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Arsenic Removal from Drinking Water by Adsorptive Media
U.S. EPA Demonstration Project at Queen Anne's County, Maryland
Final Performance Evaluation Report

by

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Sally Gutierrez, Director
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ABSTRACT

This report documents the activities performed and the results obtained from the arsenic removal treatment technology demonstration project at the community of Prospect Bay at Grasonville in Queen Anne's County, MD. The main objective of the project was to evaluate the effectiveness of Severn Trent Services (STS) SORB 33™ media in removing arsenic to meet the new arsenic maximum contaminant level (MCL) of 10 μg/L. Additionally, this project evaluated 1) the reliability of the treatment system (Arsenic Package Unit [APU]-300) for use at small water facilities, 2) the required system operation and maintenance (O&M) and operator skill levels, and 3) the capital and O&M cost of the technology. The project also characterized water in the distribution system and residuals generated by the treatment process. The types of data collected included system operation, water quality (both across the treatment train and in the distribution system), process residuals, and capital and O&M cost.

The STS system consisted of two 63-in-diameter, 86-in-tall fiberglass reinforced plastic (FRP) vessels in parallel configuration, each containing approximately 80 ft^3 of SORB 33™ media. The media is an iron-based adsorptive media developed by Bayer AG and packaged under the name SORB 33™ by STS. The system was designed for a flowrate of 300 gal/min (gpm) (150 gpm to each vessel), corresponding to a design empty bed contact time (EBCT) of about 4.0 min per vessel and a hydraulic loading rate of 6.9 gpm/ft^2. Actual flowrates through the system averaged 207 gpm, corresponding to an EBCT of 5.6 min in Vessel A and 6.0 min in Vessel B.

Upon review and approval of the engineering plan by the State, the APU-300 treatment system was installed and became operational on June 30, 2004. From June 30, 2004, through April 2, 2007, the APU-300 system operated an average of 6.2 hr/day for a total operating time of 5,890 hr. The system treated approximately 71,533,000 gal of water, or 59,800 bed volumes (BV), which was approximately 52% of the vendor-estimated working capacity for the SORB 33™ media. Several problems were encountered during the performance evaluation study, including the need to implement prechlorination, shortened run times between backwashes, and equipment malfunctions. The corrective actions taken to address the problems are detailed in the report.

Total arsenic concentrations in raw water ranged from 16.0 to 25.8 μg/L with soluble As(III) being the predominating species, averaging 18.9 μg/L. After treating only 7,400 BV of water, the arsenic concentration in the treated water exceeded the target concentration of 10 μg/L. To improve arsenic removal by the media, prechlorination was implemented in early November 2004. (Prior to this, chlorine was added at the end of the treatment train.) Arsenic in samples collected following prechlorination existed primarily as As(V) and particulate As, indicating effective As(III) oxidation. Since then, arsenic removal improved significantly, with its concentrations in the treated water decreasing from over 10 to 0.9 μg/L within two weeks following the switch to prechlorination. Total arsenic concentrations in the treated water remained at levels less than 10 μg/L (averaged at 2.1 μg/L) during the remainder of the performance evaluation study.

The APU-300 system was designed and programmed with an automatic backwash feature that would trigger backwash by either a differential pressure (Δp) setting of 10 pounds per square inch (psi) or a timer. However, backwash of the system was initiated manually by the system operator because there was no onsite disposal facility to receive the backwash wastewater, which had to be discharged into a tanker truck and transported to the Stevensville Wastewater Treatment Plant (WWTP) for disposal.

When post-chlorination was performed during the first four months of system operation, the adsorption vessels were not backwashed because there were little or no changes in pressure across both vessels. The

pressure readings began to rise once the switch to prechlorination had been implemented. The run times between backwashes shortened significantly from the initial 2,359 BV to less than 800 BV (or 2 month/backwash to less than 2 week/backwash). Media attrition appears to be the main reason for the shortened run times and more frequent backwash.

During the 33-month performance evaluation study, the adsorption system was backwashed a total of 50 times, generating 229,646 gal of wastewater. The backwash wastewater contained 100 to 430 mg/L of total dissolved solids (TDS) and 12 to 130 mg/L of total suspended solids (TSS). The backwash solids generated by each backwash cycle contained approximately 1.3 lb of iron, 0.003 lb of manganese, and 0.02 lb of arsenic.

Results of the distribution system sampling showed a distinct effect of the treatment system on arsenic concentrations in the treated water. The treatment system decreased arsenic levels in the distribution system from an average of 19.0 to 8.4 µg/L prior to the switch to prechlorination and to 3.6 µg/L after the switch to prechlorination. The results from the distribution system sampling mirrored those seen from the treatment system sampling, with As concentrations dropped once the system was put into service, rose gradually as As(III) began to break through during the first four months of system operation, and then went down again once the switch to prechlorination was made. The APU-300 did not appear to have an effect on the Pb or Cu levels in the distribution system.

The capital investment cost of $211,000 included $129,500 for equipment, $36,700 for site engineering, and $44,800 for installation. Using the system's rated capacity of 300 gpm (or 432,000 gal per day [gpd]), the unit capital cost was $703/gpm (or $0.49/gpd). This calculation does not include the cost of the building to house the treatment system. O&M cost, estimated at $0.31/1,000 gal, included only the incremental cost for electricity, replacement parts, and labor. The estimated media changeout cost was $27,728, which would represent the majority of the O&M cost. Media changeout did not occur during the performance evaluation period.

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ABBREVIATIONS AND ACRONYMS

Δp	differential pressure
AAL	American Analytical Laboratories
Al	aluminum
AM	adsorptive media
APU	arsenic package unit
As	arsenic
BET	Brunauer, Emmett, and Teller
BV	bed volume(s)
Ca	calcium
C/F	coagulation/filtration
Cl_2	chlorine
CRF	capital recovery factor
Cu	copper
DO	dissolved oxygen
EBCT	empty bed contact time
EPA	United States Environmental Protection Agency
Fe	iron
FRP	fiberglass reinforced plastic
GFH	granular ferric hydroxide
gpd	gallons per day
gpm	gallons per minute
ICP-MS	inductively coupled plasma-mass spectrometry
ID	identification
IX	ion exchange
LCR	(EPA) Lead and Copper Rule
MCL	maximum contaminant level
MDL	method detection limit
MDE	Maryland Department of the Environment
MDWCA	Mutual Domestic Water Consumers Association
Mg	magnesium
Mn	manganese
Mo	molybdenum
mV	millivolts
Na	sodium
NS	not sampled
NSF	NSF International
NTU	nephelometric turbidity units

O&M	operation and maintenance
ORD	Office of Research and Development
ORP	oxidation-reduction potential
P&ID	piping and instrumentation diagram
psi	pounds per square inch
PVC	polyvinyl chloride
QAC	Queen Anne's County
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
QA	quality assurance
RPD	relative percent difference
Sb	antimony
SDWA	Safe Drinking Water Act
SM	system modification
STMGID	South Truckee Meadows General Improvement District
STS	Severn Trent Services
TBD	to be determined
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
V	vanadium
VOC	volatile organic compounds
WRWC	White Rock Water Company
WWTP	wastewater treatment plant

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The authors wish to extend their sincere appreciation to the staff of the Queen Anne's County (QAC) Department of Public Works in Stevensville, Maryland. The QAC staff monitored the treatment system daily and collected samples from the treatment system and distribution system on a regular schedule throughout this reporting period. This performance evaluation would not have been possible without their support and dedication.

1.0 INTRODUCTION

1.1 Background

The Safe Drinking Water Act (SDWA) mandates that the U.S. Environmental Protection Agency (EPA) identify and regulate drinking water contaminants that may have adverse human health effects and that are known or anticipated to occur in public water supply systems. In 1975 under the SDWA, EPA established a maximum contaminant level (MCL) for arsenic at 0.05 mg/L. Amended in 1996, the SDWA required that EPA develop an arsenic research strategy and publish a proposal to revise the arsenic MCL by January 2000. On January 18, 2001, EPA finalized the arsenic MCL at 0.01 mg/L (EPA, 2001). In order to clarify the implementation of the original rule, EPA revised the rule text on March 25, 2003, to express the MCL as 0.010 mg/L (10 µg/L) (EPA, 2003). The final rule required all community and non-transient, non-community water systems to comply with the new standard by January 23, 2006.

In October 2001, EPA announced an initiative for additional research and development of cost-effective technologies to help small community water systems (<10,000 customers) meet the new arsenic standard, and to provide technical assistance to operators of small systems in order to reduce compliance costs. As part of this Arsenic Rule Implementation Research Program, EPA's Office of Research and Development (ORD) proposed a project to conduct a series of full-scale, onsite demonstrations of arsenic removal technologies, process modifications, and engineering approaches applicable to small systems. Shortly thereafter, an announcement was published in the *Federal Register* requesting water utilities interested in participating in Round 1 of this EPA-sponsored demonstration program to provide information on their water systems. In June 2002, EPA selected 17 out of 115 sites to host the demonstration studies. The community of Prospect Bay at Grasonville in Queen Anne's County (QAC), MD was selected as one of the 17 Round 1 host sites for the demonstration program.

In September 2002, EPA solicited proposals from engineering firms and vendors for cost-effective arsenic removal treatment technologies for the 17 host sites. EPA received 70 technical proposals for the 17 host sites, with each site receiving from one to six proposals. In April 2003, an independent technical panel reviewed the proposals and provided its recommendations to EPA on the technologies that it determined were acceptable for the demonstration at each site. Because of funding limitations and other technical reasons, only 12 of the 17 sites were selected for the demonstration project. Using the information provided by the review panel, EPA, in cooperation with the host sites and the drinking water programs of the respective states, selected one technical proposal for each site. Severn Trent Services (STS), using the Bayoxide E33 media developed by Bayer AG, was selected for the Prospect Bay facility. STS has given the E33 media the designation "SORB 33™."

1.2 Treatment Technologies for Arsenic Removal

The technologies selected for the 12 Round 1 EPA arsenic removal demonstration host sites include nine adsorptive media systems, one anion exchange system, one coagulation/filtration system, and one process modification with iron addition. Table 1-1 summarizes the locations, technologies, vendors, and key source water quality parameters of the 12 demonstration sites. An overview of the technology selection and system design (Wang et al., 2004) and the associated capital costs for each site (Chen et al., 2004) are provided on the EPA website (http://www.epa.gov/ORD/NRMRL/wswrd/dw/arsenic/index.html). As of March 2008, all 12 systems were operational, and the performance evaluation of 11 systems was completed.

Table 1-1. Summary of Round 1 Arsenic Removal Demonstration Sites

Demonstration Site	Technology (Media)	Vendor	Design Flowrate (gpm)	Source Water Quality		
				As (µg/L)	Fe (µg/L)	pH
WRWC, NH	AM (G2)	ADI	70[a]	39	<25	7.7
Rollinsford, NH	AM (E33)	AdEdge	100	36[b]	46	8.2
Queen Anne's County, MD	AM (E33)	STS	300	19[b]	270[c]	7.3
Brown City, MI	AM (E33)	STS	640	14[b]	127[c]	7.3
Climax, MN	C/F (Macrolite)	Kinetico	140	39[b]	546[c]	7.4
Lidgerwood, ND	SM	Kinetico	250	146[b]	1,325[c]	7.2
Desert Sands MDWCA, NM	AM (E33)	STS	320	23[b]	39	7.7
Nambe Pueblo Tribe, NM	AM (E33)	AdEdge	145	33	<25	8.5
Rimrock, AZ	AM (E33)	AdEdge	90[a]	50	170	7.2
Valley Vista, AZ	AM (AAFS50/ARM 200)	Kinetico	37	41	<25	7.8
Fruitland, ID	IX (A300E)	Kinetico	250	44	<25	7.4
STMGID, NV	AM (GFH/Kemiron)	Siemens	350	39	<25	7.4

AM = adsorptive media; C/F = coagulation/filtration; GFH = granular ferric hydroxide; IX = ion exchange; SM = system modification; MDWCA = Mutual Domestic Water Consumer's Association; STMGID = South Truckee Meadows General Improvement District; STS = Severn Trent Services; WRWC = White Rock Water Company

(a) Design flowrate reduced by 50% due to system reconfiguration from parallel to series operation.
(b) Arsenic exists mostly as As(III).
(c) Iron exists mostly as soluble Fe(II).

1.3 Project Objectives

The objective of the Round 1 arsenic demonstration program is to conduct full-scale arsenic treatment technology demonstration studies on the removal of arsenic from drinking water supplies. The specific objectives are to:

- Evaluate the performance of the arsenic removal technologies for use on small systems.
- Determine the required system operation and maintenance (O&M) and operator skill levels.
- Characterize process residuals produced by the technologies.
- Determine the capital and O&M cost of the technologies.

This report summarizes the performance of the STS treatment system operation from June 30, 2004, through April 2, 2007. The types of data collected include system operation, water quality (both across the treatment train and in the distribution system), residuals, and capital and preliminary O&M cost.

2.0 SUMMARY AND CONCLUSIONS

Based on the information collected from operation of STS's APU-300 arsenic removal system at Queen Anne's County, MD from June 30, 2004, to April 2, 2007, the following summary and conclusions were made relating to the overall objectives of the treatment technology demonstration study.

Performance of the arsenic removal technology for use on small systems:

- The SORB 33™ media was not effective at removing As(III), as demonstrated by arsenic breakthrough at 10 μg/L after only treating 7,400 bed volumes (BV) of water.
- Chlorine was effective at oxidizing As(III).
- Implementation of prechlorination reversed the trend of arsenic breakthrough, reducing total arsenic concentrations in the treated water from over 10 μg/L to 0.9 μg/L within two weeks.
- The use of chlorine significantly increased SORB 33™ media adsorptive capacity for arsenic. After the switch to prechlorination at approximately 10,200 BV on November 9, 2004, total arsenic concentrations in treated water remained at levels less than 10 μg/L (averaged at 2.1 μg/L) during the remainder of the performance evaluation study.
- During the 33 months of the performance evaluation study, the APU-300 system treated approximately 59,800 BV (or 71,533,000 gal) of water, which is about half of the vendor-estimated working capacity.
- Run times between backwashes shortened significantly from the initial 2,359 BV/backwash to less than 800 BV/backwash (or 2 month/backwash to less than 2 week/backwash) at the end of the performance study. Media attrition during backwash appeared to have caused more frequent backwash.
- The treatment system had a distinct effect on arsenic concentrations in the distribution system. The average arsenic concentration in the distribution system decreased from the original 19 μg/L (baseline) to 3.6 μg/L when the treatment system was in operation. Results from samples collected from within the distribution system mirrored those from the treatment system.
- The treatment did not appear to have an effect on Pb or Cu levels in the distribution system.

Simplicity of required system O&M and operator skill levels:

- The treatment system operated as expected during the demonstration study and did not experience any issues related to flow restriction or pressure drop.
- The skill requirements to operate the treatment system were minimal with a typical daily demand on the operator of 15 to 20 min. Normal operation of the system did not appear to require additional skills beyond those necessary to operate the existing water supply equipment. A Class I state-certified operator was required for operation of the water system at Prospect Bay.

Process residuals produced by the technology:

- Backwash wastewater was the only treated residual from APU-300 system operations.
- Soluble arsenic concentrations in the backwash wastewater averaged 10.1 μg/L, significantly lower than that in raw water used for backwash, indicating some soluble arsenic removal during backwash.

Cost-effectiveness of the technology:

- The capital investment for the system was $211,000, consisting of $129,500 for equipment, $36,700 for site engineering, and $44,800 for installation, shakedown, and startup.
- The unit capital cost was $703/gpm (or $0.49/gpd) based on a 300-gpm design capacity. This calculation does not reflect the building cost as it was funded by QAC.
- The vendor estimated media changeout cost was $27,728. Because media changeout did not occur during the performance evaluation, the O&M cost, estimated at $0.31/1,000 gal of water treated, included only the incremental cost for electricity, replacement parts, and labor.

3.0 MATERIALS AND METHODS

3.1 General Project Approach

Following the predemonstration activities summarized in Table 3-1, the performance evaluation study of the STS treatment system began on June 30, 2004. Table 3-2 summarizes the types of data collected and/or considered as part of the technology evaluation process. The overall performance of the system was determined based on its ability to consistently remove arsenic to the target MCL of 10 μg/L through the collection of water samples across the treatment train. The reliability of the system was evaluated by tracking the unscheduled system downtime and frequency and extent of repair and replacement. The unscheduled downtime and repair information were recorded by the plant operator on a Repair and Maintenance Log Sheet.

Table 3-1. Predemonstration Study Activities and Completion Dates

Activity	Date
Introductory Meeting Held	August 7, 2003
Request for Quotation Issued to Vendor	August 11, 2003
Draft Letter of Understanding Issued	August 13, 2003
Final Letter of Understanding Issued	September 5, 2003
Vendor Quotation Submitted to Battelle	September 8, 2003
Purchase Order Completed and Signed	October 3, 2003
Letter Report Issued	October 17, 2003
Draft Study Plan Issued	February 6, 2004
Final Study Plan Issued	February 23, 2004
Engineering Package Submitted to MDE	March 12, 2004
Building Construction Began	May 17, 2004
APU-300 Shipped by STS	May 26, 2004
APU-300 Delivered to Site and System Installation Began	June 1, 2004
Permit for Treatment System Issued by MDE	June 15, 2004
System Installation Completed	June 17, 2004
Building Construction Completed	June 24, 2004
System Shakedown Completed	June 29, 2004
Performance Evaluation Began	June 30, 2004

MDE = Maryland Department of the Environment

The O&M and operator skill requirements were evaluated based on a combination of quantitative data and qualitative considerations, including the need for pre- and/or post-treatment, levels of system automation, extent of preventative maintenance activities, frequency of chemical and/or media handling and inventory, and general knowledge needed for relevant chemical processes and related health and safety practices. The staffing requirements for the system operation were recorded on an Operator Labor Hour Log Sheet.

The quantity of aqueous and solid residuals generated was estimated by tracking the volume of backwash water produced during each backwash cycle and the need to replace the media upon arsenic breakthrough. Backwash wastewater was sampled and analyzed for chemical characteristics.

Table 3-2. Evaluation Objectives and Supporting Data Collection Activities

Evaluation Objective	Data Collection
Performance	-Ability to consistently meet 10 μg/L of arsenic in treated water
Reliability	-Unscheduled system downtime -Frequency and extent of repairs including a description of problems, materials and supplies needed, and associated labor and cost
System O&M and Operator Skill Requirements	-Pre- and post-treatment requirements -Level of system automation for system operation and data collection -Staffing requirements including number of operators and laborers -Task analysis of preventative maintenance including number, frequency, and complexity of tasks -Chemical handling and inventory requirements -General knowledge needed for relevant chemical processes and health and safety practices
Residual Management	-Quantity and characteristics of aqueous and solid residuals generated by system operation
System Cost	-Capital cost for equipment, site engineering, and installation -O&M cost for media, chemical consumption, electricity usage, and labor

The cost of the system was evaluated based on the capital cost per gpm (or gpd) of design capacity and the O&M cost per 1,000 gal of water treated. This task required tracking of the capital cost for equipment, engineering, and installation, as well as the O&M cost for media replacement and disposal, chemical supply, electricity usage, and labor.

3.2 System O&M and Cost Data Collection

The plant operator performed daily, weekly, and monthly system O&M and data collection according to instruction provided by STS and Battelle. On a daily basis, the plant operator recorded system operational data, such as pressure, flowrate, totalizer, and hour meter readings on a Daily System Operation Log Sheet; checked the chlorine gas injection system; and conducted visual inspections to ensure normal system operations. If any problems occurred, the plant operator contacted the Battelle Study Lead, who determined if the vendor should be contacted for troubleshooting. The plant operator recorded all relevant information on the Repair and Maintenance Log Sheet. Water quality parameters, including temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), and chlorine residuals, were measured and recorded on a Weekly Onsite Water Quality Parameters Log Sheet. Backwash data also were recorded on a Backwash Log Sheet.

The capital cost for the arsenic removal system consisted of the cost for equipment, site engineering, and system installation. The O&M cost consisted of the cost for media replacement and spent media disposal, chemical and electricity consumption, replacement parts, and labor. Chlorine gas application and electricity consumption were tracked using the Daily System Operation Log Sheet. Labor for various activities, such as the routine system O&M, troubleshooting and repair, and demonstration-related work, were tracked using an Operator Labor Hour Log Sheet. The routine O&M included activities such as completing daily field logs, performing regular system inspections, and others as recommended by the vendor. The demonstration-related work, including activities such as performing field measurements, collecting and shipping samples, and communicating with the Battelle Study Lead and the vendor, was recorded, but not used for the cost analysis.

3.3 Sample Collection Procedures and Schedules

To evaluate the system performance, samples were collected from the wellhead, treatment plant, and distribution system. The sampling schedules and analytes for each sampling event are listed in Table 3-3. In addition, Figure 3-1 presents a flow diagram of the treatment system along with the analytes and schedules at each sampling location. Specific sampling requirements for analytical methods, sample volumes, containers, preservation, and holding times are presented in Table 4-1 of the EPA-endorsed Quality Assurance Project Plan (QAPP) (Battelle, 2003). The procedure for arsenic speciation is described in Appendix A of the QAPP.

3.3.1 Source Water. During the initial visit to the site, source water samples were collected and speciated using an arsenic speciation kit described in Section 3.4.1. The sample tap was flushed for several minutes before sampling; special care was taken to avoid agitation, which could cause unwanted oxidation. Analytes for the source water samples are listed in Table 3-3.

3.3.2 Treatment Plant Water. During the system performance evaluation study, water samples were collected biweekly across the treatment train at the wellhead (IN), after chlorination (AC), after Vessel A (TA), and after Vessel B (TB), and analyzed for the analytes listed in Table 3-3. When speciation was performed, water samples were collected at IN, AC, and after effluent from Vessels A and B combined (TT) and analyzed for the analytes also listed in Table 3-3.

Over the course of the demonstration study, the sampling schedules were changed several times as presented below:

- During the first month of system operation, water samples were taken weekly. The sampling frequency was reduced to biweekly after the first month due to low water demand and resulting low volume throughput.
- The AC sampling location was added after the switch to prechlorination on November 9, 2004, approximately four months after system startup. Weekly sampling was conducted immediately after the switch to better monitor the conversion and breakthrough of As(III) and to better observe the effects of this change on system performance. The biweekly sampling schedule was resumed on February 1, 2005.
- Beginning on December 13, 2005, the biweekly sampling schedule was reduced to monthly. On July 23, 2006, the analytes for monthly sampling were reduced from those listed in Table 3-3 to As speciation, total and soluble Fe and Mn, and total P, Ca, and Mg. The analytes were further reduced to As speciation and total and soluble Fe and Mn on October 17, 2006.
- Since October 13, 2005, the orthophosphate analysis was replaced with total phosphorus, due to lack of orthophosphate in raw water and issues related to the short hold time for orthophosphate.

3.3.3 Backwash Wastewater. From November 17, 2004, (after the switch to prechlorination) through September 5, 2006, backwash wastewater was sampled and analyzed at 27 backwash events. Backwash water sampling was discontinued in September 2006 after almost two years of data collection.

Grab backwash wastewater samples were initially collected directly from the sample tap on the backwash wastewater discharge line during the backwash of each vessel and filtered with 0.45-µm disc filters. Beginning on December 16, 2005, composite samples also were collected following a modified procedure to allow for more representative characterization of the wastewater. Tubing directed a portion of backwash water from the sample tap at approximately 1 gpm into a clean plastic container of adequate

Table 3-3. Sampling Schedule and Analyses

Sample Type	Sample Locations[a]	No. of Samples	Frequency	Analytes	Date(s) Samples Collected
Source Water	IN	1	Once during initial site visit	As(total and soluble), As(III), As(V), Fe (total and soluble), Mn (total and soluble), Al (total and soluble), V (total and soluble), Mo (total and soluble), Sb (total and soluble), Na, Ca, Mg, Cl, F, SO_4, SiO_2, PO_4, TOC, and alkalinity	08/07/03
Treatment Plant Water	IN, AC[b], TA, TB	4	Weekly, bi-weekly, or monthly (non-speciation sampling)	Onsite: pH, temperature, DO, ORP, and Cl_2 (free and total)[b] Offsite: As (total), Fe (total), Mn (total), SiO_2, PO_4[c], turbidity, and alkalinity	See Appendix B
	IN, AC, TT	3	Weekly, bi-weekly, or monthly (speciation sampling)	Onsite: pH, temperature, DO/ORP, and Cl_2 (free and total) [b] Offsite: As(III), As(V), As(total and soluble), Fe (total and soluble), Mn (total and soluble), Ca, Mg, F, NO_3, SO_4, SiO_2, PO_4[c], turbidity, and alkalinity	See Appendix B
Distribution Water	Three LCR Residences	3	Monthly	pH, alkalinity, total As, Fe, Mn, Pb, Cu, and PO_4	Baseline sampling[d]: See Table 4-11 Monthly sampling: See Table 4-11
Backwash Wastewater	BW	2	Per backwash event[e] (27 times)	Total and/or soluble As, Fe, and Mn, pH, TDS, TSS, and/or turbidity	See Table 4-8
Backwash Solids	BW	2–3	3 times[f]	Total Al, As, Ca, Cd, Cu, Fe, Mg, Mn, Ni, P, Pb, Si, and Zn	05/12/05, 05/31/05, 06/21/05
Spent Media	At top of Vessels A and Vessel B	12[g]	1 time	Total Al, As, Ca, Cd, Cu, Fe, Mg, Mn, Ni, P, Pb, Si, and Zn	08/04/05

(a) Corresponding to sample locations in Figure 3-1: IN = at wellhead; AC = after chlorination; TA = after Vessel A; TB = after Vessel B; TT = combined effluent; and BW = at backwash water discharge line.
(b) Samples taken only after prechlorination at AC sampling location starting after November 9, 2004.
(c) PO_4 analysis replaced with total phosphorus analysis starting from October 13, 2005.
(d) Baseline sampling performed before system startup.
(e) Backwash wastewater sampling discontinued after September 5, 2006.
(f) Backwash solids were analyzed at three selected backwash events were three samples collected from each vessel both before and after backwash on August 4, 2005 when STS technicians were onsite to investigate cause of shortened run length between backwashes.

DO = dissolved oxygen; LCR = Lead and Copper Rule; ORP = oxidation-reduction potential; TDS = total dissolved solids; and TSS = total suspended solids

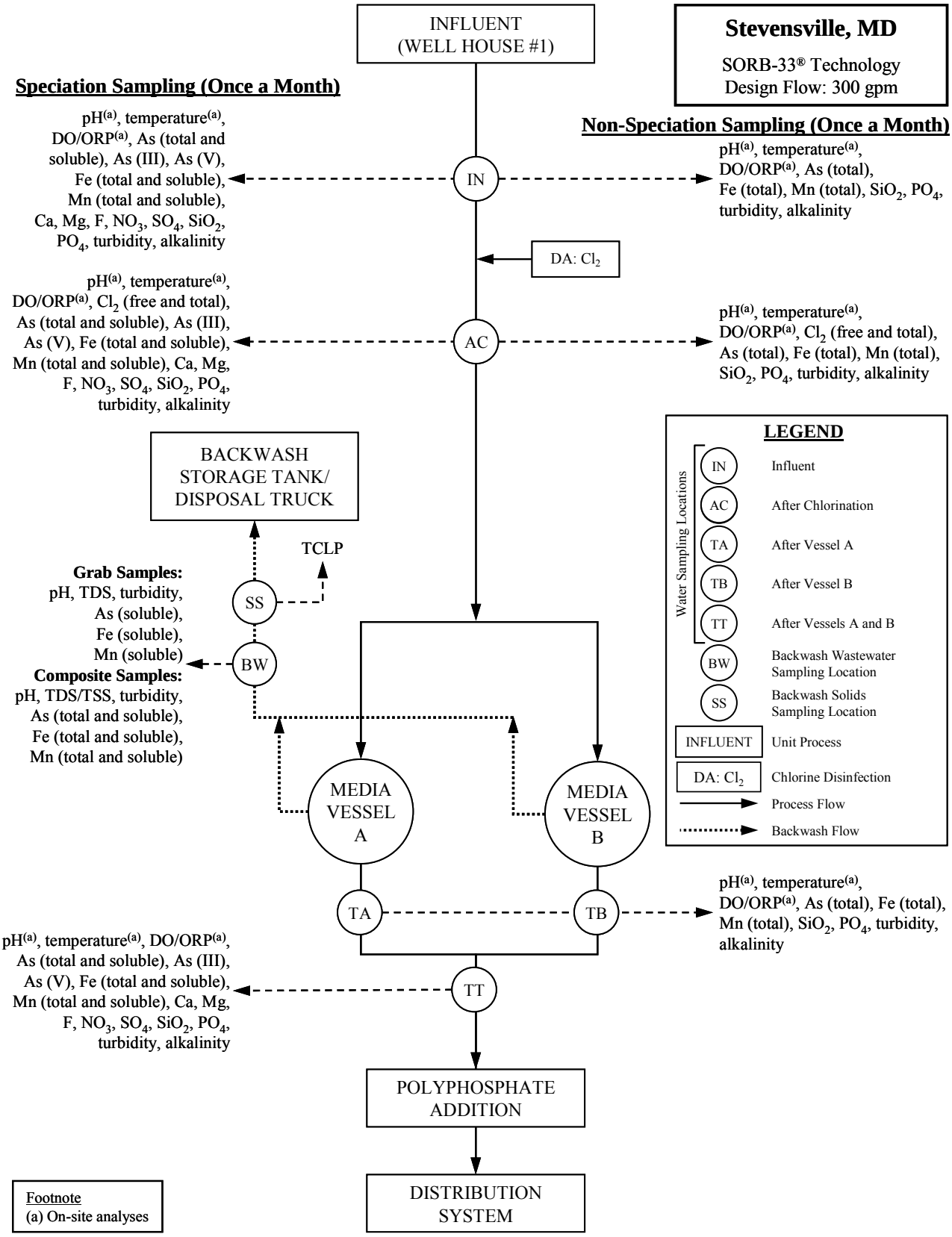

Figure 3-1. Process Flow Diagram and Sampling Locations

volume over the duration of the backwash for each vessel. After the content in the container was thoroughly mixed, composite samples were collected and/or filtered onsite with 0.45-µm disc filters. Analytes for the backwash samples are listed in Table 3-3. Only soluble As, Fe, and Mn, pH, turbidity, and total dissolved solids (TDS) were analyzed for grab samples. For composite samples, total As, Fe, Mn, and total suspended solids (TSS) also were analyzed.

3.3.4 Backwash Solids Sample Collection. Backwash solid samples were collected from 1-gal plastic jars containing backwash water/solids collected during backwash events on May 12, May 31, and June 21, 2005. After solids in the jar were settled and the supernatant was carefully decanted, residual solids samples were collected for processing and analysis by Battelle. A portion of each solids sample was air-dried, acid-digested, and analyzed for Al, As, Ca, Cd, Cu, Fe, Mg, Mn, Ni, P, Pb, Si, and Zn.

3.3.5 Media Sample Collection. Media samples were collected on August 4, 2005, by STS while its technicians were onsite to investigate the cause of shortened run times between backwashes. As part of the inspection, media samples were collected at the top and 14 in below the top of the media beds before and after backwash. Media samples were extracted from the media beds via a clean heavy-walled garden hose under vacuum-induced siphon. The media samples were collected separately into 5-gal buckets. A portion of each sample was air-dried and analyzed for Al, As, Ca, Cd, Cu, Fe, Mg, Mn, Ni, P, Pb, Si, and Zn.

3.3.6 Distribution System. Water samples were collected from the distribution system to determine the impact of the arsenic treatment system on water chemistry in the distribution system, specifically, the lead and copper level. From December 2003 through March 2004, four sets of baseline distribution system water samples were collected monthly by the plant operator at three homes that had been included in the Prospect Bay Lead and Copper Rule (LCR) sampling in the past. Following system startup, distribution system sampling continued on a monthly basis at the same three locations.

The samples collected at the LCR locations were taken following an instruction sheet developed according to the *Lead and Copper Monitoring and Reporting Guidance for Public Water Systems* (EPA, 2002). The first draw sample was collected from a cold-water faucet that had not been used for at least six hours to ensure that stagnant water was sampled. The sampler recorded the date and time of last water use before sampling and the date and time of sample collection for calculation of the stagnation time. Analytes for the baseline samples coincided with the monthly distribution system water samples as described in Table 3-3. Arsenic speciation was not performed for the distribution water samples.

3.4 Sampling Logistics

All sampling logistics including arsenic speciation kits preparation, sample cooler preparation, and sample shipping and handling are discussed below.

3.4.1 Preparation of Arsenic Speciation Kits. The arsenic field speciation method uses an anion exchange resin column to separate the soluble arsenic species, As(V) and As(III) (Edwards et al., 1998). Resin columns were prepared in batches at Battelle laboratories according to the procedures detailed in Appendix A of the EPA-endorsed QAPP (Battelle, 2003).

3.4.2 Preparation of Sampling Coolers. For each sampling event, a cooler was prepared with the appropriate number and type of sample bottles, disc filters, and /or speciation kits needed. All sample bottles were new and contained appropriate preservatives. Each sample bottle was affixed with a pre-printed, colored-coded label consisting of the sample identification (ID), data and time of sample collection, collector's name, site location, sample destination, analysis required, and preservative. The sample ID consisted of a two-letter code for the specific water facility, the sampling date, a two-letter

code for a specific sampling location, and a one-letter code designating the arsenic speciation bottle (if necessary). The sampling locations at the treatment plant were color-coded for easy identification. For example, red, orange, yellow, and green were used to designate sampling locations for IN, TA, TB, and TT, respectively. The labeled bottles for each sampling location were placed separately in one of the plastic bags (each corresponding to a specific sampling location) and packed in the cooler. When arsenic speciation samples were to be collected, an appropriate number of arsenic speciation kits also were included in the cooler. When appropriate, the sample cooler was packed with bottles for the three distribution system sampling locations and/or the two backwash sampling locations (one for each vessel).

In addition, all sampling and shipping-related materials, such as disposable gloves, sampling instructions, chain-of-custody forms, prepaid and addressed FedEx air bills, and bubble wrap, were included. The chain-of-custody forms and FedEx air bills were complete except for the operator's signature and the sampling dates and times. After preparation, the sample cooler was sent to the site via FedEx for the following week's sampling event.

3.4.3 Sample Shipping and Handling. After sample collection, samples for offsite analyses were packed carefully in the original coolers with wet ice and shipped to Battelle. Upon receipt, the sample custodian checked sample IDs against the chain-of-custody forms and verified that all samples indicated on the forms were included and intact. Discrepancies noted by the sample custodian were addressed with the plant operator by the Battelle Study Lead. The shipment and receipt of all coolers by Battelle were recorded on a sample cooler tracking log.

