DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
DIRECT SUPPORT ACTIVITY-WEST
FITZSIMONS ARMY MEDICAL CENTER
AURORA, COLORADO 80045-5001

REPLY TO
ATTENTION OF:

MCHB-AW-EH (40-5f) 28 December 1998

MEMORANDUM FOR Commander, USAIC and Fort Huachuca, ATTN: ATZS-ISB,
Chief, Environmental and Natural Resources Division
(Mr. Thomas Cochran), Fort Huachuca, AZ 85613-6000

SUBJECT: Water System Performance Evaluation No. 31-RE-1136-99, Fort Huachuca, Arizona, 14-25 September 1998

Enclosed are two copies of subject report.

FOR THE COMMANDER:

2 Enclosures
as stated

MICHAEL J. DELL'ORCO, P.E.
MAJ, MS
Chief, Environmental Health Engineering
Division

CF:
CDR, Western Regional Medical Command, ATTN: MCHJ-PV-EH (MAJ McKee)
CDR, TRADOC, ATTN: ATBO-SE (Mr. Cochran) (2 cys)
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CDR, USACHPPM, ATTN: MCHB-TS-EWS (Program 31/Mr. Valcik)
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U.S. Army Center for Health Promotion and Preventive Medicine

WATER SYSTEM PERFORMANCE EVALUATION
NO. 31-RE-1136-99
FORT HUACHUCA, ARIZONA
14-25 SEPTEMBER 1998

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DIRECT SUPPORT ACTIVITY-WEST
U.S. ARMY GARRISON, FITZSIMONS
AURORA, COLORADO 80045-5001

REPLY TO
ATTENTION OF.

EXECUTIVE SUMMARY
WATER SYSTEM PERFORMANCE EVALUATION
NO. 31-RE-1136-99
FORT HUACHUCA, ARIZONA
14-25 SEPTEMBER 1998

1. PURPOSE. The purpose of this Water System Performance Evaluation (WSPE) is to evaluate the Fort Huachuca water system, including source water, treatment, storage, and distribution. The WSPE will ensure that the system is providing safe, high quality water to the consumers and conforming to all regulatory requirements. Other issues contained in this Report include analysis of possible cost-saving measures regarding the water system, water system related safety concerns, and an overview of the post's recreational water facilities. This Evaluation and the Environmental Compliance Assessment Survey (ECAS) were performed concurrently to eliminate needless duplication of effort.

2. CONCLUSIONS. Fort Huachuca has a high-quality, reliable water source which, if properly managed, should provide enough water to meet the Installation's needs indefinitely. The staff currently employed under contract to operate and monitor the water system is capable and qualified. As currently operated, the water system is producing sufficient quantities of high-quality drinking water to meet the installation's demand. Weaknesses in the water system include erratic and poorly controlled chlorine and fluoride dosage, decentralized recordkeeping, and minor operations and maintenance deficiencies.

3. RECOMMENDATIONS.

a. Class I Recommendations.

(1) Install in-line chlorine residual monitors and low-level alarms with automatic pump shut-off at each chlorination facility. Set low-level alarms to notify operators when chlorine residual drops below 0.2 mg/l, and to shut down the well pump when chlorine residual drops to 0.0 mg/l.

(2) Install separate filtration and disinfection systems that meet State [AAC R18-5-223(A), AAC R18-5-244(A)] and Army [Technical Bulletin (TB) MED 575, 6-1] requirements for both wading pools prior to reopening the pools.

(3) Provide disinfection and bacteriological testing for the Spatial Resolution Well to meet Occupational Safety and Health Administration potable water requirements.

b. Class III Recommendations.

(1) Seal cracks around windows in surge tanks at Well Nos. 1 through 6 to exclude insects and vermin [AR 420-49, paragraph 4-1g; Technical Manual (TM) 5-660, paragraph 8-6(a)(1)].

(2) Cover windows or otherwise protect surge tanks at Well Nos. 1, 2, and 4 from contamination by vandal or sabotage.

(3) Repair missing ceiling tiles and holes in chlorination rooms at Well Nos. 3, 4, and 5 to provide a gas-tight partition between chlorination facilities and other work areas [TB MED 576, paragraph l-1].

(4) Install a Bureau of Mines or National Institute for Occupational Safety and Health-approved self-contained breathing apparatus directly outside the entrance to each chlorination facility [TB MED 576, paragraph L-6].

(5) Reduce variation in fluoride levels in finished water through calibration and servicing of fluoridation equipment and operator training.

(6) Implement effective annual distribution system flushing program IAW TM 5-660 and TB MED 576.

(7) Modify existing potable water storage tank inspection program to include all such tanks currently in use at Fort Huachuca. Include testing and maintenance of cathodic protection systems in inspection procedures.

(8) Install or repair cathodic protection systems on all steel potable water storage tanks.

(9) Install screen on 120,000-gallon storage tank (Building 12519) overflow pipe to exclude birds, insects, and airborne debris [AR 420-49, paragraph 4-1g; TM 5-660, paragraph 8-6(a)(1)].

(10) Replace broken vent screen on Well No. 8 [AR 420-49, paragraph 4-1g; TM 5-660, paragraph 8-6(a)(1)].

(11) Consolidate and centralize system records and authority to improve communication and effectiveness within water treatment, storage, and distribution operations.

(12) Ensure Johnson Controls, Inc. meets contract obligations before automation contract warranty period expires. Train Fort Huachuca employees in installation and maintenance of system components.

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REPLY TO
ATTENTION OF.

WATER SYSTEM PERFORMANCE EVALUATION
NO. 31-RE-1136-99
FORT HUACHUCA, ARIZONA
14-25 SEPTEMBER 1998

1. AUTHORITY. Military interdepartmental purchase request (MIPR8BAPG00001), 24 November 1997, request from Mr. Michael Cochran, U.S. Army Training and Evaluation Command (TRADOC), subject as above.

2. REFERENCES. A list of references is provided in Appendix A.

3. PURPOSE. The purpose of this Water System Performance Evaluation (WSPE) is to evaluate the Fort Huachuca water system, including source water, treatment, storage, and distribution. The WSPE will ensure that the system is providing safe, high quality water to the consumers and conforming to all regulatory requirements. Other issues contained in this Report include analysis of possible cost-saving measures regarding the water system, water system related safety concerns, and an overview of the post's recreational water facilities. This Evaluation and the Environmental Compliance Assessment Survey (ECAS) were performed concurrently to eliminate needless duplication of effort.

4. GENERAL.

a. Survey Personnel.

(1) 1LT Kevin Schwall, Environmental Engineer, Environmental Health Engineering Division, U.S. Army Center for Health Promotion and Preventive Medicine-West (USACHPPM-W).

(2) Ms. Sara Renner, Biologist, USACHPPM, Aberdeen Proving Grounds, Maryland.

b. Personnel Contacted. Appendix B lists personnel contacted during this Evaluation.

c. Background Information.

(1) Mission. The mission of Headquarters, Fort Huachuca is to provide logistical and administrative support to tenant organizations including the U.S. Army Intelligence Center; the U.S. Army Signal Command; the U.S. Army Information Systems Engineering Command; the Joint Interoperability Test Command; the 11th Signal Brigade; and the Raymond W. Bliss Army Health Center.

(2) Location and Climate. Fort Huachuca is located in Cochise County near the southwestern corner of Arizona. The Installation covers approximately 115 square miles directly west of the City of Sierra Vista, Arizona. It is located 60 miles southeast of Tucson and 13 miles north of the Mexican border. Elevations within Fort Huachuca range from 3,900 feet to 8,700 feet above sea level. Temperatures vary from an average low of 35.1° F in January to an average high of 94.0° F in June. Annual precipitation ranges from under 14 inches on the valley floor to over 30 inches in the mountains.

d. WSPE Protocol. The WSPE protocol is based upon the U.S. Environmental Protection Agency's (EPA) Composite Correction Program (Reference 1) used by water treatment facilities to ensure conformance with the strict treatment requirements of the Surface Water Treatment Rule. The WSPE expands the EPA's evaluation process to include an evaluation of the entire drinking water system from source to tap. Protocol procedures assess the general quality of the water source; adequacy of treatment; monitoring programs; distribution maintenance; training and credentials of operating personnel; and finished water quality. The protocol requires project officers to collect data related to the system's design and operation. The data is then evaluated against established performance criteria to determine if there are any deficiencies in the design or operation of the water system. Recommendations for correcting any deficiencies are then prioritized based upon current risk to consumers and to ensure that projects with the greatest benefit for health are completed first.

e. Environmental Compliance Assessment Survey. The ECAS Program supports the Total Army, and is centrally funded by Headquarters, Department of the Army (HQDA) and centrally managed by the U.S. Army Environmental Center (USAEC). The HQDA established the ECAS program as a tool for assisting Army installation commanders in achieving, maintaining, and monitoring environmental compliance with Federal, State, and Army regulations. An ECAS audit provides a snapshot in time evaluation of an installation's environmental compliance status. It identifies specific deficiencies as well as systemic weaknesses of their environmental program, and suggests realistic corrective actions that would help achieve, maintain, and monitor environmental compliance. The water supply management section of the ECAS evaluates the

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production, treatment, storage, and distribution of potable water as well as the management of recreational water facilities. The formal water supply management section ECAS findings are included in Appendix C of this Report.

5. REGULATORY CRITERIA.

a. Federal Regulations. Applicable Federal drinking water regulations are based on the Safe Drinking Water Act (SDWA) of 1974 (Reference 2) and subsequent amendments of 1986 (Reference 3) and 1996 (Reference 4). The SDWA resulted in the National Primary Drinking Water Regulations (NPDWR) (Reference 5) which contain enforceable health-based standards. In addition to the NPDWR, the National Secondary Drinking Water Regulations (NSDWR) (Reference 6) were developed to address the aesthetic qualities of drinking water. Since poor aesthetics of drinking water do not pose a health risk, meeting the NSDWR is not Federally enforceable, but only serves as a guideline to states for achieving desirable aesthetic water quality.

b. State Regulations. The State of Arizona has primacy and is the regulating authority for the Safe Drinking Water Act. State regulatory requirements are contained in Arizona Statutes Title 49, Chapter 2, Water Quality Control (Reference 7). The Arizona Department of Environmental Quality has enforcement responsibility for implementing the drinking water regulations.

c. Army Regulations. The principal document that lays the foundation of criteria for Army water systems is Army Regulation (AR) 200-1, Environmental Protection and Enhancement. Other applicable ARs and TMs containing guidance relating to drinking water requirements include AR 40-5, AR 420-49, Technical Bulletin (TB) Medical 576, TM 5-660, and the TM 813 series (References 8 through 15). All of the above are based on Federal regulations and cover design criteria, operations and maintenance practices impacting water quality, and good management practices.

