Pilot Study Report

for

Z-92®/Z-33™ Uranium-Arsenic Treatment Process

conducted for

Schurz Elementary School
Schurz, Nevada

February 19, 2010

WATER REMEDIATION TECHNOLOGY, LLC
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Executive Summary

This uranium, arsenic and gross alpha removal pilot study was conducted for the Schurz Elementary School treatment facility in Schurz, Nevada. The Schurz Elementary School well contains concentrations of uranium, arsenic and gross alpha in excess of the State regulated Maximum Contaminant Levels (MCL).

Schurz Elementary School selected Water Remediation Technology's (WRT) Z-92®/Z-33™ Uranium-Arsenic Treatment Process as a possible cost effective solution for their contaminant problems. WRT provided a Z-92® pilot system sized for 1.5 GPM (gallons per minute), which was delivered and installed on November 17, 2009.

The purpose of this pilot study was to document the effectiveness of the WRT Z-92®/Z-33™ media treatment process on elevated uranium, arsenic and gross alpha drinking water and to provide information necessary to meet regulatory compliance for these contaminants.

The treatment system successfully treated the well supply water and met uranium, arsenic and gross alpha compliance at all times during the arsenic pilot study. The pilot system was in operation for 58 days. Eight (8) sample sets were collected and analyzed January 13, 2010. The pilot study test apparatus at all times effectively reduced the level of uranium, and arsenic and gross alpha (Figures 1, 2 and 3) to less than the MCL.

Uranium, arsenic and gross alpha discharge from all final samples tested well below the MCL. Recovery remained high for all samples taken. At the time of the last sample collection date, approximately 15,400 bed volumes were processed before the termination of the pilot test.