Samples for metal analyses were stored at Battelle's Inductively Coupled Plasma-Mass Spectrometery (ICP-MS) Laboratory. Samples for other water quality analyses were packed in coolers at Battelle and picked up by couriers from Battelle's subcontract laboratories, including American Analytical Laboratories (AAL) in Columbus, OH and TCCI Laboratories in New Lexington, OH. The chain-of-custody forms remained with the samples from the time of preparation through analysis and final disposition. All samples were archived by the appropriate laboratories for the respective duration of the required hold time and disposed of properly thereafter.

3.5 Analytical Procedures

The analytical procedures described in Section 4.0 of the QAPP (Battelle, 2003) were followed by Battelle ICP-MS Laboratory, AAL, and TCCI Laboratories. Laboratory quality assurance/quality control (QA/QC) of all methods followed the prescribed guidelines. Data quality in terms of precision, accuracy, method detection limit (MDL), and completeness met the criteria established in the QAPP (i.e., 20% relative percent difference [RPD], 80 to 120% recovery, and 80% completeness). The quality assurance (QA) data associated with each analyte will be presented and evaluated in a QA/QC Summary Report to be prepared under separate cover upon completion of the Arsenic Demonstration Project.

Field measurements of pH, temperature, DO, and ORP were conducted by the plant operator using a WTW Multi 340i handheld meter, which was calibrated for pH and DO prior to use following the procedures provided in the user's manual. The ORP probe also was checked for accuracy by measuring the ORP of the standard solution and comparing it to the expected value. The plant operator collected a water sample in a clean, plastic beaker and placed the probe in the beaker until a stable value was obtained. The plant operator also performed free and total chlorine measurements using Hach chlorine test kits following the user's manual.

4.0 RESULTS AND DISCUSSION

4.1 Facility Description

The water system supplied drinking water to approximately 300 connections in the community of Prospect Bay at Grasonville in Queen Anne's County, MD. Source water was extracted from two wells, i.e., Wells No. 1 and No. 2, which alternated in operation on a daily basis to supply roughly half of the total production by each well. Well No. 1, located off Prospect Bay Road near the Prospect Bay Golf Course and Country Club, was chosen for treatment in the arsenic adsorption system as part of this demonstration study. Figure 4-1 shows Well House No. 1.

Well No. 1 was drilled to a depth of approximately 360 ft and estimated, prior to the beginning of the demonstration study, to operate for about 3 to 4 hr/day, every other day, at a rate of about 300 gpm. Prior to entering the distribution system, water was disinfected using chlorine gas (Figure 4-2) and treated for corrosion inhibition with polyphosphate. Historical operational data from QAC indicated that chlorine residuals in the treated water typically were about 0.5 mg/L (as Cl_2) or less and that the target polyphosphate concentration was 0.8 mg/L.

Figure 4-1. Existing Well House No. 1

4.1.1 Source Water Quality. Source water samples were collected at a sampling tap located outside Well House No. 1 on August 7, 2003, and analyzed as shown in Table 3-3. The results of the source water analyses, along with those provided by the facility to EPA for the demonstration site selection and those independently collected and analyzed by EPA, are presented in Table 4-1.

Figure 4-2. Chlorine Gas System at Well No. 1

Total arsenic concentrations in source water ranged from 17.0 to 19.0 µg/L. Based on the August 7, 2003, speciation sampling results, arsenic was present primarily as soluble As(III) (i.e., 98% of 18.8 µg/L) with only a small amount existing as particulate As (i.e., 0.1 µg/L) and soluble As(V) (i.e., 0.3 µg/L).

pH values of source water samples varied between 6.0 and 8.3, which was within the range recommended by STS. Therefore, pH adjustment was not recommended.

Source water iron levels ranged from <50 to 1,660 µg/L; however, more recent data indicated that iron levels were around 300 µg/L or less and that iron existed primarily in the soluble form. Manganese concentrations ranged from 0.4 to 8 µg/L. Because iron and manganese concentrations were sufficiently low, pretreatment prior to the adsorption process was not recommended. Concentrations of orthophosphate ranged from <0.1 to 0.4 mg/L and silica from 13.3 to 14.5 mg/L (as SiO_2). SORB 33™ media were reported to be affected by silica at levels greater than 40 mg/L (Meng et al., 2000 and 2002) and phosphate at levels greater than 1 mg/L. Neither of these compounds is expected to affect arsenic adsorption onto the media.

4.1.2 Pre-Demonstration Treated Water Quality. Treated water samples after post-chlorination were collected by QAC and EPA prior to the demonstration study and analyzed for a number of analytes shown in Table 4-1. As expected, because the treatment process prior to distribution included only chlorination and the addition of polyphosphate, concentrations of these constituents in the

Table 4-1. Prospect Bay Water Quality Data

Parameter	Unit	Utility Raw Water Data	EPA Raw Water Data	EPA Treated Water Data	Battelle Raw Water Data	QAC Raw Water Data	QAC Treated Water Data
Sampling Date		NA	10/04/02	10/04/02	08/07/03	2002–2003	2002–2003
pH		8.3	NS	NS	7.3	6.0–8.2	6.7–8.2
Total Alkalinity	mg/L	150	137	NA	168	NS	150
Hardness (as $CaCO_3$)	mg/L	91.0	98.0	NA	102	NS	91
Turbidity	mg/L	NS	NS	NS	NS	NS	NS
Chloride	mg/L	1.5	16.7	NA	1.4	NS	1.6
Fluoride	mg/L	NS	NS	NS	1.0	NS	NS
Sulfate	mg/L	5.8	4.3	4.2	4.3	NS	5.3
Silica (as SiO_2)	mg/L	14.5	13.4	13.3	14.1	NS	NS
Orthophosphate (as P)	mg/L	0.4	NS	NS	<0.1	NS	0.038
TOC	mg/L	<0.5	NS	NS	NA	NS	<0.50
As (total)	µg/L	17.0	19.0	18.0	18.8	NS	17.0–18.0
As (total soluble)	µg/L	NS	NS	NS	18.7	NS	NS
As (particulate)	µg/L	NS	NS	NS	0.1	NS	NS
As(III)	µg/L	NS	NS	NS	18.4	NS	NS
As(V)	µg/L	NS	NS	NS	0.3	NS	NS
Fe (total)	µg/L	300	95.0	91.0	270	<50–1,660	<50–1,100
Fe (soluble)	µg/L	NS	NS	NS	254	NS	NS
Al (total)	µg/L	NS	<25	<25	<10	NS	NS
Al (soluble)	µg/L	NS	NS	NS	<10	NS	NS
Mn (total)	µg/L	8.0	0.4	0.8	1.5	NS	<5.0–9.0
Mn (soluble)	µg/L	NS	NS	NS	1.4	NS	NS
V (total)	µg/L	NS	NS	NS	<0.1	NS	NS
V (soluble)	µg/L	NS	NS	NS	<0.1	NS	NS
Mo (total)	µg/L	NS	NS	NS	<0.1	NS	NS
Mo (soluble)	µg/L	NS	NS	NS	<0.1	NS	NS
Sb (total)	µg/L	NS	<25	<25	<0.1	NS	NS
Sb (soluble)	µg/L	NS	NS	NS	<0.1	NS	NS
Na	mg/L	27.0	24.1	23.6	26.2	NS	24.0
Ca	mg/L	20.0	23.3	23.0	23.5	NS	21.0
Mg	mg/L	9.7	9.7	9.5	10.4	NS	9.4

NA = Not Available
NS = Not Sampled
TOC = total organic carbon

treated water were very similar to those of raw water. Total arsenic concentrations in the treated water ranged from 17 to 18 µg/L. Iron concentration ranged from <50 to 1,100 µg/L and manganese from 0.8 to 9 µg/L. pH values of the treated water ranged from 6.7 to 8.2 based on historical data from the years 2000 to 2003.

4.1.3 Distribution System. The Prospect Bay distribution system consists of a looped drinking water distribution line supplied by two production wells (Well No. 1 and Well No. 2). Prior to the demonstration study, the two wells alternated operation on a daily basis, such that each well supplied roughly half of the total production to the community. The water is sent to a 300,000-gal storage tank,

which serves to supply the distribution system constructed primarily of polyvinyl chloride (PVC) pipe. The connections to the distribution system and piping within the residences are primarily PVC and some copper pipe. It is estimated that a few homes may have pipe with lead solder and that no homes have lead pipe.

The QAC Department of Public Works samples water from the distribution system for various parameters. Each month, five locations within the distribution system are sampled for bacterial analysis. The water also is sampled for volatile organic compounds (VOCs) on a regular basis. Under the EPA LCR, samples are collected from customer taps at five residences every three years.

4.2 Treatment Process Description

The STS arsenic package unit (APU) is designed for arsenic removal for small systems with flowrates greater than 100 gpm. It uses Bayoxide® E33 (branded as SORB 33™ by STS), an iron-based adsorptive media developed by Bayer AG, for the removal of arsenic from drinking water supplies. Table 4-2 presents vendor-provided physical and chemical properties of the media.

Table 4-2. Physical and Chemical Properties of SORB 33™ Media[(a)]

Parameter	**SORB 33™ Media**
	
Physical Properties	
Matrix	Iron oxide composite
Physical Form	Dry granules
Color	Amber
Bulk Density (lb/ft^3)	28.1
BET Area (m^2/g)	142
Attrition (%)	0.3
Moisture Content (%)	<15% (by weight)
Particle Size Distribution (U.S. Standard Mesh)	10 × 35
Crystal Size (Å)	70
Crystal Phase	A – FeOOH
Chemical Analysis	
Constituents	**Weight (%)**
FeOOH	90.1
CaO	0.27
MgO	1.00
MnO	0.11
SO_3	0.13
Na_2O	0.12
TiO_2	0.11
SiO_2	0.06
Al_2O_3	0.05
P_2O_5	0.02
Cl	0.01

(a) Provided by STS.
BET = Brunauer, Emmett, and Teller

The SORB 33™ media are delivered in a dry crystalline form and listed by NSF International (NSF) under Standard 61 for use in drinking water applications. The media exist in both granular and pelletized forms, which have similar physical and chemical properties, except that pellets are denser than granules (i.e., 35 vs. 28 lb/ft^3). The granular form of the media was used for the Prospect Bay facility.

The STS APU-300 arsenic removal treatment system consisted of two adsorption vessels, an electrically actuated valve tree, and associated piping and instrumentation. Electrically actuated butterfly valves diverted raw water downward through the two adsorption vessels operating in parallel. As water passed through the fixed-bed adsorbers, arsenic concentrations were reduced to below 10 μg/L. When reaching 10-μg/L arsenic breakthrough, the spent media would be removed and disposed of after being subjected to the EPA Toxicity Characteristic Leaching Procedure (TCLP) test. Figure 4-3 shows the APU-300 system at the manufacturing facility prior to shipment to the site. Figure 4-4 is a simplified piping and instrumentation diagram (P&ID) of the system. The design features of the APU-300 system are summarized in Table 4-3. Key process components are discussed as follows:

- **Intake**. Raw water from Well No.1 was fed from the wellhead via 4-in ductile iron pipe to the system via 4-in Schedule 80 PVC pipe. The amount of water pumped was tracked with a flow totalizer (Data Industrial Corp.) installed at the wellhead (Figure 4-5).
- **Chlorination**. During the first four months of system operation, chlorine was added at the end of the treatment train following the APU-300 adsorption vessels. In late September 2004, total arsenic levels in the treated water rose to above 10 μg/L after treating only 7,400 BV of water, much earlier than projected (see Table 4-3). The speciation results showed that the majority of arsenic passing through the SORB 33™ media was As(III). To improve performance, the chlorine injection point was relocated upstream of the adsorption vessels on November 9, 2004. With this prechlorination step in place, As(III) was oxidized to As(V) before coming in contact with the media.

  The chlorine gas feed rate was controlled by a panel-mounted automatic switchover rotameter at 12 lb/day. The chlorine gas was injected to a side stream where it was mixed with carrier water prior to being drawn into the main line. The chlorinated water then flowed into the two adsorption vessels. A sample tap at the AC location was installed on a common feed line to the adsorption vessels to collect samples of chlorinated water prior to treatment by the APU-300 system.
- **Adsorption System**. The APU-300 system was a fixed-bed down-flow adsorption system consisting of two 63-in-diameter, 86-in-tall vertical pressure vessels, constructed of fiberglass reinforced plastic (FRP). Each vessel contained approximately 80 ft^3 of SORB 33™ media supported by a gravel underbed. The skid-mounted vessels operated in parallel and were rated for 75 pounds per square inch (psi) working pressure. Empty bed contact time (EBCT) for the system was 4.0 min based on a design flowrate of 300 gpm. Hydraulic loading to each vessel was approximately 6.9 gpm/ft^2.

  As illustrated in Figure 4-5, the two adsorption vessels were interconnected with schedule 80 PVC piping and 10 electrically actuated butterfly valves using a valve tree design (Figure 4-5). During normal operation, the feed valves (i.e., BF-121 A and B) and effluent valves (i.e., BF-122 A and B) were opened and the other six valves were closed to divert water downward through the two adsorption vessels. Flow through the two vessels was balanced by throttling the effluent valves, if needed. During backwash, the feed and effluent valves were closed and the backwash feed valves (i.e., BF-123 A and B) and backwash effluent valves (i.e., BF-124

Figure 4-3. APU-300 Treatment System Prior to Shipment

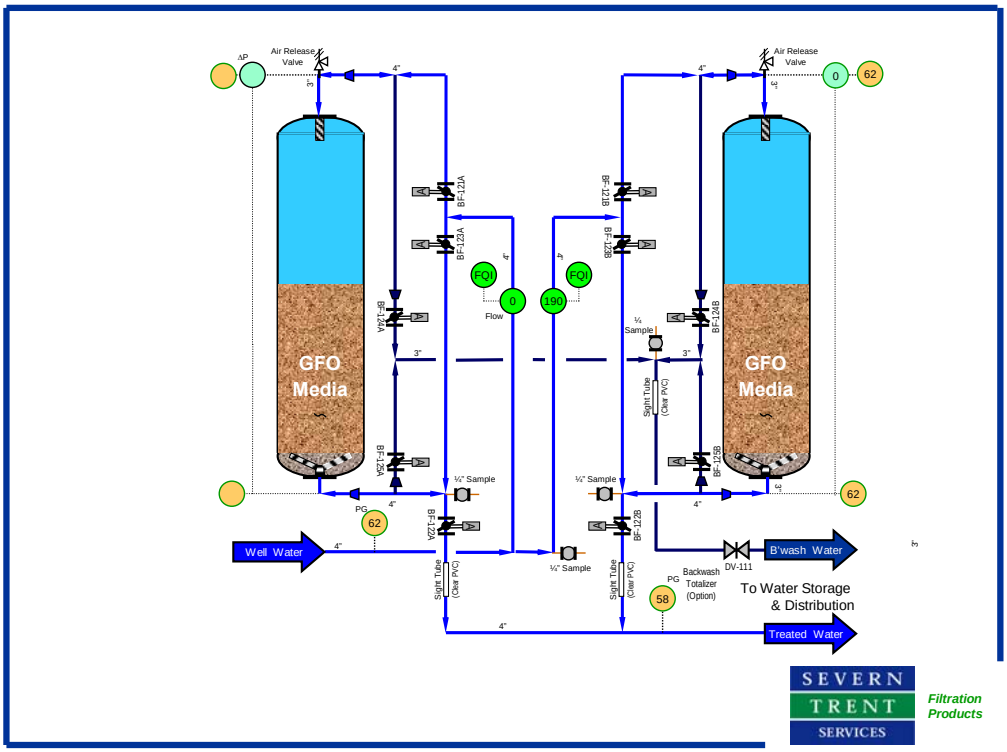

Figure 4-4. Schematic of APU-300 System

Table 4-3. Design Specifications of APU-300 System

Parameter	Value	Remarks
Pretreatment		
Chlorine Dosage (lb/day as Cl_2)	12[(a)]	–
Adsorption		
Number of Adsorption Vessels	2	–
Vessel Configuration	Parallel	–
Vessel Size (in)	63 × 86	–
Type of Media	SORB 33™	–
Media Volume (ft^3/vessel)	80	160 ft^3 total
Media Bed Depth (in)	44	–
Freeboard Depth (in)	22	–
Design Flowrate (gpm/vessel)	150	300 gpm total
Hydraulic Loading Rate (gpm/ft^2)	6.9	Based on vessel cross sectional area of 21.6 ft^2 given an inner diameter of 63 in
EBCT (min)	4.0	Based on design flow
Backwash		
Frequency (day)	45	–
Flowrate (gpm)	200	–
Hydraulic Loading Rate (gpm/ft^2)	9.2	–
Duration (min/vessel)	20	–
Fast Rinse Duration (min/vessel)	4	–
Wastewater Produced (gal/vessel)	4,800	–
System Operation		
Average Use Rate (gal/day)	72,000	Based on 4 hr/day operation at 300 gpm
Estimated Working Capacity (BV)	114,000[(b)]	BV to 10 μg/L total arsenic breakthrough based on an influent arsenic concentration of 19 μg/L and a BV of 160 ft^3
Throughput (BV/day)	60	Based on 4 hr/day operation at 300 gpm
Estimated Throughput to 10 μg/L As Breakthrough (gal)	136,400,000	Based on a bed volume of 160 ft^3
Estimated Media Life (month)	63	Estimated frequency of changeout at 17% utilization

(a) Switched from post-chlorination to prechlorination on November 9, 2004.
(b) Based on STS provided estimate with an influent As concentration of 19 μg/L.

A and B) were opened to divert water upward through the two adsorption vessels. During the backwash rinse process, the feed valves (i.e., BF-121 A and B) and rinse valves (i.e., BF-125 A and B) were opened and the other six valves were closed to rinse the media with downward water flow.

The flow meters (i.e., FI-151 A and B, +GF+SIGNET 8550 ProcessPro™ Flow Transmitter) installed in the supply line of each adsorption vessel monitored instantaneous flowrates through the vessels. The flow meters also tracked the volume of water treated in each vessel. The differential pressure (Δp) across each vessel was monitored by differential pressure gauges (i.e., PDI-173 A & B, WIKA Differential Pressure Gauge). The adsorption vessels were backwashed sequentially whenever the Δp across one vessel reached 10 psi.

- **Backwash**. STS recommended that the SORB 33™ media be backwashed using raw water approximately once every 45 days to loosen up the media bed and remove media fines and/or particles accumulated in the beds. The APU-300 system was designed and programmed with

an automatic backwash feature that would place the vessels into backwash based on a set timer or when the (Δp) across a vessel reached 10 psi. However, backwash of the APU-300 system installed at QAC was initiated manually by the system operator because there was no onsite disposal facility to receive the backwash wastewater. Backwash was initiated whenever the differential pressure of Vessels A and B approached 10 psi. The backwash wastewater was discharged into a tanker truck and transported to a local wastewater treatment plant.

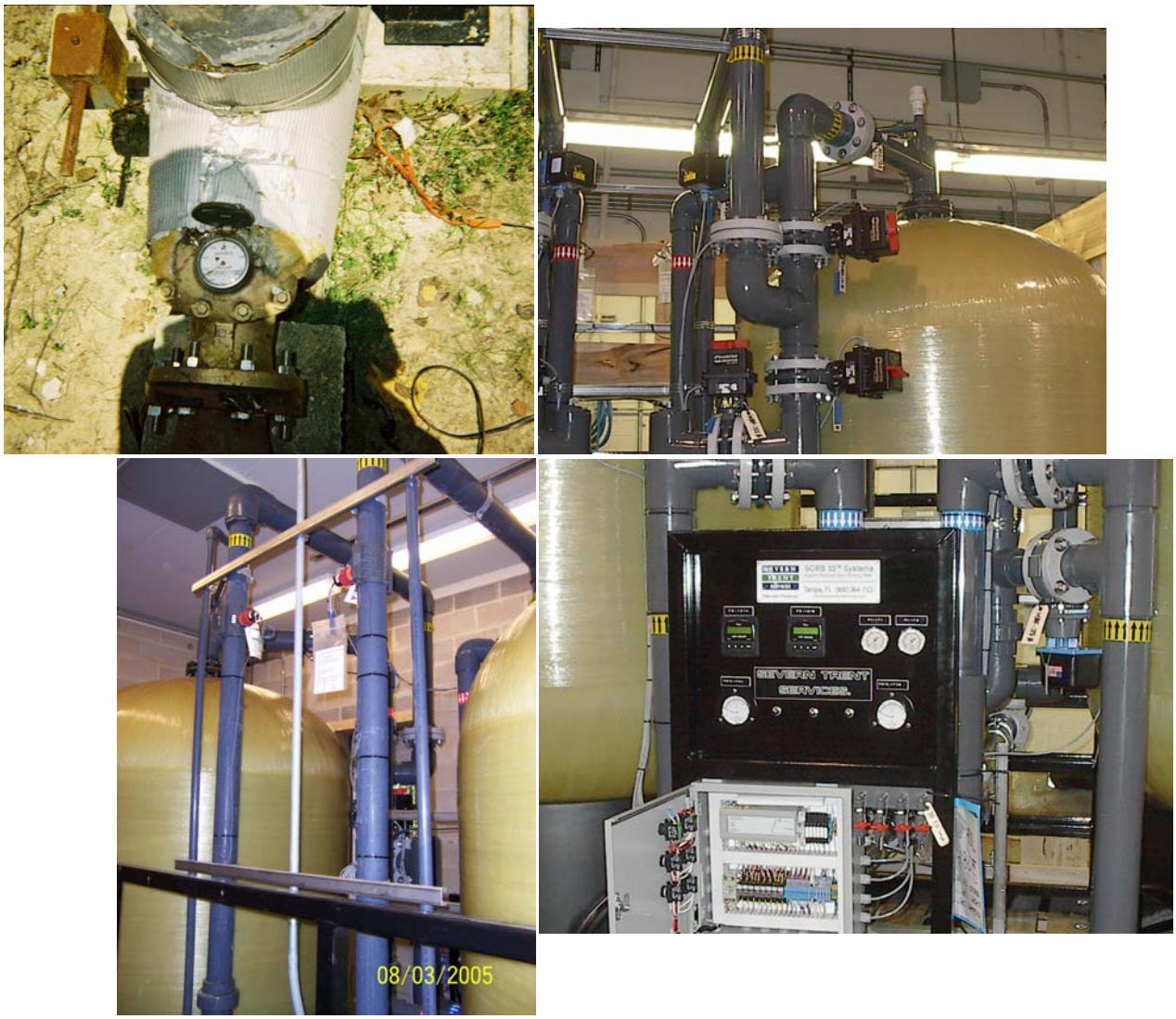

Figure 4-5 Treatment Process Components
(Clockwise from Top: Well No.1 Totalizer; APU-300 System Valve Tree; APU-300 Control Panel; and FI-151A and B Flow Meter Sensors)

4.3 System Installation

The construction of the treatment building and the installation of the STS APU-300 system were completed on June 24, 2004, by Stearns and Wheler, LLC, a local engineering subcontractor hired by QAC and STS.

4.3.1 Permitting. Prepared by Stearns and Wheler, LLC, the engineering plans for the system permit application included a site plan, construction drawings of the new treatment building, and process and mechanical drawings of the APU-300 treatment system. The plans, along with a construction permit application, were submitted to the Maryland Department of the Environment (MDE) for review on March 12, 2004. The MDE replied with comments on the engineering package on April 23, 2004, and issued a letter of approval for operation of the treatment system on June 15, 2004.

4.3.2 Building Construction. QAC constructed an addition to its existing pump house (Well House No. 1) to contain the APU-300 treatment system. The addition included a 16-ft × 23-ft treatment area onto the existing 8-ft × 16-ft well house. The building was constructed using concrete block with brick siding and included a 10-ft-wide rollup door on the end of the building and access hatches in the roof to facilitate future media replacement. A photograph of the building housing the equipment is shown in Figure 4-6. Building construction began on May 17, 2004, and was completed on June 24, 2004, including placement and setting of the vessels within the building, which were put into place before the roof was installed.

Figure 4-6. New Treatment Building Addition with Two Access Hatches on Roof

4.3.3 System Installation, Shakedown, and Startup. The APU-300 system was shipped on May 26, 2004, and arrived at the site on June 1, 2004. Stearns and Wheler, LLC performed the off-loading and installation of the system, including all plumbing, mechanical, and electrical work and connections of the treatment system to the existing entry and distribution piping. A photograph of the system being

unloaded and set in place with a crane is shown in Figure 4-7. The system mechanical equipment installation was completed by June 11, 2004. Gravel underbedding was placed in the vessels on June 15, 2004, and the adsorption media were loaded in both vessels on June 16, 2004. A bacteria test sample, required by the state, was collected on June 16, 2004 from the system, which had previously been treated with chlorine for disinfection. Once the media were loaded, Stearns and Wheler conducted a pressure test of the system piping. The system was backwashed for media conditioning prior to service on June 17, 2004. The results from the bacteria test, received on June 17, were negative.

Figure 4-7. Unloading of APU Skid into Partially Completed Treatment Building Addition

Battelle, STS, Stearns and Wheler, LLC, and representatives from QAC were on site to complete system shakedown and startup procedures on June 29, 2004. All backwashing and system shakedown procedures were completed prior to this date, so that the system was ready to go into regular service operation. Battelle provided operator training on data and sample collection and conducted a review of the P&ID and system checklist with the vendor. The system was put into regular service mode on June 30, 2004.

4.4 System Operation

4.4.1 Operational Parameters. The system operational parameters are tabulated and attached as Appendix A with the key parameters summarized in Table 4-4. The plant operation data were recorded from the beginning of the performance evaluation study on June 30, 2004, through April 2, 2007, which marked the end of the study.

Table 4-4. Summary of APU-300 System Operation

Operational Parameter	Value/Condition		
Duration	06/30/04–04/02/07 (Weeks 1 through 144)		
Cumulative Operating Time (hr)	5,890		
Range of Daily Operation Time (hr/day)	0–23.4		
Average Daily Operating Time (hr/day)	6.2		
Adsorption Vessel	A	B	Total
Throughput (kgal)	36,984	34,549	71,533
Average Flowrate (gpm)	107	100	207
Range of Flowrate (gpm)	30–198	32–207	NA
Average EBCT (min)[(b)]	5.6	6.0	NA
Range of EBCT (min)[(b)]	3.0–20.0	2.9–18.7	NA
Differential Pressure across Bed (psi)	0.8–13.2	1.2–16.6	NA
System Pressure Loss (psi)	NA	NA	1–32

(a) System down between 11/03/05 and 12/12/05 due to drilling of a new well in well house No. 1 and back online on 12/13/05.
(b) Calculated based on 80 ft^3 of media in each vessel.
NA = not applicable

Between June 30, 2004, and April 2, 2007, Well No. 1 operated for a total of 5,890 hr based on the well pump hour meter readings. As shown in Figure 4-8, daily operating times fluctuated significantly from 0 to 23.4 hr and averaged 6.2 hr. Seasonal variations were observed with relatively longer operating time starting from late spring through early autumn. During that period, the operating time often exceeded 12 hr/day. In the remainder of the year, the operating time was usually less than 12 hr/day.

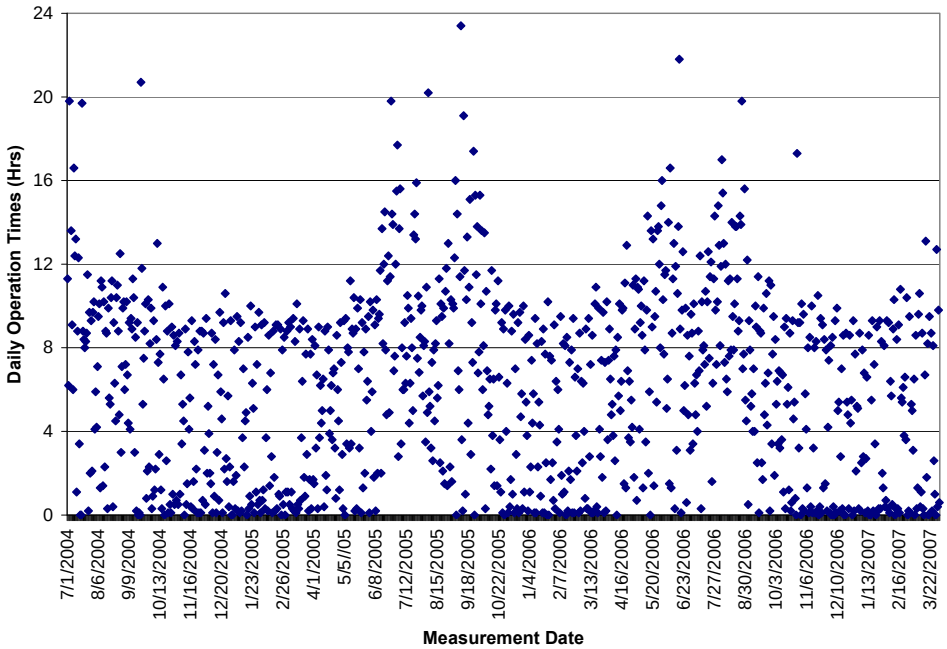

Figure 4-8. APU-300 Treatment System Daily Operating Time

Throughputs based on the totalizers installed on the adsorption vessels were 36,984,000 gal for Vessel A and 34,549,000 gal for Vessel B. Therefore, the total system throughput was 71,533,000 gal, or 59,800 BV, assuming 80 ft^3 of media in each vessel. Note that the totalizers were not functioning correctly during January 13 through March 7, 2006, and July 23 through December 5, 2006, for Vessel A and from August 14 through October 2, 2006, for Vessel B, as evidenced by uncharacteristically low throughput and flowrate readings recorded. During these periods, daily throughputs were estimated by multiplying the average flowrate (i.e., 107 gpm for Vessel A and 100 gpm for Vessel B) by daily operation time. The Vessel A totalizer was replaced on March 7 and December 7, 2006, and the Vessel B totalizer was replaced on October 2, 2006. The problems associated with the totalizers are further discussed in Section 4.4.5.

Figure 4-9 compares the daily average flowrate at the wellhead with the flowrate through each vessel. The daily average flowrate at the wellhead was calculated by dividing the daily volume recorded by the wellhead totalizer by the daily operating time. Tthe flowrates through each vessel fluctuated significantly but around 100 gpm most of the time. The exceptions occurred during the periods when the vessel totalizers were not operating correctly. Excluding the data collected during these periods, an average flowrate of 107 gpm was calculated for Vessel A and 100 gpm for Vessel B. The average flowrate through Vessel A was 7% higher than that through Vessel B, indicating slightly imbalanced flows (i.e., 51.7% through Vessel A vs. 48.3% through Vessel B). The flowrates calculated based on the totalizer at the wellhead averaged 234 gpm, which was about 13.6% higher than the 207 gpm measured at Vessels A and B. The average EBCTs in Vessels A and B based on the respective average flowrates were 5.6 and 6.0 min, respectively, which were 40 to 50% higher than the design value of 4.0 min as shown in Table 4-3.

Figure 4-10 presents measured pressures of the APU-300 treatment system. Prior to the switch to prechlorination, inlet pressure readings remained relatively constant between 60 to 65 psig for most measurements. Immediately after the switch, inlet pressure levels increased significantly to between 65 to 75 psig, and then to between 70 to 80 psig for the remainder of the performance evaluation study. Outlet pressure maintained relatively constant between 54 to 60 psig throughout the entire study duration. The increase in inlet pressure was caused primarily by the accumulation of iron solids in the adsorption vessels.

Figure 4-11 presents differential pressure (Δp) readings across the media beds. Prior to the switch to prechlorination, Δp readings were low, ranging from 2 to 3 psi. Following the switch on November 9, 2004, Δp readings began to rise from about 2.0 to 4.5 psi with 455 BV of water treated. A backwash was performed on November 17, 2004, at 10,579 BV and the Δp reading returned to the original level around 2 psi. Prior to this, no backwash had been performed. Soon after the backwash, Δp readings began to rise steadily and approached 10 psi after treating approximately 2,359 BV of water. Backwashing was performed again on January 12, 2005, at 12,938 BV. It was believed that this Δp rise was caused by the accumulation of iron solids in the media beds due to the addition of chlorine before the adsorption vessels.