6. FINDINGS AND DISCUSSION.

a. General. Fort Huachuca has one permitted drinking water system. The Arizona Department of Environmental Quality (ADEQ) classifies water systems based on treatment processes and population served. The classification of the water system is used to determine the level of operator experience required to legally operate the plant. Fort Huachuca's water system is a Grade 3 system. The system is a conventional groundwater system, owned and managed by Fort Huachuca. A contractor, Steinhoff and Sadler, Inc. (SSI), is responsible for its daily operation. The water system consists of source, treatment, storage, and distribution facilities (see Figure 1). Eight groundwater wells and seven small surge tanks located within the Installation

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comprise the source facilities. The water system's treatment facilities include seven chlorinators and seven flouridators; one at each surge tank. Eleven additional storage tanks provide drinking water and fire protection storage for all parts of the installation. The Fort Huachuca water system is operated 24 hours per day by SSI operators.

b. Population. As of 30 September 1998, the military population of Fort Huachuca was 5,421 personnel. In addition, there were 4,341 dependents living on post. The total civilian workforce at Fort Huachuca was 4,941. The combined effective population at Fort Huachuca was calculated at 11,409 (5,421 + 4,341 + 4,941/3). The consumer population for SDWA compliance purposes was calculated at 14,703 (5,421 + 4,341 + 4,941).

c. Water Sources.

(1) Wells. The wells are located in two well fields (see Figure 1). The Main Post Well Field (well Nos. 1 through 6) is located on the eastern edge of Fort Huachuca between the Main Gate and East Gate, parallel to State Highway 90. Well Nos. 1 and 2 are known as the Main Plant. The structure and layouts of the Main Post Well Field wells are similar. Wells 1 through 6 are each located in a wooden well house with a concrete slab foundation inside a fenced enclosure. The East Range Well Field (well Nos. 7 and 8) is located in the northeast corner of Fort Huachuca, east of State Highway 90. These wells are located outdoors in fenced enclosures.

(2) Surge Tanks. At each Main Post Well Field well site a 46,000-gallon surge tank collects the water as it is pumped from the well. The tanks are rectangular, constructed of concrete, topped with screened windows, and covered with a wooden roof. Some debris and dirt have collected on the interior walls and bottoms of the tanks. The concrete is weathered, but none of the tanks have visible leaks. The wooden window frames have shrunk, leaving space between the frame and the concrete building structure. This could allow insects and other vermin to gain entry to the tank, potentially contaminating the water supply. Another concern regarding these tanks is their susceptibility to deliberate contamination by vandals or terrorists. The surge tanks at Well Nos. 1, 2, and 4 are especially vulnerable due to their proximity to public roads. The screened surge tank windows at Well No. 4 are less than 30 feet from State Highway 90. This concern was identified in a Joint Service Vulnerability Assessment and poses a valid threat. Under the present conditions, a contaminant could be introduced to the water supply through the screens via a water gun or other spray device without the perpetrator needing to breach either the post or well fences.

(3) East Range. The East Range is located east of Highway 90 and has few permanent structures. This section of post is used for training and as a test site. The East Range Well Field is located in this area and supplies potable water to the main cantonment area. Another well on the East Range, referred to as the Spatial Resolution Well, supplies untreated water to the latrine

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in Building 16502 and a standpipe. The taps in Building 16502 are labeled non-potable, and the employees who work in this building supply their own bottled drinking water. The standpipe is used to fill water buffaloes and chlorinated per field water doctrine. There is an Occupational Safety and Health Administration (OSHA) requirement to provide potable water at the workplace for hand-washing purposes. To meet this requirement, the water needs to be chlorinated and monitored for total coliforms. Due to the small size of the system, it will be considered an unregulated water system. See Appendix E for guidance on water quality monitoring for unregulated systems (Reference 16).

(4) Emergency Power. There are no permanent alternate power sources in place at the wells or booster pumps. The Potable Water Emergency/Contingency Plan specifies a number of portable generators that will be pressed into service in case of a prolonged power outage. This option has never been fully exercised, although, during one extended outage, the generators were moved to the appropriate locations and work was started to connect them to the pumps.

(5) Water Production. Fort Huachuca water production fluctuates seasonally. Water demand peaks in June and dips to its lowest level in February. Historically, June water demand has been more than double that of February (see Figure 2). Fort Huachuca water plant operators try to produce as much water as possible during the night in order to minimize peak period power consumption. Due to storage capacity limitations, however, at least one well must run during the day to keep up with demand. The system's maximum capacity is limited by the production of the raw water well pumps. The total capacity of all eight well pumps is 8.06 million gallons per day (mgd). With the largest pump out of service, the system can still produce 6.91 mgd. This is more than adequate for Fort Huachuca's present and projected future needs.

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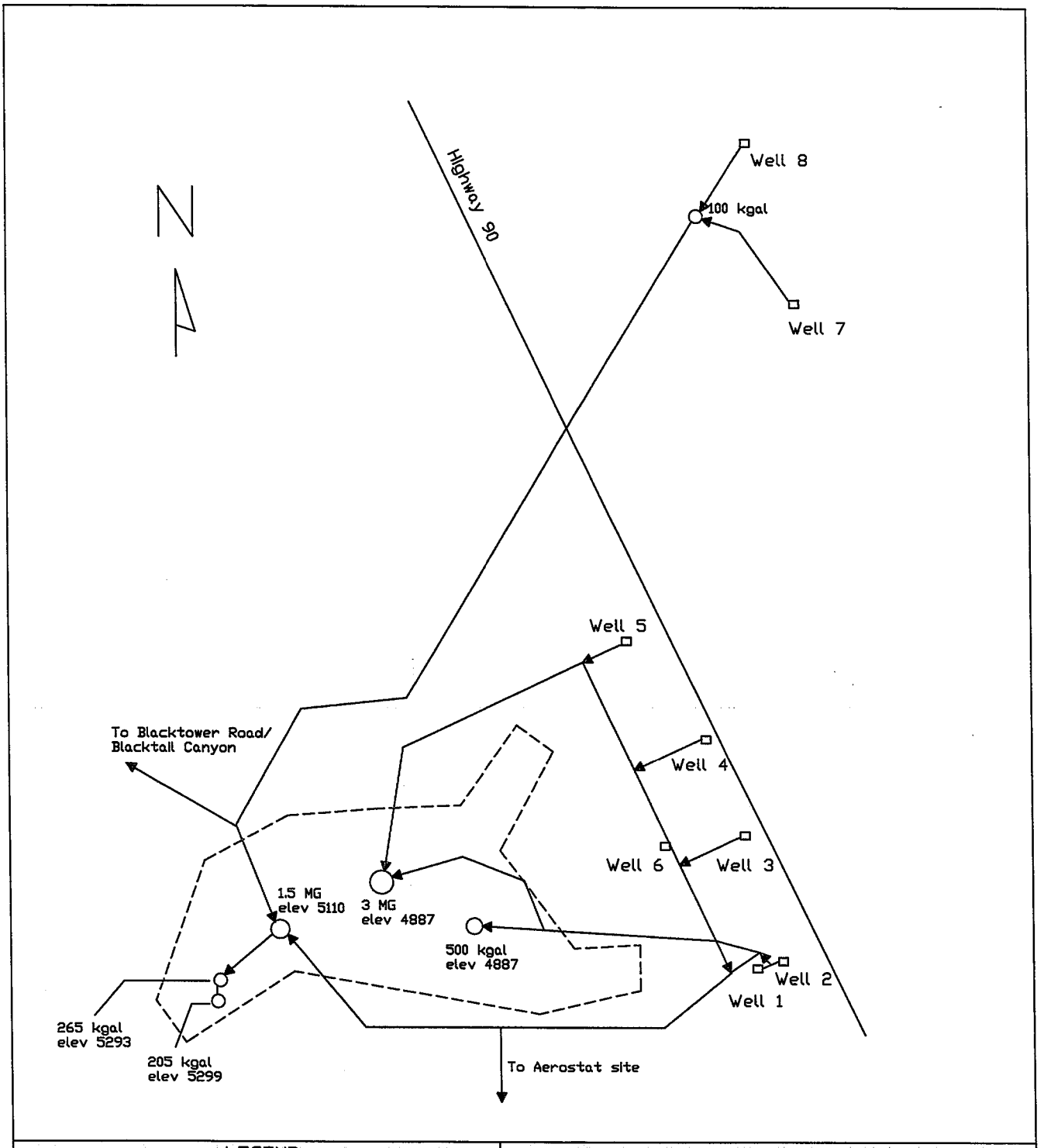

LEGEND

WATER MAIN	———
WELL	□
STORAGE TANK	○
HIGHWAY 90	———
CANTONMENT AREA	

(DRAWING NOT TO SCALE)

UNITED STATES ARMY
CENTER FOR HEALTH PROMOTION
AND PREVENTIVE MEDICINE - WEST
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FIGURE 1. CONCEPTUAL MODEL OF FORT HUACHUCA WATER SYSTEM.