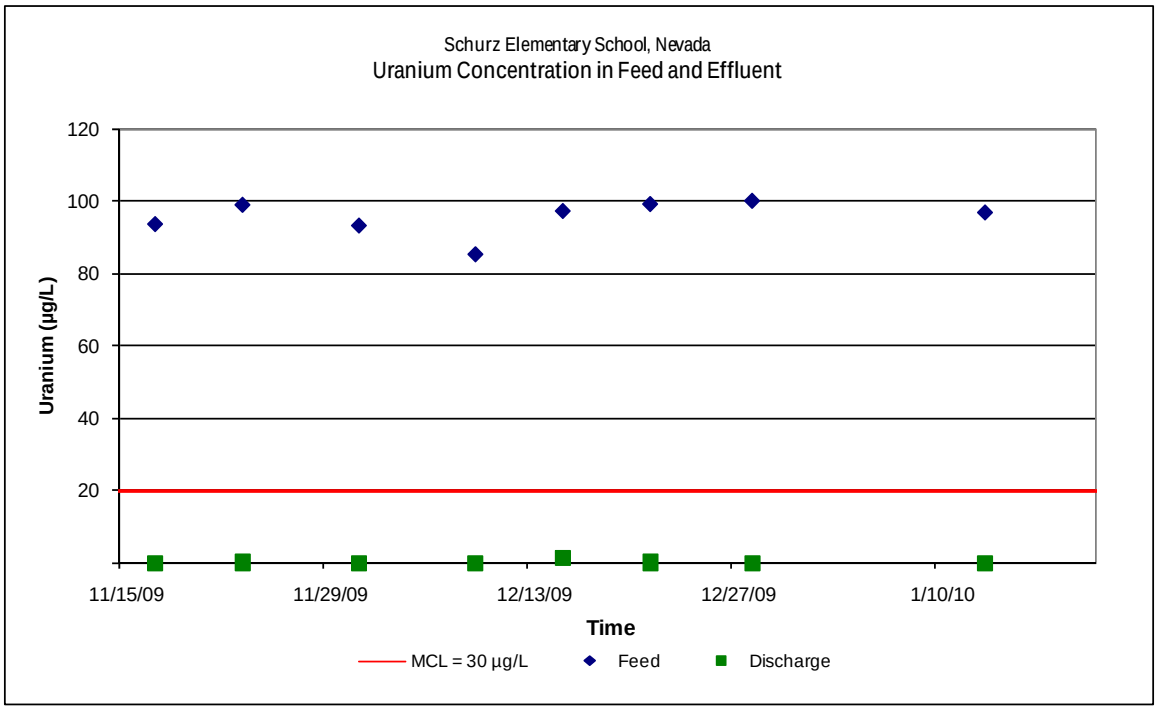

Figure 1

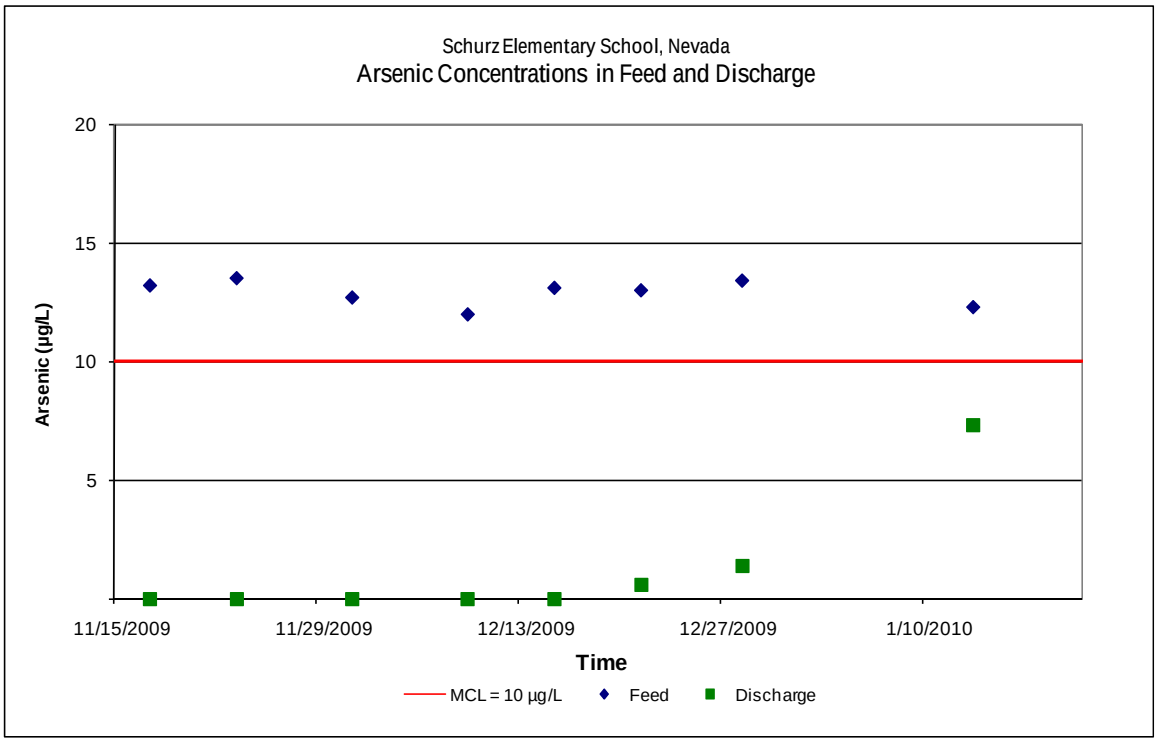

Figure 2

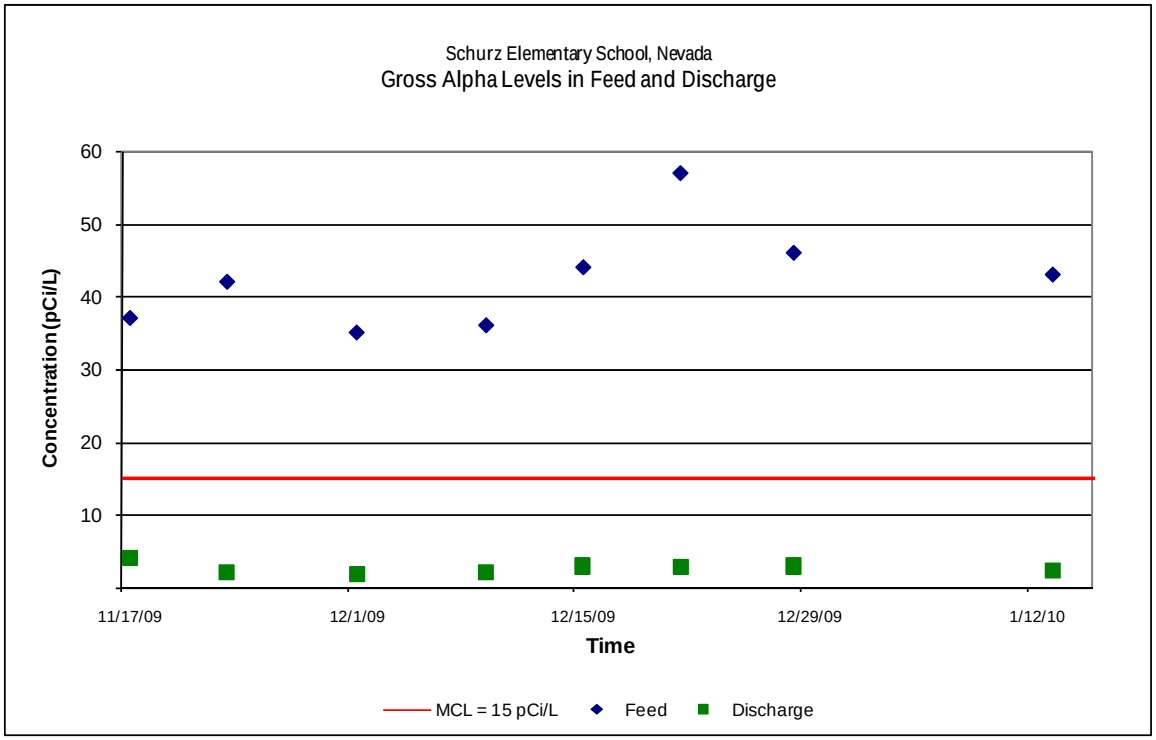
Schurz Elementary School, Nevada
Gross Alpha Levels in Feed and Discharge
Concentration (pCi/L)
60
50
40
30
20
10
11/17/09
12/1/09
12/15/09
12/29/09
1/12/10
Time
MCL = 15 pCi/L
Feed
Discharge