As presented in Figure 4-12, over the course of the performance evaluation study, the run times between two consecutive backwash cycles shortened significantly from 2,359 BV per backwash initially to less than 800 BV per backwash by the end of the study (or once every two months to less than two weeks). After being contacted by Battelle for the shortened run times, a representative from STS was onsite to inspect the system on August 3 to 4, 2005. The inspection included internal of the tanks, backwash process, and media (including performing media sampling before and after backwash using the method

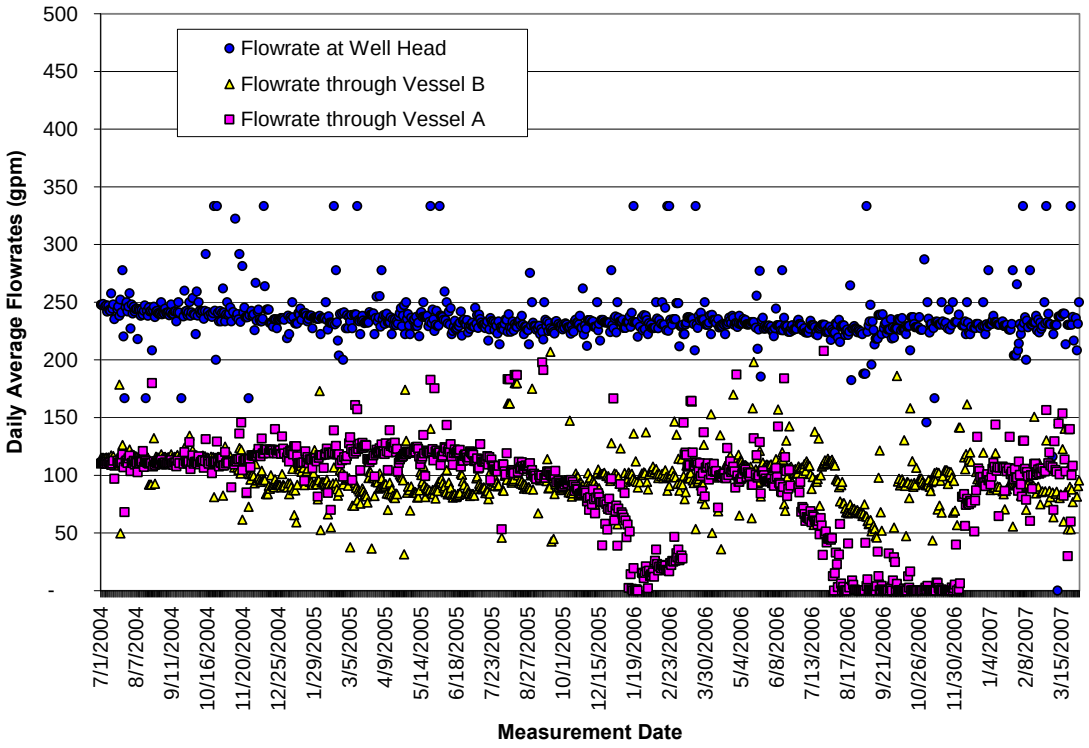

Figure 4-9. APU-300 Treatment System Daily Flowrates

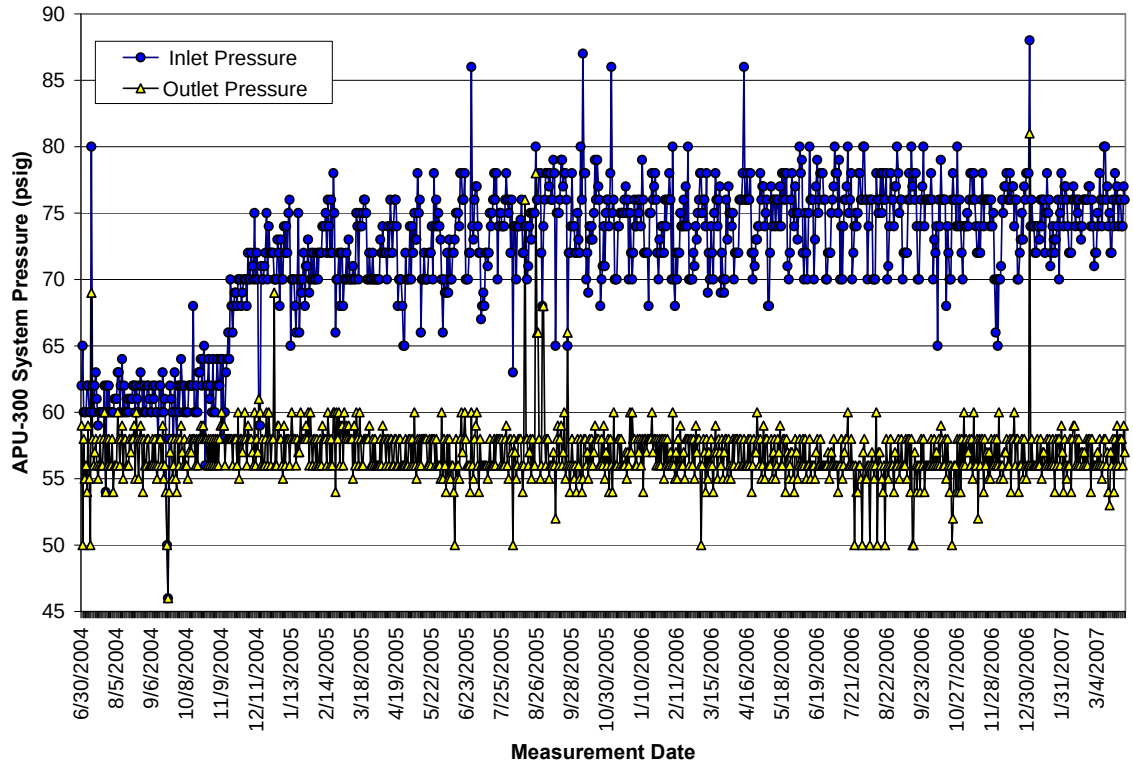

Figure 4-10. APU-300 Treatment System Inlet and Outlet Pressure

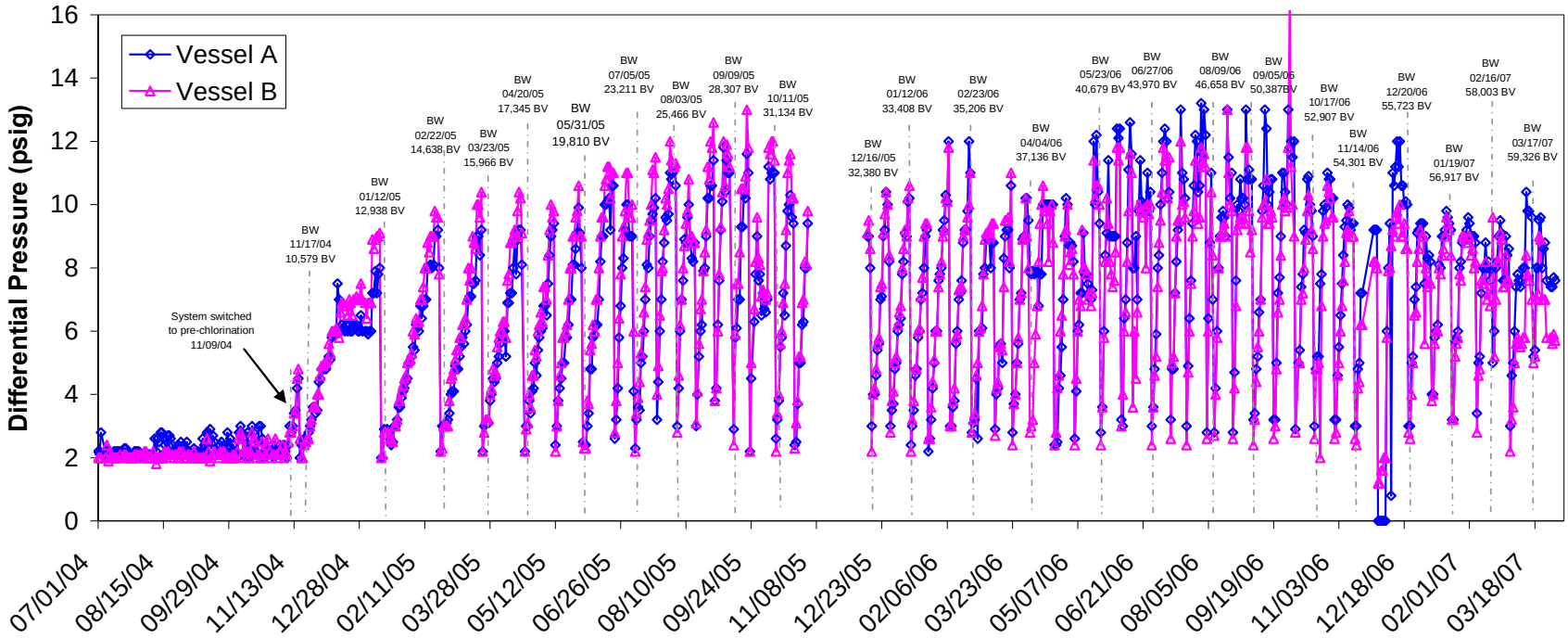

Figure 4-11. Differential Pressure Readings across Adsorption Vessels

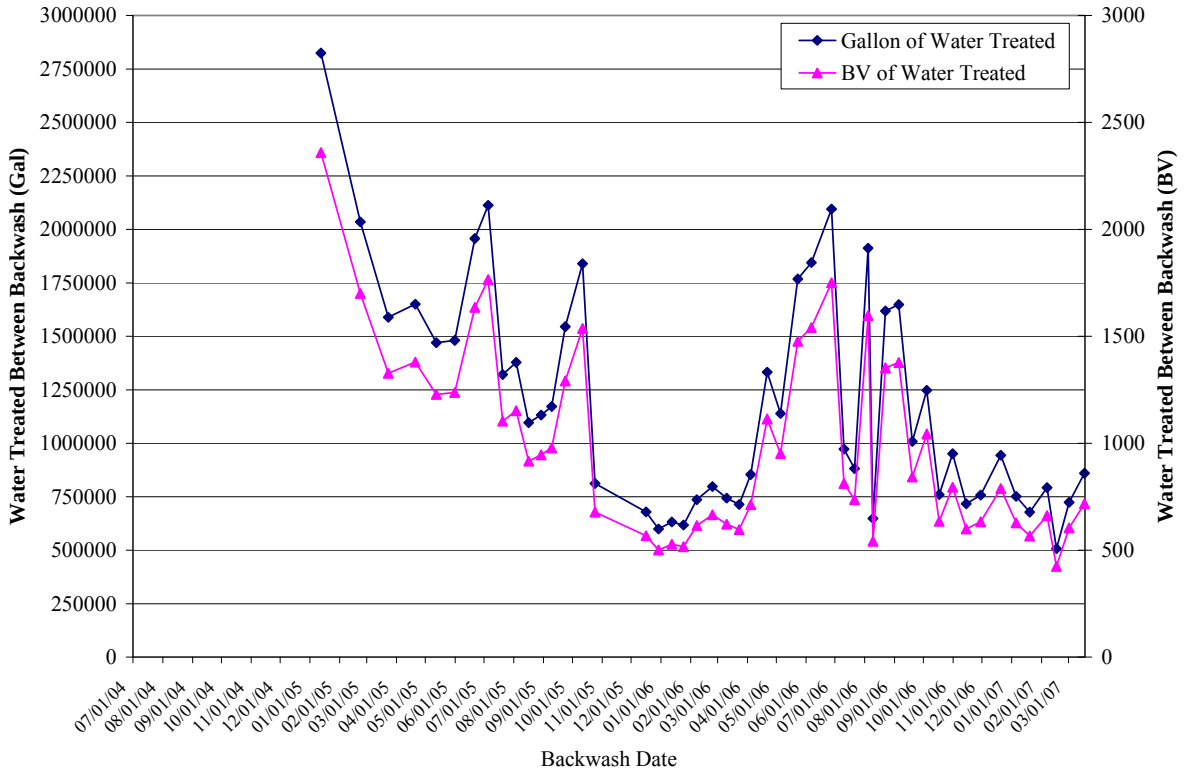

Figure 4-12. Water Production between Two Consecutive Backwash Events

described in Section 3.3.5). Measurements of vessel freeboard revealed that about 6 to 8 in of media had been lost. Because no freeboard measurements were conducted since August 5, 2005, it was not clear if the vessels continued to lose media in the remainder of the evaluation study. Sampling of the media at the bed surface and 14 in below immediately after backwash showed that media fines sized roughly 1/10 to ¼ of virgin granules constituted the top 2 to 3 in of the beds. The reduced media size suggested that media fines were produced during adsorption/backwash cycles and not completely removed during backwash. Although mostly at the top of the beds, some media fines might be accumulating in the media beds, thereby reducing bed porosity. This, along with the iron particles removed during adsorption cycles, caused Δp to rise more rapidly, thus shortening the run times between backwashes. Some iron particles also might be accumulating in the media beds, which also could reduce bed porosity and cause shortened run times.

Media attrition during backwash appeared to be the main reason for the increasingly frequent backwashes observed. During the initial four months of operation without prechlorination, Δp across the media beds was low at 2 to 3 psi even with no backwash. After the switch to prechlorination, backwashes were conducted to remove iron particles generated following prechlorination. The more backwashes that were performed, the more media fines were generated, causing run times to shorten. Similar deteriorating media integrity also was observed at other EPA arsenic demonstration sites, including Rollinsford (Cumming et al., 2008), Desert Sands (Chen et al., 2008b), and Brown City (Chen et al., 2008a). It was not clear, however, if chlorine would cause any adverse effects on media integrity. All of the demonstration sites referenced have been using chlorine prior to the adsorption vessels.

4.4.2 Previous System Design Changes. Prior to shipment of the system to Prospect Bay, it was modified from its original design with revised plumbing that included replacement of the 3-in-diameter system piping with 4-in-diameter; removal of the diaphragm valves, restrictive orifices, and valve controllers; and installation of a nested system of fully ported actuated butterfly valves, and a new control panel. A diagram of the APU-300 system as installed at Prospect Bay is shown in Figure 4-4. These modifications were made due to operational problems experienced by APU-300 systems previously installed at the Desert Sands Mutual Domestic Water Consumers Association (MDWCA) in Anthony, NM, and Brown City, MI, as part of the arsenic demonstration studies. Both of these systems experienced operational issues related to flow restriction, flow imbalance, and excessive pressure losses (Chen et al., 2008a and 2008b). To troubleshoot these operational problems, STS performed a series of systematic hydraulic testing at its Torrance, CA fabrication shop and at the Brown City, MI site. The results of this testing indicated that the flow restrictions and elevated pressure drop issues were caused primarily by the programmable Fleck valve controller and the restrictive orifices included in the original systems. After considering several options, STS retrofitted the systems as described above with larger diameter pipe and removed certain system components determined to have caused excessive flow restrictions and pressure loss.

All such system modifications were completed on the APU-300 system for Prospect Bay prior to shipment from the manufacturing facility in Torrance to the site in Maryland. With these modifications already in place, the Prospect Bay system operated as expected during the performance evaluation study and did not experience any issues observed previously at the other two locations.

4.4.3 Backwash Operation. The APU-300 system was designed and programmed with an automatic backwash feature that would trigger either vessel into backwash by a set Δp (i.e., 10 psi) or a set time. However, backwash of the APU-300 system at QAC was initiated manually by the system operator because there was no onsite disposal facility to receive the backwash water. The backwash water was discharged into a tanker truck and transported to a local wastewater treatment plant.

The APU-300 system was not backwashed during the first four months of system operation because Δp readings across both adsorption vessels remained low and because the backwash wastewater produced would require offsite disposal. Following the switch to prechlorination, Δp readings began to rise from about 2.0 to 4.5 psi. A backwash was performed on November 17, 2004, with each vessel backwashed separately at a flowrate of 200 gpm for 20 to 25 min. A total amount of 9,500 gal backwash wastewater was generated during the initial backwash event. During the performance evaluation study, the system was backwashed a total of 50 times. The backwash duration of each vessel was programmed on the programmable logic controller (PLC) and averaged 24 min including a 4-min rinse step. The amount of wastewater produced averaged 9,985 gal/backwash and totaled 499,231 gal for both vessels combined.

4.4.4 Residual Management. Residuals typically produced by the operation of the APU-300 system include spent media and backwash wastewater. The media were not exhausted during the performance evaluation study; therefore, the only residual produced was backwash wastewater. Because there was no onsite disposal facility, the backwash water was discharged into a tanker truck and transported to the Stevensville Wastewater Treatment Plant (WWTP) for disposal. The Stevensville WWTP also is owned and operated by QAC.

4.4.5 System/Operation Reliability and Simplicity. Because all relevant system modifications related to operational issues were completed prior to shipment of the system, no major operational problems were encountered. The primary source of concerns during the study was the shortened run times between backwash cycles. Other O&M issues encountered included problems with the flow meters installed on Vessels A and B and a butterfly valve assembly necessary for backwash. The flow meter for Vessel A was out of order and was replaced on March 7, 2006, and December 5, 2006. The flow meter

for Vessel B also was replaced October 2, 2006. On May 18, 2006, the butterfly valve that initiated automatic backwash on Vessel B was not opening/closing properly. Backwash had to be initiated by manually turning the valve. A new butterfly valve was ordered and installed on September 29, 2006.

The simplicity of system operation and operator skill requirements are discussed below in relation to pre- and post-treatment requirements, levels of system automation, operator skill requirements, preventive maintenance activities, and frequency of chemical/media handling and inventory requirements.

Pre- and Post-Treatment Requirements. During the first four months of operation, no pretreatment was implemented at the site. In early November 2004, the treatment system was modified to include a new chlorine addition point upstream of the adsorption vessels to oxidize As(III) to As(V) and improve the adsorption capacity of the media. Post-treatment consisted only of the addition of polyphosphate as a corrosion inhibitor using the preexisting polyphosphate feed system.

System Automation. All major functions of the APU-300 system can be automated and require only minimal operator oversight and intervention. Automated processes include system startup in the forward feed mode when the well energizes, backwash cycling based on time or pressure triggers, fast rinse cycling, and system shutdown when the well pump shuts down.

Operator Skill Requirements. Under normal operating conditions, skills required to operate the system were basic and limited to observation of equipment integrity and recording of operating parameters, such as pressure, flow, and system run time. The operational setup was intuitive and all major system operations were automated as described above. The daily demand on the operator was typically only 10 to 15 min to allow the operator to visually inspect the system and record the operating parameters on the daily log sheets. The time requirement does not include travel time to and from the site.

Based on the treatment technology, the State of Maryland requires Category T-Class 5 certification for the operation of the STS treatment system at the Queen Anne's County, MD. Five categories of certificates are issued by the State of Maryland, i.e. water distribution (Category D), water treatment (Category T), wastewater treatment (Category W), wastewater collection (Category C), and industrial wastewater treatment (Category I). Under the Category T (water treatment) there are five levels of certificates, which are classified according to the treatment technology (as presented in Table 4-5). Each certificate is process-specific, which ensures that operators are technically-qualified for the processes they are certified to operate.

Table 4-5. Classification of Water Treatment Plants in State of Maryland

Class	Type of Treatment Systems	Typical Processes Included
1	Disinfection	Chlorination
2	Chemical Treatment	Chlorination, pH control, and fluoridation
3	Simple Iron Removal	Chlorination, pH control, fluoridation, filtration, and iron removal utilizing ion exchange or contact oxidation processes
4	Complete Treatment	Chlorination, pH control, fluoridation, aeration, coagulation, sedimentation, filtration, and complex iron removal
5	Site Specific	Any alternative technology plants not covered under the classification system

Preventive Maintenance Activities. Preventive maintenance tasks recommended by STS included monthly inspection of the control panel, quarterly checking and calibration of the flow meters, biannual inspection of the actuator housings, fuses, relays, and pressure gauges, and annual inspection of the butterfly valves. Further, inspection of the adsorber laterals and replacement of the underbedding gravel were recommended concurrently with the media replacement. During the performance evaluation study, maintenance activities performed by the operator included cleaning and repair of the flow meter paddle wheels on the flow meter for Vessel B, replacing flow meters on both Vessels A and B, and replacing an automatic butterfly valve necessary to backwash Vessel B.

Chemical/Media Handling and Inventory Requirements. The chemicals required for system operation included the chlorine gas injection system and the polyphosphate addition system which were both already in use at the site. Media changeout was not required during the performance evaluation study; however, replacement media were purchased and stored at the facility to facilitate timely media changeout once arsenic breakthrough is detected at 10 µg/L.

4.5 System Performance

The system performance was evaluated based on analyses of water samples collected from the treatment plant, backwash, and distribution system.

4.5.1 Treatment Plant Sampling. Water samples were collected at four locations throughout the treatment train: at the inlet (IN), after Vessels A and B (TA and TB), and after the combined effluent (TT). Following the switch to prechlorination on November 9, 2004, a fifth sampling location was added after the prechlorination injection point (AC). Overall, during the performance evaluation study, water samples were collected on 58 occasions with field speciation performed on 39 occasions. Table 4-6 summarizes the minimum, maximum, and average concentrations of As, Fe, and Mn measured prior to the switch to prechlorination; Table 4-7 summarizes concentrations after the switch to prechlorination on November 9, 2004. Standard deviations also are included in Tables 4-6 and 4-7. Table 4-8 summarizes the results of other water quality parameters collected during performance evaluation study. Appendix B contains a complete set of analytical results collected during this period. The results of the water samples collected throughout the treatment plant are discussed below.

Arsenic Removal. Figure 4-13 contains three bar charts showing the concentrations of total As, particulate As, and soluble As(III) and As(V) at the IN, AC, and TT locations for each speciation sampling event. Total As concentrations in source water ranged from 16.0 to 25.8 µg/L and averaged 20.6 µg/L (Tables 4-6 and 4-7). Soluble As(III) was the predominating species (about 91% of total As), ranging from 12.8 to 22.7 µg/L and averaging 18.9 µg/L. Particulate As concentrations were low, averaging 0.5 µg/L. Soluble As(V) concentrations were typically below the detection limit of 0.1 µg/L. Arsenic concentrations measured in source water during this performance evaluation study were consistent with those of the source water sample collected on August 7, 2003 (Table 4-1).

The key parameter for evaluating the effectiveness of the SORB 33™ system was the concentration of arsenic in the treated water. The arsenic breakthrough curve is presented in Figure 4-14 with total arsenic concentration plotted against the volume of water treated in BV. As shown in the figure, before the switch to prechlorination (at about 10,200 BV), total arsenic concentrations in the treated water increased steadily and exceeded, in late September 2004, the target level of 10 µg/L at 7,400 BV, which was significantly lower than the vendor-provided working capacity of 114,000 BV (Table 4-3). Because arsenic existed primarily as As(III) in source water and because As(V) has much higher adsorptive affinity than As(III), prechlorination was implemented on November 9, 2004. Chlorine gas was applied at a rate of 12 lb/day, equivalent to a dosage of 3.6 mg/L (as Cl_2) assuming complete dissolution of chlorine gas in water. The chlorine residual measured at the plant tap just prior to entering the

Table 4-6. Summary of Arsenic, Iron, and Manganese Analytical Results Prior to Switch to Prechlorination (July 7 to November 3, 2004)

Parameter	Sampling Location	Unit	Number of Samples	Minimum Concentration	Maximum Concentration	Average Concentration	Standard Deviation
As (total)	IN	µg/L	12	18.4	25.8	21.0	2.2
	TA	µg/L	7	0.7	14.8	-[(a)]	-
	TB	µg/L	7	0.3	12.9	-	-
	TT	µg/L	6	0.3	13.3	-	-
As (soluble)	IN	µg/L	5	19.0	22.0	20.6	1.3
	TT	µg/L	4	0.2	13.1	-	-
As (particulate)	IN	µg/L	5	<0.1	0.8	0.3	0.3
	TT	µg/L	4	<0.1	0.2	-	-
As(III)	IN	µg/L	6	12.8	22.4	18.7	4.0
	TT	µg/L	6	0.2	13.2	-	-
As(V)	IN	µg/L	5	0.1	8.1	1.7	3.6
	TT	µg/L	4	<0.1	0.3	-	-
Fe (total)	IN	µg/L	12	193	315	241	36
	TA	µg/L	7	<25	77	-	-
	TB	µg/L	7	<25	38	-	-
	TT	µg/L	6	<25	116	-	-
Fe (soluble)	IN	µg/L	5	161	222	195	24
	TT	µg/L	4	<25	80	-	-
Mn (total)	IN	µg/L	12	1.4	6.0	2.4	1.4
	TA	µg/L	6[(b)]	1.2	6.8	4.4	2.1
	TB	µg/L	7	0.8	9.6	4.9	2.9
	TT	µg/L	6	1.5	6.7	4.4	2.0
Mn (soluble)	IN	µg/L	5	1.5	3.1	2.0	0.7
	TT	µg/L	4	1.5	5.9	3.5	1.9

(a) Not meaningful for data related to breakthrough curves; see Figures 4-13 and 4-15 and Appendix B for results.
(b) One outlier (i.e., 17.9 µg/L on 10/07/07) omitted.
One-half detection limit used for samples with concentrations less than detection limit; duplicate samples included for calculations.

distribution system increased from 0.1 to 0.5 mg/L (as Cl_2) approximately 12 hr after the relocation of the chlorine addition point. Measurements collected over the next two days showed 0.5 to 0.9 mg/L (as Cl_2) following the treatment system.

The day after the switch to prechlorination, a treated water sample was collected from the TT location and speciated for arsenic. This sample had a total arsenic concentration of 14.7 µg/L with arsenic present as As(III). One week later on November 16, 2004 (or after approximately 220 BV of water had been treated since the switch to prechlorination), samples were collected from the IN, AC, and TT locations and speciated for arsenic. As shown in Figure 4-13, As(III) in source water was converted almost completely to As(V) and particulate As (i.e., 12.0 and 7.7 µg/L, respectively) after chlorination at the AC location; however, about 87% of the 12.0 µg/L of total arsenic in the combined effluent at the TT location remained as As(III). It was likely that chlorine added to the water was consumed by the As(III) and ferrous ions previously removed by the media and some As(III) adsorbed by the media were displaced by As(V) into the treated water. Two weeks later on November 23, 2004 (or after approximately 440 BV of water had been treated since the switch to prechlorination), total arsenic concentration in the treated water

Table 4-7. Summary of Arsenic, Iron, and Manganese Analytical Results after Switch to Prechlorination (November 9, 2004 to April 2, 2007)

Parameter	Sampling Location	Unit	Number of Samples	Minimum Concentration	Maximum Concentration	Average Concentration	Standard Deviation
As (total)	IN	µg/L	44	16.0	25.2	20.1	2.0
	AC	µg/L	45[a]	16.8	23.2	20.2	1.8
	TA	µg/L	16	0.3	6.8	-[b]	-
	TB	µg/L	16	0.1	3.8	-	-
	TT	µg/L	33	0.3	14.7	-	-
As (soluble)	IN	µg/L	28	17.4	26.0	20.1	1.8
	AC	µg/L	31	11.2	21.1	15.4	3.3
	TT	µg/L	33	0.2	14.6	-	-
As (particulate)	IN	µg/L	28	0.1	3.0	0.7	0.8
	AC	µg/L	31	0.1	10.1	4.9	3.7
	TT	µg/L	33	0.1	6.2	-	-
As(III)	IN	µg/L	28	15.2	22.7	19.1	1.8
	AC	µg/L	31	0.1	20.9	6.8	8.9
	TT	µg/L	33	<0.1	14.8	-	-
As(V)	IN	µg/L	28	<0.1	10.3	1.3	2.1
	AC	µg/L	31	<0.1	14.0	8.7	5.8
	TT	µg/L	33	<0.1	6.0	-	-
Fe (total)	IN	µg/L	44[c]	194	473	269	80
	AC	µg/L	45	<25	376	230	63
	TA	µg/L	16[d]	<25	<25	<25	-
	TB	µg/L	16	<25	<25	<25	-
	TT	µg/L	33[e]	<25	25.4	<25	-
Fe (soluble)	IN	µg/L	29[f]	44.9	495	244	101
	AC	µg/L	31	<25	363	86.1	102
	TT	µg/L	33[g]	<25	<25	<25	-
Mn (total)	IN	µg/L	44	1.2	14.1	2.9	2.6
	AC	µg/L	45	<0.1	3.8	1.8	0.6
	TA	µg/L	16	<0.1	0.1	2.1	0.7
	TB	µg/L	16	<0.1	3.0	0.8	1.1
	TT	µg/L	33	<0.1	11.5	1.5	2.9
Mn (soluble)	IN	µg/L	26[h]	1.5	5.7	2.5	1.3
	AC	µg/L	31	<0.1	3.8	0.9	0.9
	TT	µg/L	33	<0.1	11.5	1.5	2.9

(a) One outlier (i.e., 0.4 µg/L on 12/01/04) omitted.
(b) Not meaningful for data related to breakthrough curves; see Figure 4-13 and Appendix B for results.
(c) Two outliers (i.e., 802 µg/L on 11/16/04 and 888 µg/L 01/21/07) omitted.
(d) One outlier (i.e., 30.4 µg/L on 04/25/05) omitted.
(e) Two outliers (i.e., 108 µg/L on 11/9/04 and 361 µg/L on 05/11/05) omitted.
(f) Two outliers (i.e., 777 µg/L on 11/16/04 and 733 µg/L on 01/21/07) omitted.
(g) One outlier (i.e., 61.4 µg/L on 11/9/04) omitted.
(h) Two outliers (i.e., 14.3 µg/L on 11/16/04 and 14.0 µg/L on 01/21/07) omitted.
See Appendix B for complete analytical results.
One-half detection limit used for samples with concentrations less than detection limit; duplicate samples included for calculations.

Table 4-8. Summary of Water Quality Parameter Results

Parameter	Sampling Location	Unit	Number of Samples	Minimum Concentration	Maximum Concentration	Average Concentration	Standard Deviation
Alkalinity (as $CaCO_3$)	IN	mg/L	48	158	198	171	8.2
	AC	mg/L	36	154	186	171	8.4
	TA	mg/L	23	154	183	170	8.5
	TB	mg/L	23	154	180	170	7.0
	TT	mg/L	30	152	178	168	7.5
Fluoride	IN	mg/L	48	0.5	1.0	0.8	0.1
	AC	mg/L	36	0.7	1.1	0.8	0.1
	TA	mg/L	23	0.5	1.0	0.8	0.1
	TB	mg/L	23	0.5	1.0	0.8	0.1
	TT	mg/L	30	0.3	1.1	0.8	0.1
Sulfate	IN	mg/L	31	1.5	5.3	3.8	0.8
	AC	mg/L	23	2.7	6.0	4.1	0.6
	TA	mg/L	5	2.5	5.3	3.3	1.2
	TB	mg/L	5	2.5	3.7	2.7	0.5
	TT	mg/L	30	0.5	6.0	3.8	0.9
Orthophosphate (as P)	IN	mg/L	39	<0.05	<0.06	<0.05	-
	AC	mg/L	27[a]	<0.05	<0.06	<0.05	-
	TA	mg/L	22	<0.05	<0.1	<0.05	-
	TB	mg/L	22	<0.05	<0.1	<0.05	-
	TT	mg/L	22	<0.05	<0.1	<0.05	-
P (total) (as P)	IN	µg/L	13	<10	28.6	17.3	6.4
	AC	µg/L	13	<10	29.7	16.3	7.0
	TT	µg/L	2	<10	<10	<10	
Silica (as SiO_2)	IN	mg/L	48	8.5	23.4	14.6	1.9
	AC	mg/L	36	12.0	18.8	14.8	1.1
	TA	mg/L	23	13.2	18.5	14.8	1.0
	TB	mg/L	23	13.2	18.9	14.6	1.1
	TT	mg/L	30	11.9	17.1	14.6	0.9
Nitrate (as N)	IN	mg/L	26[b]	<0.04	<0.04	<0.04	-
	AC	mg/L	21[c]	<0.04	<0.04	<0.04	-
	TA	mg/L	5	<0.04	<0.04	<0.04	-
	TB	mg/L	4[d]	<0.04	<0.04	<0.04	-
	TT	mg/L	26[e]	<0.04	<0.04	<0.04	-
Turbidity	IN	NTU	48	0.2	5.4	1.0	0.8
	AC	NTU	36	0.1	7.3	0.7	1.2
	TA	NTU	23	<0.1	1.0	0.3	0.2
	TB	NTU	23	<0.1	0.9	0.3	0.2
	TT	NTU	30	<0.1	4.2	0.4	0.8
pH	IN	S.U.	44	7.1	8.2	7.8	0.3
	AC	S.U.	31	7.5	8.1	7.7	0.2
	TA	S.U.	20	7.2	8.2	7.7	0.3
	TB	S.U.	20	7.2	8.3	7.7	0.3
	TT	S.U.	30	7.3	8.3	7.7	0.2
Temperature	IN	ºC	44	14.3	21.7	16.4	1.7
	AC	ºC	31	14.4	17.4	15.7	0.8
	TA	ºC	20	15.0	18.4	16.3	1.0
	TB	ºC	20	15.1	18.6	16.3	1.1
	TT	ºC	30	7.5	18.4	15.6	1.8

Table 4-8. Summary of Water Quality Parameter Results (Continued)

Parameter	Sampling Location	Unit	Number of Samples	Minimum Concentration	Maximum Concentration	Average Concentration	Standard Deviation
Dissolved Oxygen	IN	mg/L	41	0.9	7.7	4.4	1.7
	AC	mg/L	29	1.1	6.4	3.4	1.4
	TA	mg/L	18	0.8	4.8	2.4	1.3
	TB	mg/L	17	0.7	5.1	2.1	1.3
	TT	mg/L	29	2.1	6.1	4.2	1.3
ORP	IN	mV	43	-148	220	-23	114
	AC	mV	29	-144	603	177	204
	TA	mV	19	-112	592	86.1	196
	TB	mV	19	-94.0	614	96.3	197
	TT	mV	30	-110	612	141	196
Free Chlorine	AC	mg/L	37	0.0	1.1	0.3	0.3
	PT	mg/L	41	0.0	1.9	0.3	0.3
Total Chlorine	AC	mg/L	37	0.0	2.2	0.7	0.6
	PT	mg/L	41	0.0	2.1	0.7	0.5
Total Hardness (as $CaCO_3$)	IN	mg/L	28	90.9	117	101	6.8
	AC	mg/L	25	90.2	113	99.3	4.7
	TT	mg/L	33	90.0	160	103	13.1
Ca Hardness (as $CaCO_3$)	IN	mg/L	28	45.6	67.3	57.9	5.0
	AC	mg/L	25	44.6	66.7	57.1	4.1
	TT	mg/L	33	44.3	90.0	58.6	7.4
Mg Hardness (as $CaCO_3$)	IN	mg/L	28	34.9	54.5	43.4	4.5
	AC	mg/L	25	36.4	47.4	42.2	2.9
	TT	mg/L	33	36.2	75.2	44.6	8.1

(a) Two outliers (i.e., 1.6 and 1.3 mg/L on 12/01/04) omitted.
(b) Three outliers (i.e., 0.1 mg/L on 02/15/05 and 08/16/05 and 0.2 mg/L on 10/05/05) omitted.
(c) Two outliers (i.e., 0.4 mg/L on 08/16/05 and 0.2 mg/L on 10/05/05) omitted.
(d) One outlier (i.e., 0.1 mg/L on 07/13/04) omitted.
(e) Four outliers (i.e., 0.4 mg/L on 01/26/05, 0.1 mg/L on 02/15/05 and 07/19/05, and 0.6 mg/L on 04/13/05) omitted

NTU = nephelometric turbidity units
See Appendix B for complete analytical results.
One-half detection limit used for samples with concentrations less than detection limit; duplicate samples included for calculations.

decreased sharply to 0.9 µg/L, of which only 0.4 µg/L existed as As(III) (soluble). Since then, total arsenic concentrations in treated water were maintained at a level of less than 10 µg/L.

As shown in Figure 4-13, most samples collected after prechlorination at the AC location contained mostly soluble As(V) and particulate arsenic, indicating effective oxidation of As(III) with chlorine. The exceptions were the 10 samples collected on May 11, July 19, August 15, September 21, and December 13, 2005; May 17, August 16, October 17, and November 12, 2006; and March 7, 2007. The results of speciation sampling indicated that As (III) was the predominating species with levels similar to those in source water. A careful review of the field data revealed that these samples were collected as the system was approaching backwash. It happened that the operator usually switched the chlorine injection point from the pre- to post-chlorination location at this time to help resolve chlorine injection problems due to buildup of back pressure at the system inlet (Figure 4-10) Because chlorine was not injected prior to the AC location, As(III) and iron (II) remained to be untreated at the AC location.