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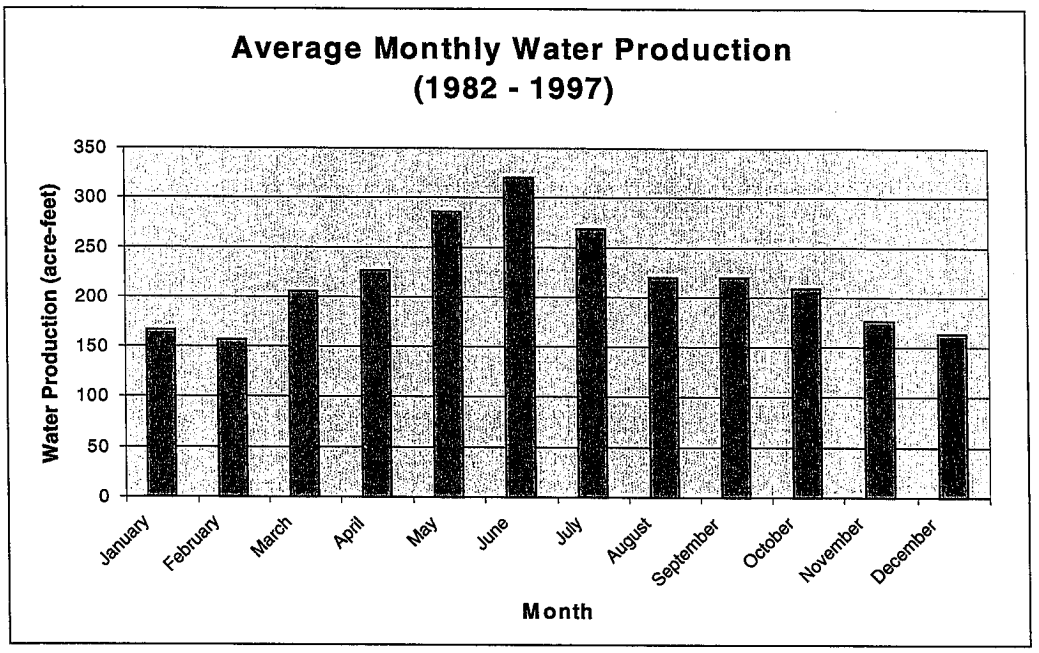

Figure 2. Average Monthly Water Production.

(6) Flow Measurement. The quantity of water produced by each well is measured by an electronic flow meter installed at the well site. The value recorded by the meter is checked against a calculated value based on the pump's capacity and hours of operation

d. Water Treatment.

(1) General. Water is treated at each well site with chlorine and fluoride. The water at Well Nos. 1 through 6 is treated as it exits the surge tanks. Water from Well Nos. 7 and 8 is pumped into a 100,000-gallon storage tank located on the East Range and treated as it exits the tank.

(2) Chlorination.

(a) Well Nos. 1 through 6 each have an enclosed chlorination facility attached to the well house. V-notch vacuum type chlorinators supplied by 150-pound chlorine gas cylinders treat the water through an injection line as it leaves the surge tanks. Each chlorination facility is equipped with an electronic chlorine gas detector and alarm as well as a ventilation fan. The chlorination rooms at Well Nos. 3, 4, and 5 had various openings including missing ceiling tiles and conduit holes which could allow chlorine gas to enter the pump room. Army regulations require chlorination facilities to be separated from other areas by a gas-tight partition [TB MED 576,

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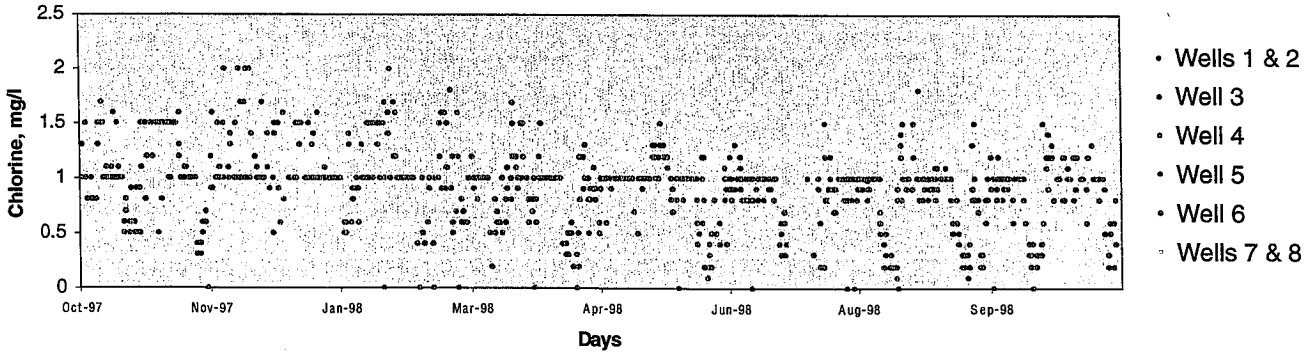
para L-1]. Although SSI personnel who work in the chlorination rooms carry self-contained breathing apparatuses (SCBAs) in their vehicles and are trained in SCBA use, no SCBAs are available on site. Army regulations require at lease one Bureau of Mines (BM) or National Institute for Occupational Safety and Health (NIOSH)-approved chlorine gas mask to be available and located directly outside the chlorination facility entrance [TB MED 576, para L-6].

(b) The water from Well Nos. 7 and 8 is treated with chlorine through an injection line as it exits the 100,000-gallon surge tank. The chlorination facility uses 150-pound chlorine cylinders located on an open-air concrete pad adjacent to the water storage tank. The concrete pad is open on three sides, has a sheet metal wall on the fourth side, and is equipped with a cradle and crane to handle one-ton chlorine gas cylinders. Smaller, 150-pound chlorine cylinders are currently used due to the potential hazard of transporting a one-ton cylinder over the rough East Range roads.

(c) The chlorine residual is tested daily at the point of entry of each operating well. These values are recorded in the production log. Fort Huachuca's operators try to maintain a residual of 1.0 mg/l at these points. During the past year, the chlorine residual has ranged from 0.0 to 2.0 mg/l and averaged 0.92 mg/l (see Figure 3). The residual was measured at 0.0 mg/l on 16 separate occasions during the 12 months analyzed, and each time was found to be the result of an empty chlorine cylinder. This pattern of repeatedly introducing water that has not been disinfected into the distribution system is unacceptable. This is essentially raw water and poses a potential health threat to those who consume it.

Figure 3. Fort Huachuca's Drinking Water Chlorine Residual at Point of Entry to Distribution System Oct 97 - Oct 98



(d) The erratic pattern of chlorine residual readings during the past year highlights Fort Huachuca's need for an automated chlorine monitoring and alarm system. Such a system would provide operators the ability to continuously measure the chlorine residual in water being produced by each well, and notify the operator on duty with an alarm whenever the chlorine

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produced by each well, and notify the operator on duty with an alarm whenever the chlorine residual for water being treated drops below 0.2 mg/l. As an additional precaution, the system should automatically turn off the well pump when the chlorine residual drops to 0.0 mg/l. Such a system would prevent situations such as those which occurred 16 times during the past 12 months where raw water was pumped into the distribution system without being disinfected.

(3) Fluoridation.

(a) Water is fluoridated at all wells by metered units using a sodium fluoride solution. The fluoridation devices for Well Nos. 1 through 6 are located in the same facilities as the chlorinators. Fluoridation for Well Nos. 7 and 8 takes place in the booster pump station adjacent to the 100,000-gallon surge tank on the East Range. The operator on duty measures fluoride concentration at each point of entry on a daily basis.

(b) A review of monthly operating logs revealed that the average fluoride concentration in treated water over the past year was 1.0 mg/l and ranged in value from 0.0 mg/l to 2.5 mg/l. The concentration is measured once each day at every operating well. During the 12-month period studied, Fort Huachuca always complied with the 4.0-mg/l maximum contaminant level (MCL). However, the fluoride concentration was out of compliance with the secondary maximum contaminant level (SMCL) of 2.0 mg/l on five days during the past year. While there is no regulatory requirement to meet SMCLs, these exceedances underscore Fort Huachuca's problem of erratic fluoridation. Figure 4 illustrates the inconsistency of fluoride application during the past year. This variability could be due to poorly maintained or improperly functioning fluoridation equipment, inattention, or operator error. Steps should be taken to reduce the variability of the fluoride level in Fort Huachuca's water. Possible actions include calibration and verification of the fluoride feeders; maintenance checks on the fluoridation equipment; installation of continuous fluoride monitors at each treatment site; and training for the operators in charge of the equipment. The American Water Works Association Manual of Water Supply Practices entitled Water Fluoridation Principles and Practices (Reference 17) is an excellent reference for fluoridation methods, equipment, maintenance, and troubleshooting.

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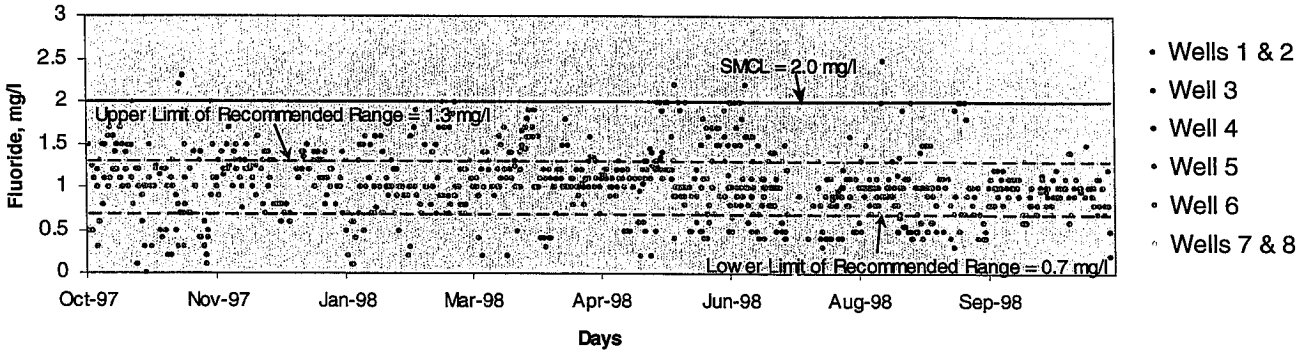
Figure 4. Comparison of Fort Huachuca's Drinking Water Fluoride Dosage to Recommended Levels Oct 97 - Oct 98



(c) The Centers for Disease Control and Prevention (CDC) has been tasked by the Public Health Service with developing clearer guidance on a range of fluoride concentrations in fluoridated water that takes into account all the available research literature to date. The CDC published a table for recommended fluoride levels taking into account the increases in fluoride dosages people are receiving through other sources such as dental cleanings and fluoride fortified toothpaste (see Table). These recommendations are expected to be incorporated into Army doctrine. Fort Huachuca has an average annual maximum daily temperature of 76.7°F. For this temperature, the CDC recommends an optimal fluoride concentration of 0.8 mg/l and a range of 0.7 - 1.3 mg/l. Review of plotted data in Figure 4 indicates that the fluoride concentration in Fort Huachuca's treated water was outside of this range over one-third of the time during the past year.