Figure 3

The results are also shown in Table 1. The average feed concentration of uranium 95.4 µg/L, was reduced to an average of less than 0.2 µg/L, well below the MCL of 30 µg/L. The average feed of arsenic, 12.9 µg/L, was reduced to an average of less than 1.2 µg/L, well below the MCL of 10 µg/L. The average feed of gross alpha, 42.5 pCi/L was reduced to an average of 2.6 pCi/L, well below the MCL of 15 pCi/L.

Table 1. Uranium, arsenic and gross alpha levels in feed and discharge water.

Uranium	Feed (µG/L)	Discharge @ Column 2 (µG/L)
Uranium MCL	**—**	**30.0**
Average	95.4	0.2
Highest value	99.9	1.3
Lowest Value	85.2	0.0
Arsenic	**Feed (µg/L)**	**Discharge @ Column 2 (µg/L)**
Arsenic MCL	**—**	**10.0**
Average	12.9	1.2
Highest value	13.5	7.3
Lowest Value	12.0	0.0
Gross Alpha	**Feed (pCi/L)**	**Discharge @ Column 2 (pCi/L)**
Gross Alpha MCL	**—**	**15.0**
Average	42.5	2.6
Highest value	57.0	4.0
Lowest Value	35.0	1.8

Application Information

The Schurz Elementary School treatment facility is located Schurz, Nevada, approximately 100 miles southeast of Reno. Schurz Elementary School serves grades K-8 in the Mineral County School District. Water is supplied to approximately 200 children, faculty and staff members. This well roduces an average of 15 to 25 gallons per minute.

Technology Overview

Water Remediation Technology's (WRT) Z-92®/Z-33™ Uranium-Arsenic Treatment Process utilizes proprietary ion exchange media in a series of down-flow treatment vessels to remove uranium, arsenic and gross alpha from drinking water. The water is moved through the treatment system using the water pressure generated from the well source. No chemicals are added to the water for the treatment process. After the media is loaded with uranium, arsenic and gross alpha contaminant, it is removed from the circuit and permanently disposed of in a licensed facility. WRT designs, manufactures and provides the equipment and media used in the facility. The handling and exchange of new media to replace spent media, as well as the shipping and disposal into licensed disposal sites, is handled by WRT. The Z-92®/Z-33™ treatment media is ANSI/NSF Standard 61 certified for use in drinking water.

Equipment Overview

The WRT Z-92®/Z-33™ pilot system used for this pilot study consists of two (2) 6-inch diameter by 3-foot 4-inch vertical height columns each containing approximately 30-inches of an uranium-arsenic Z-92®/Z-33™ media. The columns in the pilot unit are clear for visual observation of the media and process. The source water enters the unit through a ¾-inch diameter hose, passes through a control valve and flow meter, and enters the top of the first Z-92®/Z-33™ column. All Z-92®/Z-33™ columns operate in a down-flow configuration, with the flow exiting the bottom of the first column, then following the same flow path through columns 2 in series (see Figure 4). Sample ports are located prior to the first column, and after each of the columns in the series.