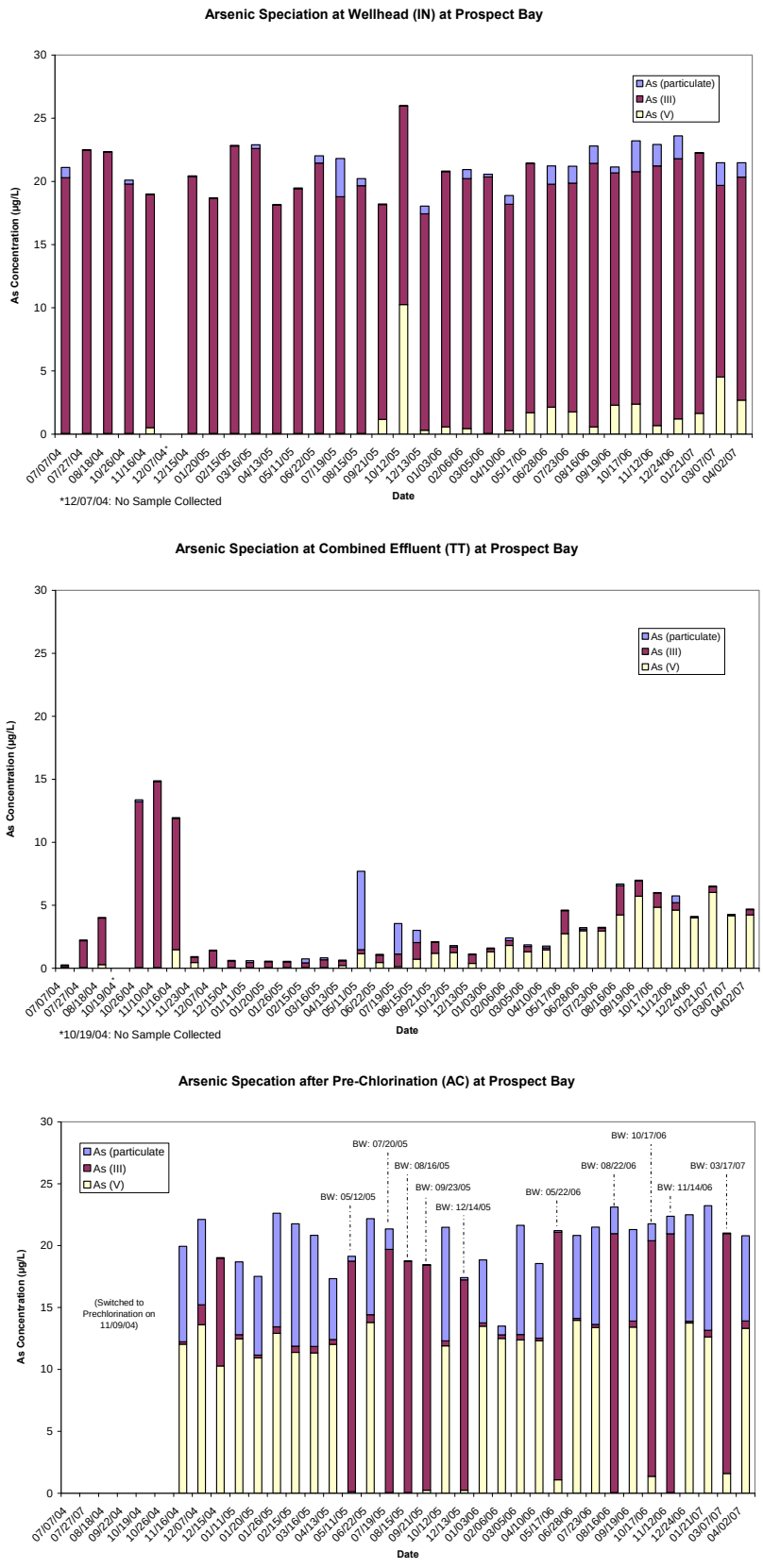

Figure 4-13. Concentration of Arsenic Species at IN, AC, and TT Sample Locations

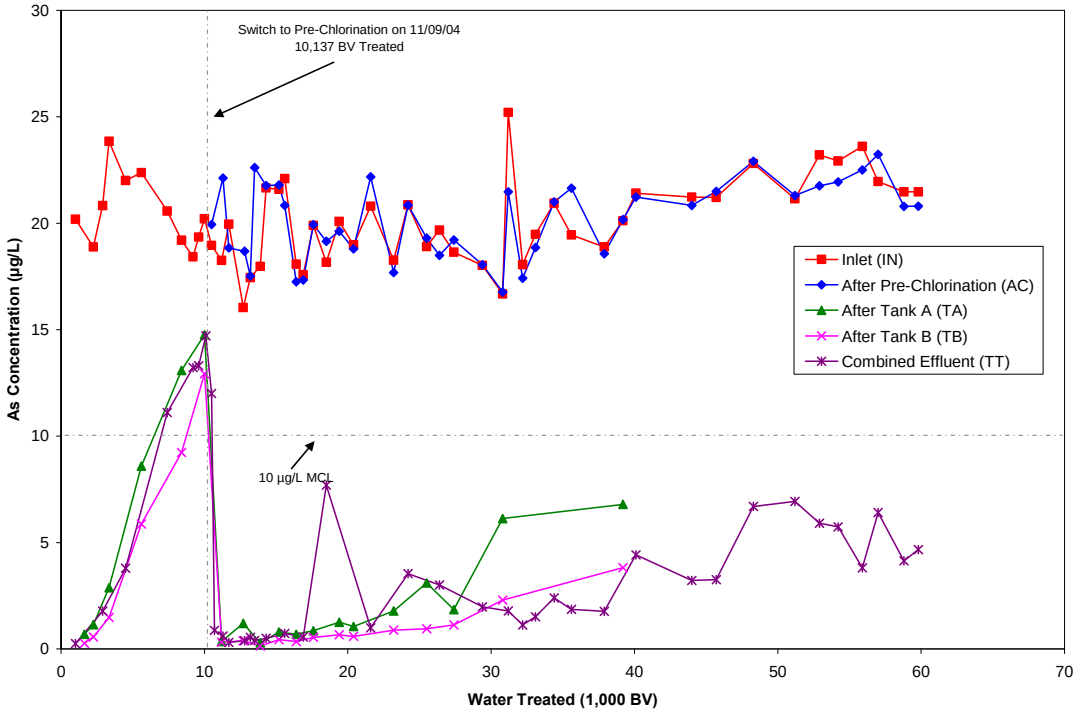

Figure 4-14. Total Arsenic Breakthrough Curve

Figure 4-15 compares average concentrations of As(III), As(V), and particulate As in samples collected at the wellhead and after prechlorination, with the error bars illustrating the standard deviation of the measurements. The averaged concentrations at the AC location did not include the samples collected on

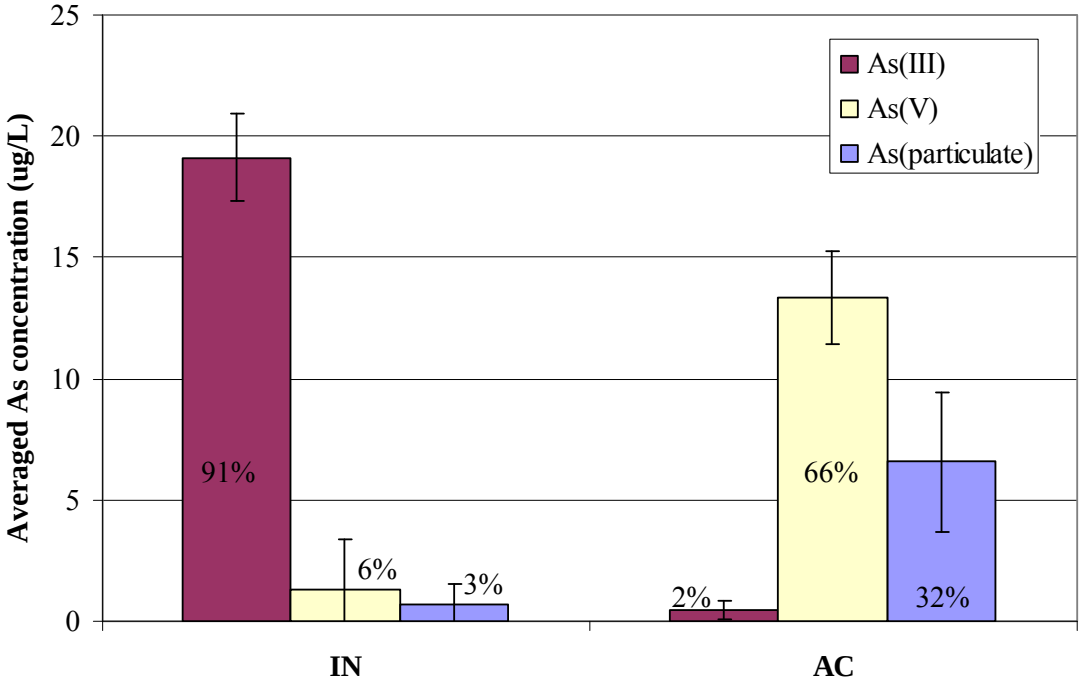

Figure 4-15. Average Concentrations of Arsenic Species at IN and AC Sampling Locations

the 10 occasions where prechlorination was not performed. As illustrated in Figure 4-14, chlorine effectively oxidized As(III), from 91% in source water to 2% after chlorination. After chlorination, 66% of arsenic was present as soluble As(V) and 32% as particulate As. Soluble As(V) was removed by the SORB 33™ media via adsorption and particulate As was removed via filtration.

The performance evaluation study demonstrated that prechlorination was effective at increasing SORB 33™ media adsorptive capacity and sustaining media life. The APU-300 system treated approximately 59,800 BV, equivalent to 71,533,000 gal of water, which is about half of the vendor-estimated working capacity. The averaged total arsenic concentration in the treated water during the last six months of performance evaluation study was around 5 µg/L (Figure 4-14), much less than the 10- µg/L target concentration requiring media rebedding.

Iron. Figure 4-16 shows total iron concentrations versus BV of water treated across the treatment train during the performance evaluation study. Total iron concentrations in source water varied from 193 to 473 µg/L, with most iron present in the soluble form at concentrations ranging from 44.9 to 495 µg/L (Tables 4-6 and 4-7). Except for the first four months of system operation, SORB 33^{TM} media removed iron almost completely, with iron concentrations in the treated water below the detection limit of 25 µg/L most of the time.

The SORB 33^{TM} media beds demonstrated the capability to remove soluble iron before the switch to pre-chlorination (Figure 4-16), when iron in the influent to the bed was present mainly in the soluble form. While it was not clear how soluble iron was removed, its removal did not appear to be related to iron precipitation based on the constant Δp readings observed across the adsorption vessels (Figure 4-11). Before the switch to prechlorination, total iron concentration in the treated water was initially below the detection limit of 25 µg/L. After treating about 9,970 BV of water, total iron concentrations began to increase, indicating breakthrough of soluble Fe.

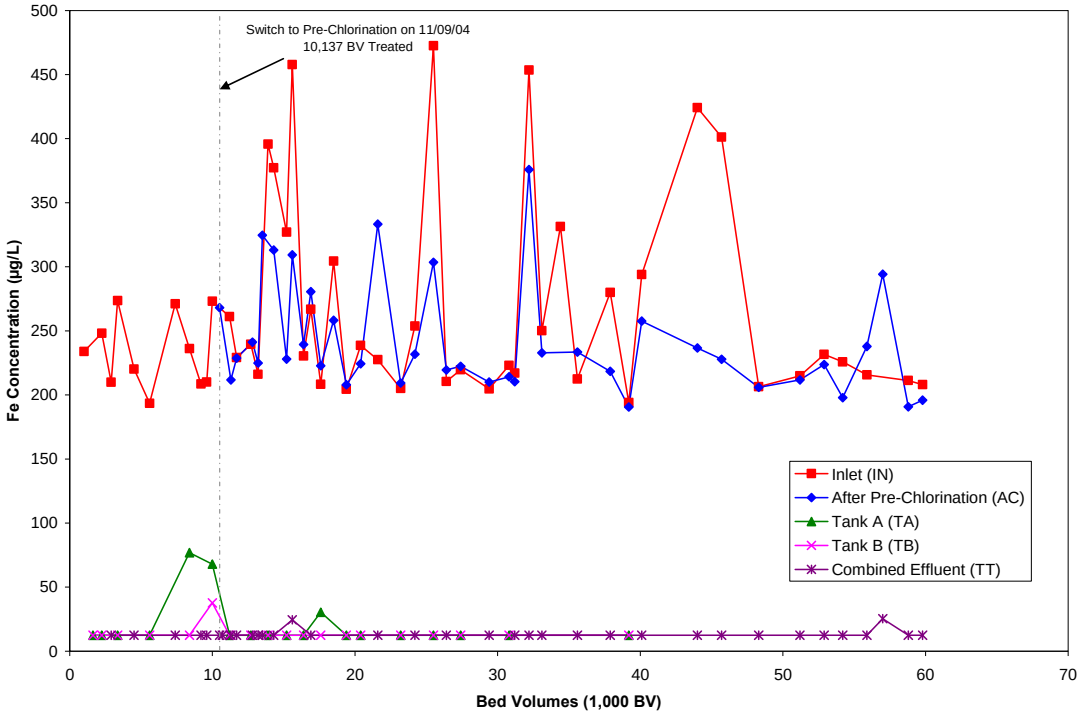

Figure 4-16. Total Iron Concentrations Versus Amount of Water Treated

After the switch to prechlorination, soluble iron in source water was oxidized to Fe(III) and precipitated as iron solids. The average soluble iron concentration measured after chlorination reduced significantly from about 91% in source water to 37% after chlorination (Table 4-7). Presumably, the SORB 33™ media beds removed soluble iron by adsorption and iron solids by filtration. The differential pressure across the media beds started to increase steadily after the switch to prechlorination (Figure 4-11) indicating gradual accumulation of oxidized solids (mainly iron particles) in the media beds.

Manganese. Figure 4-17 shows total Mn concentrations versus BV of water treated across the treatment train. Total Mn concentrations in raw water were low, ranging from 1.2 to 14.1 µg/L (Tables 4-6 and 4-7) and existing almost entirely in the soluble form. After approximately 4,500 BV of water treated, total Mn concentrations in raw and treated water were similar with most values less than 4 µg/L. Since then, but prior to the switch to prechlorination (at about 10,200 BV), Mn concentrations in the treated water began to increase, and became higher than those in raw water. It is not clear why Mn concentrations increased in the treated water.

After the switch to prechlorination in November 2004 through the end of the performance evaluation study, total Mn concentrations in the treated water were reduced to levels lower than those in source water. As shown in Table 4-7, the averaged total Mn concentration of the combined effluent was approximately half of that in source water.

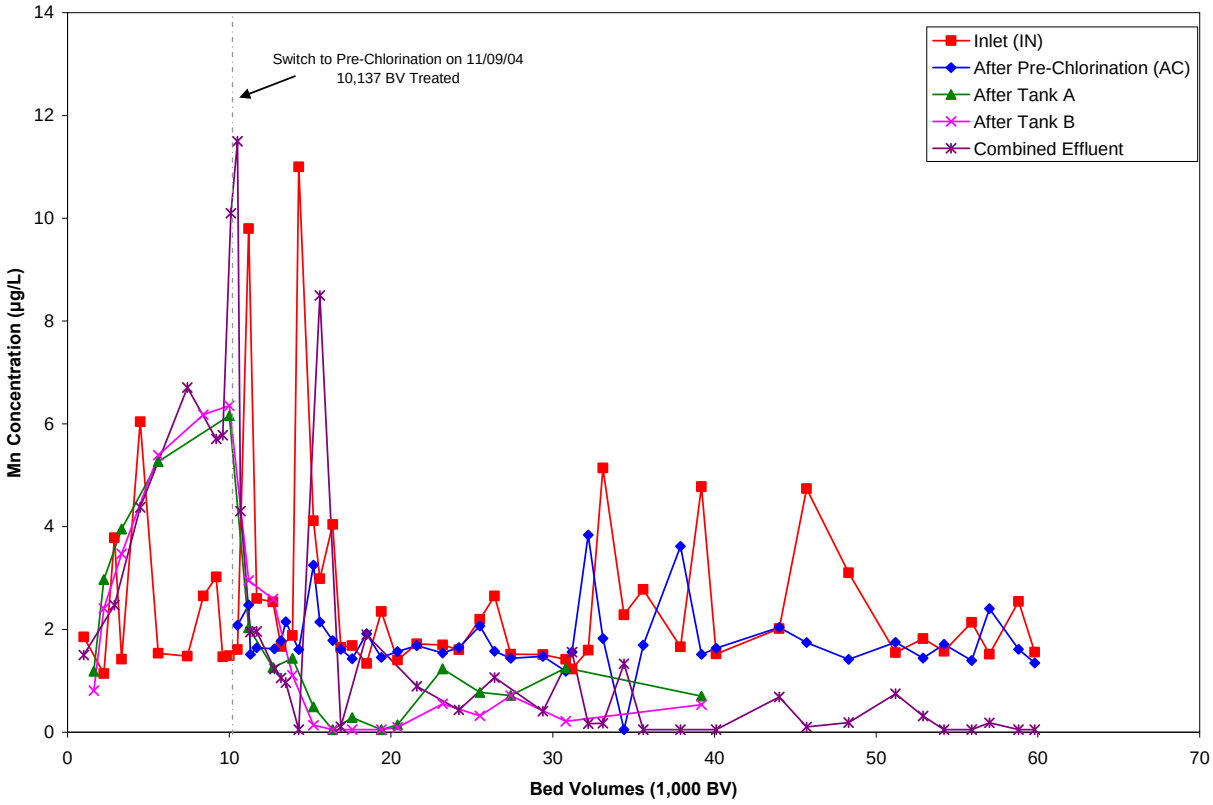

Figure 4-17. Total Manganese Concentrations Versus Bed Volumes

Other Water Quality Parameters. In addition to arsenic, iron, and manganese, other water quality parameters were analyzed to provide insight into the chemical processes occurring within the treatment

system. The results of the water quality parameters are included in Appendix B and are summarized in Table 4-8.

Source water pH values ranged from 7.1 to 8.2 and averaged 7.8. The pH values were similar at all sampling locations across the treatment train. Free and total chlorine were monitored at the AC location and at a tap just prior to the distribution system (referred to as the Plant Tap, PT, as listed in Table 4-8). Free chlorine measurements at the AC and PT locations ranged from 0.0 to 1.9 mg/L and total chlorine levels ranged from 0.0 to 2.2 mg/L (Table 4-8). ORP measurements across the treatment train were erratic with a wide range of values collected at the inlet (from -148 to 220 mV), and following the treatment (from -112 to 614 mV). DO measurements also were highly variable. Several attempts were made to verify and improve the readings, including replacing the field meter and probe and working closely with the operator to ensure the meter was used properly. Due to the spread in these measurements, no discernable trend could be identified from these data.

The results for alkalinity, fluoride, sulfate, silica, and nitrate remained fairly constant throughout the treatment train, appearing unaffected by the media and prechlorination. Orthophosphate (as P) was less than the detection limit for all samples and total phosphorous averaged 17.3 µg/L in source water and less than the detection limit for all samples following the effluent of the treatment system. Total hardness ranged from 90.9 to 117 mg/L (as $CaCO_3$), consisting of approximately 57% Ca hardness and 43% Mg hardness, and remained constant across the treatment train.

4.5.2 Backwash Wastewater Sampling. The analytical results of the backwash wastewater samples are summarized in Table 4-9. As described in Section 3.3.3, the analytes for backwash wastewater samples were modified on December 16, 2005, to include total As, Fe, and Mn, and TSS. The results presented in Table 4-9 reflect these changes.

Raw water was used for backwash. Soluble arsenic and iron concentrations in the backwash water from both vessels were significantly lower than those in raw water, averaging 10.1 and 98.7 µg/L, respectively (compared to 20.6 and 220 µg/L, respectively in raw water). The lower soluble arsenic and iron concentrations indicated removal of some of these ions during backwash. pH values of the backwash wastewater were similar to those of raw water. The results of all parameters measured from Vessel A were consistent with those from Vessel B.

TDS concentrations ranged from 100 to 430 mg/L and averaged 196 mg/L; TSS concentrations ranged from 12 to 130 mg/L and averaged 85 mg/L. Concentrations of total As, Fe, and Mn ranged from 49.7 to 468 µg/L (averaged 248.3 µg/L), from 2.6 to 29.1 mg/L (averaged 16.0 mg/L), and from 7.2 to 128 µg/L (averaged 38.5 µg/L), respectively. On average, approximately 7.5% of As, 0.6% of Fe, and 13.2% of Mn existed in the soluble form in the backwash wastewater. Using the above average concentrations, approximately 0.02 lb of As, 1.3 lb of Fe, and 0.003 lb of Mn were discharged, mostly as backwash solids, during each backwash cycle.

The backwash solids were collected and analyzed in May and June 2005 (Section 3.3.4). The analytical results are summarized in Table 4-10. The averaged As, Fe, and Mn concentrations in backwash solids were 2.3, 400.8, and 1.1 mg/g, respectively. Based on an average TSS concentration of 85 mg/L in backwash wastewater, approximately 7 lb of solids were produced from backwashing both vessels. Assuming the above average concentrations in backwash solids were representative, approximately 0.016 lb of As, 2.8 lb of Fe, and 0.008 lb of Mn would be discharged from both vessels as backwash solids during each backwash. Comparing these results with those calculated based on the analytical results of backwash wastewater, the arsenic amounts were comparable and iron and manganese amounts were within a factor of 2.7. This degree of consistency is promising, considering that the results were generated by two completely independent sampling and analysis systems.

Table 4-9. Backwash Water Sampling Results

Sampling Event		Vessel A											Vessel B									
		pH	Turbidity	TDS	TSS	As (Total)	As (Soluble)	As (Particulate)	Fe (Total)	Fe (Soluble)	Mn (Total)	Mn (Soluble)	pH	Turbidity	TDS	TSS	As (Total)	As (Soluble)	As (Particulate)	Fe (Total)	Fe (Soluble)	Mn (Total)	Mn (Soluble)
No.	Date	S.U.	NTU	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	S.U.	NTU	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1	11/17/04	7.3	600	234	NS	NS	5.4	NS	NS	<25	NS	1.6	7.2	520	222	NS	NS	3.4	NS	NS	<25	NS	2.1
2	01/12/05	7.9	68	100	NS	NS	3.0	NS	NS	<25	NS	5.1	7.9	39	430	NS	NS	2.7	NS	NS	<25	NS	2.8
3	02/22/05	7.8	16	190	NS	NS	2.8	NS	NS	<25	NS	2.6	7.7	12	184	NS	NS	2.3	NS	NS	<25	NS	0.1
4	03/23/05	7.9	17	220	NS	NS	4.1	NS	NS	<25	NS	0.8	7.8	14	216	NS	NS	2.4	NS	NS	<25	NS	0.2
5	04/20/05	7.5	25	212	NS	NS	5.2	NS	NS	<25	NS	1.6	7.6	210	204	NS	NS	4.5	NS	NS	<25	NS	2.5
6	05/12/05	7.3	250	210	NS	NS	5.2	NS	NS	<25	NS	0.3	7.5	180	194	NS	NS	0.2	NS	NS	<25	NS	0.9
7	05/31/05	7.2	18	154	NS	NS	7.8	NS	NS	<25	NS	4.5	7.4	14	160	NS	NS	9.7	NS	NS	<25	NS	2.9
8	06/21/05	7.6	120	178	NS	NS	10.5	NS	NS	<25	NS	5.7	7.8	82	240	NS	NS	10.5	NS	NS	<25	NS	2.9
9	07/05/05	7.7	23[a]	210	NS	NS	11.6	NS	NS	<25	NS	3.1	7.8	17[a]	200	NS	NS	12.4	NS	NS	<25	NS	2.8
10	07/20/05	7.7	53[a]	202	NS	NS	7.2	NS	NS	37	NS	2.5	7.8	17[a]	218	NS	NS	8.3	NS	NS	28	NS	2.5
11	08/03/05	7.7	522[a]	212	NS	NS	10.4	NS	NS	57	NS	4.0	7.8	159[a]	188	NS	NS	11.8	NS	NS	28	NS	5.9
12	08/16/05	NA[b]											7.7	14	202	NS	NS	11.3	NS	NS	28	NS	2.5
13	08/29/05	7.4	32	174	NS	NS	6.0	NS	NS	27	NS	1.8	7.6	26	166	NS	NS	5.8	NS	NS	<25	NS	1.9
14	09/09/05	7.5	9	196	NS	NS	13.7	NS	NS	<25	NS	3.1	7.8	7	210	NS	NS	13.0	NS	NS	<25	NS	2.8
15	09/23/05	7.7	23	236	NS	NS	9.0	NS	NS	<25	NS	1.8	7.8	20	184	NS	NS	11.8	NS	NS	<25	NS	2.9
16	10/11/05	8.0	29	178	NS	NS	9.3	NS	NS	<25	NS	2.1	7.9	18	176	NS	NS	11.6	NS	NS	<25	NS	2.3
17	10/25/05	8.0	2	178	NS	NS	7.9	NS	NS	<25	NS	2.2	NA[c]	NA[c]	NA[c]	NS	NS	8.1	NS	NS	<25	NS	2.2
18	12/16/05[d]	7.9	NS	198	76	178	9.0	169	20,067	113.76	39.54	14.5	7.9	NS	186	110	215	9.7	206	27,503	<25	56.4	4.0
19	01/24/06	7.7	NS	186	130	356	7.9	348	24,378	29	128	0.3	7.8	NS	194	92	317	8.4	309	19,494	<25	96.5	0.1
20	02/23/06	7.9	NS	180[a]	98	369	25.9	343	21,371	781	65.8	9.1	7.8	NS	174[a]	66	217	8.8	208	13,296	<25	41.9	3.4
21	03/10/06	7.7	NS	222	48	66.1	13.1	53.1	3,787	35	14.8	2.7	7.7	NS	172	12	49.7	9.6	40.1	2,556	<25	7.2	0.7
22	04/21/06	7.8	NS	174	90	111	21.3	90.1	10,755	101	25.8	3.3	7.8	NS	176	102	179	18.5	160	14,312	76.9	31.6	4.2
23	05/23/06	7.9	NS	188	104	323	17.6	305	20,242	29.4	21.8	2.1	7.9	NS	194	88	219	18.2	201	13,207	69.2	14.9	2.3
24	06/06/06	7.8	NS	190	128	298	12.3	286	19,587	142	31.3	2.6	7.8	NS	172	100	399	12.3	387	22,473	84.9	31.2	4.0
25	07/10/06	7.8	NS	162	90	257	12.3	245	29,050	25.5	45.4	4.8	7.8	NS	210	70	218	11.6	207	15,726	<25	24.5	4.1
26	08/09/06	7.7	NS	196	89	250	15.9	235	5,142	<25	29.0	4.5	7.7	NS	190	39	283	13.7	269	4,460	<25	20.3	4.2
27	09/05/06	7.6	NS	190	68	193	17.8	175	10,014	<25	16.8	3.2	7.7	NS	156	90	468	21.3	447	22,664	84.3	28.2	4.1

NA = not available; NS = not sampled; TDS = total dissolved solids; TSS = total suspended solids

(a) Reanalyzed outside of hold time.

(b) Samples for Vessel A not taken.

(c) Insufficient sample for analysis due to loss during transit.

(d) Modified backwash procedure utilized for the first time and thereafter.

Table 4-10. Backwash Solids Sampling Results

Date: Location	Mg mg/g	Al mg/g	Si mg/g	P mg/g	Ca mg/g	Fe mg/g	Mn mg/g	Ni µg/g	Cu µg/g	Zn µg/g	As mg/g	Cd µg/g	Pb µg/g
05/12/05: Vessel A	2.71	0.17	0.17	4.30	8.63	610	2.11	108	22	401	2.55	<0.15	2.92
	2.66	0.18	0.06	4.39	8.88	606	2.09	100	20	406	2.61	<0.15	2.94
	2.77	0.17	0.10	4.62	9.73	606	2.07	101	21	408	2.69	<0.15	3.15
Average	**2.71**	**0.17**	**0.11**	**4.44**	**9.08**	**607**	**2.09**	**103**	**21**	**405**	**2.61**	**<0.15**	**3.00**
05/12/05: Vessel B	2.53	0.19	0.06	2.91	6.07	634	2.07	114	18	339	1.78	<0.15	1.91
	2.50	0.19	0.05	2.93	6.33	619	2.03	113	18	339	1.82	<0.15	2.01
	2.48	0.18	0.08	2.76	6.42	624	2.06	110	18	344	1.92	<0.15	3.37
Average	**2.50**	**0.19**	**0.06**	**2.87**	**6.27**	**625**	**2.06**	**113**	**18**	**341**	**1.84**	**<0.15**	**2.43**
05/31/05: Vessel A	22.1	0.39	0.60	6.50	72.3	322	0.81	38.0	63	819	3.30	<1.0	23.6
	17.8	0.37	2.76	6.96	73.6	313	0.62	87.0	68	778	3.25	1	21.4
Average	**20.0**	**0.38**	**1.68**	**6.73**	**73.0**	**318**	**0.71**	**62.5**	**65**	**799**	**3.27**	**1**	**22.5**
05/31/05: Vessel B	21.0	0.82	1.66	4.72	86.7	224	0.51	126	65	353	2.06	<2.0	7.63
	23.3	0.84	6.05	4.79	86.4	231	0.52	122	72	359	2.11	<2.0	6.81
Average	**22.2**	**0.83**	**3.86**	**4.75**	**86.5**	**227**	**0.51**	**124**	**69**	**356**	**2.09**	**<2.0**	**7.22**
06/21/05: Vessel A	17.3	0.53	2.61	6.17	72.1	322	0.45	120	139	618	2.46	<2.0	21.4
	17.1	0.38	3.74	5.57	72.6	313	0.45	113	81	593	2.47	<2.0	19.0
	18.8	0.46	5.69	5.87	73.2	292	0.46	131	116	647	2.62	3	21.0
Average	**17.7**	**0.46**	**4.01**	**5.87**	**72.6**	**309**	**0.45**	**121**	**112**	**619**	**2.51**	**3**	**20.5**
06/21/05: Vessel B	15.0	2.33	3.58	3.77	63.6	308	0.69	161	61	530	1.66	4	23.4
	16.3	2.34	2.51	3.89	63.4	330	0.68	141	81	536	1.68	4	22.4
Average	**15.6**	**2.33**	**3.04**	**3.83**	**63.5**	**319**	**0.69**	**151**	**71**	**533**	**1.67**	**4**	**22.9**

Table 4-11. Media Sampling Results

Sample ID	Mg ug/g	Al ug/g	Si ug/g	P ug/g	Ca ug/g	Fe ug/g	Mn ug/g	Ni ug/g	Cu ug/g	Zn ug/g	As ug/g	Cd ug/g	Pb ug/g
SV-Vessel A-Pre BW-Surface-A	1,059	164	218	1,403	2,267	617,448	1,636	145	11.0	151	850	<0.25	0.57
SV-Vessel A-Pre BW-Surface-B	1,060	167	153	1,375	2,231	612,131	1,632	142	12.4	144	882	<0.25	0.65
SV-Vessel A-Pre BW-Surface-C	1,111	174	129	1,549	2,284	614,355	1,626	139	11.5	152	916	<0.25	0.60
SV-Vessel A-Post BW-Surface-A	1,295	152	5,393	1,158	2,424	485,966	1,270	122	12.9	292	209	<0.25	0.64
SV-Vessel A-Post BW-Surface-B	1,332	155	4,763	1,253	2,449	519,752	1,322	121	13.0	290	267	<0.25	0.66
SV-Vessel A-Post BW-Surface-C	1,318	154	5,943	1,279	2,406	513,650	1,315	114	13.3	291	288	<0.25	0.62
SV-Vessel B-Pre BW-Surface-A	1,706	202	232	1,805	2,746	617,138	1,652	120	16.4	406	1,816	<0.25	0.85
SV-Vessel B-Pre BW-Surface-B	1,710	203	582	1,803	2,695	592,282	1,595	125	16.1	385	1,746	<0.25	0.87
SV-Vessel B-Pre BW-Surface-C	1,721	206	1,026	1,786	2,756	598,376	1,626	126	16.0	385	1,657	<0.25	0.84
SV-Vessel B-Post BW-Surface-A	1,598	185	9,321	1,602	2,794	539,008	1,417	111	16.7	462	843	<0.25	0.91
SV-Vessel B-Post BW-Surface-B	1,606	159	3,981	912	2,647	450,598	1,123	103	16.3	473	228	<0.25	0.86
SV-Vessel B-Post BW-Surface-C	1,576	168	6,016	1,197	2,659	500,171	1,206	106	16.3	470	405	<0.25	0.87

4.5.3 Adsorptive Media Sampling. Table 4-11 presents the analytical results of media samples collected on August 4, 2005, from the top of each media bed both before and after backwash. The spent media collected from both Vessels A and B after backwash contained mostly iron, averaging 502 mg/g (as Fe) or 800 mg/g (as FeOOH) of the spent media. The FeOOH content of the spent media was lower than the 90.1% (by weight) specified by the Bayer AG for the virgin media (Table 4-2). Challenges associated with sampling (i.e., if representative samples were taken) and sample digestion (i.e., if samples were completely digested) were believed to have contributed, in part, to the discrepancies observed.

Average arsenic loadings on the spent media samples collected after backwash were 0.26 and 0.49 mg/g for Vessels A and B, respectively. As shown in Table 4-11, backwash removed approximately 17.6% of iron and 71.5% of arsenic from both Vessels A and B. The average mass ratio of the iron and arsenic removed was 114, which is similar to that (i.e., 171) of the backwash solids as shown in Table 4-9. As such, the iron removed during backwash was mostly the oxidized iron formed following prechlorination and accumulating in the media beds.

4.5.4 Distribution System Water Sampling. The results of the 20 distribution system sampling events (including four baseline sampling events) are summarized in Table 4-12. The most apparent change in the distribution water quality since the system began operation was the decrease in arsenic concentrations once the treatment system became operational. Baseline arsenic concentrations averaged 19.2, 19.3, and 18.6 µg/L for the first draw samples at the DS1, DS2, and DS3 sampling locations, respectively. After the performance evaluation began, arsenic concentrations at DS1, DS2, and DS3 averaged 7.7, 7.7, and 9.9 µg/L, respectively, prior to the switch to prechlorination on November 9, 2004 and 3.9, 3.0, and 3.9 µg/L after the switch. The arsenic results from the distribution sampling mirrored the results from the treatment system sampling in that the As concentrations dropped once the system was put into service, rose gradually during the first four months of operation as As(III) began to break through, and then went down again once the switch to prechlorination was made.

Lead concentrations ranged from less than the detection limit of 0.1 to 2 µg/L, with the exception of one sample collected at DS3 on January 10, 2006, which had a lead concentration of 10.6 µg/L. Copper concentrations ranged from 10.5 to 774 µg/L. None of the lead and copper samples exceeded the respective action levels for these two metals (15 µg/L and 1,300 µg/L for Pb and Cu, respectively). No trend/discernable difference could be drawn or was observed between the samples collected during baseline sampling and after system startup.

pH values collected following treatement ranged from 6.8 to 7.8, with the exception of the values measured on December 8, 2004 and March 3, 2005, which were higher at 8.2 to 8.9. In general, the pH values collected following treatment were consistent with those collected from baseline sampling, ranging from 7.2 to 7.8. Similarly, no major difference was observed in alkalinity, with concentrations ranging from 154 to 182 mg/L (as $CaCO_3$). Total iron concentrations were generally less than the method reporting limit of 25 µg/L for all baseline samples except for two collected on December 17, 2003, and February 11, 2004. Since the system became operational, iron concentrations in the distribution system samples were consistently less than the detection limit with only two exceptions at DS3. Total Mn concentrations in the distribution system samples were typically low, ranging from 0.5 to 22.9 µg/L, with the majority at less than 5 µg/L.

4.6 System Cost

The cost-effectiveness of the system is evaluated based on the capital cost per gpm (or gpd) of the design capacity and the O&M cost per 1,000 gal of water treated. The capital costs included equipment, engineering, and installation costs and O&M costs included media replacement and disposal, chemical supply, electrical power use, and labor.