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Table. Recommended Optimal Fluoride Level Table for Community Water Systems.

Annual Average of Maximum Daily Air Temperatures* (degrees F)	Recommended Fluoride Concentrations (mg/l)	Recommended Control Range (mg/l)	(mg/l)
53.7 and below	1.2	1.1	1.7
53.8 – 58.3	1.1	1.0	1.6
58.4 – 63.8	1.0	0.9	1.5
63.9 – 70.6	0.9	0.8	1.4
70.7 – 79.2	**0.8**	**0.7**	**1.3**
79.3 and above	0.7	0.6	1.2

*Based on most recent temperature data obtained from National Weather Service for a minimum of five years and a maximum of 100 years calculated at least every ten years. Within the United States, average temperatures should be obtained from the National Weather Service. Outside the United States, refer to the most reliable source of temperature data since no single reliable source exists for all areas.

e. Water Storage. Eleven tanks of varying capacity provide water storage Fort Huachuca. These tanks range in size from the 1,000-gallon tank at Building 12586 to the 3-MG tank on main post. A table of capacities and construction types for all of Fort Huachuca's potable water storage and surge tanks can be found in Appendix C. The majority of Fort Huachuca's water is stored in the 3-MG and 1.5-MG ground tanks, the 500,000-gallon tower, and the 265,000 and 205,000-gallon Old Reservoirs. The 46,000-gallon surge tanks at Well Nos. 1 through 6 and the 100,000-gallon surge tank shared by Well Nos. 7 and 8 are also shown in the Table. The other water tanks listed are scattered throughout remote reaches of post and generally provide water for a single building or a small group of buildings. All storage tanks inspected during the WSPE were clean and free of insects, vermin, and debris.

(1) Corrosion Control. Storage tanks with metal construction should be equipped with cathodic protection to prohibit corrosion. This is especially important for all surfaces in constant contact with soil or water. The 100,000-gallon surge tank on the East Range has a cathodic protection device in place, but it has not been tested in recent memory and is probably inoperable. The 500,000-gallon elevated storage tank does not have cathodic protection of any kind. It is not known whether cathodic protection devices exist on the other steel storage tanks, but since they have not received maintenance or testing, they are probably no longer operational.

(2) Inspection. Under the current program, each tank should receive an inspection semi-annually to detect leaks, cracks, missing screens, security problems, and other maintenance issues. Good records are being kept of these inspections, but at the time of the Evaluation, not all potable water storage tanks were included in the inspection program.

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(3) Screening. For the most part, all well and tank vents and tank overflow pipes were properly screened to exclude debris and vermin. A single West Range storage tank (Building 12519) did not have a screen on its overflow pipe. It should be screened to prevent the introduction of vermin and airborne debris. In addition, the screen on the Well No. 8's well vent was broken and should be replaced.

f. Distribution System.

(1) Description. The potable water distribution system consists of over 300 miles of underground water lines ranging in diameter from 4-24 inches. The majority of the system was constructed in the 1940's. Construction materials consisted of cast iron, copper, steel, and asbestos-concrete pipes (Reference 18). The water is introduced to the system from eight wells, each of which has a booster pump at the well house. Four additional booster stations transport the water through the mains to the storage tanks and provide pressure throughout the system. The system is divided into three pressure zones. Water is pumped from Well Nos. 1 through 6 to the lowest pressure zone, Zone C [elevation 4,887 feet above mean sea level (MSL)]. The 3-MG tank and 500,000-gallon tower were built at the same elevation and function as a single tank, riding off the system and providing storage and pressure for Zone C. The 1.5-MG storage tank provides pressure for Zone B (elevation 5,110 feet above MSL). This tank is supplied with water directly from Well Nos. 7 and 8. A booster station pumps water from Zone B to the Old Reservoirs in Zone A (elev. 5299 above MSL). Check valves control flow between zones but can be opened for unusual circumstances.

(2) Water Main Flushing. The fire station periodically flushes hydrants and dead-end lines on post; however, this is inadequate to completely flush the entire system. Flushing is necessary to remove built up debris and corrosion from the interior pipe walls. The process also ensures chlorinated water reaches points of the distribution system that may otherwise stagnate, such as areas of low water use and dead ends. When flushing the distribution system, each loop of the system must be isolated and flushed individually. The process begins at the highest elevation (lower pressure) of the system and systematically flushes each loop in progression towards the lowest elevation (higher pressure). AR 420-49 requires Army installations to have a routine and thorough flushing program. Complete descriptions of the procedure may be found in paragraph 8-3d, TM 5-660 and paragraph 4-3b, TB MED 576.

(3) Cross-Connection-Control Program. A back-flow prevention and cross-connection control program is being implemented. This Program involves a continuous process of identifying and testing backflow prevention devices. As new devices are installed or old devices found, they are tested and entered into a database. Each device in the database is then tested annually. This Program is well run and appears to be effective.

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g. Potable Water Quality Monitoring. Water quality monitoring at Fort Huachuca is managed by SSI and conducted through a contract by Aqua Tech Environmental Laboratories, Inc. Additional monitoring is performed by the MEDDAC Preventive Medicine Service (PVNTMED Svc) personnel. Fort Huachuca's monitoring program meets State and Federal standards. Although the monitoring appeared to be up to date and in compliance, various system records, including production logs, tank inspection records, flushing data, and chemical monitoring records were scattered between numerous buildings all over post. This decentralized system impedes communication and has resulted in functions such as testing of storage tank cathodic protection systems slipping through the cracks.

(1) Bacteriological Analysis. A contract laboratory, Acculabs Inc., of Tucson, AZ, conducts reportable microbiological sampling on a monthly basis. The contractor is responsible for sampling, analyzing, and reporting 20 samples per month. The PVNTMED Svc conducts separate sampling and analysis as a quality control and safety measure. Fort Huachuca has not had any positive coliform results in the past year.

(2) Chlorine Residual. Chlorine residual is monitored daily by the water plant operators at all points of entry to the water system. This reading is used to adjust the chlorine feed. The PVNTMED Svc performs additional chlorine residual analysis during their routine water quality monitoring. See paragraph 6d(2) of this Report for further discussion.

(3) Fluoride Analysis. Fluoride is tested daily at the points of entry as part of the operators' rounds. See paragraph 6d(3) of this Report for further discussion.

(4) Asbestos Analysis. One sample is required every nine years from each point of entry to the distribution system. The last sample was taken in January 1994 and the next is scheduled for January 2003. No asbestos was detected in any of the 1994 samples.

(5) Nitrate Analysis. Nitrate sampling is required annually. The last round of sampling occurred in March 1998 and consisted of two composited samples. The highest nitrate level found in these two samples was 1.1 mg/l. The MCL for nitrate is 10 mg/l.

(6) Nitrite Analysis. Fort Huachuca has qualified for reduced monitoring for nitrite and must only submit samples every nine years. The last samples were submitted in January 1994 and the next round is scheduled in January 2003. No nitrite was detected in any of the 1994 samples.

(7) Sodium Analysis. There is no regulatory standard for sodium in drinking water, but Federal regulations require community water systems using groundwater to analyze for it once

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every three years. Fort Huachuca last submitted samples in January 1998. One sample was drawn from each point of entry and revealed sodium concentrations of 18.0 to 23.0 mg/l. The next round of sampling is scheduled in Jan 2001.

(8) Sulfate Analysis. Sulfate is regulated under the secondary drinking water standards and has a SMCL of 250 mg/l. Fort Huachuca must submit one sample for analysis from each point of entry every five years. The last round of sampling occurred in December 1997 and produced sulfate measurements of 4-7 mg/l. The next round is scheduled for 2002.

(9) Inorganic Chemical Analysis. One sample from the point of entry is analyzed for inorganic chemicals every three years, as required by the State of Arizona. The last analysis was performed January 1996. The next sample is due January 1999. No metals were found above their respective detection limits.

(10) Volatile Organic Compound Analysis. One sample every three years is required for analysis of regulated volatile organic compounds (VOCs). In addition, Fort Huachuca analyzes one sample every five years for a list of unregulated VOCs (see Appendix D). Regulated VOCs were last sampled in January 1996, and will be sampled again in January 1999. Unregulated VOCs were last sampled in January 1998 and will be sampled again in January 2003.

(11) Synthetic Organic Chemicals. Two non-consecutive quarterly samples are taken every three years for regulated synthetic organic chemical (SOC) analysis. The State of Arizona requires Fort Huachuca to analyze for all regulated SOCs except for 2, 3, 7, 8-TCDD (Dioxin) and Glyphosate, for which Fort Huachuca has State waivers. The last samples were taken in 1997 and the next round is scheduled for 2000. No regulated SOCs were detected in the 1997 samples. Fort Huachuca also monitors a list of unregulated SOCs. These contaminants are monitored for four consecutive quarters every five years. The last round occurred in 1998 and the next round is scheduled for 2003. No unregulated SOCs were detected in 1998.

(12) Lead and Copper Analysis. Fort Huachuca has qualified for reduced lead and copper monitoring and is required to take 30 samples every three years from predetermined distribution system locations. The last round of sampling occurred in July 1998. During the last round of sampling, five samples contained concentrations of lead above the action level, placing the 90th percentile above the action level. Four of these five samples were taken from abandoned buildings scheduled for demolition. After receiving the initial results, Fort Huachuca resampled two of the original locations and sampled four new sites as replacements for three of the abandoned buildings. None of these samples contained lead concentrations above the action

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level. A letter detailing the situation was sent to the State of Arizona with the new sample results in hopes of avoiding a lead violation, but an official response has not yet been received. If this resampling is accepted, the next set of samples is due in July 2001.

(13) Radiological Analysis. Four composited quarterly samples taken from the wells (before treatment) are required for analysis every four years. The last analysis was performed in 1997. The next round of analysis is scheduled for 2000. The latest sample in October 1997 contained 2.7 picocuries per liter (pCi/l) gross alpha, well below the 15 pCi/l MCL.