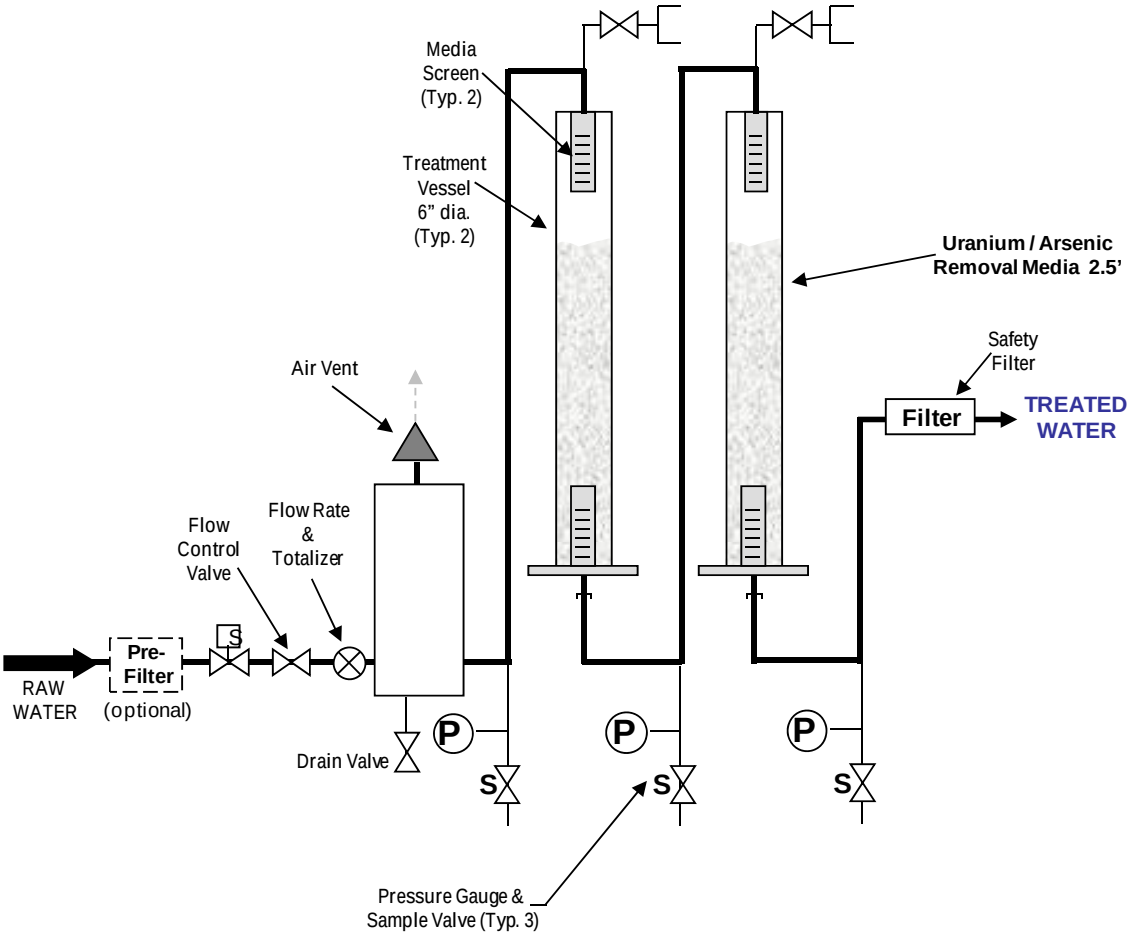

Figure 4. Simplified Process Flow Diagram.

Schurz Elementary School's
Z-92®/Z-33™ treatment system.

Statement of Purpose

The uranium levels in the raw water tested as high as 99.90 µg/L, averaging 95.4 µg/L. Arsenic levels in the raw water during the pilot study were as high as 13.5 µg/L and averaged 12.9 µg/L during the testing. Gross alpha levels in the raw water during the pilot study were as high as 57.0 pCi/L and averaged 42.5 pCi/L during the testing. All raw water samples exceeded the Environmental Protection Agency (EPA) mandated MCL of 30 µg/L uranium, 10 µg/L arsenic and 15 pCi/L gross alpha.

The purposes of the Z-92®/Z-33™ pilot study are to:

- Demonstrate the ability of the Z-92®/Z-33™ Treatment Process to consistently and effectively reduce uranium, arsenic and gross alpha to below the MCL on this specific water.
- Demonstrate the reliability and ease of operation of the WRT Z-92®/Z-33™ process.
- Comply with regulatory requirements.
- Develop design criteria for the full-scale facility.

Delivery and Installation of the Treatment System

The pilot treatment system was delivered and installed on November 17, 2009. Set up consists of mounting the columns to a frame and connecting the water source and discharge line. The pilot study began the same day. Data was collected for 58 days; the last water samples collected on January 13, 2010.

Operator training for system operation, monitoring and sampling was conducted on the day of installation, and a schedule for sampling was established. Samples were collected by the Schurz Elementary School personnel from sample valves located in the feed line and after discharge from each respective treatment vessel, at pre-determined sample intervals.