Table 4-12. Distribution System Sampling Results

Sampling Event		DS1									DS2									DS3								
	Sample Type	LCR									LCR									LCR								
	Flushed / 1st Draw	1st Draw									1st Draw									1st Draw								
	Sampling Date	Stagnation Time	pH	Alkalinity	As	Fe	Mn	Pb	Cu	PO_4 (ortho)	Stagnation Time	pH	Alkalinity	As	Fe	Mn	Pb	Cu	PO_4 (ortho)	Stagnation Time	pH	Alkalinity	As	Fe	Mn	Pb	Cu	PO_4 (ortho)
No.	Date	hr	S.U.	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	hr	S.U.	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	hr	S.U.	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BL1	12/17/03	8.3	7.2	166	18.5	87.5	0.8	1.3	255.0	0.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.0	7.6	164	16.0	<25	0.7	0.5	287.6	0.5
BL2	01/14/04	8.5	7.8	159	17.5	<25	0.5	0.6	429.0	0.4	8.5	7.6	163	21.5	<25	1.0	<0.1	210.0	1.0	6.0	7.6	159	19.5	<25	16.6	0.4	299.0	0.6
BL3	02/11/04	7.8	7.4	174	21.2	107.0	1.1	0.9	180.0	0.4	10.0	7.3	182	18.1	47.0	3.9	0.1	207.0	0.5	6.0	7.2	161	19.5	68.9	9.9	0.5	279.0	0.4
BL4	03/19/04	7.1	7.2	156	19.5	<25	0.7	0.6	248.0	0.4	7.5	7.2	160	18.4	<25	1.5	0.2	120.0	0.5	6.0	7.7	168	19.2	<25	1.3	0.4	322.0	0.4
1	07/20/04	10.3	6.8	156	3.0	<25	1.3	0.9	360.0	2.2	10.8	6.9	156	3.5	<25	1.1	0.3	171.0	0.5	6.0	6.8	160	4.6	<25	1.2	1.1	297.0	0.5
2	08/31/04	8.3	7.6	167	7.7	<25	4.1	1.0	384.0	0.5	Homeowner not available									6.0	7.5	155	7.0	<25	3.6	0.8	279.0	0.6
3	09/23/04	8.2	7.1	162	8.4	<25	5.5	1.7	462.0	1.6	9.5	7.3	162	8.8	<25	3.0	0.6	65.0	2.2	8.3	7.4	162	16.7	26.9	8.7	1.6	494.0	2.3
4	10/26/04	7.5	7.7	164	11.9	<25	4.6	0.9	407.0	1.9	9.0	7.6	164	10.7	<25	2.6	0.3	146.0	1.8	9.0	7.7	164	11.2	<25	2.4	0.5	200.0	1.9
5	11/16/04	9.0	7.6	164	12.3	<25	22.9/ 20.6	0.8	174.0	1.7	7.5	7.7	164	13.2	<25	2.7	0.2	126.0	1.8	9.0	7.7	164	12.4	<25	11.8	0.3	53.0	1.6
6	12/8/04[a]	8.5	8.9	162	1.5	<25	2.2	0.5	231.0	0.5	8.0	8.4	162	3.6	<25	2.3	0.1	83.6	0.6	7.0	8.2	162	4.3	26.0	1.9	0.3	416.0	0.6
7	01/05/05	Homeowner not available									7.0	7.7	165	1.5	<25	1.8	0.2	280.0	0.4	8.0	7.4	178	1.4	<25	1.4	0.3	466.0	0.6
8	02/02/05	8.8	7.2	171	0.6	<25	0.9	0.6	581.5	4.6	11.0	7.3	166	0.9	<25	1.0	0.2	159.3	1.2	8.0	7.5	180	1.1	<25	0.9	0.4	96.8	1.0
9	3/3/05[b]	8.5	7.3	169	1.4	<25	0.3	0.2	281.0	1.0	9.0	8.2	174	1.4	<25	0.5	0.1	267.0	1.1	Homeowner not available								
10	4/12/05[c]	8.5	7.7	178	1.0	<25	0.1	0.2	373.0	1.2	9.3	7.7	176	1.0	<25	0.5	0.2	253.0	1.3	8.0	7.7	176	1.2	<25	0.4	0.4	774.0/ 541.0	1.2
11	05/10/05	8.3	7.8	176	1.4	<25	<0.1	0.5	481.2	1.9	7.3	7.6	176	1.0	<25	<0.1	0.1	242.3	1.9	7.0	7.8	176	1.0	<25	<0.1	0.3	438.0	1.8
12	06/22/05	8.8	7.5	163	3.1	<25	0.5	0.4	114.1	1.4	8.3	7.5	167	2.2	<25	0.6	0.2	101.0	1.4	8.5	7.6	163	2.5	<25	0.6	0.3	160.8	1.3
13	07/19/05	8.8	7.2	167	1.5	<25	0.9	0.3	123.1	1.6	10.0	7.3	172	1.3	<25	0.6	0.1	234.0	1.6	9.5	7.3	172	1.6	<25	0.4	1.3	293.2	1.4
14	08/16/05	Homeowner not available									16.0	7.4	154	1.9	<25	1.3	0.4	115.6	1.4	8.0	7.3	154	2.0	<25	0.7	0.5	151.3	1.2
15	9/20/05[d]	8.5	7.5	167	2.0	<25	0.3	1.4	222.0	1.3	8.5	7.5	176	2.1	<25	0.5	0.4	111.7	1.5	8.5	7.5	172	2.0	<25	0.5	0.4	148.0	1.4
14	10/12/05	8.5	7.5	172	3.2	<25	0.7	<0.1	30.3	0.6	8.0	7.6	176	4.0	<25	0.5	<0.1	10.5	<0.06	8.0	7.5	176	3.0	<25	1.3	0.4	57.7	<0.06
15	12/14/05	8.5	7.8	180	15.7	<25	0.5	2.0	432.1	0.2	Homeowner not available									9.2	7.8	176	15.5	<25	0.3	0.8	304.3	0.2
16	01/10/06	9.0	7.7	172	2.6	<25	0.2	0.9	327.0	0.6	9.5	7.8	172	4.5	<25	0.2	0.3	213.0	0.4	8.5	7.8	172	3.4	<25	0.1	10.6	470.0	0.4

(a) DS2 sampled on December 7, 2004.
(b) DS2 sampled on March 4, 2005.
(c) DS1 sampled on April 13, 2005.
(d) DS2 sampled on September 21, 2005.
(/) indicates re-run data with original result/re-run result.
NS = not sampled; NA = data not available
Lead action level = 15 µg/L; copper action level = 1.3 mg/L
BL = baseline sampling

4.6.1 Capital Cost. The capital investment cost for equipment, site engineering, and installation was $211,000 (see Table 4-13). The equipment cost was $129,500 (or 62% of the total capital investment), which included costs for two FRP pressure vessels, 160 ft^3 of SORB 33™ media ($150/$ft^3$ or $5.34/lb), piping and valves, instrumentation and controls, field services (including operator training, technical support, and system shakedown), and miscellaneous materials and supplies.

The engineering cost included that for preparation of the system layout and footprint, treatment system process flow diagram, and mechanical drawings of the treatment system equipment submitted as part of the permit application submittal (Section 4.3.1). The final set of engineering plans were prepared by Stearns and Wheler and included detailed construction drawings of the new treatment building, a floor plan, and tie-ins and connections for the treatment system. The engineering cost was $36,700, which was 17% of the total capital investment.

Table 4-13. Capital Investment for Prospect Bay Treatment System

Description	Cost	% of Capital Investment Cost
APU Skid-Mounted System	$72,200	–
E33 Media	$24,000	–
Misc. Equipment and Materials	$19,800	–
Vendor Labor	$10,000	–
Vendor Travel	$3,500	–
Equipment Total	**$129,500**	**62%**
Subcontractor	28,940	–
Vendor Labor	$6,680	–
Vendor Travel	$1,080	–
Engineering Total	**$36,700**	**17%**
Subcontractor	$35,800	–
Vendor Labor	$5,600	–
Vendor Travel	$3,400	–
Installation Total	**$44,800**	**21%**
Total Capital Investment	**$211,000**	**100%**

The installation cost includes the labor, equipment, and materials to unload and install the skid-mounted unit, perform the piping tie-ins and electrical work, and load and backwash the media. The installation was performed by the vendor and the installation subcontractor, Stearns and Wheler. The installation cost was $44,800, or 21% of the total capital investment.

The QAC Department of Public Works subcontracted Stearns and Wheler to construct the addition to the treatment building. Total construction cost for the addition was $92,630, including about $18,000 for the building design and $75,000 for construction. The 16-ft × 23-ft treatment area was an addition to the original 8-ft × 16-ft well house. The building was constructed using concrete block and brick siding. Construction took approximately one month to complete including placement and setting of the vessels within the building, which were put into place before the roof was installed.

The total capital cost of $211,000 was normalized to $703/gpm ($0.49/gpd) of design capacity using the system's rated capacity of 300 gpm (or 432,000 gpd). The capital cost also was converted to an annualized cost of $19,916/year by multiplying by a capital recovery factor (CRF) of 0.09439 based on a 7% interest rate and a 20-year return period (Chen et al., 2004). Assuming that the system operated 24 hr/day, 7 day/wk at the design flowrate of 300 gpm to produce 157,680,000 gal/yr, the unit capital cost

would be $0.13/1,000 gal. During the performance evaluation study, the system operated only 6.2 hr/day at 207 gpm on average (see Table 4-4). Based on this reduced use rate, the system would produce only 28,106,000 gal of water in one year (assuming 365 days per year) and the unit capital cost would increase to $0.70/1,000 gal.

4.6.2 Operation and Maintenance Cost. The O&M costs include only incremental costs associated with the APU-300 treatment system, such as media replacement, chemical supply, electricity, replacement parts, and labor. These costs are summarized in Table 4-14.

Table 4-14. O&M Cost for Prospect Bay Treatment System

Cost Category	Value	Assumptions
Volume Processed (Kgal)	65,023	From 06/30/04 through 04/02/07
Media Replacement and Disposal		
Media Cost ($/ft^3)	$155.80	Purchased price
Total Media Volume (ft^3)	160	Both vessels
Media Replacement Cost ($)	$24,928	Purchased price
Labor Cost ($)	$2,120	Vendor quote
Media Disposal Fee ($)	$680	Vendor quote
Subtotal ($)	$27,728	Vendor quote
Media Replacement/Disposal Cost ($/1,000 gal)	See Figure 4-18	Based upon media run length at 10-µg/L arsenic breakthrough
Chemical Usage		
Chemical Cost ($)	$0.00	No additional chemical usage required
Electricity		
Electric Utility Charge ($/kWh)	$0.10	Including delivery and supply charges
Incremental Monthly Usage (kWh)	1200	Average monthly incremental usage for August and September 2004
Estimated Incremental Electricity cost ($)	$720	From July to December 2004
Incremental cost ($/1,000 gal)	$0.05	–
Replacement Parts		
Signet Flow Meter Sensors ($)	$654	Three replacement sensors; not including installation
Replacement Paddle Wheel and Pin for Flow Meter Sensor ($)	$41	Not including installation
Automatic Butterfly Valve Assembly	$950	Not including installation
Total Cost of Parts Replaced during Performance Evaluation Study	$1,645	–
Incremental Cost ($/1,000 gal)	$0.03	–
Labor		
Average Weekly Labor (hr)	1.75	15 min/day, 7 day/week
Labor Cost ($/1,000 gal)	$0.23	Average Labor rate = $21.75/hr
Total O&M Cost/1,000 gallons	See Figure 4-18	Based upon media run length at 10-µg/L arsenic breakthrough

Although media replacement and disposal did not take place during the performance evaluation study, virgin Bayoxide E33 media were purchased at a unit cost of $155.80/ft^3 for a total of $24,928 and stored onsite to prepare for timely media replacement. The vendor estimated $27,728 to change out both vessels, which included the purchased price of the media, freight, labor, travel expenses, and media profiling and disposal fee. This cost was used to estimate the media replacement cost per 1,000 gal of

water treated as a function of the projected media run length to the 10 µg/L arsenic breakthrough (Figure 4-18).

The chemical cost associated with the operation of the treatment system included chlorine addition prior to the adsorption vessels and injection of polyphosphate after the APU-300 system. Both of these treatment steps were in use at the site prior to installation of the APU-300 treatment system, which did not have a significant effect on the chlorine gas usage based on the data collected during the performance evaluation study. Therefore, the incremental chemical cost due to the APU-300 system was negligible.

The incremental electrical power consumption was reviewed. Electrical usage during the months of August and September 2003 were compared to usage for the same period in 2004 following installation of the APU system. Additionally, the 2003 usage estimate was determined by adding the usage at both Wells No. 1 and No. 2 because operation of these wells was alternated during this time. The estimated average monthly usage for Wells No. 1 and No. 2 for August and September 2003 was about 4,160 kWh. For August and September 2004, the average monthly usage for Well No. 1 was 5,360 kWh. Once the APU-300 treatment system was installed at Well House No. 1, Well No. 2 was only rarely operated, if at all. The incremental electrical usage was thus determined to be approximately 1,200 kWh per month during the summer months when peak water demand was expected. At a rate of about $0.10/kWh (including delivery and supply charges), an additional utility cost of approximately $120 per month to operate the APU-300 system was calculated. Over the performance evaluation period, the incremental utility cost to operate the treatment system was $0.05/1,000 gal. Although there are few electrical parts on the APU-300 system that would require additional electrical consumption, the increased usage might have been due to increased total dynamic head on the well pump and electrical consumption within the treatment building addition (i.e., lights, heating, etc.).

During the performance evaluation study, several parts were not functioning properly and had to be repaired and/or replaced, including three flow meter sensors, an automatic butterfly valve, and parts for the flow meter sensors. The cost for the replacement parts was $1,645, not including installation, which resulted in an incremental cost of $0.03/1,000 gallons of water treated.

The routine, non-demonstration-related labor activities consumed only about 15 min/day, as noted in Section 4.4.5. Based on this time requirement and a labor rate of $21.75/hr, the labor cost was $0.23/1,000 gal of water treated.

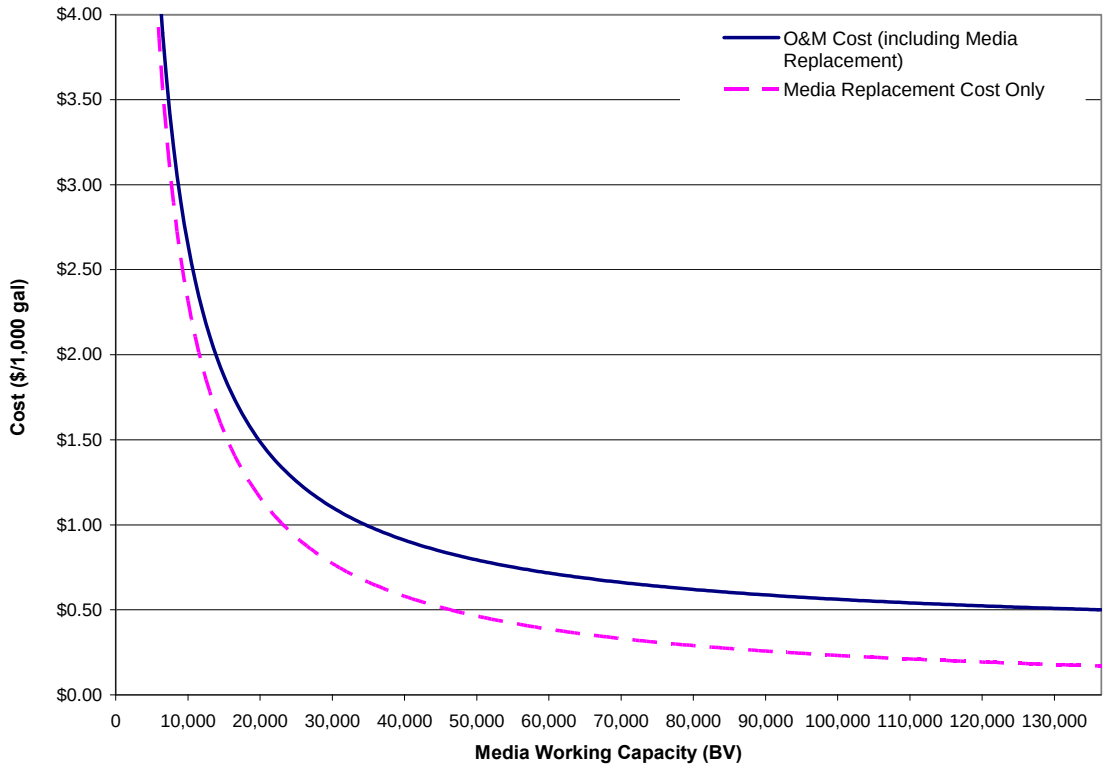

Figure 4-18. Media Replacement and Operation and Maintenance Costs

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APPENDIX A

OPERATIONAL DATA

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	6/28/2004	NM	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	NA	NA	NA	NA	NM	NM	NA	
	Tue	6/29/2004	NM	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	NA	NA	NA	NA	NM	NM	NA	
	Wed	6/30/2004	08:35	NA	NA	NA	356.97	110.0	NA	NA	NA	115.0	NA	NA	NA	NA	NA	2.1	2.2	3	
1	Thu	7/1/2004	11:10	11.3	168,000	248	359.55	115.4	74,596	75	125	119.4	78,002	78	130	153	127	2.2	2.0	15	
	Fri	7/2/2004	09:00	6.2	92,000	247	360.98	116.4	41,182	116	193	119.8	42,825	121	202	237	198	2.2	2.0	2	
	Sat	7/3/2004	17:30	19.8	295,000	248	365.51	116.9	131,384	247	413	112.8	136,697	258	430	505	422	2.8	2.0	5	
	Sun	7/4/2004	NM	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	NA	NA	NA	NA	NM	NM	NA	
	Mon	7/5/2004	NM	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	NA	NA	NA	NA	NM	NM	NA	
	Tue	7/6/2004	14:30	35.1	NA	NA	373.56	105.5	233,007	480	802	115.4	242,208	500	835	980	819	2.2	2.0	4	
	Wed	7/7/2004	08:30	13.6	201,000	246	376.67	117.6	89,596	570	952	118.0	93,006	593	990	1,163	971	2.2	2.4	8	
2	Thu	7/8/2004	09:00	9.1	135,000	247	37876	119.1	60,836	631	1,054	112.3	63,025	656	1,096	1,286	1,075	2.0	1.9	3	
	Fri	7/9/2004	08:00	6.0	87,000	242	380.13	115.2	39,484	670	1,120	118.4	40,866	697	1,164	1,367	1,142	2.2	2.2	5	
	Sat	7/10/2004	17:00	16.6	246,000	247	388.94	114.5	111,180	781	1,306	118.9	115,029	812	1,356	1,593	1,331	2.0	2.1	10	
	Sun	7/11/2004	16:37	12.4	181,000	243	386.77	121.2	82,160	863	1,443	112.2	85,111	897	1,499	1,760	1,471	2.0	2.0	11	
	Mon	7/12/2004	09:00	13.2	192,000	242	387.79	110.0	88,057	951	1,590	115.0	90,949	988	1,650	1,939	1,620	2.2	2.0	4	
	Tue	7/13/2004	08:30	1.1	17,000	258	390.04	115.0	7,189	959	1,602	117.0	7,743	995	1,663	1,954	1,633	2.2	2.0	4	
	Wed	7/14/2004	08:35	8.8	129,000	244	392.06	115.0	58,164	1,017	1,699	118.0	60,356	1,056	1,764	2,073	1,732	2.2	2.0	5	
3	Thu	7/15/2004	16:00	12.3	183,000	248	394.89	110.9	83,084	1,100	1,838	114.1	86,176	1,142	1,908	2,242	1,873	2.2	2.0	5	
	Fri	7/16/2004	14:25	3.4	48,000	235	395.67	110.3	19,785	1,120	1,871	115.1	22,136	1,164	1,945	2,284	1,908	2.2	2.1	5	
	Sat	7/17/2004	NM	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	NA	NA	NA	NA	NM	NM	NA	
	Sun	7/18/2004	NM	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	NA	NA	NA	NA	NM	NM	NA	
	Mon	7/19/2004	09:20	19.7	288,000	244	400.18	110.0	132,805	1,253	2,093	112.0	136,364	1,300	2,173	2,553	2,133	2.3	2.1	4	
	Tue	7/20/2004	08:20	8.8	130,000	246	402.21	111.0	58,346	1,311	2,190	115.0	60,629	1,361	2,274	2,672	2,232	2.3	2.1	4	
	Wed	7/21/2004	09:00	8.4	120,000	238	405.21	114.0	86,744	1,398	2,335	121.0	90,042	1,451	2,425	2,849	2,380	2.1	2.0	2	
4	Thu	7/22/2004	11:00	8.0	121,000	252	406.02	112.0	22,936	1,421	2,374	119.3	23,801	1,475	2,465	2,896	2,419	2.0	2.0	4	
	Fri	7/23/2004	10:30	8.3	120,000	241	407.92	113.5	54,659	1,475	2,465	120.1	56,781	1,532	2,560	3,007	2,512	2.0	2.0	4	
	Sat	7/24/2004	17:00	8.7	145,000	278	410.05	117.5	61,575	1,537	2,568	118.0	65,885	1,598	2,670	3,134	2,619	2.1	2.0	2	
	Sun	7/25/2004	16:00	11.5	152,000	220	412.59	116.9	73,723	1,610	2,691	115.2	74,606	1,672	2,794	3,283	2,743	2.1	2.0	2	
	Mon	7/26/2004	14:00	0.2	2,000	167	41265	115.0	816	1,611	2,693	118.2	809	1,673	2,796	3,284	2,744	2.2	2.1	NA	
	Tue	7/27/2004	08:40	9.7	143,000	246	41489	115.0	65,100	1,676	2,801	117.0	67,746	1,741	2,909	3,417	2,855	2.2	2.1	4	
	Wed	7/28/2004	08:45	2.0	30,000	250	41539	115.0	13,538	1,690	2,824	117.4	14,109	1,755	2,932	3,445	2,878	2.2	2.1	4	
5	Thu	7/29/2004	09:45	9.3	135,000	242	41754	115.0	61,676	1,752	2,927	117.0	64,301	1,819	3,040	3,571	2,983	2.2	2.0	4	
	Fri	7/30/2004	08:50	2.1	31,000	246	41803	110.4	14,427	1,766	2,951	112.8	14,811	1,834	3,065	3,600	3,008	2.0	2.1	4	
	Sat	7/31/2004	16:20	9.7	150,000	258	42039	112.7	68,032	1,834	3,065	110.1	71,159	1,905	3,184	3,739	3,124	2.1	2.0	4	
	Sun	8/1/2004	17:00	10.2	139,000	227	42058	113.5	63,423	1,898	3,171	114.4	66,111	1,971	3,294	3,869	3,232	2.0	2.1	2	
	Mon	8/2/2004	09:00	4.1	61,000	248	42354	110.8	27,257	1,925	3,216	116.7	29,114	2,000	3,343	3,925	3,279	2.1	2.2	6	
	Tue	8/3/2004	08:40	5.9	85,000	240	42487	115.0	39,161	1,964	3,282	114.0	40,056	2,040	3,410	4,004	3,346	2.1	2.2	5	
	Wed	8/4/2004	08:40	4.2	62,000	246	42586	112.3	28,372	1,992	3,329	113.7	29,620	2,070	3,459	4,062	3,394	2.1	2.0	5	
6	Thu	8/5/2004	08:45	7.1	103,000	242	42748	113.4	46,481	2,039	3,407	114.6	48,794	2,119	3,541	4,158	3,474	2.1	2.0	5	
	Fri	8/6/2004	08:35	9.5	139,000	244	42967	114.6	63,769	2,103	3,513	116.3	66,395	2,185	3,652	4,288	3,582	2.1	2.0	3	
	Sat	8/7/2004	19:00	10.1	148,000	244	43199	112.2	67,176	2,170	3,626	116.5	70,276	2,256	3,769	4,425	3,697	2.1	2.0	5	
	Sun	8/8/2004	17:00	1.3	17,000	218	43228	113.2	7,991	2,178	3,639	119.3	8,387	2,264	3,783	4,442	3,711	2.1	2.2	4	
	Mon	8/9/2004	11:30	11.2	164,000	244	43456	115.6	74,820	2,253	3,764	117.8	78,224	2,342	3,914	4,595	3,839	2.6	2.0	4	
	Tue	8/10/2004	10:15	10.9	159,000	243	43736	115.6	72,213	2,325	3,885	117.8	75,495	2,418	4,040	4,742	3,962	2.2	1.8	5	
	Wed	8/11/2004	08:05	1.4	20,000	238	43769	115.8	9,410	2,334	3,900	117.4	9,855	2,427	4,056	4,762	3,978	2.6	2.0	5	
7	Thu	8/12/2004	09:00	10.2	149,000	243	44005	115.7	68,284	2,402	4,015	117.3	71,321	2,499	4,176	4,901	4,095	2.5	2.0	4	
	Fri	8/13/2004	08:30	2.3	33,000	239	44057	114.4	16,716	2,419	4,042	113.7	15,314	2,514	4,201	4,933	4,122	2.8	2.0	2	
	Sat	8/14/2004	16:00	8.8	128,000	242	44260	115.0	56,623	2,476	4,137	113.0	61,165	2,575	4,303	5,051	4,220	2.8	2.0	4	
	Sun	8/15/2004	22:45	8.7	129,000	247	44464	114.7	58,200	2,534	4,234	116.6	60,658	2,636	4,405	5,170	4,320	2.6	2.0	5	
	Mon	8/16/2004	08:30	0.3	3,000	167	44469	115.0	2,031	2,536	4,238	117.0	2,125	2,638	4,408	5,174	4,323	2.4	2.2	4	
	Tue	8/17/2004	08:33	9.9	144,000	242	44696	114.0	65,975	2,602	4,348	118.5	68,720	2,707	4,523	5,309	4,436	2.2	2.1	3	
	Wed	8/18/2004	09:30	5.6	80,000	238	44824	115.0	37,117	2,639	4,410	112.0	38,753	2,746	4,588	5,385	4,499	2.7	2.2	4	
8	Thu	8/19/2004	06:30	5.3	78,000	245	44947	116.4	34,980	2,674	4,468	116.2	36,539	2,782	4,649	5,456	4,559	2.7	2.1	3	
	Fri	8/20/2004	10:50	10.4	151,000	242	45187	115.3	69,060	2,743	4,584	117.8	72,203	2,854	4,770	5,597	4,677	2.6	2.0	4	
	Sat	8/21/2004	16:00	11.2	163,000	243	45442	114.0	74,300	2,817	4,708	115.0	39,677	2,894	4,836	5,711	4,772	2.4	2.1	3	
	Sun	8/22/2004	17:47	0.4	5,000	208	45452	114.2	4,317	2,822	4,715	116.9	42,340	2,936	4,907	5,758	4,811	2.2	2.0	5	
	Mon	8/23/2004	06:40	9.2	134,000	243	45662	116.2	59,331	2,881	4,814	116.1	62,063	2,998	5,010	5,879	4,912	2.2	2.1	2	
	Tue	8/24/2004	09:00	6.3	93,000	246	45809	113.3	42,352	2,923	4,885	112.5	49,976	3,048	5,094	5,972	4,989	2.2	2.1	3	
	Wed	8/25/2004	09:04	4.5	64,000	237	45912	117.4	29,426	2,953	4,934	116.3	25,030	3,073	5,136	6,026	5,035	2.4	2.0	5	
9	Thu	8/26/2004	08:50	10.4	151,000	242	46151	116.3	69,319	3,022	5,050	119.4	72,483	3,146	5,257	6,168	5,153	2.2	2.2	4	
	Fri	8/27/2004	11:30	11.0	160,000	242	46403	114.8	72,930	3,095	5,172	114.7	76,212	3,222	5,384	6,317	5,278	2.5	2.1	4	
	Sat	8/28/2004	16:50	8.8	127,000	241	46603	110.5	58,423	3,154	5,270	111.1	60,951	3,283	5,486	6,437	5,378	2.3	2.2	4	
	Sun	8/29/2004	16:43	4.8	69,000	240	46714	112.5	31,787	3,185	5,323	114.4	33,072	3,316	5,541	6,501	5,432	2.3	2.0	6	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	8/30/2004	08:51	12.5	180,000	240	47000	110.7	82,429	3,268	5,460	114.9	86,046	3,402	5,685	6,670	5,573	2.1	2.0	4	
	Tue	8/31/2004	09:15	3.0	45,000	250	47070	114.0	20,390	3,288	5,495	114.7	21,267	3,423	5,721	6,712	5,608	2.5	2.0	4	
	Wed	9/1/2004	09:00	7.1	102,000	239	47233	112.3	46,552	3,335	5,572	114.8	48,640	3,472	5,802	6,807	5,687	2.2	2.1	4	
10	Thu	9/2/2004	09:00	9.9	143,000	241	47460	112.0	65,717	3,400	5,682	117.5	68,830	3,541	5,917	6,941	5,799	2.2	2.1	4	
	Fri	9/3/2004	14:45	10.2	147,000	240	47695	112.4	67,801	3,468	5,795	120.2	70,859	3,612	6,035	7,080	5,915	2.1	2.0	4	
	Sat	9/4/2004	17:00	6.0	88,000	244	47834	112.9	39,926	3,508	5,862	119.8	41,777	3,654	6,105	7,162	5,984	2.1	2.0	5	
	Sun	9/5/2004	15:40	7.2	104,000	241	47999	112.7	47,129	3,555	5,941	117.4	49,304	3,703	6,187	7,258	6,064	2.3	2.2	4	
	Mon	9/6/2004	16:30	10.2	147,000	240	48234	115.8	67,428	3,623	6,054	112.6	70,507	3,773	6,305	7,396	6,179	2.1	2.0	4	
	Tue	9/7/2004	09:15	6.7	97,000	241	48388	115.4	44,441	3,667	6,128	114.9	46,486	3,820	6,383	7,487	6,255	2.1	2.0	4	
	Wed	9/8/2004	08:45	4.4	63,000	239	48489	116.9	28,996	3,696	6,176	117.6	30,355	3,850	6,434	7,546	6,305	2.2	2.0	5	
11	Thu	9/9/2004	06:43	9.2	133,000	241	48701	114.9	61,176	3,757	6,279	115.4	63,947	3,914	6,541	7,671	6,410	2.1	2.0	4	
	Fri	9/10/2004	10:00	4.1	61,000	248	48797	112.6	27,810	3,785	6,325	116.7	29,065	3,943	6,589	7,728	6,457	2.2	2.0	4	
	Sat	9/11/2004	19:00	9.4	135,000	239	49013	119.9	62,208	3,847	6,429	115.9	64,951	4,008	6,698	7,855	6,563	2.6	2.0	5	
	Sun	9/12/2004	17:30	8.9	128,000	240	49216	113.0	58,221	3,906	6,526	114.0	60,651	4,069	6,799	7,974	6,663	2.4	2.0	2	
	Mon	9/13/2004	09:40	11.3	164,000	242	49477	116.0	75,205	3,981	6,652	117.2	78,686	4,147	6,930	8,128	6,791	2.2	2.0	4	
	Tue	9/14/2004	10:00	10.4	151,000	242	49718	118.0	69,193	4,050	6,768	118.6	72,236	4,220	7,051	8,270	6,909	2.8	2.6	4	
	Wed	9/15/2004	09:10	3.0	42,000	233	49580	116.0	19,391	4,069	6,800	117.9	20,268	4,240	7,085	8,309	6,942	2.8	2.2	4	
12	Thu	9/16/2004	09:25	8.5	123,000	241	49984	119.7	57,406	4,127	6,896	115.9	59,956	4,300	7,185	8,427	7,041	2.9	1.9	4	
	Fri	9/17/2004	09:15	0.2	3,000	250	49989	116.0	372	4,127	6,896	116.0	378	4,300	7,186	8,427	7,041	2.3	2.0	5	
	Sat	9/18/2004	23:30	9.2	133,000	241	50201	116.0	60,975	4,188	6,998	116.0	63,743	4,364	7,292	8,552	7,145	2.7	2.1	5	
	Sun	9/19/2004	16:40	0.0	0	NA	50203	115.0	436	4,189	6,999	114.0	410	4,364	7,293	8,553	7,146	2.5	2.2	4	
	Mon	9/20/2004	09:41	0.1	1,000	167	50204	0.0	0	4,189	6,999	0.0	0	4,364	7,293	8,553	7,146	0.0	0.0	NA	
	Tue	9/21/2004	09:00	0.0	0	NA	50207	0.0	0	4,189	6,999	0.0	0	4,364	7,293	8,553	7,146	0.0	0.0	NA	
	Wed	9/22/2004	10:50	20.7	295,000	238	50668	112.8	136,428	4,325	7,227	114.0	142,109	4,507	7,531	8,832	7,379	2.2	2.0	4	
13	Thu	9/23/2004	09:20	11.8	184,000	260	50964	113.0	84,943	4,410	7,369	114.0	87,677	4,594	7,677	9,004	7,523	2.4	2.2	5	
	Fri	9/24/2004	09:30	5.3	77,000	242	51090	110.0	35,677	4,446	7,429	117.0	36,979	4,631	7,739	9,077	7,584	2.5	2.1	3	
	Sat	9/25/2004	17:00	7.5	109,000	242	51267	116.0	50,093	4,496	7,512	119.0	52,133	4,683	7,826	9,179	7,669	2.3	2.2	5	
	Sun	9/26/2004	16:30	8.8	126,000	239	51468	115.0	58,078	4,554	7,609	116.0	60,246	4,744	7,927	9,297	7,768	2.4	2.2	2	
	Mon	9/27/2004	09:10	10.1	146,000	241	51701	115.6	67,606	4,621	7,722	117.9	70,299	4,814	8,044	9,435	7,883	2.2	2.0	5	
	Tue	9/28/2004	08:45	0.8	12,000	250	51722	116.8	6,185	4,628	7,733	118.6	6,449	4,820	8,055	9,448	7,894	2.8	2.0	5	
	Wed	9/29/2004	13:10	2.1	30,000	238	51772	117.7	13,275	4,641	7,755	116.8	13,762	4,834	8,078	9,475	7,916	2.4	2.0	4	
14	Thu	9/30/2004	09:15	10.3	149,000	241	52005	114.5	68,860	4,710	7,870	117.8	71,435	4,906	8,197	9,615	8,034	2.6	2.0	4	
	Fri	10/1/2004	11:23	2.3	35,000	254	52065	116.0	16,185	4,726	7,897	115.0	16,814	4,922	8,225	9,648	8,061	2.2	2.0	4	
	Sat	10/2/2004	16:30	8.2	118,000	240	52252	115.0	54,064	4,780	7,987	116.0	56,077	4,978	8,319	9,758	8,153	2.4	2.1	4	
	Sun	10/3/2004	18:00	9.9	142,000	239	52479	114.0	65,658	4,846	8,097	114.0	68,260	5,047	8,433	9,892	8,265	2.2	2.0	5	
	Mon	10/4/2004	12:31	0.3	4,000	222	52509	110.3	7,911	4,853	8,110	116.7	8,223	5,055	8,447	9,908	8,279	2.2	2.0	5	
	Tue	10/5/2004	08:45	0.9	14,000	259	52511	114.8	693	4,854	8,111	116.3	715	5,056	8,448	9,910	8,280	2.0	2.2	4	
	Wed	10/6/2004	09:30	9.3	133,000	238	52123	115.8	61,428	4,916	8,214	115.3	33,834	5,089	8,505	10,005	8,359	2.8	2.6	4	
15	Thu	10/7/2004	8:30	1.2	18,000	250	52723	114.5	8,380	4,924	8,228	114.8	38,685	5,128	8,569	10,052	8,399	3.0	2.8	4	
	Fri	10/8/2004	07:45	2.2	32,000	242	52805	113.3	14,438	4,938	8,252	117.7	14,984	5,143	8,594	10,082	8,423	2.8	2.6	4	
	Sat	10/9/2004	16:45	8.4	121,000	240	52999	115.9	56,137	4,995	8,346	117.5	58,266	5,201	8,692	10,196	8,519	2.6	2.2	5	
	Sun	10/10/2004	16:40	13.0	189,000	242	53300	115.6	87,365	5,082	8,492	117.5	90,817	5,292	8,843	10,374	8,668	2.2	2.2	5	
	Mon	10/11/2004	14:30	7.3	106,000	242	53469	119.3	49,514	5,131	8,575	112.1	51,276	5,344	8,929	10,475	8,752	2.0	2.0	4	
	Tue	10/12/2004	08:51	2.9	41,000	236	53537	115.5	18,537	5,150	8,606	112.0	19,419	5,363	8,962	10,513	8,784	2.8	2.2	5	
	Wed	10/13/2004	13:00	7.7	112,000	242	53717	115.0	51,851	5,202	8,692	114.1	53,812	5,417	9,051	10,619	8,872	2.0	2.0	4	
16	Thu	10/14/2004	06:15	1.2	21,000	292	53910	115.0	9,456	5,211	8,708	114.5	9,816	5,427	9,068	10,638	8,888	2.2	2.2	10	
	Fri	10/15/2004	08:45	0.3	0	NA	53252	115.1	79	5,211	8,708	115.7	133	5,427	9,068	10,638	8,888	3.0	2.8	2	
	Sat	10/16/2004	18:59	10.9	158,000	242	54008	114.9	72,979	5,284	8,830	113.3	75,785	5,502	9,195	10,787	9,012	2.8	2.6	4	
	Sun	10/17/2004	16:30	6.5	93,000	238	54161	115.4	42,868	5,327	8,902	114.0	44,422	5,547	9,269	10,874	9,085	2.4	2.5	4	
	Mon	10/18/2004	08:40	0.0	1,000	NA	54165	114.3	1,280	5,328	8,904	NM	1,303	5,548	9,271	10,877	9,088	2.2	2.0	4	
	Tue	10/19/2004	11:15	10.0	144,000	240	54396	114.8	67,164	5,396	9,016	NM	69,750	5,618	9,388	11,014	9,202	2.5	2.1	5	
	Wed	10/20/2004	08:56	2.6	37,000	237	54457	113.8	15,874	5,412	9,043	115.2	16,580	5,635	9,415	11,046	9,229	3.0	2.1	5	
17	Thu	10/21/2004	10:40	8.8	127,000	241	54662	114.0	58,523	5,470	9,141	114.6	61,191	5,696	9,518	11,166	9,329	3.0	2.0	5	
	Fri	10/22/2004	11:00	0.1	2,000	333	54669	114.2	958	5,471	9,142	114.0	487	5,696	9,518	11,167	9,330	2.6	2.5	4	
	Sat	10/23/2004	19:30	10.1	147,000	243	55011	112.0	70,293	5,541	9,260	113.3	72,836	5,769	9,640	11,310	9,450	2.0	2.0	5	
	Sun	10/24/2004	17:19	0.5	6,000	200	55021	115.8	367	5,542	9,260	NM	360	5,769	9,641	11,311	9,450	2.2	2.1	7	
	Mon	10/25/2004	08:50	0.1	2,000	333	55029	115.0	775	5,542	9,261	116.0	745	5,770	9,642	11,313	9,452	2.2	2.4	2	
	Tue	10/26/2004	09:20	9.0	130,000	241	55240	118.0	60,228	5,603	9,362	115.0	62,643	5,833	9,747	11,435	9,554	2.2	2.6	4	
	Wed	10/27/2004	08:30	1.0	14,000	233	55266	117.4	6,450	5,609	9,373	114.8	6,614	5,839	9,758	11,449	9,565	2.2	2.2	6	
18	Thu	10/28/2004	09:10	8.6	125,000	242	55466	115.0	57,600	5,667	9,469	114.6	59,760	5,899	9,858	11,566	9,663	2.2	2.0	6	
	Fri	10/29/2004	14:00	0.5	7,000	233	55482	114.8	3,317	5,670	9,475	113.3	3,510	5,903	9,863	11,573	9,669	2.4	2.1	5	
	Sat	10/30/2004	18:18	8.1	117,000	241	55670	115.7	55,657	5,726	9,568	116.3	57,678	5,960	9,960	11,686	9,764	2.0	2.1	4	
	Sun	10/31/2004	17:00	0.7	11,000	262	55688	115.3	53,272	5,779	9,657	117.5	3,461	5,964	9,966	11,743	9,811	2.2	2.6	4	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	11/1/2004	10:50	8.3	120,000	241	55880	113.2	5,306	5,784	9,666	114.5	57,348	6,021	10,061	11,805	9,864	2.2	2.1	6	
	Tue	11/2/2004	15:45	0.5	7,000	233	55893	112.2	3,603	5,788	9,672	112.9	3,745	6,025	10,068	11,813	9,870	2.2	2.0	4	
	Wed	11/3/2004	08:30	8.7	125,000	239	56092	114.0	57,521	5,845	9,768	113.5	59,592	6,084	10,167	11,930	9,967	2.4	2.2	2	
19	Thu	11/4/2004	10:17	1.0	15,000	250	56117	112.7	6,715	5,852	9,779	116.7	7,051	6,092	10,179	11,944	9,979	2.3	2.2	6	
	Fri	11/5/2004	10:25	6.7	96,000	239	56272	113.0	44,495	5,897	9,853	117.0	46,148	6,138	10,256	12,034	10,055	2.2	2.4	6	
	Sat	11/6/2004	17:30	3.4	49,000	240	56355	NA	5,971	5,903	9,863	118.7	23,800	6,161	10,296	12,064	10,080	2.4	2.0	6	
	Sun	11/7/2004	17:00	5.3	78,000	245	56478	112.7	NA	NA	NA	115.3	36,998	6,198	10,358	NA	NA	2.2	2.2	4	
	Mon	11/8/2004	08:45	4.5	63,000	233	56580	115.2	24,165	5,927	9,904	118.4	30,428	6,229	10,409	12,156	10,156	2.0	2.1	5	
	Tue	11/9/2004[b]	09:30	0.0	0	NA	56573	114.0	307	5,927	9,904	113.5	1,208	6,230	10,411	12,157	10,157	2.4	2.5	2	
	Wed	11/10/2004	08:00	8.9	129,000	242	56839	113.5	59,588	5,987	10,004	114.7	60,214	6,290	10,511	12,277	10,257	3.0	2.8	5	
20	Thu	11/11/2004	16:40	0.5	0	NA	56901	114.0	3,276	5,990	10,009	114.0	3,206	6,294	10,517	12,283	10,263	2.8	2.8	1	
	Fri	11/12/2004	09:00	1.5	29,000	322	56954	115.7	10,076	6,000	10,026	116.4	10,159	6,304	10,534	12,304	10,280	3.0	3.0	4	
	Sat	11/13/2004	17:10	7.8	111,000	237	57191	115.1	52,462	6,052	10,114	113.9	51,398	6,355	10,619	12,408	10,367	3.4	3.4	5	
	Sun	11/14/2004	16:45	4.1	59,000	240	57339	116.8	28,033	6,080	10,161	114.5	26,286	6,381	10,663	12,462	10,412	3.5	3.5	6	
	Mon	11/15/2004	08:42	5.6	79,000	235	57490	120.4	38,171	6,119	10,224	110.3	35,151	6,417	10,722	12,535	10,473	4.2	4.5	8	
	Tue	11/16/2004	12:50	0.4	7,000	292	57550	120.6	3,266	6,122	10,230	109.4	2,965	6,420	10,727	12,541	10,478	4.5	4.8	6	
	Wed	11/17/2004	13:35	9.3	130,000	233	57795	113.0	63,838	6,186	10,336	115.0	56,559	6,476	10,822	12,662	10,579	2.0	2.6	12	Yes
21	Thu	11/18/2004	08:30	0.3	0	NA	57832	114.0	2,622	6,188	10,341	114.0	2,197	6,478	10,825	12,667	10,583	2.4	2.0	10	
	Fri	11/19/2004	08:20	1.6	27,000	281	57878	113.6	10,021	6,198	10,358	0.0	5,912	6,484	10,835	12,683	10,596	2.4	2.0	10	
	Sat	11/20/2004	15:10	8.3	120,000	241	58092	113.5	55,850	6,254	10,451	0.0	4	6,484	10,835	12,738	10,643	2.6	2.4	10	
	Sun	11/21/2004	20:35	7.2	106,000	245	58279	114.8	48,828	6,303	10,533	0.0	4	6,484	10,835	12,787	10,684	2.5	2.5	11	
	Mon	11/22/2004	11:30	2.2	30,000	227	58340	105.0	14,981	6,318	10,558	110.2	709	6,485	10,836	12,803	10,697	2.6	2.6	11	
	Tue	11/23/2004	08:30	0.1	1,000	167	58362	108.0	510	6,319	10,558	110.0	507	6,485	10,837	12,804	10,698	2.8	2.6	12	
	Wed	11/24/2004	09:45	7.9	114,000	241	58567	114.8	51,827	6,370	10,645	115.1	50,210	6,536	10,921	12,906	10,783	3.0	3.0	10	
22	Thu	11/25/2004	07:45	0.1	1,000	167	58573	115.4	2,515	6,373	10,649	117.4	436	6,536	10,922	12,909	10,786	3.2	3.2	15	
	Fri	11/26/2004	16:30	8.8	126,000	239	58779	115.0	60,649	6,434	10,751	114.0	53,276	6,589	11,011	13,023	10,881	3.6	3.6	12	
	Sat	11/27/2004	16:25	0.1	0	NA	58785	114.5	642	6,434	10,752	114.0	577	6,590	11,012	13,024	10,882	3.6	3.6	10	
	Sun	11/28/2004	20:45	8.8	128,000	242	58997	117.1	65,763	6,500	10,862	114.7	57,210	6,647	11,107	13,147	10,984	3.4	3.6	12	
	Mon	11/29/2004	09:15	0.7	10,000	238	59089	117.0	609	6,501	10,863	117.3	531	6,648	11,108	13,148	10,985	3.5	4.0	12	
	Tue	11/30/2004	09:00	8.7	125,000	239	59219	117.0	61,763	6,562	10,966	110.7	51,917	6,700	11,195	13,262	11,080	4.4	4.0	10	
	Wed	12/1/2004	09:55	3.1	42,000	226	59256	118.0	80,938	6,643	11,101	117.0	17,309	6,717	11,224	13,360	11,162	4.5	4.6	12	
23	Thu	12/2/2004	09:00	0.5	8,000	267	59363	117.2	3,805	6,647	11,107	117.1	3,291	6,720	11,229	13,367	11,168	4.8	4.9	12	
	Fri	12/3/2004	09:40	9.4	132,000	234	59519	119.4	6,240	6,653	11,118	108.7	53,833	6,774	11,319	13,427	11,219	4.8	4.9	13	
	Sat	12/4/2004	17:00	2.0	29,000	242	59872	118.4	14,265	6,668	11,142	113.6	11,705	6,786	11,339	13,453	11,240	4.8	5.0	12	
	Sun	12/5/2004	21:00	5.2	76,000	244	59676	118.1	38,344	6,706	11,206	105.5	30,674	6,816	11,390	13,522	11,298	4.8	5.0	12	
	Mon	12/6/2004	08:30	3.9	55,000	235	59787	116.0	27,502	6,733	11,252	111.1	22,476	6,839	11,428	13,572	11,340	5.0	5.1	14	
	Tue	12/7/2004	11:15	2.0	28,000	233	59840	113.9	13,968	6,747	11,275	103.9	11,310	6,850	11,447	13,598	11,361	5.2	5.6	14	
	Wed	12/8/2004	06:40	1.5	21,000	233	59876	118.8	11,862	6,759	11,295	105.2	9,352	6,860	11,462	13,619	11,379	5.1	5.3	14	
24	Thu	12/9/2004	09:15	8.7	123,000	236	60077	117.9	61,600	6,821	11,398	104.2	46,889	6,906	11,541	13,727	11,469	5.8	6.0	15	
	Fri	12/10/2004	09:30	0.1	2,000	333	60083	114.1	1,174	6,822	11,400	105.6	1,065	6,907	11,542	13,730	11,471	5.9	6.0	14	
	Sat	12/11/2004	15:45	7.2	114,000	264	60270	118.1	58,547	6,881	11,498	106.2	44,047	6,952	11,616	13,832	11,557	5.9	6.0	14	
	Sun	12/12/2004	16:25	0.9	0	NA	60275	118.9	699	6,881	11,499	105.6	538	6,952	11,617	13,833	11,558	5.9	6.1	13	
	Mon	12/13/2004	10:36	8.4	120,000	238	60470	116.6	61,680	6,943	11,602	106.9	46,064	6,998	11,694	13,941	11,648	7.5	6.0	2	
	Tue	12/14/2004	10:00	0.1	1,000	167	60476	114.9	1,330	6,944	11,604	109.4	711	6,999	11,695	13,943	11,650	7.0	5.8	1	
	Wed	12/15/2004	07:30	3.0	47,000	261	60555	118.3	21,446	6,966	11,640	92.7	16,333	7,015	11,722	13,981	11,681	6.0	6.6	15	
25	Thu	12/16/2004	08:30	6.7	89,000	221	60705	118.2	88,821	7,055	11,788	98.9	35,533	7,051	11,782	14,105	11,785	6.2	6.9	12	
	Fri	12/17/2004	09:30	0.7	9,000	214	60725	114.7	5,448	7,060	11,797	101.8	4,197	7,055	11,789	14,115	11,793	6.1	6.9	14	
	Sat	12/18/2004	20:24	9.7	140,000	241	60958	120.7	30,992	7,091	11,849	94.9	53,058	7,108	11,877	14,199	11,863	6.0	6.8	15	
	Sun	12/19/2004	16:20	5.9	81,000	229	61093	115.0	43,071	7,134	11,921	95.0	32,119	7,140	11,931	14,274	11,926	6.2	6.8	14	
	Mon	12/20/2004	06:30	4.6	69,000	250	61199	110.1	32,883	7,167	11,976	100.1	24,734	7,165	11,972	14,332	11,974	6.0	6.5	15	
	Tue	12/21/2004	09:00	0.1	2,000	333	61207	112.9	840	7,168	11,977	100.2	579	7,165	11,973	14,333	11,975	6.2	7.0	14	
	Wed	12/22/2004	06:30	9.2	125,000	226	61421	113.0	67,298	7,235	12,090	107.1	50,603	7,216	12,058	14,451	12,074	6.0	6.9	14	
26	Thu	12/23/2004	07:30	2.2	30,000	227	61476	118.6	15,682	7,251	12,116	102.6	12,187	7,228	12,078	14,479	12,097	6.0	6.5	14	
	Fri	12/24/2004	14:30	10.6	66,000	104	61556	117.3	34,011	7,285	12,173	103.1	25,545	7,254	12,121	14,538	12,147	6.2	7.0	16	
	Sat	12/25/2004	14:30	2.7	83,000	512	61724	115.9	42,802	7,328	12,244	106.9	32,226	7,286	12,175	14,614	12,210	6.1	7.0	14	
	Sun	12/26/2004	14:10	1.6	61,000	635	61828	115.0	31,925	7,360	12,298	100.0	24,038	7,310	12,215	14,669	12,256	6.2	7.1	14	
	Mon	12/27/2004	10:45	5.7	79,000	231	61960	115.7	40,560	7,400	12,366	104.5	30,584	7,341	12,266	14,741	12,316	6.0	7.0	1	
	Tue	12/28/2004	07:00	0.4	7,000	292	61987	116.1	3,208	7,403	12,371	105.1	2,425	7,343	12,270	14,746	12,321	6.0	7.0	14	
	Wed	12/29/2004	10:00	2.3	33,000	239	62089	117.6	16,983	7,420	12,399	103.9	12,656	7,356	12,291	14,776	12,345	6.5	7.5	14	
27	Thu	12/30/2004	06:30	9.3	131,000	235	62344	118.8	66,355	7,487	12,510	101.8	50,701	7,406	12,376	14,893	12,443	6.0	7.0	14	
	Fri	12/31/2004	NA	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	NA	NA	NA	NA	NM	NM	NA	
	Sat	1/1/2005	16:00	NA	134,000	NA	626449	116.3	NA	7,487	12,510	104.9	52,422	7,459	12,464	NA	NA	6.0	6.9	13	
	Sun	1/2/2005	16:45	1.6	21,000	219	62719	118.0	11,087	7,498	12,529	100.0	8,590	7,467	12,478	14,965	12,503	6.0	6.4	10	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

