.
8. The drilling of a new bedrock water-supply well is a potential option to improve the quality of the water supplied to the school. However, there are uncertainties associated with this approach. It cannot be determined without drilling and testing the water supply well if this option is feasible relative to obtaining the desired yield and quality. In addition, it cannot be determined if operating the new water-supply well over time would induce groundwater with larger concentrations of sodium and chloride to the new well.

The cost associated with connecting a new bedrock water-supply well would need to be further evaluated to develop a precise estimate.

9. The installation of a corrosion control system could be considered as a protective measure against the future potential for corrosion of the existing distribution system.
10. Turbidity, iron and manganese are settling in the 10,000-gallon atmospheric storage tank which results in the need for quarterly cleaning. In addition, the existing iron filters may not be functioning properly and the filter media has not been changed-out in over 10 years.
11. A leaching area that can accept the backwash water from water treatment equipment has been identified, and tested and determined to have adequate capacity to accept backwash water from a new iron filter.

Recommendations

1. Consideration should be given toward the drilling and testing of a new bedrock water-supply well.
2. A corrosion control system should be installed on the existing water-supply system.
3. Additional water samples to evaluate corrosive potential of the water supplied to the school should be collected.
4. Cost proposals from contractors should be obtained to determine the cost to install the leaching system that can accept backwash water from water treatment equipment.
5. Cost proposals for the installation of an iron filter that is located before the 10,000-gallon atmospheric storage tank should be obtained.
6. The existing iron filters should be disconnected from the water supply system as part of installing a new iron filter.

Facilities Committee Input:

- Remediation activities should be considered against the cost/benefits of continuing the existing usage of bottle water for consumptive purposes (~$7,000 annual cost).
- Drilling a new well costs a minimum of $17,500 to $25,000 to evaluate the well, and another $70,000+ to $100,000+ to connect, with no guarantee of long-term resolution
- Water treatment equipment to reduce sodium and chloride, and connection to a water main, are cost–prohibitive and should not be pursued.
- Additional remediation efforts to reduce turbidity, iron, and manganese ($7,500 to $12,500 + installation of leaching system) should be pursued (reduces impact on distribution system, corrects code issue with cross-connection, extends life of septic field, reduces maintenance costs).
- Have professional firm evaluate building water distribution system to provide recommendations related to possible corrosion of the distribution system.

- Subject to the results of the evaluation, water treatment equipment to control corrosion should be pursued to protect the distribution system since the well water will continue to be used for sanitary purposes