Analytical

Samples were delivered to ACZ Laboratories, Inc. in Steamboat Springs, Colorado for uranium, arsenic, gross alpha and inorganic water quality analysis. ACZ Laboratories, Inc. is National Environmental Laboratory Accreditation Program certified.

Analyte	Method
Uranium	EPA 200.8 (ICP-MS)
Arsenic	EPA 200.8 (ICP-MS)
Gross Alpha	EPA M900.0

Results

The sampling results for uranium, arsenic and gross alpha removal are shown in Table 2, 3 and 4. In the pilot test, uranium samples were collected immediately prior to the first Z-92®/Z-33™ column, after column no. 1 (C1), and at the discharge point, column no. 2 (C2). Analytical laboratory certificates for the pilot testing are attached as Appendix A.

Figure 5 illustrates uranium levels in the feed water entering the pilot unit, and treated water exiting the pilot unit. The graphs show that the pilot unit reduced the uranium in the treated water to non-detectable levels well below the required MCL for all test samples for the duration of the testing.

Table 2. Uranium Test Results

Uranium	Column Concentrations (µg/L)			
Date	Feed	C1	C2	MCL
11/17/09	93.5	0.1	0.0	30.0
11/23/09	98.8	0.1	0.2	30.0
12/1/09	93.1	0.0	0.0	30.0
12/9/09	85.2	0.0	0.0	30.0
12/15/09	97.1	0.2	1.3	30.0
12/21/09	99.0	0.0	0.2	30.0
12/28/09	99.9	0.0	0.0	30.0
1/13/10	96.7	0.0	0.0	30.0

Figure 5 below, presents in graph format, the data in Table 2.

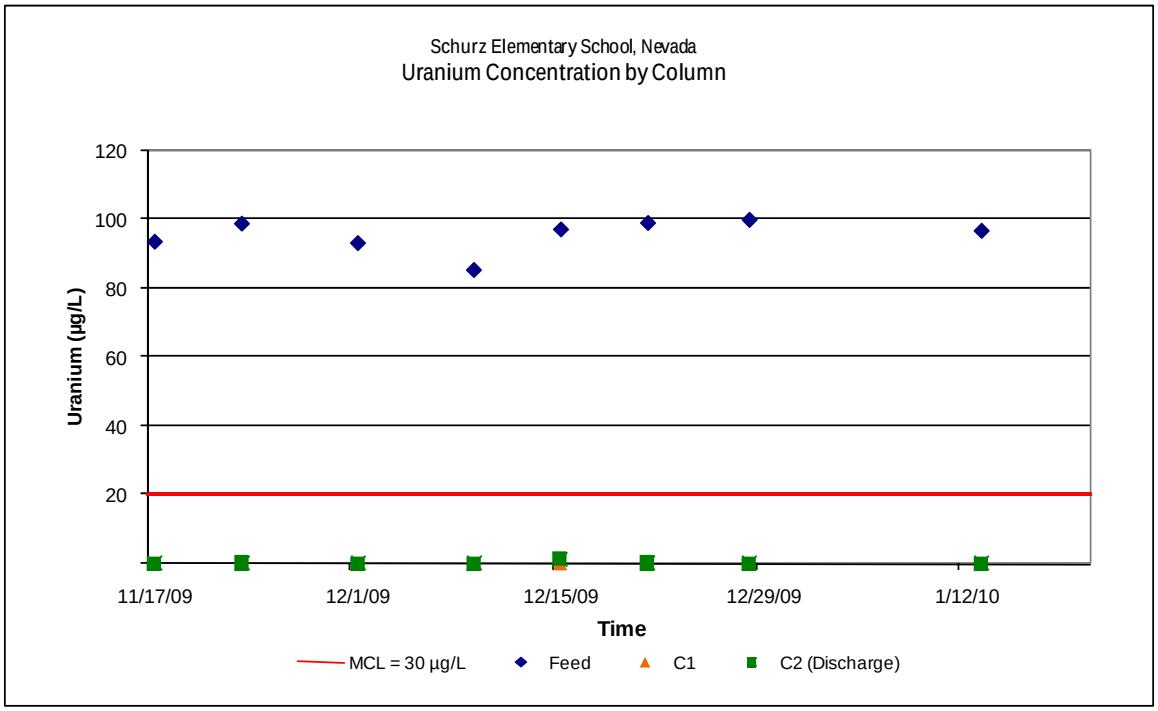

Figure 5

Results for arsenic removal are shown in Table 3. Similar to uranium samples, arsenic samples were collected immediately prior to the first Z-92®/Z-33™ column, after column no. 1 (C1), and at the discharge point, column no. 2 (C2). Analytical laboratory certificates for the pilot testing are attached as Appendix A. Figure 6 illustrates arsenic levels in the feed water entering the pilot unit, and treated water exiting the pilot unit. The graphs show that the pilot unit reduced the arsenic in the treated water to levels below the required MCL for all test samples for the duration of the testing.