(14) Total Trihalomethane Analysis. Annual discrete sampling is conducted at the system point of entry. The last sample was submitted in March 1998. The next sample is scheduled for January 1999. The highest level of total THM's found in the March 1998 samples was 35.9 μg/l, with most of the samples containing less that one-third of that level. The current MCL is 100 μg/l. Fort Huachuca should have no problem meeting the proposed Stage 1 Disinfectants/Disinfection By-Products Rule TTHM MCL of 80 μg/l and should also be able to meet the proposed Stage II MCL of 40 μg/l (Reference 19).

h. Operator Certification. The State of Arizona requires the chief operator or superintendent in direct responsible charge of a treatment plant and distribution system to be certified at the grade of the facility and system. Furthermore, the State requires the shift foremen or other operators in charge of the facility in the absence of the chief operator or superintendent to be certified at a grade no lower than one grade below the grade of the facility and system. Fort Huachuca's water plant and distribution system are classified as Grade 3. The plant and system are contractor operated by SSI. SSI currently employs one Grade 4 operator and four other operators of Grade 2 or 3 to run the plant and system. The certification qualifications of this staff exceed the State requirements.

7. INSTALLATION EMERGENCY WATER SUPPLY. The only emergency water supply in place is water stored in the holding reservoirs. This equals approximately 5.5 MG above ground if all the tanks are full, not including the surge tanks at each well. If each surge tank is full, an additional 377,000 gallons is available. However, most of Fort Huachuca's water storage is located at lower elevations than its customers. Without backup power in place, only the water in the old reservoirs (470,000 gallons) is available to serve the old post housing areas (zone A). Similarly, only the 1.5-MG tank is available to serve zone B. The bulk of the system's storage, the 3-MG tank and the 500,000 gallon tower, are located at the bottom of the system, and can only serve zone C without power to the booster pumps. Water in the surge tanks needs to be pumped to the system before it can be used.

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8. WATER TELEMETRY/AUTOMATION SYSTEM.

a. History. The Fort Huachuca water system's widely dispersed wells, booster pumps, and storage facilities necessitate the presence of a useful and dependable automated control and telemetry system. Fort Huachuca had a system in the early 1980's that controlled the major system functions from Greeley Hall. The system went to a contract in 1986 and by all accounts gradually fell into disrepair. A study was performed in 1990 to determine the requirements for a new system. Construction was started soon after, but the project fell short on funding and was never completed. In 1997, construction began on the current system, a project run through the Corps of Engineers at a cost of $507,057. Johnson Controls, Inc (JCI), a subcontractor of Miller and Associates, has the contract to install the current system. The contract is in a 1-year warranty period now, but according to Engineering Plans and Services personnel, the installation is not happy with the installed system (Reference 20).

b. Current System. The capabilities sought in the new telemetry system would allow Fort Huachuca water plant operators to monitor the water levels in all storage tanks, measure the production of each well, and to control all booster pumps from a computer at one central location. These were the goals of the contract with JCI, but at the time of the visit, nearly a year after the system came on line (25 September 1997), the system was not operating as planned. The control of the system is performed through a personal computer (PC) at the Main Plant. The PC and all data connections except Well Nos. 7 and 8 are connected via telephone lines to control panels at Greeley Hall. Due to their remote location, Well Nos. 7 and 8 use a radio frequency link to Well No. 6. The heart of the system's problems seems to be trouble keeping the telephone lines up and correctly connected. Other problems that have plagued the system include faulty or incorrectly installed sensors on the water storage tanks. In addition, surges and dips in electrical power, which are very common at Fort Huachuca, continuously trigger a variety of system alarms. The system has the capability to perform all functions originally sought, but due to tremendous reliability problems, the operators are unable to depend on it. This effectively defeats the purpose of the system. Currently the operators make rounds every shift, turning booster pumps on and off manually and checking the status of wells in person. Repairs are currently performed by Installation personnel with funds from outside the JCI contract because it is quicker and more effective to fix the system themselves than to try and get JCI to do it.
Fort Huachuca personnel should thoroughly document the system's shortfalls, report them to JCI, and resolve these problems under the current contract before the warranty period expires.

c. Future of System. The true benefits of having an automated water system cannot be realized at Fort Huachuca until the system is working properly and has earned the operators' trust. Once the system has proven the ability to consistently report accurate information and perform automated tasks, monetary benefits in the form of reduced power and labor costs might be realized. By optimizing the system to perform the bulk of its pumping at night, and to pump

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d. as little as possible during peak electrical usage periods during the day, Fort Huachuca can lower peak power usage and reduce electricity costs. Currently, operators attempt to perform this function manually, but it can probably be performed better, cheaper, and more easily by an automated system. A fully optimized and reliable system could alleviate the necessity of having water plant operators on duty 24 hours a day as is currently the case. By reducing staffing levels to one shift per day, Fort Huachuca could save over $100,000 per year. One Fort Huachuca employee is currently being trained to install and program JCI equipment. Training Fort Huachuca maintenance personnel in the troubleshooting and maintenance of this equipment will likely save time and money in the future.

9. RECREATIONAL WATERS.

a. General. Fort Huachuca operates three swimming pools, the Barnes Field House Pool (indoor), Grierson Pool (building #22011), and Irwin Pool (building #70563). Both outdoor pools (Grierson and Irwin) operate a wading pool. The outdoor pools were closed for the winter season at the time of the Visit, but the Barnes Field House pool is open all year.

b. Operation and Maintenance.

(1) The pools are disinfected using gaseous chlorine supplied by 150-pound cylinders. A caustic soda injection system is used to maintain pH. The outdoor pools use cyanuric acid to prevent rapid chlorine dissipation. Sand filters are used at all three pools for filtration.

(2) Contracted operators maintain and monitor the filtration and chlorination equipment on a daily basis. A daily log is kept in the filter area, with problems recorded as they occur. Chlorine residual, pH, and temperature measurements are also recorded (twice each shift) in the log. The PVNTMED Svc personnel conduct pre-opening inspections at the start of the season as well as periodic pool inspections. In addition, they perform bacteriological examinations using heterotrophic plate count tests.

c. Pool Infrastructure.

(1) The Irwin and Grierson wading pools are connected to the same recirculation, chlorination, and filtration system used for the adult pools. Arizona State regulations require separate circulation, chlorination, and filtration facilities for wading pools. Additionally, Arizona regulations specify a 1-hour turnover rate for wading pools, which is not occurring in the Irwin and Grierson wading pools. According to Engineering Plans and Services personnel, this is a result of the wading pool drainpipes being undersized and possibly clogged with debris. Previously, Irwin Pool had a separate system for its wading pool, but it was dismantled at some

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point. The Grierson facility was never equipped with separate circulation, chlorination, or filtration facilities for its wading pool. This was a finding in the June 1995 Environmental Compliance Assessment System (ECAS) survey (Reference 21).

(2) Arizona regulations were updated in July 1998 to include the following requirements: "Swimming pool disinfection must meet specific requirements" [AAC R18-5-234(A)]. A public swimming pool or spa shall have a water circulation system that provides complete circulation of water through all parts of the swimming pool and can maintain water chemistry and water clarity requirements. The water circulation system for a wading pool shall have a turnover rate of at least once every hour. The water circulation system shall be designed to give the proper turnover rate without exceeding the maximum filtration rate for the filter [AAC R18-5-223(A)]. All wading pools shall have separate equipment for water circulation and disinfection. The water in a wading pool shall have a maximum turnover cycle of one hour [AAC R18-5-244(A)].

(3) In addition to Arizona regulations, the Army requires wading pools to have a faster turnover rate than regular pools. The TB MED 575, Occupational and Environmental Health Swimming Pools and Bathing Facilities, stipulates "Wading pools should be provided with a continuous flow of water every 2 hours" [TB MED 575, paragraph 6-2 b (3)]. The TM 5-662, Swimming Pool Operation and Maintenance, mandates "Wading pools should have a continuous flow of water providing a complete change of water every two hours [TM 5-662, paragraph 3-7].

(4) Since Irwin and Grierson pools are out of compliance with State regulations, the recommendation was made during the WSPE that Fort Huachuca create separate circulation, chlorination, and filtration facilities for the wading pools. Fort Huachuca's Engineering Plans and Services Division created plans for a separate system after the June 1995 ECAS, but they were not implemented due to lack of funding. Engineering Plans and Services personnel estimate it will cost approximately $20,000 to upgrade each outdoor pool facility to meet State requirements.

(5) The addition of separate disinfection and filtration facilities will allow for the proper turnover rate in the wading pools. Achieving the proper turnover rate is very important, especially for the children's wading pools. Children tend to have less bodily control, leading to a higher potential for fecal accidents. Separate systems will prevent the mixing of contaminated water between the two pools. Proper filtration (in the form of a 1-hour turnover) will remove potentially disinfection resistant, disease-causing organisms found in fecal matter from the water.

10. WATER CONSERVATION. Fort Huachuca is located in an arid environment, receiving approximately 13.5 inches of rainfall per year. Fort Huachuca, the surrounding city of Sierra Vista, and other nearby communities rely entirely on groundwater sources for their water needs. Due to the low annual precipitation, high average annual temperature (average daily high of

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76.7° F), and low relative humidity, groundwater recharge is very low. This has placed a heavy burden on the local groundwater resources. This fact, coupled with intense local political pressure, has caused Fort Huachuca to place special emphasis on water conservation during the last few years. A variety of conservation measures have been taken during this time.
Fort Huachuca has installed low-flow plumbing fixtures and no-flush urinals throughout post, performed a leak-detection survey and removed old and leaky infrastructure, reduced landscape water requirements, and placed restrictions on residential water use (which are strictly enforced by the military police). The net result of these actions has been a reduction in overall water production of 22% between 1993 and 1997. Water production figures through September 1998 indicate that Fort Huachuca will achieve a nearly 30% reduction in water production for the five years 1993 through 1998 (see Figure 5). In addition to the widely implemented programs mentioned above, Fort Huachuca is studying other initiatives for future implementation. A rainwater reuse test project is in progress at the Veterinary Care Clinic that involves using the roof to collect rainwater and cistern to store it until it is needed. It is hoped that this concept could be used on a larger scale to supply much of the post's water for landscape irrigation. Most of the water produced at Fort Huachuca eventually ends up at the wastewater treatment plant. Fort Huachuca hopes to use the treated wastewater effluent to recharge up to 1,000 acre-feet per year through infiltration from effluent ponds. Studies are underway to monitor resulting groundwater chemistry changes. Research is also underway to examine the possibility of recharging the aquifer with captured runoff from the mountains around Fort Huachuca. It is estimated that this project will result in up to 2,000 acre-feet of recharge per year.