Week No.	Day of Week	Date	Time	Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
				Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	1/3/2005	09:00	7.9	113,000	238	62928	116.9	56,789	7,555	12,624	102.7	44,154	7,512	12,552	15,066	12,588	5.9	6.9	15	
	Tue	1/4/2005	09:10	0.3	4,000	222	62947	118.1	2,015	7,557	12,627	104.4	1,507	7,513	12,554	15,070	12,591	6.0	6.9	14	
	Wed	1/5/2005	07:00	1.9	27,000	237	62999	117.1	13,698	7,570	12,650	105.2	10,599	7,524	12,572	15,094	12,611	6.0	6.9	15	
28	Thu	1/6/2005	09:00	9.5	134,000	235	63227	115.9	68,867	7,639	12,765	102.1	51,258	7,575	12,658	15,214	12,711	7.2	8.9	15	
	Fri	1/7/2005	06:30	0.2	3,000	250	63237	113.4	1,776	7,641	12,768	103.0	1,267	7,576	12,660	15,217	12,714	7.2	8.6	16	
	Sat	1/8/2005	18:00	8.3	118,000	237	63436	115.9	58,795	7,700	12,866	102.3	43,307	7,619	12,732	15,319	12,799	7.9	8.9	16	
	Sun	1/9/2005	16:40	0.1	0	NA	63442	114.0	2,444	7,702	12,870	100.0	393	7,620	12,733	15,322	12,802	7.2	9.0	14	
	Mon	1/10/2005	11:15	9.2	128,000	232	63660	121.5	67,846	7,770	12,984	90.3	47,953	7,668	12,813	15,438	12,898	7.8	9.0	17	
	Tue	1/11/2005	11:45	0.2	2,000	167	63668	121.3	1,019	7,771	12,985	92.7	711	7,668	12,814	15,439	12,900	8.0	9.1	20	
	Wed	1/12/2005	11:15	3.7	52,000	234	63761	117.2	25,851	7,797	13,029	115.4	20,376	7,689	12,848	15,486	12,938	2.0	2.0	7	Yes
29	Thu	1/13/2005	12:40	7.0	101,000	240	63927	116.4	46,401	7,843	13,106	116.5	44,884	7,734	12,923	15,577	13,015	2.0	2.1	10	
	Fri	1/14/2005	11:00	2.3	33,000	239	63983	116.7	15,217	7,858	13,132	115.1	14,512	7,748	12,947	15,607	13,039	2.9	2.8	12	
	Sat	1/15/2005	18:00	4.5	66,000	244	64030	116.0	10,616	7,869	13,149	116.7	29,204	7,777	12,996	15,647	13,073	2.8	2.8	12	
	Sun	1/16/2005	16:20	4.9	69,000	235	64207	115.0	51,789	7,921	13,236	114.0	30,315	7,808	13,047	15,729	13,141	2.9	2.8	10	
	Mon	1/17/2005	16:20	0.0	0	NA	64214	112.0	386	7,921	13,236	110.0	356	7,808	13,047	15,729	13,142	2.8	2.8	10	
	Tue	1/18/2005	09:00	8.5	122,000	239	64414	113.9	56,726	7,978	13,331	112.0	54,297	7,862	13,138	15,840	13,235	2.6	2.6	12	
	Wed	1/19/2005	09:30	0.3	3,000	167	64425	114.5	1,711	7,980	13,334	112.0	1,649	7,864	13,141	15,844	13,238	2.4	2.6	18	
30	Thu	1/20/2005	06:35	0.9	15,000	278	64484	112.8	6,517	7,986	13,345	110.7	6,180	7,870	13,151	15,856	13,248	2.5	2.5	9	
	Fri	1/21/2005	09:10	10.0	143,000	238	64756	112.8	67,000	8,053	13,457	111.3	62,201	7,932	13,255	15,986	13,356	3.0	3.0	10	
	Sat	1/22/2005	03:00	0.5	7,000	233	64797	114.3	3,468	8,057	13,463	109.2	3,170	7,936	13,261	15,992	13,362	3.0	3.0	11	
	Sun	1/23/2005	16:25	6.3	89,000	235	65001	113.0	41,738	8,098	13,532	110.0	42,803	7,978	13,332	16,077	13,432	3.2	3.2	12	
	Mon	1/24/2005	09:00	5.1	73,000	239	65146	121.8	34,348	8,133	13,590	122.9	25,719	8,004	13,375	16,137	13,482	3.6	3.8	14	
	Tue	1/25/2005	09:20	0.1	1,000	167	65185	120.0	1,232	8,134	13,592	115.4	1,096	8,005	13,377	16,139	13,484	3.6	3.8	10	
	Wed	1/26/2005	10:10	9.0	129,000	239	65434	114.2	61,282	8,195	13,694	96.4	53,683	8,059	13,467	16,254	13,580	3.9	4.1	12	
31	Thu	1/27/2005	11:25	1.1	15,000	227	65502	116.6	7,000	8,202	13,706	98.8	6,051	8,065	13,477	16,267	13,591	4.1	4.3	13	
	Fri	1/28/2005	09:45	7.2	102,000	236	65711	116.8	31,261	8,234	13,758	95.6	43,979	8,109	13,550	16,342	13,654	4.2	4.5	13	
	Sat	1/29/2005	19:20	0.5	8,000	267	65794	115.9	24,282	8,258	13,799	99.3	3,655	8,113	13,556	16,370	13,678	4.4	4.6	13	
	Sun	1/30/2005	11:00	9.7	137,000	235	66050	116.3	64,366	8,322	13,906	97.6	54,326	8,167	13,647	16,489	13,777	4.5	5.0	10	
	Mon	1/31/2005	09:05	0.7	10,000	238	66095	111.1	4,708	8,327	13,914	108.7	3,866	8,171	13,654	16,498	13,784	5.0	5.1	14	
	Tue	2/1/2005	09:00	0.1	2,000	333	66141	113.8	489	8,327	13,915	107.9	475	8,171	13,654	16,499	13,785	5.0	5.1	14	
	Wed	2/2/2005	09:25	9.1	128,000	234	66395	116.2	62,857	8,390	14,020	103.9	52,256	8,224	13,742	16,614	13,881	5.2	5.3	14	
32	Thu	2/3/2005	09:20	0.7	10,000	238	66429	116.2	8,878	8,399	14,035	106.2	7,264	8,231	13,754	16,630	13,894	5.5	6.0	12	
	Fri	2/4/2005	09:20	1.2	16,000	222	66448	116.6	4,538	8,404	14,043	102.5	3,778	8,235	13,760	16,638	13,901	5.4	5.9	14	
	Sat	2/5/2005	17:00	9.2	132,000	239	66687	115.0	64,825	8,468	14,151	100.2	52,066	8,287	13,847	16,755	13,999	6.2	6.4	14	
	Sun	2/6/2005	20:35	0.3	3,000	167	66714	118.0	4,193	8,473	14,158	95.1	3,361	8,290	13,853	16,763	14,005	6.1	6.3	14	
	Mon	2/7/2005	10:00	3.7	52,000	234	66811	114.9	23,601	8,496	14,197	100.8	18,883	8,309	13,884	16,805	14,041	6.0	6.3	16	
	Tue	2/8/2005	13:15	6.0	85,000	236	66968	113.7	42,437	8,539	14,268	103.1	33,074	8,342	13,940	16,881	14,104	6.8	7.0	14	
	Wed	2/9/2005	09:00	0.2	3,000	250	66984	111.6	1,422	8,540	14,271	102.7	1,083	8,343	13,941	16,883	14,106	6.4	7.0	16	
33	Thu	2/10/2005	06:30	8.6	121,000	234	67195	116.7	63,494	8,604	14,377	98.7	49,612	8,393	14,024	16,996	14,200	6.8	7.4	15	
	Fri	2/11/2005	09:00	1.4	19,000	226	67253	116.4	7,121	8,611	14,389	106.1	5,555	8,398	14,034	17,009	14,211	7.0	8.0	16	
	Sat	2/12/2005	18:00	6.8	97,000	238	67441	116.5	48,860	8,660	14,470	97.0	37,714	8,436	14,097	17,096	14,283	7.0	8.0	16	
	Sun	2/13/2005	18:30	2.8	39,000	232	67523	116.0	19,863	8,679	14,503	98.4	14,960	8,451	14,122	17,130	14,312	8.0	8.8	17	
	Mon	2/14/2005	08:03	0.1	1,000	167	67534	116.1	420	8,680	14,504	110.1	329	8,451	14,122	17,131	14,313	8.0	8.5	16	
	Tue	2/15/2005	16:50	8.8	123,000	233	67755	118.1	62,638	8,742	14,609	101.6	47,767	8,499	14,202	17,241	14,405	8.1	9.0	16	
	Wed	2/16/2005	09:00	1.8	25,000	231	67812	116.5	12,933	8,755	14,630	103.2	10,049	8,509	14,219	17,264	14,425	8.0	9.0	16	
34	Thu	2/17/2005	09:00	0.2	4,000	333	67831	118.2	1,667	8,757	14,633	103.3	1,281	8,510	14,221	17,267	14,427	8.1	9.0	16	
	Fri	2/18/2005	09:00	9.1	126,000	231	68060	114.2	64,954	8,822	14,742	101.1	48,515	8,559	14,302	17,381	14,522	9.0	9.8	18	
	Sat	2/19/2005	17:50	0.3	5,000	278	68111	117.6	2,257	8,824	14,746	104.6	1,679	8,561	14,305	17,385	14,525	9.0	9.6	16	
	Sun	2/20/2005	16:45	9.1	127,000	233	68345	117.4	70,593	8,895	14,863	94.3	48,066	8,609	14,385	17,503	14,624	9.2	9.6	18	
	Mon	2/21/2005	17:15	1.0	13,000	217	68385	118.1	2,313	8,897	14,867	101.5	4,939	8,614	14,393	17,511	14,630	8.0	7.8	15	
	Tue	2/22/2005	13:36	0.9	11,000	204	68419	116.0	5,044	8,902	14,876	111.5	4,637	8,618	14,401	17,520	14,638	2.2	2.2	12	Yes
	Wed	2/23/2005	09:05	8.9	128,000	240	68637	116.2	58,793	8,961	14,974	115.8	55,869	8,674	14,494	17,635	14,734	3.0	2.3	10	
35	Thu	2/24/2005	06:45	0.0	0	NA	68655	116.4	374	8,961	14,975	111.3	331	8,674	14,495	17,636	14,735	3.0	3.0	12	
	Fri	2/25/2005	07:05	7.9	114,000	241	68868	117.5	53,569	9,015	15,064	113.4	48,663	8,723	14,576	17,738	14,820	3.0	3.0	12	
	Sat	2/26/2005	NA	0.5	6,000	200	68915	117.2	2,962	9,018	15,069	107.9	2,761	8,726	14,581	17,744	14,825	3.1	3.0	12	
	Sun	2/27/2005	16:20	8.5	123,000	241	69133	116.0	58,954	9,077	15,168	103.0	51,267	8,777	14,667	17,854	14,917	3.2	3.0	13	
	Mon	2/28/2005	10:10	0.0	0	NA	69133	116.0	0	9,077	15,168	103.0	0	8,777	14,667	17,854	14,917	3.2	3.3	13	
	Tue	3/1/2005	09:05	1.1	15,000	227	69214	116.0	7,492	9,084	15,180	102.0	6,351	8,783	14,677	17,868	14,929	3.4	3.8	12	
	Wed	3/2/2005	06:45	8.8	126,000	239	69425	117.2	61,510	9,146	15,283	102.7	51,329	8,835	14,763	17,981	15,023	4.0	4.5	10	
36	Thu	3/3/2005	06:55	1.1	15,000	227	69477	116.4	1,258	9,147	15,285	105.1	6,008	8,841	14,773	17,988	15,029	4.1	4.6	12	
	Fri	3/4/2005	14:50	9.2	131,000	237	69724	116.2	70,531	9,218	15,403	103.9	53,845	8,895	14,863	18,112	15,133	4.1	4.8	13	
	Sat	3/5/2005	16:30	0.5	7,000	233	69757	125.0	3,990	9,222	15,410	100.0	1,127	8,896	14,865	18,117	15,137	4.9	5.1	12	
	Sun	3/6/2005	NA	9.0	129,000	239	69991	119.5	66,231	9,288	15,520	91.8	51,624	8,947	14,951	18,235	15,236	4.8	5.4	14	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	3/7/2005	08:40	1.1	15,000	227	70021	118.8	6,321	9,294	15,531	110.1	4,871	8,952	14,959	18,246	15,245	5.2	5.8	12	
	Tue	3/8/2005	06:30	0.3	0	NA	70036	119.4	2,161	9,296	15,534	110.5	11,660	8,964	14,979	18,260	15,257	5.5	5.8	12	
	Wed	3/9/2005	08:55	9.4	137,000	243	70277	115.8	66,967	9,363	15,646	102.5	41,451	9,005	15,048	18,369	15,347	5.8	6.2	12	
37	Thu	3/10/2005	14:41	0.2	3,000	250	70320	121.5	1,930	9,365	15,650	104.5	1,120	9,006	15,050	18,372	15,350	5.6	6.2	16	
	Fri	3/11/2005	11:15	8.3	117,000	235	70530	116.7	60,041	9,425	15,750	102.3	44,447	9,051	15,124	18,476	15,437	6.0	6.4	11	
	Sat	3/12/2005	11:20	0.1	2,000	333	70553	118.1	943	9,426	15,751	106.4	470	9,051	15,125	18,478	15,438	6.2	7.0	14	
	Sun	3/13/2005	16:50	10.1	142,000	234	70602	117.4	74,359	9,501	15,876	102.1	53,229	9,105	15,214	18,605	15,545	7.0	8.0	15	
	Mon	3/14/2005	09:15	0.5	7,000	233	70827	117.0	3,816	9,504	15,882	86.6	2,581	9,107	15,218	18,612	15,550	7.1	7.6	16	
	Tue	3/15/2005	08:35	0.3	4,000	222	70852	118.6	1,879	9,506	15,885	96.5	1,357	9,109	15,220	18,615	15,553	7.1	8.0	14	
	Wed	3/16/2005	06:00	8.9	125,000	234	71073	117.5	66,022	9,572	15,996	98.1	45,768	9,154	15,297	18,727	15,646	7.5	9.0	15	
38	Thu	3/17/2005	06:30	0.7	10,000	238	71107	115.0	5,380	9,578	16,005	95.5	3,722	9,158	15,303	18,736	15,654	7.5	8.8	16	
	Fri	3/18/2005	09:25	3.7	52,000	234	71213	128.7	27,473	9,605	16,050	92.7	19,170	9,177	15,335	18,782	15,693	7.6	8.6	18	
	Sat	3/19/2005	05:00	6.4	89,000	232	71383	129.4	47,968	9,653	16,131	95.7	31,829	9,209	15,388	18,862	15,759	9.0	10.0	19	
	Sun	3/20/2005	17:30	9.3	130,000	233	71611	124.6	70,434	9,724	16,248	84.5	46,450	9,255	15,466	18,979	15,857	9.0	10.0	18	
	Mon	3/21/2005	09:25	1.8	26,000	241	71664	123.1	13,591	9,737	16,271	84.6	8,824	9,264	15,481	19,001	15,876	8.4	9.6	18	
	Tue	3/22/2005	09:00	0.9	11,000	204	71699	127.8	6,161	9,743	16,281	87.8	4,126	9,268	15,488	19,012	15,884	9.2	10.4	17	
	Wed	3/23/2005	15:30	7.7	108,000	234	71902	122.7	52,194	9,796	16,368	88.6	45,090	9,314	15,563	19,109	15,966	2.2	2.2	12	Yes
39	Thu	3/24/2005	06:30	2.9	42,000	241	71981	109.7	19,359	9,815	16,401	101.6	18,007	9,332	15,593	19,146	15,997	3.0	2.8	12	
	Fri	3/25/2005	06:50	8.9	127,000	238	72215	116.7	61,345	9,876	16,503	99.9	54,887	9,386	15,685	19,263	16,094	3.1	3.2	13	
	Sat	3/26/2005	18:00	0.2	4,000	333	72231	117.3	529	9,877	16,504	101.1	439	9,387	15,686	19,264	16,095	3.1	3.2	14	
	Sun	3/27/2005	16:30	1.7	24,000	235	72285	115.0	11,665	9,888	16,524	101.0	10,038	9,397	15,702	19,285	16,113	3.1	3.2	14	
	Mon	3/28/2005	09:01	7.7	111,000	240	72477	115.7	54,068	9,943	16,614	110.4	45,151	9,442	15,778	19,385	16,196	3.8	4.0	14	
	Tue	3/29/2005	06:45	0.3	4,000	222	72492	113.6	1,782	9,944	16,617	108.1	1,475	9,443	15,780	19,388	16,199	4.0	4.2	14	
	Wed	3/30/2005	10:55	8.4	119,000	236	72899	113.4	59,856	10,004	16,717	107.9	47,669	9,491	15,860	19,495	16,288	4.5	4.8	12	
40	Thu	3/31/2005	11:45	1.7	26,000	255	72753	115.1	12,449	10,017	16,738	103.3	9,805	9,501	15,876	19,518	16,307	4.4	4.6	14	
	Fri	4/1/2005	09:55	1.5	21,000	233	72798	116.0	10,769	10,027	16,756	106.0	8,450	9,509	15,890	19,537	16,323	4.5	4.7	14	
	Sat	4/2/2005	16:15	8.1	115,000	237	73000	118.6	58,495	10,086	16,854	106.7	43,007	9,552	15,962	19,638	16,408	5.0	5.5	14	
	Sun	4/3/2005	16:50	3.2	49,000	255	73089	117.0	23,702	10,110	16,893	107.0	19,513	9,572	15,995	19,682	16,444	5.2	5.8	14	
	Mon	4/4/2005	09:21	6.7	92,000	229	73253	115.4	48,659	10,158	16,975	103.3	35,928	9,608	16,055	19,766	16,515	5.6	6.0	15	
	Tue	4/5/2005	09:15	0.3	5,000	278	73271	137.9	2,280	10,161	16,978	94.7	1,750	9,610	16,058	19,770	16,518	5.8	6.0	16	
	Wed	4/6/2005	09:02	9.0	127,000	235	73486	119.6	65,387	10,226	17,088	92.9	48,427	9,658	16,139	19,884	16,613	6.0	6.3	15	
41	Thu	4/7/2005	09:00	3.7	53,000	239	73578	133.2	26,794	10,253	17,132	99.1	20,457	9,679	16,173	19,931	16,653	6.0	6.3	14	
	Fri	4/8/2005	13:15	6.2	86,000	231	73725	119.9	44,002	10,297	17,206	93.8	33,888	9,712	16,230	20,009	16,718	5.2	5.8	14	
	Sat	4/9/2005	17:45	4.4	63,000	239	73839	116.9	33,715	10,330	17,262	89.1	24,429	9,737	16,270	20,067	16,766	6.9	7.6	16	
	Sun	4/10/2005	16:40	5.0	72,000	240	73958	119.0	36,192	10,367	17,323	88.0	25,275	9,762	16,313	20,129	16,818	6.9	7.8	12	
	Mon	4/11/2005	13:30	6.5	76,000	195	74085	136.9	40,782	10,407	17,391	97.8	27,261	9,789	16,358	20,197	16,874	7.2	8.8	16	
	Tue	4/12/2005	07:18	0.4	5,000	208	74095	123.2	2,874	10,410	17,396	74.1	2,010	9,791	16,361	20,202	16,879	7.2	8.8	16	
	Wed	4/13/2005	09:05	8.8	138,000	261	74325	125.0	73,391	10,484	17,518	86.7	49,380	9,841	16,444	20,324	16,981	8.0	9.0	18	
42	Thu	4/14/2005	10:00	1.9	27,000	237	74372	139.9	14,287	10,498	17,542	99.9	9,518	9,850	16,460	20,348	17,001	8.8	9.2	16	
	Fri	4/15/2005	09:15	1.2	16,000	222	74402	134.5	9,137	10,507	17,557	71.3	6,349	9,857	16,471	20,364	17,014	7.8	9.0	16	
	Sat	4/16/2005	20:50	9.0	127,000	235	74613	125.4	67,377	10,574	17,670	85.5	44,441	9,901	16,545	20,476	17,107	9.0	9.8	18	
	Sun	4/17/2005	17:00	7.9	109,000	230	74796	123.0	58,750	10,633	17,768	85.0	38,390	9,939	16,609	20,573	17,189	9.2	10.4	18	
	Mon	4/18/2005[c]	09:10	3.9	55,000	235	748.89	133.1	29,997	10,663	17,818	85.5	18,763	9,958	16,640	20,621	17,229	9.2	10.2	18	
	Tue	4/19/2005	13:40	5.0	69,000	230	750.05	115.4	35,971	10,699	17,878	93.2	25,230	9,983	16,682	20,683	17,280	8.1	9.1	18	
	Wed	4/20/2005	09:10	6.2	87,000	234	751.5	NM	45,688	10,745	17,955	NM	31,096	10,015	16,734	20,759	17,345	NM	NM	NA	Yes
43	Thu	4/21/2005	08:44	3.6	50,000	231	752.36	109.6	22,292	10,767	17,992	112.0	23,054	10,038	16,773	20,805	17,382	2.2	2.2	12	
	Fri	4/22/2005	09:22	6.8	97,000	238	753.98	109.6	45,121	10,812	18,067	105.0	41,900	10,079	16,843	20,892	17,455	3.0	2.9	12	
	Sat	4/23/2005	17:20	7.0	101,000	240	75562	116.3	47,719	10,860	18,147	107.9	42,283	10,122	16,914	20,982	17,530	3.0	3.1	12	
	Sun	4/24/2005	17:20	3.2	47,000	245	75639	116.6	22,167	10,882	18,184	108.6	19,036	10,141	16,945	21,023	17,565	3.8	4.0	14	
	Mon	4/25/2005	09:00	0.8	11,000	229	756.58	115.0	5,559	10,888	18,194	105.0	4,706	10,146	16,953	21,033	17,573	3.4	3.6	12	
	Tue	4/26/2005	10:30	8.6	123,000	238	758.62	125.8	60,272	10,948	18,294	109.3	49,398	10,195	17,036	21,143	17,665	4.1	4.6	9	
	Wed	4/27/2005	09:05	6.0	89,000	247	759.08	117.9	14,220	10,962	18,318	82.9	11,363	10,206	17,055	21,168	17,686	4.2	4.6	9	
44	Thu	4/28/2005	09:04	4.5	60,000	222	761.07	114.4	60,732	11,023	18,419	84.2	47,021	10,253	17,133	21,276	17,776	5.0	5.4	14	
	Fri	4/29/2005	09:06	1.2	18,000	250	761.35	121.6	8,175	11,031	18,433	85.9	9,350	10,263	17,149	21,294	17,791	4.6	5.2	14	
	Sat	4/30/2005	17:50	9.2	130,000	236	763.51	121.7	66,498	11,098	18,544	85.4	46,878	10,310	17,227	21,407	17,886	5.4	6.0	14	
	Sun	5/1/2005	19:00	7.3	105,000	240	765.23	128.8	30,865	11,128	18,596	98.5	39,485	10,349	17,293	21,477	17,945	5.8	6.2	12	
	Mon	5/2/2005	09:29	2.9	40,000	230	765.91	129.0	42,884	11,171	18,667	93.7	15,159	10,364	17,319	21,536	17,993	6.0	6.6	16	
	Tue	5/3/2005	09:00	0.3	4,000	222	765.98	119.0	1,620	11,173	18,670	118.9	1,249	10,365	17,321	21,538	17,995	6.1	6.3	14	
	Wed	5/4/2005	10:00	9.3	132,000	237	768.17	117.0	67,142	11,240	18,782	104.0	50,406	10,416	17,405	21,656	18,094	6.8	7.4	16	
45	Thu	5/5//05	09:30	0.0	0	NA	769.14	117.0	461	11,241	18,783	109.5	360	10,416	17,406	21,657	18,094	6.8	7.4	16	
	Fri	5/6/2005	09:00	9.4	132,000	234	770.37	119.9	67,450	11,308	18,896	100.8	19,333	10,436	17,438	21,744	18,167	6.5	7.0	15	
	Sat	5/7/2005	16:50	3.4	48,000	235	771.18	118.0	24,890	11,333	18,937	85.0	47,837	10,483	17,518	21,816	18,228	7.5	8.4	17	
	Sun	5/8/2005	20:45	8.0	110,000	229	773.03	115.2	57,871	11,391	19,034	84.4	39,464	10,523	17,584	21,914	18,309	8.4	9.2	18	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
46	Mon	5/9/2005	09:05	7.8	111,000	237	774.86	121.8	58,249	11,449	19,131	92.7	39,670	10,562	17,650	22,012	18,391	9.0	10.0	20	
	Tue	5/10/2005	05:45	3.2	44,000	229	775.61	126.1	23,935	11,473	19,171	101.1	15,515	10,578	17,676	22,051	18,424	9.2	9.6	19	
	Wed	5/11/2005	09:35	11.2	156,000	232	778.21	122.0	82,557	11,556	19,309	100.0	54,538	10,633	17,767	22,188	18,538	9.4	9.8	18	
	Thu	5/12/2005	10:30	3.4	45,000	221	779.02	115.0	23,709	11,579	19,349	109.0	17,725	10,650	17,797	22,230	18,573	2.4	2.2	10	Yes
	Fri	5/13/2005	08:35	8.9	128,000	240	781.10	115.0	58,359	11,638	19,447	108.0	54,908	10,705	17,888	22,343	18,668	3.0	3.0	12	
	Sat	5/14/2005	16:25	8.7	126,000	241	783.16	118.0	59,623	11,697	19,546	110.0	52,331	10,758	17,976	22,455	18,761	3.8	3.8	12	
	Sun	5/15/2005	19:15	10.4	148,000	237	785.58	116.0	72,527	11,770	19,667	95.7	59,017	10,817	18,075	22,586	18,871	4.2	4.6	14	
47	Mon	5/16/2005	09:30	0.2	3,000	250	785.65	118.7	1,618	11,771	19,670	101.5	1,295	10,818	18,077	22,589	18,873	4.5	5.0	12	
	Tue	5/17/2005	08:45	8.9	127,000	238	787.73	120.2	63,517	11,835	19,776	112.0	48,605	10,866	18,158	22,701	18,967	5.0	5.8	12	
	Wed	5/18/2005	06:45	0.3	3,000	167	787.80	120.8	1,788	11,837	19,779	100.6	1,461	10,868	18,160	22,705	18,970	5.0	5.8	14	
	Thu	5/19/2005	13:15	9.9	142,000	239	790.13	112.1	72,115	11,909	19,900	101.9	52,975	10,921	18,249	22,830	19,074	5.8	6.0	16	
	Fri	5/20/2005	08:35	7.0	100,000	238	797.76	114.0	50,506	11,959	19,984	109.0	37,176	10,958	18,311	22,917	19,148	5.8	6.2	14	
	Sat	5/21/2005	17:00	3.2	44,000	229	792.51	114.0	23,182	11,982	20,023	102.8	16,495	10,975	18,339	22,957	19,181	6.2	7.0	16	
	Sun	5/22/2005	17:30	10.3	144,000	233	754.90	110.6	74,014	12,057	20,147	101.7	53,770	11,028	18,428	23,085	19,287	7.0	8.0	16	
48	Mon	5/23/2005	08:30	0.1	2,000	333	794.94	126.4	1,096	12,058	20,148	103.1	842	11,029	18,430	23,087	19,289	7.0	8.0	12	
	Tue	5/24/2005	08:00	9.2	128,000	232	797.08	121.0	66,765	12,124	20,260	100.0	46,593	11,076	18,508	23,200	19,384	8.1	9.0	20	
	Wed	5/25/2005	NM	1.3	19,000	244	797.41	113.7	9,573	12,134	20,276	82.6	6,807	11,083	18,519	23,216	19,397	8.1	9.0	18	
	Thu	5/26/2005	14:00	7.8	110,000	235	799.24	115.0	52,787	12,187	20,364	80.0	39,164	11,122	18,584	23,308	19,474	8.6	9.6	18	
	Fri	5/27/2005	10:30	2.0	27,000	225	799.72	116.7	21,042	12,208	20,399	83.7	10,510	11,132	18,602	23,340	19,501	9.1	9.8	18	
	Sat	5/28/2005	18:25	8.9	123,000	230	801.78	121.7	64,296	12,272	20,507	85.4	42,622	11,175	18,673	23,447	19,590	9.9	10.6	19	
	Sun	5/29/2005	17:20	5.5	80,000	242	803.08	113.3	40,037	12,312	20,574	94.9	28,863	11,204	18,722	23,516	19,648	9.1	9.0	18	
49	Mon	5/30/2005	17:40	6.4	88,000	229	804.57	117.3	45,544	12,358	20,650	100.1	33,177	11,237	18,777	23,595	19,713	8.0	9.0	18	
	Tue	5/31/2005	13:00	9.5	131,000	230	806.78	100.3	66,883	12,425	20,762	95.8	49,196	11,286	18,859	23,711	19,810	2.5	2.5	10	Yes
	Wed	6/1/2005	09:00	0.1	2,000	333	806.82	106.4	2,129	12,427	20,765	105.5	2,061	11,288	18,863	23,715	19,814	2.4	2.3	11	
	Thu	6/2/2005	09:15	10.2	146,000	239	809.20	107.8	66,613	12,493	20,876	107.4	60,980	11,349	18,964	23,842	19,920	2.4	2.3	12	
	Fri	6/3/2005	08:00	4.0	57,000	238	810.14	108.7	27,741	12,521	20,923	102.4	23,270	11,372	19,003	23,893	19,963	3.0	3.8	13	
	Sat	6/4/2005	16:30	5.9	84,000	237	811.53	112.6	41,415	12,562	20,992	106.9	33,000	11,405	19,059	23,968	20,025	3.4	3.7	15	
	Sun	6/5/2005	16:30	9.8	138,000	235	813.81	120.0	70,980	12,633	21,111	95.0	52,400	11,458	19,146	24,091	20,128	4.8	5.4	14	
50	Mon	6/6/2005	13:55	1.8	28,000	259	814.25	125.7	13,427	12,647	21,133	87.2	9,771	11,468	19,162	24,114	20,148	4.8	5.6	14	
	Tue	6/7/2005	09:05	9.1	128,000	234	816.37	123.7	67,378	12,714	21,246	95.8	46,551	11,514	19,240	24,228	20,243	5.8	6.2	15	
	Wed	6/8/2005	09:00	0.2	3,000	250	816.44	122.2	1,722	12,716	21,248	96.6	1,254	11,515	19,242	24,231	20,245	5.9	6.0	15	
	Thu	6/9/2005	NM	10.3	143,000	231	818.79	124.8	74,450	12,790	21,373	99.0	51,529	11,567	19,328	24,357	20,351	6.2	7.0	14	
	Fri	6/10/2005	05:47	2.0	29,000	242	819.29	121.3	14,713	12,805	21,397	95.8	11,234	11,578	19,347	24,383	20,372	6.2	7.0	16	
	Sat	6/11/2005	16:50	9.4	130,000	230	821.46	115.5	67,669	12,873	21,511	99.0	47,760	11,626	19,427	24,499	20,469	7.0	8.0	18	
	Sun	6/12/2005	16:30	9.6	141,000	245	823.80	116.0	73,088	12,946	21,633	95.0	51,315	11,677	19,513	24,623	20,573	8.2	9.0	23	
51	Mon	6/13/2005	15:15	11.7	156,000	222	826.40	115.1	81,297	13,027	21,769	85.2	58,263	11,735	19,610	24,763	20,689	9.0	9.6	17	
	Tue	6/14/2005	09:15	2.0	27,000	225	826.86	115.3	13,084	13,040	21,790	90.0	9,696	11,745	19,626	24,785	20,708	9.0	9.6	20	
	Wed	6/15/2005	15:45	13.7	188,000	229	830.03	116.3	98,019	13,138	21,954	90.8	68,660	11,814	19,741	24,952	20,848	10.0	10.6	19	
	Thu	6/16/2005	12:05	8.2	115,000	234	831.97	117.2	60,189	13,198	22,055	84.8	41,161	11,855	19,810	25,053	20,932	10.0	10.8	19	
	Fri	6/17/2005	08:45	12.0	163,000	226	834.72	115.5	85,774	13,284	22,198	85.5	58,457	11,913	19,907	25,198	21,053	10.1	11.2	20	
	Sat	6/18/2005	16:45	14.5	198,000	228	838.06	118.0	104,304	13,389	22,372	94.9	71,079	11,985	20,026	25,373	21,199	10.2	11.2	18	
	Sun	6/19/2005	18:40	7.9	109,000	230	839.90	120.8	57,719	13,446	22,469	84.5	39,826	12,024	20,093	25,471	21,281	9.2	10.2	19	
52	Mon	6/20/2005	08:40	4.8	66,000	229	841.02	115.0	34,507	13,481	22,526	85.5	23,924	12,048	20,133	25,529	21,330	10.6	11.0	18	
	Tue	6/21/2005	05:45	11.2	156,000	232	843.63	115.5	81,980	13,563	22,663	87.0	56,791	12,105	20,228	25,668	21,446	10.6	11.0	18	Yes
	Wed	6/22/2005	08:30	12.4	180,000	242	846.51	115.0	79,859	13,643	22,797	100.0	75,500	12,181	20,354	25,823	21,575	2.6	2.8	12	
	Thu	6/23/2005	09:15	4.9	65,000	221	847.68	117.1	33,035	13,676	22,852	103.2	29,496	12,210	20,403	25,886	21,628	3.2	3.8	14	
	Fri	6/24/2005	09:30	11.4	160,000	234	850.32	111.8	77,040	13,753	22,981	109.3	64,843	12,275	20,511	26,028	21,746	4.2	5.0	14	
	Sat	6/25/2005	18:30	19.8	279,000	235	854.90	114.6	138,654	13,891	23,213	109.0	108,773	12,384	20,693	26,275	21,953	5.8	6.4	16	
	Sun	6/26/2005	18:50	14.4	200,000	231	858.23	116.0	101,961	13,993	23,383	87.4	72,559	12,456	20,814	26,449	22,099	6.8	7.8	18	
53	Mon	6/27/2005	09:00	13.9	192,000	230	861.45	117.1	98,307	14,092	23,547	91.6	71,048	12,527	20,933	26,619	22,240	8.0	9.0	26	
	Tue	6/28/2005	14:15	6.9	97,000	234	863.07	113.2	47,728	14,139	23,627	86.7	36,769	12,564	20,995	26,703	22,311	8.3	9.3	18	
	Wed	6/29/2005	14:15	7.6	102,000	224	864.81	113.9	51,534	14,191	23,713	87.4	38,867	12,603	21,060	26,794	22,386	9.2	9.8	18	
	Thu	6/30/2005	09:45	12.0	165,000	229	867.58	116.6	83,047	14,274	23,852	92.0	60,714	12,664	21,161	26,938	22,506	10.0	11.0	18	
	Fri	7/1/2005	15:55	15.5	211,000	227	871.19	115.0	112,226	14,386	24,039	81.5	76,348	12,740	21,289	27,126	22,664	10.0	11.0	18	
	Sat	7/2/2005	23:20	17.7	244,000	230	875.25	114.8	127,285	14,513	24,252	81.5	88,825	12,829	21,437	27,342	22,845	9.0	9.6	17	
	Sun	7/3/2005	16:50	2.8	39,000	232	875.91	114.3	19,948	14,533	24,285	NM	14,088	12,843	21,461	27,376	22,873	9.0	9.6	18	
54	Mon	7/4/2005	16:30	13.7	188,000	229	879.06	115.0	96,898	14,630	24,447	97.6	68,924	12,912	21,576	27,542	23,012	9.0	10.0	18	
	Tue	7/5/2005	09:55	15.6	214,000	229	882.66	145.1	161,205	14,791	24,717	67.2	77,113	12,989	21,705	27,780	23,211	4.1	6.0	14	Yes
	Wed	7/6/2005	09:45	3.4	50,000	245	883.50	102.4	926	14,792	24,718	98.1	23,469	13,012	21,744	27,805	23,231	2.3	2.2	11	
	Thu	7/7/2005	09:45	8.0	111,000	231	885.32	110.4	19,561	14,812	24,751	92.5	46,729	13,059	21,822	27,871	23,286	3.2	3.4	12	
	Fri	7/8/2005	12:10	6.0	86,000	239	886.77	111.3	41,231	14,853	24,820	92.7	35,639	13,095	21,881	27,948	23,351	3.6	3.9	13	
	Sat	7/9/2005	17:20	6.0	82,000	228	888.14	115.3	38,071	14,891	24,883	111.6	31,721	13,126	21,934	28,018	23,409	3.5	4.4	12	
	Sun	7/10/2005	16:30	9.2	132,000	239	890.32	113.6	58,780	14,950	24,982	109.0	51,112	13,178	22,020	28,128	23,501	5.0	5.3	16	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	7/11/2005	09:55	6.3	89,000	235	891.77	112.0	47,991	14,998	25,062	89.6	34,178	13,212	22,077	28,210	23,569	5.2	6.0	16	
	Tue	7/12/2005	09:30	7.6	106,000	232	893.54	113.3	51,811	15,050	25,148	86.8	40,283	13,252	22,144	28,302	23,646	6.0	6.6	16	
	Wed	7/13/2005	09:45	10.5	145,000	230	895.96	110.9	70,387	15,120	25,266	93.6	55,371	13,307	22,237	28,428	23,751	7.0	7.4	16	
55	Thu	7/14/2005	09:00	9.9	137,000	231	898.26	113.0	66,307	15,187	25,377	92.9	53,209	13,361	22,326	28,547	23,851	8.1	8.9	17	
	Fri	7/15/2005	13:00	4.4	61,000	231	899.29	110.9	29,464	15,216	25,426	94.5	23,539	13,384	22,365	28,600	23,896	8.0	9.1	18	
	Sat	7/16/2005	16:30	6.3	86,000	228	900.74	115.6	42,308	15,258	25,497	104.6	31,964	13,416	22,419	28,674	23,958	9.0	9.5	19	
	Sun	7/17/2005	17:10	9.4	130,000	230	902.93	119.1	64,062	15,322	25,604	101.3	48,541	13,465	22,500	28,787	24,052	9.5	10.0	20	
	Mon	7/18/2005	10:20	8.0	112,000	233	904.81	115.7	55,935	15,378	25,697	74.2	41,439	13,506	22,569	28,884	24,133	9.7	11.1	20	
	Tue	7/19/2005	08:24	5.0	65,000	217	905.93	115.0	32,729	15,411	25,752	90.0	23,769	13,530	22,609	28,941	24,180	9.9	11.0	20	
	Wed	7/20/2005	09:00	13.4	182,000	226	909.03	112.0	93,010	15,504	25,907	84.0	67,530	13,597	22,721	29,101	24,314	10.2	11.5	20	Yes
56	Thu	7/21/2005	12:32	14.4	204,000	236	912.37	113.6	83,036	15,587	26,046	89.1	89,154	13,687	22,870	29,274	24,458	3.2	4.0	12	
	Fri	7/22/2005	08:30	13.2	185,000	234	915.44	111.8	89,979	15,677	26,197	95.5	75,384	13,762	22,996	29,439	24,596	4.4	4.9	16	
	Sat	7/23/2005	04:30	15.9	221,000	232	919.11	112.5	103,465	15,781	26,369	97.2	87,779	13,850	23,143	29,630	24,756	6.0	6.5	17	
	Sun	7/24/2005	17:00	7.5	105,000	233	920.56	116.0	48,282	15,829	26,450	110.8	42,609	13,892	23,214	29,721	24,832	7.0	7.9	19	
	Mon	7/25/2005	09:38	10.5	142,000	226	923.25	104.1	66,035	15,895	26,560	102.2	57,073	13,949	23,310	29,844	24,935	8.2	8.0	16	
	Tue	7/26/2005	08:12	6.8	95,000	232	924.85	102.8	42,807	15,938	26,632	100.1	39,813	13,989	23,376	29,927	25,004	8.8	9.2	18	
	Wed	7/27/2005	09:40	8.5	117,000	229	926.82	103.2	53,273	15,991	26,721	91.1	47,693	14,037	23,456	30,028	25,088	9.6	10.2	18	
57	Thu	7/28/2005	06:05	9.8	131,000	223	929.07	110.2	60,708	16,052	26,822	100.6	53,145	14,090	23,545	30,142	25,184	9.5	10.0	18	
	Fri	7/29/2005	06:40	10.0	140,000	233	931.31	110.5	64,824	16,116	26,931	100.0	54,720	14,145	23,636	30,261	25,283	9.7	10.5	19	
	Sat	7/30/2005	15:30	5.7	73,000	213	932.70	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.0	12.0	20	
	Sun	7/31/2005	23:30	8.1	111,000	228	934.60	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.8	11.4	20	
	Mon	8/1/2005	11:00	8.3	113,000	227	936.50	118.6	26,542	16,143	26,975	74.4	22,862	14,168	23,674	30,311	25,325	11.0	11.2	18	
	Tue	8/2/2005	16:00	3.5	48,000	229	937.32	108.6	22,984	16,166	27,013	84.6	18,358	14,186	23,705	30,352	25,359	11.2	11.2	14	
	Wed	8/3/2005	07:15	10.9	148,000	226	939.84	105.5	71,505	16,237	27,133	85.0	56,590	14,243	23,800	30,480	25,466	10.6	11.3	19	Yes
58	Thu	8/4/2005	01:30	4.9	68,000	231	941.04	107.0	30,382	16,268	27,184	97.7	29,314	14,272	23,849	30,540	25,516	3.0	2.8	13	
	Fri	8/5/2005	10:00	20.2	285,000	235	945.73	100.0	122,108	16,390	27,388	99.0	121,016	14,393	24,051	30,783	25,719	4.2	4.6	16	
	Sat	8/6/2005	17:20	5.9	83,000	234	947.10	97.0	42,160	16,432	27,458	93.0	34,010	14,427	24,108	30,859	25,783	6.0	6.2	17	
	Sun	8/7/2005	20:15	5.2	70,000	224	948.29	104.6	32,162	16,464	27,512	96.6	29,681	14,457	24,157	30,921	25,835	7.0	7.0	15	
	Mon	8/8/2005	08:09	3.2	46,000	240	949.85	111.1	20,380	16,485	27,546	83.3	18,299	14,475	24,188	30,960	25,867	7.6	8.0	18	
	Tue	8/9/2005	08:47	7.3	100,000	228	950.74	114.1	45,856	16,531	27,623	107.9	41,204	14,516	24,257	31,047	25,940	8.9	8.7	16	
	Wed	8/10/2005	08:46	2.6	35,000	224	951.34	111.6	15,945	16,546	27,649	87.4	14,900	14,531	24,281	31,077	25,965	8.8	9.4	16	
59	Thu	8/11/2005	08:33	7.9	108,000	228	953.18	121.6	49,528	16,596	27,732	86.0	44,334	14,575	24,356	31,171	26,044	9.6	9.8	17	
	Fri	8/12/2005	06:35	4.5	63,000	233	954.24	103.2	27,935	16,624	27,779	95.8	25,760	14,601	24,399	31,225	26,089	10.0	10.8	20	
	Sat	8/13/2005	17:45	8.2	111,000	226	956.11	105.0	50,101	16,674	27,862	99.5	47,529	14,649	24,478	31,323	26,170	8.8	9.0	18	
	Sun	8/14/2005	16:40	9.3	129,000	231	958.28	106.2	57,249	16,731	27,958	98.3	55,199	14,704	24,570	31,435	26,264	8.3	9.0	16	
	Mon	8/15/2005	08:34	5.6	77,000	229	959.56	109.0	33,843	16,765	28,015	94.5	32,771	14,737	24,625	31,502	26,320	8.2	8.8	2	
	Tue	8/16/2005	08:31	6.2	85,000	228	961.02	111.6	38,056	16,803	28,078	100.1	36,898	14,774	24,687	31,577	26,382	8.8	8.8	16	Yes
	Wed	8/17/2005	09:05	11.3	158,000	233	963.63	100.1	69,707	16,873	28,195	98.1	67,768	14,841	24,800	31,714	26,497	3.0	3.1	12	
60	Thu	8/18/2005	06:50	2.5	35,000	233	964.23	114.2	16,748	16,890	28,223	100.5	15,739	14,857	24,826	31,747	26,524	4.0	4.1	15	
	Fri	8/19/2005	10:00	10.1	142,000	234	966.58	103.8	63,942	16,954	28,330	97.9	58,222	14,915	24,924	31,869	26,627	5.2	5.6	17	
	Sat	8/20/2005	17:40	9.5	131,000	230	968.77	100.8	60,897	17,014	28,431	90.6	52,895	14,968	25,012	31,983	26,722	6.0	6.7	17	
	Sun	8/21/2005	16:34	2.1	30,000	238	969.28	104.9	14,027	17,028	28,455	94.4	11,963	14,980	25,032	32,009	26,743	6.2	7.0	18	
	Mon	8/22/2005	08:45	9.9	137,000	231	971.56	110.2	63,942	17,092	28,562	103.4	54,509	15,035	25,123	32,127	26,842	7.9	7.9	17	
	Tue	8/23/2005	08:45	1.5	20,000	222	971.91	113.5	9,458	17,102	28,577	108.4	7,956	15,043	25,136	32,144	26,857	8.0	8.5	19	
	Wed	8/24/2005	09:45	10.7	147,000	229	974.40	116.8	69,314	17,171	28,693	108.9	59,208	15,102	25,235	32,273	26,964	9.0	9.2	19	
61	Thu	8/25/2005	08:56	11.8	162,000	229	977.14	111.2	76,801	17,248	28,822	84.9	63,506	15,165	25,341	32,413	27,081	10.2	11.2	2	
	Fri	8/26/2005	08:40	1.4	19,000	226	977.47	112.6	8,865	17,257	28,836	103.1	7,401	15,173	25,354	32,430	27,095	10.2	10.8	10	
	Sat	8/27/2005	NM	13.0	176,000	226	980.46	115.5	83,860	17,341	28,977	87.2	69,824	15,243	25,470	32,583	27,223	10.6	12.0	10	
	Sun	8/28/2005	17:00	8.2	105,000	213	982.36	110.0	53,304	17,394	29,066	89.1	44,174	15,287	25,544	32,681	27,305	10.6	11.8	20	
	Mon	8/29/2005	09:00	2.3	38,000	275	982.90	112.5	15,238	17,409	29,091	90.2	12,168	15,299	25,565	32,708	27,328	11.4	12.6	23	Yes
	Tue	8/30/2005	09:30	10.3	142,000	230	985.29	109.5	62,618	17,472	29,196	101.0	61,825	15,361	25,668	32,833	27,432	3.8	3.8	16	
	Wed	8/31/2005	08:47	1.6	24,000	250	985.68	109.5	10,038	17,482	29,212	115.2	16,803	15,377	25,696	32,859	27,454	4.2	4.2	NA	
62	Thu	9/1/2005	09:00	10.1	140,700	232	988.01	111.1	60,984	17,543	29,314	110.3	53,110	15,431	25,785	32,973	27,550	6.2	6.0	6	
	Fri	9/2/2005	06:30	9.9	136,300	229	990.31	108.7	60,142	17,603	29,415	113.3	59,256	15,490	25,884	33,093	27,649	7.6	7.8	18	
	Sat	9/3/2005	16:35	12.3	169,000	229	993.17	107.7	73,519	17,677	29,538	118.0	72,574	15,562	26,005	33,239	27,771	9.2	9.3	22	
	Sun	9/4/2005	20:15	16.0	217,000	226	NM	100.0	93,151	17,770	29,693	105.0	92,694	15,655	26,160	33,425	27,927	10.1	10.4	20	
	Mon	9/5/2005	17:30	0.0	0	NA	697.93	99.0	76,630	17,846	29,821	100.0	26,183	15,681	26,204	33,528	28,013	11.8	12.0	20	
	Tue	9/6/2005[d]	09:00	14.4	196,000	227	0.19	103.3	8,614	17,855	29,836	99.9	57,958	15,739	26,300	33,594	28,068	10.4	10.6	22	
	Wed	9/7/2005	09:00	6.9	95,000	229	1.80	106.4	41,389	17,896	29,905	101.2	40,380	15,780	26,368	33,676	28,136	11.4	11.9	22	
63	Thu	9/8/2005	09:21	6.0	80,000	222	3.18	109.6	35,177	17,932	29,964	105.6	34,431	15,814	26,425	33,746	28,195	11.0	11.6	20	
	Fri	9/9/2005	09:03	11.4	155,000	227	5.81	102.2	68,299	18,000	30,078	105.7	65,654	15,880	26,535	33,880	28,307	11.0	11.2	20	Yes
	Sat	9/10/2005[e]	23:45	23.4	315,000	224	11.23	NA	277,863	18,278	30,542	0.0	5,708	15,885	26,545	34,163	28,543	8.0	0.0	22	
	Sun	9/11/2005[e]	16:45	3.6	47,000	218	12.06	NA	41,292	18,319	30,611	0.0	0	15,885	26,545	34,204	28,578	8.0	0.0	22	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