Table 3. Arsenic Test Results

Arsenic	Column Concentrations (µg/L)			
Date	Feed	Col 1	Col 2	MCL
11/17/09	13.2	0.0	0.0	10.0
11/23/09	13.5	0.0	0.0	10.0
12/1/09	12.7	0.0	0.0	10.0
12/9/09	12.0	1.9	0.0	10.0
12/15/09	13.1	6.6	0.0	10.0
12/21/09	13.0	8.9	0.6	10.0
12/28/09	13.4	11.0	1.4	10.0
1/13/10	12.0	12.9	7.3	10.0

Figure 6 below, presents in graph format, the data in Table 3.

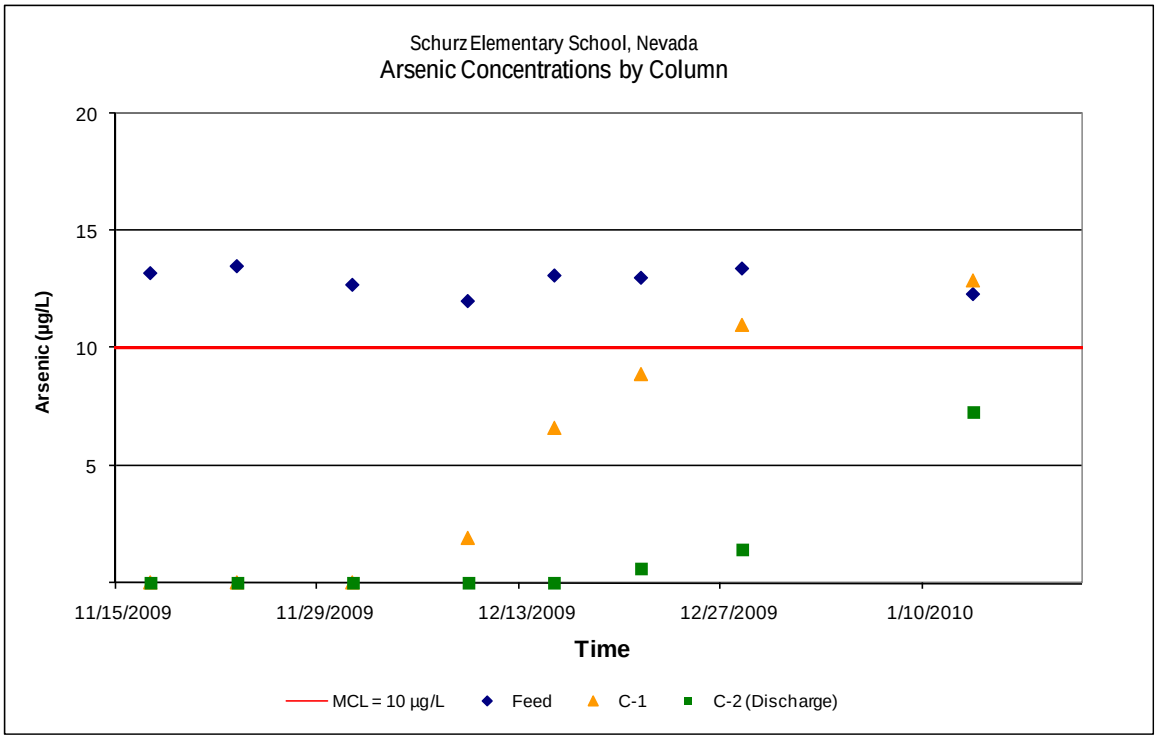

Figure 6

Results for gross alpha are shown in Table 4. Similar to uranium and arsenic samples, gross alpha samples were collected immediately prior to the first Z-92®/Z-33™ column, after column no. 1 (C1), and at the discharge point, column no. 2 (C2). Analytical laboratory certificates for the pilot testing are attached as Appendix A. Figure 7 illustrates gross alpha levels in the feed water entering the pilot unit, and treated water exiting the pilot unit. The graphs show that the pilot unit reduced the gross alpha in the treated water to levels below the required MCL for all test samples for the duration of the testing.