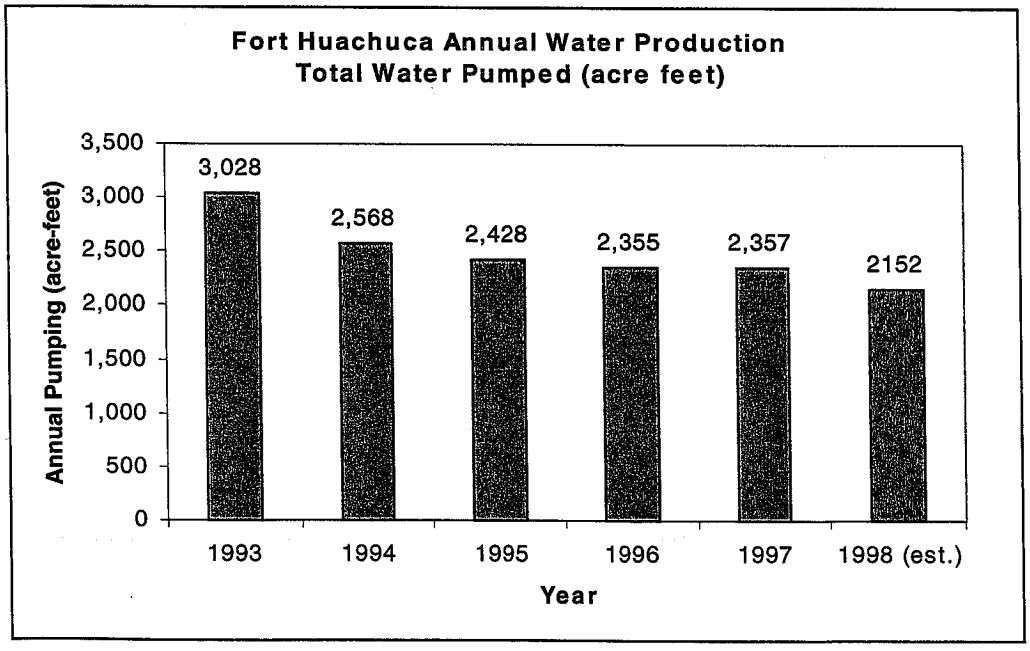

Figure 5. Annual Water Production, 1993-1998.

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11. CONCLUSIONS. Fort Huachuca has a high-quality, reliable water source, which, if properly managed, should provide enough water to meet the Installation's needs indefinitely. The staff currently employed under contract to operate and monitor the water system is capable and qualified. As currently operated, the water system is producing sufficient quantities of high-quality drinking water to meet the Installation's demand. Weaknesses in the water system include erratic and poorly controlled chlorine and fluoride dosage, decentralized record keeping, and minor operations and maintenance deficiencies.

12. RECOMMENDATIONS.

a. Class I Recommendations.

(1) Install in-line chlorine residual monitors and low-level alarms with automatic pump shut-off at each chlorination facility. Set low-level alarms to notify operators when chlorine residual drops below 0.2 mg/l, and to shut down the well pump when chlorine residual drops to 0.0 mg/l.

(2) Install separate filtration and disinfection systems that meet State [AAC R18-5-223(A), AAC R18-5-244(A)] and Army [TB MED 575, 6-1] requirements for both wading pools prior to reopening the pools.

(3) Provide disinfection and bacteriological testing for the Spatial Resolution Well to meet OSHA potable water requirements.

b. Class III Recommendations.

(1) Seal cracks around windows in surge tanks at Well Nos. 1 through 6 to exclude insects and vermin [AR 420-49, paragraph 4-1g; TM 5-660, paragraph 8-6(a)(1)].

(2) Cover windows or otherwise protect surge tanks at Well Nos. 1, 2, and 4 from contamination by vandal or sabotage.

(3) Repair missing ceiling tiles and holes in chlorination rooms at Well Nos. 3, 4, and 5 to provide a gas-tight partition between chlorination facilities and other work areas [TB MED 576, paragraph l-1].

(4) Install a BM- or NIOSH-approved self-contained breathing apparatus directly outside the entrance to each chlorination facility [TB MED 576, paragraph L-6].

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(5) Reduce variation in fluoride levels in finished water through calibration and servicing of fluoridation equipment and operator training.

(6) Implement effective annual distribution system flushing program IAW TM 5-660 and TB MED 576.

(7) Modify existing potable water storage tank inspection program to include all such tanks currently in use at Fort Huachuca. Include testing and maintenance of cathodic protection systems in inspection procedures.

(8) Install or repair cathodic protection systems on all steel potable water storage tanks.

(9) Install screen on 120,000-gallon storage tank (Bldg 12519) overflow pipe to exclude birds, insects, and airborne debris [AR 420-49, paragraph 4-1g; TM 5-660, paragraph 8-6(a)(1)].

(10) Replace broken vent screen on Well No. 8 [AR 420-49, paragraph 4-1g; TM 5-660, paragraph 8-6(a)(1)].

(11) Consolidate and centralize system records and authority to improve communication and effectiveness within water treatment, storage, and distribution operations.

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(12) Ensure Johnson Controls, Inc. meets contract obligations before automation contract warrantee period expires. Train Fort Huachuca employees in installation and maintenance of system components.

KEVIN SCHWALL
1LT, MS
Sanitary Engineer

REVIEWED AND APPROVED BY:

MICHAEL J. DELL'ORCO, P.E.
MAJ, MS
Chief, Environmental Health Engineering Division

Use of trademarked names does not imply endorsement by the U.S. Army but is intended only to assist in identification of a specific product.

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APPENDIX A

REFERENCES

1. EPA/625/6-91/027, February 1991, Handbook – Optimizing Water Treatment Plant Performance using the Composite Correction Program.

2. Public Law 93-523, 16 December 1974, The Safe Drinking Water Act of 1974.

3. Public Law 99-339, 19 June 1986, The Safe Drinking Water Act Amendments of 1986.

4. Public Law 104-182, 6 August 1996, The Safe Drinking Water Act Amendments of 1996.

5. Title 40, Code of Federal Regulations (CFR), 1998 rev., Part 141, National Primary Drinking Water Regulations.

6. Title 40, CFR, 1998 rev., Part 143, National Secondary Drinking Water Regulations.

7. Arizona Statutes Title 49, Chapter 2, Water Quality Control, 1998.

8. AR 40-5, 15 October 1990, Preventive Medicine.

9. AR 200-1, 21 February 1997, Environmental Protection and Enhancement.

10. AR 420-49, 28 April 1997, Utility Services.

11. TB MED 576, March 1982, Sanitary Control and Surveillance of Water Supplies at Fixed Installations.

12. TM 5-660, 30 August 1984, Real Property Operation and Maintenance, Maintenance and Operation of Water Supply, Treatment and Distribution Systems.

13. TM 813-1, 4 June 1987, Water Supply, Sources, and General Considerations.

14. TM 813-3, 16 September 1985, Water Supply, Water Treatment.

15. TM 813-4, 20 September 1985, Water Supply, Water Storage.

16. Providing Safe Drinking Water from Unregulated Water Systems, USACHPPM Information Paper No. 31-016, September 1996.

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17. Water Fluoridation Principles and Practice, American Water Works Association Manual M4, 1995.

18. Water Quality Consultation Survey No. 31-09-4166-95, Fort Huachuca, Arizona, 18-22 September 1995.

19. Proposed Rule, NPDWR: Disinfectants and Disinfection By-Products; Notice of Data Availability, 62 FR 59388, 3 November 1997.

20. Conversation with Craig Hansen, Energy and Water Management Technician, Engineering Plans and Services, 24 September 1998, subject: Drinking Water System Automation Project.

21. 1995 Environmental Compliance Assessment Survey.

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APPENDIX B

PERSONNEL CONTACTED

Name	Title
Mr. Jerry Highley	Water/Wastewater Technician, ENRD
Mr. Ray Wilson	Water/Wastewater Operator
Mr. Thomas Campbell	Mechanical Engineer, DPW
Mr. Thomas Cochran	Chief, ENRD
Mr. Craig Hansen	Engineering Plans and Services
Mr. Sal Aguilar	
2LT John Young	Environmental Science Officer
Ms. Susan Buckley	Supervisory Recreation Assistant
Mr. Wade Goodall	
Mr. Mike Shaughnessy	Water Issues Coordinator

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APPENDIX C

1998 ECAS FINDINGS

WQ.2.1.A #1 III ARMY/DOD FINDING Water Quality

FINDING ID: WQ-KS-01
MANUAL QUESTION NUMBER: WQ-002-001-A
FINDING CATEGORY: CLASS III
FINDING TYPE: Negative
EXISTING NOV: NO
LOCATION: DIS, ENRD
IFS FACILITY NUMBER: MULT
FACILITY TYPE: UTILITIES & GROUND IMPROVEMENTS

FINDING DESCRIPTION: Steel drinking water storage tanks at Fort Huachuca are not protected from corrosion by operational cathodic protection systems. Most of the steel storage tanks lack cathodic protection systems entirely. Others, including West Range Tank 12519, are reported to have cathodic protection. Since these systems have never been tested, they cannot be assumed to be functioning correctly.

SUGGESTED/ALTERNATIVE CORRECTIVE ACTION(S): Submit work order to provide cathodic protection as necessary. Implement periodic monitoring and maintenance program IAW manufacturer's maintenance recommendations to ensure cathodic protection systems remain operational. Estimated cost: $20,000.

CRITERIA: External surfaces in contact with soil and all internal surfaces of steel water storage tanks should be protected from corrosion by a cathodic protection system [AR 420-49, para 4-10(d)].

FINDING COMMENTS: The lack of cathodic protection for corrosion control for the steel water storage tanks was first identified in the 1989 Environmental Program Review performed by the Army Environmental Hygiene Agency. This finding was also identified during the last ECAS (June 1995) and Water Quality Consultation Survey No. 31-09-4166-96 performed by USACHPPM (September 1995).