Week No.	Day of Week	Date	Time	Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer						Vessel ΔP (psi)			
				Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]			System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
64	Mon	9/12/2005	09:00	0.2	3,000	250	12.16	101.9	2,458	18,321	30,615	102.8	2,826	15,888	26,549	34,210	28,582	2.9	2.4	13	
	Tue	9/13/2005	09:20	19.1	269,000	235	16.57	102.5	110,547	18,432	30,800	106.9	118,130	16,006	26,747	34,438	28,773	5.8	5.9	17	
	Wed	9/14/2005	09:40	11.7	161,000	229	19.27	109.7	70,416	18,502	30,918	108.6	66,639	16,073	26,858	34,575	28,888	6.1	7.5	16	
	Thu	9/15/2005	09:00	1.0	14,000	233	19.51	113.0	37,345	18,540	30,980	109.2	6,844	16,080	26,870	34,620	28,925	7.0	7.5	19	
	Fri	9/16/2005	09:10	10.3	139,000	225	21.91	111.7	32,613	18,572	31,035	104.2	54,804	16,135	26,961	34,707	28,998	7.0	8.5	18	
	Sat	9/17/2005	05:00	13.3	185,000	232	24.98	111.9	81,840	18,654	31,171	100.6	71,217	16,206	27,080	34,860	29,126	9.3	10.5	20	
	Sun	9/18/2005	04:45	4.4	60,000	227	26.00	113.5	26,559	18,681	31,216	106.2	54,656	16,261	27,172	34,941	29,194	9.3	10.5	23	
65	Mon	9/19/2005	09:00	10.9	147,000	225	28.52	94.4	65,159	18,746	31,325	99.1	27,930	16,288	27,218	35,034	29,271	10.4	10.5	20	
	Tue	9/20/2005	09:10	15.1	205,000	226	32.00	102.2	89,768	18,836	31,475	100.5	88,306	16,377	27,366	35,212	29,420	10.2	10.9	18	
	Wed	9/21/2005	08:30	2.9	39,000	224	32.67	98.4	17,370	18,853	31,504	94.9	7,806	16,385	27,379	35,238	29,441	11.6	13.0	23	
	Thu	9/22/2005	09:10	9.2	123,000	223	34.79	99.9	55,167	18,908	31,596	95.5	46,266	16,431	27,456	35,339	29,526	11.0	11.8	20	
	Fri	9/23/2005	13:15	7.3	102,000	233	36.50	92.7	45,442	18,954	31,672	90.0	40,302	16,471	27,523	35,425	29,598	2.2	2.2	1	Yes
	Sat	9/24/2005	13:30	17.4	244,000	234	40.53	97.6	97,901	19,052	31,835	99.0	103,142	16,574	27,696	35,626	29,766	4.5	5.0	16	
	Sun	9/25/2005	NM	NA	NA	NA	NM	NM	NA	NA	NA	NM	NA	#VALUE!	NA	NA	#VALUE!	NM	NM	NA	
66	Mon	9/26/2005	09:15	15.3	212,000	231	44.10	99.6	87,378	19,139	31,981	94.6	86,122	16,660	27,840	35,799	29,911	6.3	6.7	18	
	Tue	9/27/2005	09:15	11.5	158,000	229	46.76	91.4	64,543	19,203	32,089	94.2	61,630	16,722	27,943	35,926	30,016	7.8	8.2	18	
	Wed	9/28/2005	08:55	13.8	189,000	228	49.97	96.2	76,724	19,280	32,217	86.5	72,219	16,794	28,063	36,074	30,140	9.0	9.6	20	
	Thu	9/29/2005	09:05	6.8	94,000	230	51.55	90.7	37,279	19,317	32,280	89.0	36,425	16,831	28,124	36,148	30,202	7.6	8.3	18	
	Fri	9/30/2005	08:55	7.8	106,000	226	53.35	100.3	42,300	19,360	32,350	94.7	41,438	16,872	28,194	36,232	30,272	7.8	8.1	19	
	Sat	10/1/2005	17:00	15.3	211,000	230	56.90	104.3	85,146	19,445	32,493	101.1	83,295	16,955	28,333	36,400	30,413	6.5	7.1	16	
	Sun	10/2/2005	16:33	10.1	138,000	228	59.22	107.7	55,700	19,501	32,586	103.6	54,367	17,010	28,424	36,510	30,505	7.2	7.3	18	
67	Mon	10/3/2005	11:00	13.6	189,000	232	62.40	95.5	77,231	19,578	32,715	94.7	74,691	17,084	28,548	36,662	30,632	6.7	7.2	17	
	Tue	10/4/2005	09:20	6.0	83,000	231	63.79	99.2	33,764	19,612	32,771	95.2	32,636	17,117	28,603	36,729	30,687	6.6	7.0	17	
	Wed	10/5/2005	09:40	8.1	112,000	230	65.67	91.5	45,167	19,657	32,847	88.2	43,545	17,161	28,676	36,817	30,761	7.0	7.2	17	
	Thu	10/6/2005	09:00	13.5	183,000	226	68.79	93.5	76,225	19,733	32,974	86.8	68,867	17,230	28,791	36,963	30,882	11.2	11.8	22	
	Fri	10/7/2005	11:30	0.3	5,000	278	68.89	94.4	2,937	19,736	32,979	87.2	2,652	17,232	28,795	36,968	30,887	10.8	11.6	22	
	Sat	10/8/2005	12:10	10.7	143,000	223	71.35	88.7	61,532	19,797	33,082	87.1	54,418	17,287	28,886	37,084	30,984	11.0	12.0	32	
	Sun	10/9/2005	17:00	6.9	95,000	229	72.95	88.0	37,695	19,835	33,145	86.0	33,746	17,320	28,942	37,156	31,044	11.0	12.0	20	
68	Mon	10/10/2005	17:00	4.8	65,000	226	73.91	85.0	27,130	19,862	33,190	83.0	24,287	17,345	28,983	37,207	31,087	11.0	11.4	20	
	Tue	10/11/2005	11:00	5.2	70,000	224	75.27	92.4	28,589	19,891	33,238	97.3	28,355	17,373	29,030	37,264	31,134	2.6	2.2	14	Yes
	Wed	10/12/2005	09:40	6.5	91,000	233	76.78	94.1	33,658	19,925	33,294	97.4	38,600	17,412	29,095	37,336	31,195	3.2	3.4	15	
	Thu	10/13/2005	09:15	2.2	31,000	235	77.32	95.2	11,884	19,936	33,314	110.0	13,403	17,425	29,117	37,361	31,216	3.8	4.0	14	
	Fri	10/14/2005	15:20	11.7	163,000	232	80.03	84.2	62,056	19,999	33,418	95.7	69,070	17,494	29,233	37,493	31,325	5.5	5.6	16	
	Sat	10/15/2005	16:54	3.8	53,000	232	80.96	84.2	19,999	20,019	33,451	100.4	22,474	17,517	29,270	37,535	31,361	5.8	6.0	17	
	Sun	10/16/2005	16:20	6.5	90,000	231	82.45	84.0	32,094	20,051	33,505	98.0	36,227	17,553	29,331	37,603	31,418	7.2	6.9	16	
69	Mon	10/17/2005	07:30	1.4	20,000	238	82.77	92.6	7,047	20,058	33,517	94.1	7,860	17,561	29,344	37,618	31,430	6.5	7.5	17	
	Tue	10/18/2005	08:50	9.8	134,000	228	85.04	98.6	49,349	20,107	33,599	97.6	54,865	17,615	29,436	37,722	31,517	8.7	9.2	18	
	Wed	10/19/2005	08:52	10.1	138,000	228	87.38	89.9	51,084	20,158	33,684	96.0	54,390	17,670	29,527	37,828	31,605	9.8	11.0	20	
	Thu	10/20/2005	09:40	1.4	22,000	262	87.73	88.0	7,250	20,165	33,696	94.0	7,676	17,678	29,539	37,843	31,618	10.0	11.4	18	
	Fri	10/21/2005	13:30	11.2	149,000	222	90.33	85.6	57,571	20,223	33,793	82.1	58,603	17,736	29,637	37,959	31,715	10.3	11.6	21	
	Sat	10/22/2005	19:13	6.6	91,000	230	91.87	88.6	34,344	20,257	33,850	97.6	34,250	17,770	29,695	38,028	31,772	9.6	10.2	19	
	Sun	10/23/2005	17:05	3.6	49,000	227	92.27	89.1	18,353	20,276	33,881	101.6	18,573	17,789	29,726	38,065	31,803	9.4	10.2	20	
70	Mon	10/24/2005	13:25	1.1	14,000	212	92.98	95.4	5,101	20,281	33,889	110..9	6,114	17,795	29,736	38,076	31,813	2.4	2.3	12	Yes
	Tue	10/25/2005	13:00	9.2	130,000	236	95.13	90.0	44,191	20,325	33,963	100.0	56,210	17,851	29,830	38,176	31,896	2.5	3.1	12	
	Wed	10/26/2005	09:15	0.1	2,000	333	95.17	87.8	420	20,325	33,964	105.6	553	17,852	29,831	38,177	31,897	3.7	3.8	15	
	Thu	10/27/2005	09:03	8.9	124,000	232	97.22	90.9	43,199	20,369	34,036	109.6	52,251	17,904	29,918	38,273	31,977	5.0	5.2	15	
	Fri	10/28/2005	09:45	NA	NA	NA	97.30	91.0	4,527	20,373	34,044	107.4	1,778	17,906	29,921	38,279	31,982	5.0	5.2	16	
	Sat	10/29/2005	16:45	9.8	137,000	233	99.52	95.6	43,962	20,417	34,117	106.4	54,891	17,961	30,013	38,378	32,065	6.2	6.9	18	
	Sun	10/30/2005	16:50	4.0	56,000	233	100.46	90.1	21,003	20,438	34,152	112.6	22,870	17,984	30,051	38,422	32,101	6.3	7.0	20	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	10/31/2005	08:50	6.3	87,000	230	NM	90.4	29,920	20,468	34,202	103.2	35,348	18,019	30,110	38,487	32,156	8.0	8.2	18	
	Tue	11/1/2005	10:00	0.1	2,000	333	101.96	90.8	401	20,468	34,203	105.1	447	18,019	30,111	38,488	32,157	8.0	8.1	20	
	Wed	11/2/2005	07:00	10.0	136,000	227	104.27	89.2	48,343	20,517	34,284	105.7	54,430	18,074	30,202	38,591	32,243	9.4	9.8	20	
71	Thu	11/3/2005																			
	Fri	11/4/2005																			
	Sat	11/5/2005																			
	Sun	11/6/2005																			
	Mon	11/7/2005																			
	Tue	11/8/2005																			
	Wed	11/9/2005																			
72	Thu	11/10/2005																			
	Fri	11/11/2005																			
	Sat	11/12/2005																			
	Sun	11/13/2005																			
	Mon	11/14/2005																			
	Tue	11/15/2005																			
	Wed	11/16/2005																			
73	Thu	11/17/2005																			
	Fri	11/18/2005																			
	Sat	11/19/2005																			
	Sun	11/20/2005																			
	Mon	11/21/2005																			
	Tue	11/22/2005																			
	Wed	11/23/2005																			
74	Thu	11/24/2005																			
	Fri	11/25/2005																			
	Sat	11/26/2005																			
	Sun	11/27/2005																			
	Mon	11/28/2005																			
	Tue	11/29/2005																			
	Wed	11/30/2005																			
75	Thu	12/1/2005																			
	Fri	12/2/2005																			
	Sat	12/3/2005																			
	Sun	12/4/2005																			
	Mon	12/5/2005																			
	Tue	12/6/2005																			
	Wed	12/7/2005																			
76	Thu	12/8/2005																			
	Fri	12/9/2005																			
	Sat	12/10/2005																			
	Sun	12/11/2005																			
	Mon	12/12/2005																			
	Tue	12/13/2005[f]	11:30	0.4	6,000	250	103.39	91.0	2,204	20,519	34,287	105.6	2,452	18,076	30,206	NA	NA	9.0	9.1	30	
	Wed	12/14/2005	09:00	1.7	23,000	225	108.90	94.1	8,604	20,527	34,302	104.8	10,714	18,087	30,224	38,615	32,263	9.0	9.5	21	
77	Thu	12/15/2005	06:30	8.8	122,000	231	110.98	98.7	42,774	20,570	34,373	102.7	46,954	18,134	30,302	38,704	32,338	8.0	8.6	16	
	Fri	12/16/2005	10:20	1.0	13,000	217	11.28	90.9	24,411	20,595	34,414	108.8	25,761	18,160	30,345	38,754	32,380	3.0	2.2	14	Yes
	Sat	12/17/2005	16:30	9.6	136,000	236	113.55	79.1	24,305	20,619	34,455	96.7	38,803	18,199	30,410	38,818	32,432	4.0	4.0	14	
	Sun	12/18/2005	16:30	0.1	1,000	167	113.60	87.9	235	20,619	34,455	102.1	280	18,199	30,410	38,818	32,433	4.0	4.2	14	
	Mon	12/19/2005	13:30	7.0	98,000	233	115.00	80.0	32,275	20,651	34,509	100.0	42,615	18,241	30,482	38,893	32,495	4.6	4.8	16	
	Tue	12/20/2005	06:45	2.9	42,000	241	115.97	82.4	13,356	20,665	34,531	106.9	17,783	18,259	30,511	38,924	32,521	5.4	5.6	16	
	Wed	12/21/2005	03:30	0.3	3,000	167	116.67	84.0	1,041	20,666	34,533	107.4	1,424	18,261	30,514	38,927	32,523	5.6	5.8	19	
78	Thu	12/22/2005	14:20	9.2	128,000	232	118.25	93.5	41,314	20,707	34,602	108.2	54,889	18,316	30,605	39,023	32,604	7.0	7.4	17	
	Fri	12/23/2005	06:30	0.1	1,000	167	118.28	90.1	317	20,708	34,602	111.5	436	18,316	30,606	39,023	32,604	7.1	7.5	19	
	Sat	12/24/2005	16:30	9.7	135,000	232	120.59	91.8	41,175	20,749	34,671	118.0	57,774	18,374	30,703	39,122	32,687	9.0	9.1	19	
	Sun	12/25/2005	16:45	4.7	66,000	234	121.71	76.6	22,453	20,771	34,709	96.5	27,550	18,401	30,749	39,172	32,729	9.2	9.7	20	
	Mon	12/26/2005	16:40	5.8	78,000	224	123.06	80.5	24,334	20,795	34,749	99.6	33,109	18,434	30,804	39,230	32,777	10.4	10.4	20	
	Tue	12/27/2005	09:40	0.3	5,000	278	123.18	92.8	1,744	20,797	34,752	99.0	2,302	18,437	30,808	39,234	32,780	10.0	10.0	20	
	Wed	12/28/2005	15:00	10.0	138,000	230	125.55	80.5	43,286	20,840	34,825	98.5	58,744	18,495	30,906	39,336	32,865	8.2	8.4	19	
79	Thu	12/29/2005	11:10	1.1	15,000	227	125.81	80.1	10,991	20,851	34,843	97.0	6,547	18,502	30,917	39,353	32,880	3.0	2.8	14	Yes
	Fri	12/30/2005	06:45	8.4	119,000	236	127.78	81.2	30,656	20,882	34,894	107.0	51,254	18,553	31,003	39,435	32,948	3.5	3.8	15	
	Sat	12/31/2005	23:20	5.4	77,000	238	129.09	78.5	22,356	20,904	34,932	100.9	31,287	18,585	31,055	39,489	32,993	3.7	4.1	15	
	Sun	1/1/2006	16:30	3.8	51,000	224	129.98	75.0	16,817	20,921	34,960	100.0	22,994	18,608	31,093	39,529	33,027	4.8	5.0	10	