Table 4. Gross Alpha Test Results

Gross Alpha	Column Concentrations (pCi/L)			
Date	Feed	Col 1	Col 2	MCL
11/17/09	37.0	4.1	4.0	15.0
11/23/09	42.0	0.8	2.1	15.0
12/1/09	35.0	2.1	1.8	15.0
12/9/09	36.0	4.6	2.1	15.0
12/15/09	44.0	2.0	2.9	15.0
12/21/09	57.0	2.6	2.7	15.0
12/28/09	46.0	1.9	2.9	15.0
1/13/10	43.0	1.5	2.2	15.0

Figure 7 below, presents in graph format, the data in Table 4.

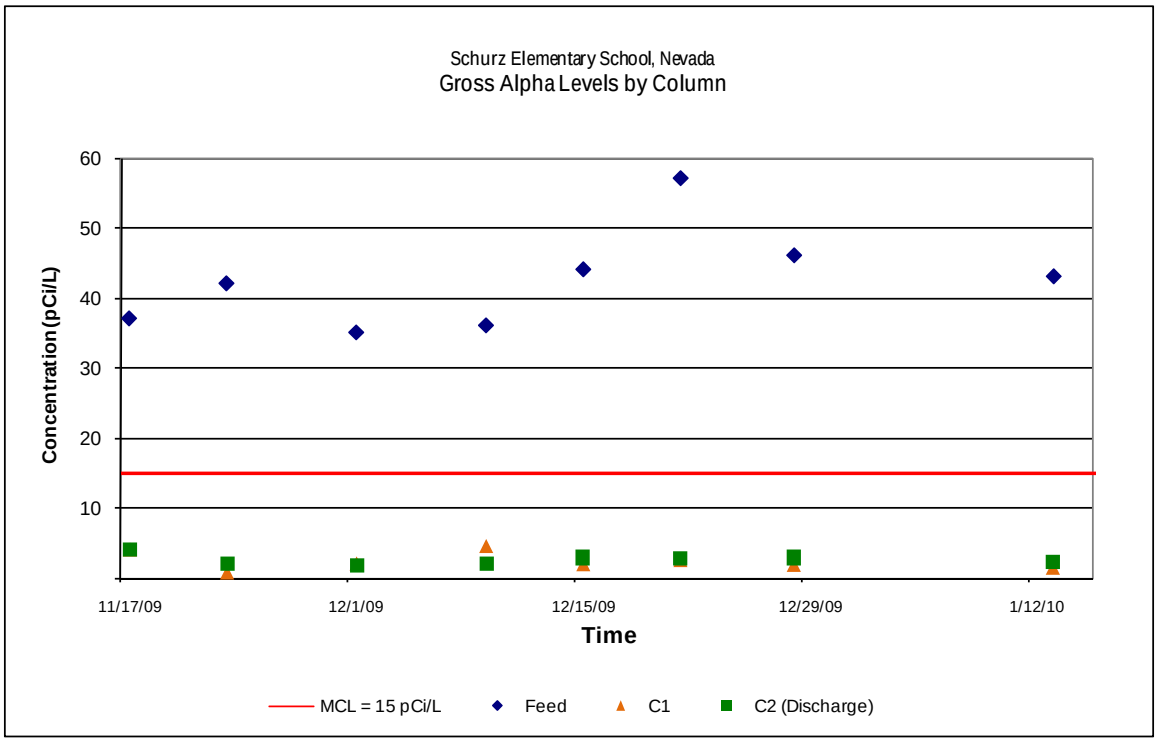

Figure 7

The pilot testing provides sufficient operational data necessary to estimate the expected service run length for the media. Of the two target contaminants analyzed during the pilot testing, arsenic capacity is the limiting factor for the Z-92®/Z-33™ media service run length. A detailed analysis of the media performance based upon the pilot test data shows an estimated equivalent service run length for the media of 123,000 gallons throughput per cu. ft. of media. This estimate presumes the use of multiple removal stages in series to assure very low treated water arsenic levels at all times during the service cycle. Overall treated water throughput for a full-scale system can be calculated using this volume throughput value.

The Shurz Elementary School treatment system is currently designed to include three stages of media in a series configuration. To accommodate the necessary flow rate of the well system, two trains of treatment vessels are included. Each treatment vessel houses approximately three cubic feet of treatment media for a total of nine cubic feet of media per train. Normal operation of the treatment system presupposes the exchange of the first two stages of media at the prescribed end of the service run. Therefore the estimated service run period for a two train treatment system based on a total throughput volume of six cubic feet of treatment media or 1,476,000 gallons. At this throughput volume the first two stages of each train is exchanged for new media and the third vessel is moved into the primary, lead position.

If the proposed treatment process should include three treatment trains of vessels, the total throughput volume before media changeout is proportionately increased to 2,214,000 gallons.