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WQ.2.1.A #2 III ARMY/DOD FINDING Water Quality

FINDING ID: WQ-KS-02
MANUAL QUESTION NUMBER: WQ-002-001-A
FINDING CATEGORY: CLASS III
FINDING TYPE: Negative
EXISTING NOV: NO
LOCATION: DIS, ENRD
IFS FACILITY NUMBER: MULT
FACILITY TYPE: UTILITIES & GROUND IMPROVEMENTS

FINDING DESCRIPTION: The chemical (chlorination and flouridation) facilities at wells 3, 4, and 5 had various openings including missing ceiling tiles and conduit holes which could allow chlorine gas to enter the room where the well and booster pump are located.

SUGGESTED/ALTERNATIVE CORRECTIVE ACTION(S): Replace missing ceiling tiles and plug conduit holes between chlorination and pump rooms. Estimated cost: $250.

CRITERIA: Storage of chlorine should be above ground in a well ventilated area separated from other occupational areas by a gas-tight partition. (TB MED 576 page L-1)

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WQ.2.1.A #3 III ARMY/DOD FINDING Water Quality

FINDING ID: WQ-KS-03
MANUAL QUESTION NUMBER: WQ-002-001-A
FINDING CATEGORY: CLASS III
FINDING TYPE: Negative
EXISTING NOV: NO
LOCATION: DIS, ENRD
IFS FACILITY NUMBER: MULT
FACILITY TYPE: UTILITIES & GROUND IMPROVEMENTS

FINDING DESCRIPTION: Good ventilation practices were not observed upon entering the chlorine facilities for the drinking water wells. The fans were not always turned on prior to entering the chlorine facilities. In addition, there were not adequate ventilation grills and the fan was not of sufficient capacity to provide at least one air change every two minutes. Although respirators are available in the operators' trucks, no respirators are permanently available at the chlorination facilities.

SUGGESTED/ALTERNATIVE CORRECTIVE ACTION(S): Suggest installing automatic fan switches to activate ventilation system as soon as the door to the chlorination room is opened. Suggest installing additional vents and larger exhaust fans (as necessary) to improve airflow in chlorination rooms. Install BM or NIOSH-approved respirators in weather-proof boxes by the entrances to all chlorination facilities. Estimated cost: $2000.

CRITERIA: The chlorine room shall be ventilated at a rate of one air change every two minutes by means of exhaust grills located not more than six inches above floor level (TB MED 576, para L-2). At least one BM- or NIOSH-approved chlorine gas mask shall be available and located directly outside the chlorination facility entrance (TB MED 576, para L-6).

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WQ.5.5.AZ #1 I STATE CORRECTIVE ACTION Water Quality

FINDING ID: WQ-SR-04
MANUAL QUESTION NUMBER: WQ-005-005-AZ
FINDING CATEGORY: CLASS I
FINDING TYPE: Negative
EXISTING NOV: NO
LOCATION: DMWR, SD
IFS FACILITY NUMBER: MULT
FACILITY TYPE: HOUSING & COMMUNITY FACILITIES

FINDING DESCRIPTION: The wading pools at Grierson Pool (Bldg 22011) and Irwin Pool (Bldg 70563) are connected to the same filtration, chlorination, and recirculation system as the adult pools. Additionally, the wading pools do not achieve adequate turnover rates.

SUGGESTED CORRECTIVE ACTION(S): Equip each wading pool with a separate pump, sand filter, and piping. Estimated cost: $20,000 per wading pool.

CRITERIA: Swimming pool disinfection must meet specific requirements (AAC R18-5-234(A)) [Added July 1998]. A public swimming pool or spa shall have a water circulation system that provides complete circulation of water through all parts of the swimming pool and can maintain water chemistry and water clarity requirements. The water circulation system for a wading pool shall have a turnover rate of at least once every hour. The water circulation system shall be designed to give the proper turnover rate without exceeding the maximum filtration rate for the filter. (AAC R18-5-223(A)) All wading pools shall have separate equipment for water circulation and disinfection. The water in a wading pool shall have a maximum turnover cycle of one hour. [AAC R18-5-244(A)]

FINDING COMMENTS: At one time, Irwin Pool had a separate filtration, chlorination, and recirculation system for its wading pool. It has since been disconnected. Grierson Pool was never outfitted with a separate system for the wading pool. Since each wading pool is connected to the adult pool recirculation and filtration systems and the wading pool drain pipes are undersized, the wading pools are not receiving the required 1-hour turnover. This was a finding in a previous ECAS (June 1995).

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WQ.4.1.A #1 III ARMY/DOD CORRECTIVE ACTION Water Quality

FINDING ID: WQ-SR-03
MANUAL QUESTION NUMBER: WQ-004-001-A
FINDING CATEGORY: CLASS III
FINDING TYPE: Negative
EXISTING NOV: NO
LOCATION: DMWR, SD
IFS FACILITY NUMBER: MULT
FACILITY TYPE: HOUSING & COMMUNITY FACILITIES

FINDING DESCRIPTION: Swimming pool records (i.e., appropriate chlorine and pH measurements) are kept for one season. TB MED 575 requires records to be kept for at least two seasons.

SUGGESTED CORRECTIVE ACTION(S): Maintain all records for at least two seasons. Estimated cost: $0.

CRITERIA: The operation, maintenance, and repair of swimming pools will be done according to the standards outlined in TB MED 575 (AR 420-46, para 9-1 and 9-4). Retain all records for at least two swimming seasons (TB MED 575, 6-26d).

USF200003672

WSPE Project No. 31-RE-1136-99, Ft Huachuca, AZ, 14-25 Sep 98

WQ.999.1.A #1 III ARMY/DOD CORRECTIVE ACTION Water Quality

FINDING ID: WQ-SR-01
MANUAL QUESTION NUMBER: WQ-999-001-A
FINDING CATEGORY: CLASS III
FINDING TYPE: Negative EXISTING NOV: NO
LOCATION: DIS, ENRD
IFS FACILITY NUMBER: MULT
FACILITY TYPE: UTILITIES & GROUND IMPROVEMENTS

FINDING DESCRIPTION: Well #8 had a broken vent screen and a storage tank (building 12519) was missing a screen on the overflow spout.

SUGGESTED CORRECTIVE ACTION(S): Ensure that all storage tanks are inspected at least semi-annually. Replace broken and missing screens as necessary. Estimated cost: $200.

CRITERIA: Operation, maintenance and repair of water supply systems will be IAW TM 5-660. (AR 420-49, 4-1g) The exterior (of storage tanks) should be inspected to ensure paint is in good condition, screens are free of holes, and hatches are secure, watertight, and positioned to exclude animals and insects. (TM 5-660, Table 8-4)

FINDING COMMENTS: Broken and/or missing screens were previously identified in Water Quality Consultation No. 31-09-4166-95 (September 1995).

USF200003673

WQ.999.2.A #1 III ARMY/DOD CORRECTIVE ACTION Water Quality

FINDING ID: WQ-SR-02
MANUAL QUESTION NUMBER: WQ-999-002-A
FINDING CATEGORY: CLASS III
FINDING TYPE: Negative
EXISTING NOV: NO
LOCATION: DIS, ENRD
IFS FACILITY NUMBER: MULT
FACILITY TYPE: UTILITIES & GROUND IMPROVEMENTS

FINDING DESCRIPTION: Although water main dead ends are flushed and the fire department periodically flushes fire hydrants on post, systematic flushing on an annual basis does not occur.

SUGGESTED CORRECTIVE ACTION(S): Begin annual systematic flushing of the distribution system. When flushing the distribution system, each loop of the distribution system must be isolated and flushed individually. The process begins at the highest elevation (lowest pressure) of the system and systematically flushes each loop in progression towards the lowest elevation (highest pressure). Flushing can be performed entirely under Directorate of Installation Support (DIS) control or coordinated with the Fire Department to reduce duplication of effort (see Finding Comments). Estimated cost: 1/8 man-years = $8000.

CRITERIA: Operation, maintenance, and repair of water supply systems will be IAW TM 5-660. (AR 420-49, 4-1) Water distribution systems should be flushed as necessary to remove accumulated debris per TM 5-660 and TB MED 576. (TM 5-660 8-3d) Existing water mains should be flushed, as a matter of policy, at least annually. A program to provide for periodic flushing of all water mains shall be established by the facilities engineer and coordinated with the appropriate installation medical authority. (TB MED 576 4-3b)

FINDING COMMENTS: The lack of systematic water distribution system flushing was a previous finding in Water Quality Consultation No. 31-09-4166-95 (September 1995). Although the fire station periodically flushes hydrants on post, this is insufficient to completely flush the entire system. In the interest of cost savings and efficiency, a formalized agreement between DIS and the Fire Department should be generated. Fire hydrant flow testing, water main flushing, and valve exercising could be combined into one coordinated program. This approach would eliminate duplication of effort, fulfill all requirements, and reduce the overall number of man-hours necessary to complete the programs individually. Flushing is necessary to remove built up debris and corrosion from the interior pipe walls. The process also ensures chlorinated water reaches all points of the distribution system which may otherwise stagnate at areas of low water use or at dead ends.