Radium Results

The radium sampling results are shown in Table 5. Samples from the feed water source for radium testing were collected once at the installation of the pilot unit. The analytical laboratory certificate is attached as Appendix B. The results for radium sampling shows the feed water average combined RA-226 and Ra-228 concentration is within compliance of the radium MCL. Of the radium isotopes normally found in ground water, Ra-226 will contribute to the measured gross alpha of the water sample.

Table 5. Radium 226, 228 Raw Water Test Results

Date	Radium 226 Feed	Radium 228 Feed	Combined Radium Feed	MCL
11/17/09	0.0	0.4	0.4	5.0

Water Quality

A water quality analysis was performed on the feed water to the treatment system and on the treated water exiting the WRT system to document any changes in water quality through the treatment process. The results of those tests are shown in Table 6. Other than the reduction of uranium, arsenic and gross alpha, there is no significant change to the water quality. Support documentation for Table 6 is attached as Appendix B.

Table 6. Water Quality Test Results

Schurz Elementary School, Nevada Water Quality Data			
Item	**Pre WRT Process**	**units**	**Post WRT Process**
Alkalinity	304	mg/L	303
Antimony	<	mg/L	<
Arsenic	0.0122	mg/L	<
Barium	0.0879	mg/L	0.0886
Beryllium	<	mg/L	<
Cadmium	<	mg/L	<
Calcium	86.8	mg/L	87.4
Chloride	49	mg/L	49
Chromium	0.0007	mg/L	0.0006
Copper	0.0029	mg/L	0.0009
Fluoride	0.5	mg/L	0.5
Hardness	279	mg/L	281
Iron	<	mg/L	<
Lead	0.0003	mg/L	0.0014
Magnesium	15.0	mg/L	15.1
Manganese	<	mg/L	<
Mercury	<	mg/L	<
Nickel	0.02	mg/L	0.02
Nitrate	1.65	mg/L	1.67
Nitrate/Nitrite	1.67	mg/L	1.69
Nitrite	0.02	mg/L	0.02
Phosphate	0.06	mg/L	0.06
Phosphorus	0.02	mg/L	0.02
Potassium	10.1	mg/L	9.8
Selenium	0.0013	mg/L	0.0013
Silica	49.3	mg/L	50.1
Sodium	104	mg/L	106
Strontium	0.92	mg/L	0.94
Sulfate	130	mg/L	125
Thallium	<	mg/L	<
Total Dissolved Solids	610	mg/L	600
Total Organic Carbon	8	mg/L	7
Uranium	0.0850	mg/L	<
Vanadium	0.019	mg/L	0.006
Zinc	0.03	mg/L	0.05

Note: < is below detection levels

Hydraulic Loading Rate (HLR) and Empty-bed Contact Time (EBCT)

The pilot unit operated nominally at 1.5 gallons per minute, for a HLR of 7.6 gallons per minute per square foot. No documented operating anomalies were reported throughout the pilot test. The total gallons treated during the pilot study are summarized in Tables 7 and in Appendices C.

The EBCT at this HLR through two (2) columns, each containing 30-inches of media, is 4.90 minutes.

Table 7. Cumulative treated flow in gallons

Sample Data	Treated Flow in Gallons
11/17/09	0
12/1/09	27,633
12/9/09	42,917
12/15/09	54,519
12/21/09	67,249
1/13/10	113,044

Radiation Safety

The treatment system is designed to collect uranium and radium, naturally occurring radioactive materials, while in operation. Because of this action, it gradually becomes radioactive during normal operation. WRT both predicts and monitors the level of radiation present in the treatment system.

The US EPA guidelines for the total amount of radiation that members of the general public can be exposed to is 2 mrem per hour and 100 mrem over the course of a year. The maximum radiation activity measured from WRT's pilot unit is less than half of the hourly exposure limit (<1 mrem). Due to the limited amount of operator attention necessary for the pilot test, the annual exposure limit is also readily met.

WRT has prepared a safety plan for its tests that includes radiation level monitoring, logging time spent in proximity to a test unit, emergency procedures to be followed and an introduction to radiation safety for operators. Operators are instructed in radiation safety before the pilot test is started.

Any full scale system will include appropriate equipment and operating personnel radiation level monitoring, and a corresponding safety plan approved by regulatory authorities will be put into place.

Operational Results

Operation logs were maintained during the pilot study, and are attached as Appendix C. The treatment system operated easily and reliably during the study.

Conclusion

The WRT Z-92®/Z-33™ Uranium-Arsenic Treatment Process consistently reduced the uranium, arsenic and gross alpha discharge to levels below the required MCLs as a stand alone treatment process.

WRT would like to thank the personnel and staff of the Schurz Elementary School treatment facility for their cooperation and participation in this study.

Appendices available upon request