USF200003674

APPENDIX D

STORAGE TANK DATA

Structure Number	Capacity (gal)	Material	Location/Notes
90017	46,000	Masonry	Well #1 surge tank
90013	46,000	Masonry	Well #2 surge tank
90431	46,000	Masonry	Well #3 surge tank
90672	46,000	Masonry	Well #4 surge tank
90860	46,000	Masonry	Well #5 surge tank
79692	47,000	Masonry	Well #6 surge tank
15663	100,000	Steel	Well #7 & 8 surge tank, cathodic protection untested
22002	265,000	Masonry	Old Reservoir #1
22001	205,000	Masonry	Old Reservoir #2
49001	500,000	Steel	Elevated, no cathodic protection
22020	1,500,000	Masonry	
61609	3,000,000	Masonry	
NA	10,000	Masonry	Blacktower Road/Blacktail Canyon location (by Bldg 12508)
NA	28,200	Steel	Blacktower Road/Blacktail Canyon location
12519	120,000	Steel	New, cathodic protection untested
NA	5,000	Steel	Aerostat Site (by Bldg. 16201)
NA	2,000		Rod and Gun club
NA	1,000	Steel	Fire protection for Bldg. 12586

USF200003675

APPENDIX E

ROUTINE TESTS FOR UNREGULATED SYSTEMS

Parameter	Sampling Location	Frequency[1]	Typical Range or Standard	Affects
pH[2]	S, DS[3]	Annually	6.5 - 8.5 units	--
Temperature	S, DS[4]		--	--
Disinfectant Residual	DS[5]	Weekly	Detectable (≥0.1)	Health[6]
Total/Fecal Coliform	S[7] DS	Annually Quarterly	Absence of any coliforms	Health
Nitrate	S	Annually	MCL= 10 mg/L	Health
Total Dissolved Solids	S	Annually	SMCL[8]= 500 mg/L	Aesthetics[9]
Sulfate	S	Triennially	SMCL= 250 mg/L	Aesthetics[9]
Chloride	S	Triennially	SMCL= 250 mg/L	Aesthetics
Iron	S, DS[12]	Triennially	SMCL= 0.3 mg/L	Aesthetics
Manganese	S	Triennially	SMCL= 0.05 mg/L	Aesthetics
Hardness	S	Triennially	50 - 150 mg/L as $CaCO_3$	Aesthetics
Total Trihalomethanes[10]	DS		MCL= 0.100 mg/L	Health
Corrosion Index[11]	S	Triennially	SMCL= Noncorrosive	12
Lead[13]	DS	at least one time	AL= 0.015 mg/L	Health

USF200003676

Parameter	Sampling Location	Frequency[1]	Typical Range or Standard	Affects...

NOTES: S - source DS - distribution system (taps) MCL - Maximum Contaminant Level AL - Action Level
SMCL - Secondary Maximum Contaminant Level

1. Frequencies based upon recommendations by the EPA (reference 4).
2. The pH affects the corrosivity of water and the disinfection process. The pH value is also used in the calculation of the corrosion index.
3. pH values throughout the distribution system should be similar (desirably +/- 0.5 units) to the value measured at the source. Large changes (approximately >1.0 units) could indicate stagnant water conditions or a potential cross-connection.
4. Temperature differences in the distribution system (>10 degrees) may indicate stagnant water conditions.
5. If a disinfectant is applied to the water, the residual leaving the treatment facility should be closely monitored, perhaps daily, to ensure proper operation of disinfecting equipment. The furthest points in the distribution system should be checked to ensure a detectable residual extends throughout the distribution system.
6. A detectable disinfectant residual provides protection against microbiological contaminants.
7. Total/fecal coliforms need only be monitored at the source if a disinfectant is not applied prior to distribution.
8. SMCLs are not Federally enforceable, but are recommendations to improve the aesthetic quality of drinking water.
9. High values of TDS/sulfate may have a temporary laxative effect during adjustment to new water.
10. Trihalomethanes are formed by time-dependent reactions between a disinfectant (e.g., chlorine) and organic matter in the water. Because the reactions are time-dependant, points further in the distribution system can be expected to have higher values of trihalomethanes than locations closer to the source. Trihalomethanes should be monitored if changes in source water quality occur or the disinfection process is changed.
11. Determination of corrosivity of water shall include measurement of pH, calcium hardness, alkalinity, temperature, and total dissolved solids. These values can be used to calculate the Langelier Saturation Index (LSI), a common corrosion index. Calculation equations for the LSI can be found in Standard Methods for the Examination of Water and Wastewater (reference 15). Some labs may calculate the LSI. Make this request when submitting samples for analysis. Corrosive water has a negative LSI value.
12. If water is found to be corrosive, systems may want to consider testing for other distribution system metals subject to leaching such as iron, lead, copper, cadmium, and zinc.
13. Most of the lead concentration in drinking water comes from the corrosion of plumbing materials. Lead content should be monitored at the source if elevated levels of lead are detected at the tap to ensure that the source is not contaminated. If source is located near a potential source of lead contamination, triennial sampling of the source should be performed. Regulated water systems must meet the action level in at least 90 percent of tap water samples collected. For purposes of protecting health, unregulated systems could apply this limit to all samples collected.

USF200003677

APPENDIX F

EPR REPORTS

USF200003678

Installation Name: FORT HUACHUCA
Street Address: ATTN: ATZS-EHB
City: FORT HUACHUCA
Congressional District:
Abbreviation:
Local Information:
ASG:
Agency Project Number: WQKS01
Project Name: Install Cathodic Protection for Storage Tanks
Date of Initial Entry: 12/23/98
Reason for Initiation: ENVIR AUDIT
P2 Category:
Pillar: Compliance
Construction/Work Start:
Progress Code: DEF
Project Contact Name: JERRY HIGHLEY
Geographic Initiative:
Program Area:
Other Project ID Type:
Local Priority:

FFID: AZ-213720434
Property Number: 20434
State: ARIZONA
BSB:
Multiple Installations:
Must Fund (Y/N): N
Construction/Work Complete:

Major Command: TRADOC
Support Installation:
Country: US Zip: 85613
Ownership Type: GOCO
Installation Type: TROOP OPERATIONS
Subcommand:
Date of Last Revision: 12/23/98
Law/Reg Area: SDWA
Environmental Category: PDWS
Compliance Status: ESDL
Project Assessment: M
Class: 3
Design Plan Completion
Final Compliance Required:
Year Funding Required:
Contact Telephone:
Total Cost Estimate: $ 20,000
Project Type: Other
Other Project ID:
Command Priority:

Fund Code: OMA(VENC) O&M ARMY (MDEP VENC

FY	Budget Code	Required	Prg/Bdgt	Obligated	FY	Budget Code	Required	Prg/Bdgt	Obligated
000	325756.22	$20,000	$0	$0					

arrative:
eel drinking water storage tanks at Fort Huachuca are not protected from corrosion by operational cathodic protection systems. The lack of cathodic protection for corrosion control for the steel water storage tanks was first identified in the 89 Environmental Program Review conducted by the Army Environmental Hygiene Agency, but has not been corrected due to lack of funding. Cathodic protection must be installed on tanks lacking cathodic protection, and repaired on nks with existing systems that are not working

omments:

Page 1 of 1 Exp Date 4/30

USF200003679

Report Date: 12/23/98

EXHIBIT 2 REPORT

WQKS03

Installation Name: FORT HUACHUCA
Street Address: ATTN: ATZS-EHB
City: FORT HUACHUCA
Congressional District:
Abbreviation:
Local Information:
ASG:
Agency Project Number: WQKS03
Project Name: Improve chlorine room ventilation, add respirators
Date of Initial Entry: 12/23/98
Reason for Initiation: ENVIR AUDIT
P2 Category:
Pillar: Compliance
Construction/Work Start:
Progress Code: OTH
Project Contact Name: JERRY HIGHLEY
Geographic Initiative:
Program Area:
Other Project ID Type:
Local Priority:

FFID: AZ-213720434
Property Number: 20434
State: ARIZONA

BSB:
Multiple Installations:

Must Fund (Y/N): Y
Construction/Work Complete:

Major Command: TRADOC
Support Installation:
Country: US Zip: 85613
Ownership Type: GOCO
Installation Type: TROOP OPERATIONS
Subcommand:
Date of Last Revision: 12/23/98
Law/Reg Area: SDWA
Environmental Category: PDWS
Compliance Status: ESDP
Project Assessment: H
Class: 1
Design Plan Completion
Final Compliance Required:
Year Funding Required:
Contact Telephone:
Total Cost Estimate: $ 2,000
Project Type: Other
Other Project ID:
Command Priority:

Fund Code: OMA(VENC) O&M ARMY (MDEP VENC

FY	Budget Code	Required	Prg/Bdgt	Obligated
2000	325756.22	$2,000	$0	$0

FY	Budget Code	Required	Prg/Bdgt	Obligated

Narrative:
Chlorination facilities are not properly ventilated. Chlorine rooms shall be ventilated at a rate of one air change every two minutes. The ventilation fans should be activated automatically when the doors to the chlorine rooms are opened. In addition, at least one Bureau of Mines (BM) or National Institute for Occupational Safety and Health (NIOSH) approved chlorine gas mask must be available and located directly outside chlorination facility entrances.

Comments:

USF200003680

EXHIBIT 2 REPORT

WQSR04

Installation Name: FORT HUACHUCA
Street Address: ATTN: ATZS-EHB
City: FORT HUACHUCA
Congressional District:
Abbreviation:
Local Information:
ASG:
Agency Project Number: WQSR04
Project Name: Install wading pool filtration and treatment
Date of Initial Entry: 12/23/98
Reason for Initiation: ENVIR AUDIT
P2 Category:
Pillar: Compliance
Construction/Work Start:
Progress Code: DES
Project Contact Name: JERRY HIGHLEY
Geographic Initiative:
Program Area:
Other Project ID Type:
Local Priority:

FFID: AZ-213720434
Property Number: 20434
State: ARIZONA
BSB:
Multiple Installations:
Must Fund (Y/N): Y
Construction/Work Complete:

Major Command: TRADOC
Support Installation:
Country: US Zip: 85613
Ownership Type: GOCO
Installation Type: TROOP OPERATIONS
Subcommand:
Date of Last Revision: 12/23/98
Law/Reg Area: SDWA
Environmental Category: PDWS
Compliance Status: INOV
Project Assessment: H
Class: 1
Design Plan Completion
Final Compliance Required:
Year Funding Required:
Contact Telephone:
Total Cost Estimate: $ 40,000
Project Type: Construction
Other Project ID:
Command Priority:

Fund Code: OMA(VENC) O&M ARMY (MDEP VENC

FY	Budget Code	Required	Prg/Bdgt	Obligated
2000	325756.22	$40,000	$0	$0

FY	Budget Code	Required	Prg/Bdgt	Obligated

Narrative:
The wading pools at Grierson Pool and Irwin Pool are connected to the same filtration, chlorination and recirculation systems as the adult pools. This violates Arizona regulations which require separate equipment for circulation and disinfection and a maximum turnover rate of one hour. These two wading pools must be taken out of service until separate filtration, disinfection, and recirculation systems are installed.

Comments:

USF200003681