Plant Switched Off Due to Drilling of New Well in Wellhouse No. 1.

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
80	Mon	1/2/2006	16:20	0.2	3,000	250	130.04	70.5	467	20,922	34,961	100.5	690	18,608	31,095	39,530	33,028	5.0	5.2	14	
	Tue	1/3/2006	09:15	8.6	122,000	236	132.07	73.6	36,639	20,958	35,022	97.4	50,766	18,659	31,179	39,617	33,101	6.0	6.2	18	
	Wed	1/4/2006	09:10	1.1	15,000	227	132.37	78.2	815	20,959	35,023	96.1	6,108	18,665	31,190	39,624	33,106	6.2	6.6	18	
	Thu	1/5/2006	09:55	2.3	41,000	297	133.07	73.1	12,722	20,972	35,044	90.7	16,999	18,682	31,218	39,654	33,131	6.4	6.8	18	
	Fri	1/6/2006	09:39	7.4	95,000	214	134.68	72.4	30,072	21,002	35,095	93.5	41,229	18,723	31,287	39,725	33,191	7.8	8.0	18	
	Sat	1/7/2006	18:10	4.4	62,000	235	135.81	69.2	17,426	21,019	35,124	90.4	23,845	18,747	31,327	39,767	33,225	8.2	8.6	18	
	Sun	1/8/2006	16:40	5.8	79,000	227	137.12	64.5	21,986	21,041	35,160	90.0	31,733	18,779	31,380	39,820	33,270	9.1	9.2	18	
81	Mon	1/9/2006	10:00	0.1	1,000	167	137.16	71.7	507	21,042	35,161	111.4	612	18,780	31,381	39,821	33,271	9.0	9.0	18	
	Tue	1/10/2006	07:10	9.4	129,000	229	139.36	72.1	34,239	21,076	35,219	111.9	53,270	18,833	31,470	39,909	33,344	10.1	10.2	21	
	Wed	1/11/2006	10:00	0.1	1,000	167	139.40	85.8	277	21,076	35,219	113.1	383	18,833	31,470	39,910	33,345	10.2	10.6	22	
	Thu	1/12/2006	13:00	8.2	113,000	230	141.34	71.8	28,150	21,105	35,266	111.1	47,783	18,881	31,550	39,986	33,408	2.4	2.2	14	Yes
	Fri	1/13/2006[g]	09:05	2.3	34,000	246	141.92	0.0	14,766	21,119	35,291	113.3	14,117	18,895	31,574	40,014	33,432	3.0	3.2	14	
	Sat	1/14/2006	17:15	5.4	77,000	238	143.22	0.0	34,668	21,154	35,349	107.5	32,699	18,928	31,629	40,082	33,489	3.5	3.8	15	
	Sun	1/15/2006	17:00	4.3	59,000	229	144.24	70.0	27,606	21,182	35,395	95.5	24,716	18,952	31,670	40,134	33,532	4.6	4.8	14	
82	Mon	1/16/2006	17:00	0.9	13,000	241	144.50	0.0	5,778	21,187	35,404	NA	5,470	18,958	31,679	40,145	33,542	4.8	4.8	10	
	Tue	1/17/2006	09:20	8.3	116,000	233	146.45	0.0	53,286	21,241	35,493	98.4	48,240	19,006	31,760	40,247	33,627	5.8	6.0	17	
	Wed	1/18/2006	09:02	0.1	2,000	333	146.53	0.0	642	21,241	35,495	107.1	817	19,007	31,761	40,248	33,628	6.0	6.1	17	
	Thu	1/19/2006	10:15	8.9	124,000	232	148.62	67.1	57,138	21,298	35,590	109.3	50,828	19,058	31,846	40,356	33,718	7.0	7.1	18	
	Fri	1/20/2006	09:00	0.1	1,000	167	148.75	66.3	642	21,299	35,591	101.0	672	19,059	31,847	40,358	33,719	7.2	7.7	19	
	Sat	1/21/2006	16:45	7.7	108,000	234	150.73	0.0	49,434	21,349	35,674	104.2	43,556	19,102	31,920	40,451	33,797	8.0	9.0	19	
	Sun	1/22/2006	17:30	2.5	33,000	220	151.90	60.0	16,050	21,365	35,701	95.5	13,409	19,115	31,942	40,480	33,821	9.0	9.4	20	
83	Mon	1/23/2006	09:20	0.0	1,000	NA	151.54	76.9	0	21,365	35,701	101.9	341	19,116	31,943	40,480	33,822	9.2	9.4	20	
	Tue	1/24/2006	11:00	10.2	140,000	229	154.05	79.4	65,484	21,430	35,810	113.4	57,571	19,173	32,039	40,603	33,924	2.2	2.6	14	Yes
	Wed	1/25/2006	08:40	0.0	0	NA	154.13	78.1	0	21,430	35,810	108.4	123	19,174	32,039	40,604	33,925	2.6	2.6	14	
	Thu	1/26/2006	09:35	7.6	108,000	237	155.63	44.3	48,792	21,479	35,891	97.7	46,379	19,220	32,117	40,699	34,004	3.2	3.6	15	
	Fri	1/27/2006	10:00	1.7	23,000	225	156.33	65.4	10,914	21,490	35,910	119.5	10,217	19,230	32,134	40,720	34,022	4.2	4.4	16	
	Sat	1/28/2006	17:30	7.4	106,000	239	158.31	44.3	47,508	21,537	35,989	109.4	45,480	19,276	32,210	40,813	34,099	5.0	5.1	16	
	Sun	1/29/2006	16:30	2.5	34,000	227	158.92	40.1	16,050	21,553	36,016	105.0	15,257	19,291	32,235	40,844	34,126	6.0	6.0	16	
84	Mon	1/30/2006	11:15	0.7	10,000	238	159.11	29.5	4,494	21,558	36,023	100.6	5,767	19,297	32,245	40,854	34,134	6.0	6.0	17	
	Tue	1/31/2006	09:10	9.1	128,000	234	161.27	35.9	58,422	21,616	36,121	103.1	51,485	19,348	32,331	40,964	34,226	7.6	7.4	18	
	Wed	2/1/2006	09:10	0.3	4,000	222	161.37	44.3	1,926	21,618	36,124	97.2	1,579	19,350	32,334	40,968	34,229	7.8	7.8	18	
	Thu	2/2/2006	09:05	6.4	89,000	232	162.89	22.2	41,088	21,659	36,193	97.7	38,760	19,388	32,398	41,048	34,296	8.0	8.2	18	
	Fri	2/3/2006	09:30	3.5	48,000	229	163.74	44.3	22,470	21,682	36,230	118.2	21,717	19,410	32,435	41,092	34,333	9.2	9.0	20	
	Sat	2/42006	16:25	6.0	83,000	231	165.16	24.0	38,520	21,720	36,295	116.8	37,244	19,447	32,497	41,168	34,396	9.5	9.2	22	
	Sun	2/5/2006	16:30	4.1	56,000	228	166.13	22.0	26,322	21,747	36,339	112.0	25,358	19,473	32,539	41,219	34,439	10.3	10.2	19	
85	Mon	2/6/2006	09:00	0.1	1,000	167	166.17	44.3	642	21,747	36,340	114.4	645	19,473	32,540	41,221	34,440	10.1	10.1	14	
	Tue	2/7/2006	06:15	9.5	130,000	228	168.39	44.3	60,990	21,808	36,442	120.8	58,421	19,532	32,638	41,340	34,540	12.0	11.8	20	Yes
	Wed	2/8/2006	11:00	1.9	26,000	228	168.90	33.6	12,198	21,820	36,462	108.6	11,920	19,544	32,658	41,364	34,560	3.0	3.0	14	
	Thu	2/9/2006	09:00	1.0	15,000	250	169.17	44.3	6,420	21,827	36,473	105.7	6,324	19,550	32,668	41,377	34,571	3.0	3.0	13	
	Fri	2/10/2006	14:20	8.2	116,000	236	171.14	29.5	52,644	21,880	36,561	100.0	49,620	19,600	32,751	41,479	34,656	3.6	3.8	15	
	Sat	2/11/2006	17:00	1.1	15,000	227	171.43	46.5	7,062	21,887	36,573	104.1	6,449	19,606	32,762	41,493	34,667	3.8	4.2	15	
	Sun	2/12/2006	16:20	8.1	114,000	235	173.35	40.1	52,002	21,939	36,660	106.0	49,181	19,655	32,844	41,594	34,752	5.6	5.8	14	
86	Mon	2/13/2006	09:00	0.0	2,000	NA	173.39	44.3	0	21,939	36,660	118.2	339	19,656	32,845	41,594	34,752	6.0	5.9	16	
	Tue	2/14/2006	09:06	8.5	118,000	231	175.40	46.8	54,570	21,993	36,751	100.9	50,600	19,706	32,929	41,699	34,840	7.0	7.3	16	
	Wed	2/15/2006	09:20	0.2	3,000	250	175.49	29.6	1,284	21,994	36,753	101.6	1,215	19,707	32,931	41,702	34,842	7.2	7.4	18	
	Thu	2/16/2006	09:10	2.1	29,000	230	176.00	56.8	13,482	22,008	36,775	99.8	12,278	19,720	32,952	41,728	34,864	7.6	7.4	18	
	Fri	2/17/2006	9:20	7.3	101,000	231	177.73	44.3	46,866	22,055	36,854	99.0	43,700	19,763	33,025	41,818	34,939	8.8	9.0	19	
	Sat	2/18/2006	16:25	1.7	25,000	245	178.18	24.3	10,914	22,066	36,872	98.0	10,639	19,774	33,043	41,840	34,957	9.2	9.2	19	
	Sun	2/19/2006	16:45	7.9	107,000	226	185.05	22.0	50,718	22,116	36,957	98.0	46,829	19,821	33,121	41,937	35,039	9.2	9.2	19	
87	Mon	2/20/2006	16:30	0.1	2,000	333	180.10	35.0	642	22,117	36,958	110.0	520	19,821	33,122	41,938	35,040	9.8	9.6	16	
	Tue	2/21/2006	10:55	9.4	127,000	225	182.30	39.7	60,348	22,177	37,059	120.6	55,685	19,877	33,215	42,055	35,137	12.0	10.0	22	
	Wed	2/22/2006	09:45	0.1	2,000	333	182.35	42.9	642	22,178	37,060	113.3	545	19,878	33,216	42,056	35,138	11.0	11.0	14	
	Thu	2/23/2006	12:45	6.6	93,000	235	183.95	18.5	42,372	22,220	37,131	101.6	39,078	19,917	33,281	42,137	35,206	2.8	2.8	12	Yes
	Fri	2/24/2006	11:10	3.8	53,000	232	184.86	23.1	24,396	22,245	37,171	109.1	22,994	19,940	33,320	42,185	35,245	3.1	3.2	12	
	Sat	2/25/2006	15:30	2.1	29,000	230	185.39	35.9	13,482	22,258	37,194	113.5	13,090	19,953	33,341	42,211	35,268	3.2	3.4	14	
	Sun	2/26/2006	16:30	7.0	100,000	238	187.07	20.0	44,940	22,303	37,269	100.0	41,768	19,995	33,411	42,298	35,340	4.5	4.6	14	
88	Mon	2/27/2006	09:10	0.1	1,000	167	187.12	59.9	642	22,304	37,270	97.4	880	19,995	33,413	42,299	35,341	2.6	5.0	16	
	Tue	2/28/2006	08:55	8.7	122,000	234	189.18	112.1	55,854	22,360	37,363	102.7	51,295	20,047	33,498	42,406	35,431	6.0	6.0	15	
	Wed	3/1/2006	08:45	0.2	4,000	333	189.32	57.8	1,284	22,361	37,365	91.5	1,624	20,048	33,501	42,409	35,433	6.0	6.1	16	
	Thu	3/2/2006	09:30	6.4	89,000	232	190.80	72.3	41,088	22,402	37,434	96.6	35,531	20,084	33,560	42,486	35,497	6.1	6.8	17	
	Fri	3/3/2006	11:30	2.5	43,000	287	191.56	71.4	16,050	22,418	37,461	98.3	17,170	20,101	33,589	42,519	35,525	7.8	7.8	18	
	Sat	3/4/2006	17:05	6.3	80,000	212	192.94	122.2	40,446	22,459	37,529	105.1	32,801	20,134	33,644	42,592	35,586	8.0	8.9	22	
	Sun	3/5/2006	16:30	4.0	55,000	229	193.90	90.0	25,680	22,484	37,571	100.0	22,319	20,156	33,681	42,640	35,626	9.0	9.1	28	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
89	Mon	3/6/2006	09:05	0.8	11,000	229	194.11	60.1	5,136	22,489	37,580	100.3	5,470	20,162	33,690	42,651	35,635	8.9	9.1	19	
	Tue	3/7/2006[h]	18:40	8.9	123,000	230	194.70	120.0	57,138	22,547	37,676	90.0	49,107	20,211	33,772	42,757	35,724	8.9	9.1	18	
	Wed	3/8/2006	09:45	0.3	4,000	222	196.36	128.6	2,619	22,549	37,680	87.5	1,789	20,213	33,775	42,762	35,728	8.0	9.0	19	
	Thu	3/9/2006	09:05	0.3	4,000	222	196.46	125.8	2,125	22,551	37,683	87.9	1,428	20,214	33,778	42,765	35,731	8.8	9.4	20	
	Fri	3/10/2006	5:55	9.4	130,000	230	198.64	116.6	67,408	22,619	37,796	91.2	48,199	20,262	33,858	42,881	35,827	8.8	9.4	20	Yes
	Sat	3/11/2006	20:08	2.8	39,000	232	199.36	113.0	19,749	22,638	37,829	103.7	18,211	20,280	33,889	42,919	35,859	2.9	2.7	14	
	Sun	3/12/2006	16:30	7.2	104,000	241	201.09	112.0	46,417	22,685	37,907	100.0	42,656	20,323	33,960	43,008	35,933	4.0	4.2	15	
90	Mon	3/13/2006	09:10	0.1	1,000	167	201.13	109.7	367	22,685	37,907	98.3	50,490	20,374	34,044	43,059	35,976	4.2	4.4	14	
	Tue	3/14/2006	09:20	8.6	121,000	234	203.15	110.3	56,426	22,742	38,002	97.6	299	20,374	34,045	43,116	36,023	5.5	5.5	16	
	Wed	3/15/2006	09:15	0.1	1,000	167	203.23	110.5	692	22,742	38,003	95.5	611	20,374	34,046	43,117	36,024	5.6	5.6	16	
	Thu	3/16/2006	06:20	0.2	4,000	333	203.44	119.3	2,268	22,745	38,007	99.8	1,966	20,376	34,049	43,121	36,028	5.0	5.4	16	
	Fri	3/17/2006	11:00	10.1	142,000	234	205.93	116.9	72,575	22,817	38,128	95.1	57,856	20,434	34,146	43,251	36,137	8.3	7.4	18	
	Sat	3/18/2006	23:30	10.9	151,000	231	208.44	111.6	72,969	22,890	38,250	93.5	61,066	20,495	34,248	43,386	36,249	9.0	9.5	19	
	Sun	3/19/2006	16:30	0.4	5,000	208	208.57	110.5	565	22,891	38,251	93.0	462	20,496	34,249	43,387	36,250	9.2	9.5	19	
91	Mon	3/20/2006	08:55	0.1	2,000	333	208.61	108.0	410	22,891	38,251	96.7	321	20,496	34,249	43,387	36,250	9.2	9.6	19	
	Tue	3/21/2006	08:35	9.9	137,000	231	210.97	117.0	66,124	22,957	38,362	104.2	57,261	20,553	34,345	43,511	36,353	8.0	8.2	18	
	Wed	3/22/2006	09:50	4.1	56,000	228	211.93	110.8	26,911	22,984	38,407	103.3	23,241	20,577	34,384	43,561	36,395	10.6	11.0	20	
	Thu	3/23/2006	13:10	2.8	40,000	238	212.65	108.5	17,531	23,002	38,436	103.5	16,215	20,593	34,411	43,595	36,424	2.8	2.4	13	Yes
	Fri	3/24/2006	11:11	7.4	104,000	234	214.39	109.4	49,022	23,051	38,518	101.7	45,972	20,639	34,488	43,690	36,503	3.7	3.7	14	
	Sat	3/25/2006	16:45	1.8	26,000	241	214.85	108.7	10,720	23,061	38,536	105.6	9,852	20,649	34,504	43,710	36,520	4.0	4.0	15	
	Sun	3/26/2006	17:15	9.7	110,000	189	216.68	108.0	50,260	23,112	38,620	104.5	46,588	20,695	34,582	43,807	36,601	5.0	5.0	12	
92	Mon	3/27/2006	13:20	0.1	1,000	167	216.74	124.6	611	23,112	38,621	105.7	553	20,696	34,583	43,808	36,602	5.6	5.8	12	
	Tue	3/28/2006	13:40	7.3	130,000	297	218.93	117.1	60,112	23,172	38,721	107.0	55,407	20,751	34,676	43,924	36,698	7.0	7.0	18	
	Wed	3/29/2006	09:05	0.2	3,000	250	218.99	113.7	979	23,173	38,723	107.1	901	20,752	34,677	43,926	36,700	7.2	7.2	18	
	Thu	3/30/2006	09:20	10.2	142,000	232	221.38	112.9	65,138	23,239	38,832	110.5	59,976	20,812	34,777	44,051	36,805	8.9	8.9	19	
	Fri	3/31/2006	11:06	3.6	90,000	417	222.25	111.6	23,142	23,262	38,871	107.3	21,518	20,834	34,813	44,095	36,842	9.0	9.0	19	
	Sat	4/1/2006	17:00	7.4	61,000	137	224.03	111.1	48,920	23,311	38,952	108.2	44,250	20,878	34,887	44,188	36,920	10.2	10.2	20	
	Sun	4/2/2006	21:45	8.9	124,000	232	226.07	95.5	51,398	23,362	39,038	100.0	53,425	20,931	34,976	44,293	37,007	10.2	9.0	18	
93	Mon	4/3/2006	11:23	6.5	93,000	238	227.59	119.3	41,466	23,403	39,107	108.8	40,162	20,971	35,044	44,375	37,076	9.5	8.0	17	
	Tue	4/4/2006	13:00	4.8	64,000	222	228.74	110.2	28,973	23,432	39,156	105.7	44,010	21,015	35,117	44,448	37,136	7.9	2.8	14	Yes
	Wed	4/5/2006	13:25	5.3	76,000	239	229.98	112.3	33,992	23,466	39,213	107.0	15,917	21,031	35,144	44,498	37,178	7.8	3.0	14	
	Thu	4/6/2006	09:17	3.8	122,000	535	230.86	112.2	23,612	23,490	39,252	116.7	23,071	21,054	35,182	44,545	37,217	7.9	3.2	14	
	Fri	4/7/2006	13:48	7.6	40,000	88	232.66	112.4	50,092	23,540	39,336	110.7	46,654	21,101	35,260	44,641	37,298	7.8	5.0	14	
	Sat	4/8/2006	16:50	2.6	35,000	224	233.37	111.6	16,059	23,556	39,363	111.7	15,284	21,116	35,286	44,673	37,324	7.9	5.9	16	
	Sun	4/9/2006	16:45	7.9	110,000	232	235.11	110.0	49,126	23,605	39,445	105.0	47,342	21,164	35,365	44,769	37,405	7.9	6.8	18	
94	Mon	4/10/2006	13:11	NA	NA	NA	235.90	114.2	21,270	23,627	39,480	124.9	20,106	21,184	35,398	NA	#VALUE!	6.8	8.2	18	
	Tue	4/11/2006	14:00	8.5	120,000	235	237.28	114.0	36,680	23,663	39,542	120.5	34,995	21,219	35,457	44,882	37,499	7.8	9.4	20	
	Wed	4/12/2006	13:20	5.7	78,000	228	238.60	103.2	34,097	23,697	39,599	102.9	33,954	21,253	35,514	44,950	37,556	7.8	10.0	22	
	Thu	4/13/2006	13:07	10.1	139,000	229	240.96	113.2	60,320	23,758	39,699	114.4	81,644	21,334	35,650	45,092	37,675	10.0	10.6	28	
	Fri	4/14/2006	16:45	5.0	69,000	230	242.14	102.3	29,999	23,788	39,749	111.4	10,805	21,345	35,668	45,133	37,709	10.0	9.8	20	
	Sat	4/15/2006	16:30	6.4	88,000	229	243.62	111.2	37,776	23,825	39,813	118.4	38,495	21,384	35,732	45,209	37,773	10.0	9.8	20	
	Sun	4/16/2006	16:20	9.8	136,000	231	245.89	96.0	59,346	23,885	39,912	110.0	59,561	21,443	35,832	45,328	37,872	10.0	9.4	22	
95	Mon	4/17/2006	13:26	9.9	137,000	231	248.20	110.1	60,303	23,945	40,013	108.7	60,171	21,503	35,933	45,449	37,973	10.0	8.2	18	
	Tue	4/18/2006	11:30	1.5	20,000	222	248.60	110.3	69,928	24,015	40,129	111.6	9,743	21,513	35,949	45,528	38,039	10.0	9.8	20	
	Wed	4/19/2006	15:00	11.1	154,000	231	251.10	113.6	3,722	24,019	40,136	120.3	65,542	21,579	36,058	45,598	38,097	10.0	10.0	20	
	Thu	4/20/2006	13:53	1.3	18,000	231	251.47	111.5	9,634	24,028	40,152	122.0	8,525	21,587	36,073	45,616	38,112	10.0	8.8	18	
	Fri	4/21/2006	13:41	12.9	180,000	233	254.49	130.6	77,468	24,106	40,281	122.7	87,455	21,675	36,219	45,781	38,250	7.0	2.4	14	Yes
	Sat	4/22/2006	16:30	6.9	98,000	237	256.10	109.1	43,476	24,149	40,354	112.1	46,776	21,722	36,297	45,871	38,325	2.4	2.8	14	
	Sun	4/23/2006	16:45	3.7	52,000	234	257.02	109.8	24,873	24,174	40,395	110.8	25,998	21,748	36,340	45,922	38,368	2.5	4.2	14	
96	Mon	4/24/2006	14:54	6.4	89,000	232	258.46	108.4	39,423	24,214	40,461	111.4	40,856	21,788	36,409	46,002	38,435	4.2	4.6	16	
	Tue	4/25/2006	14:00	3.5	50,000	238	259.28	119.0	21,895	24,236	40,498	115.6	22,609	21,811	36,446	46,047	38,472	4.6	6.0	13	
	Wed	4/26/2006	13:00	5.5	78,000	236	260.59	120.1	35,423	24,271	40,557	116.8	56,095	21,867	36,540	46,138	38,549	5.5	6.5	16	
	Thu	4/27/2006	13:22	4.2	58,000	230	261.52	112.2	26,078	24,297	40,601	118.3	6,821	21,874	36,552	46,171	38,576	7.0	7.8	18	
	Fri	4/28/2006	13:00	11.0	153,000	232	264.13	117.4	58,896	24,356	40,699	113.4	71,361	21,945	36,671	46,301	38,685	9.0	9.0	20	
	Sat	4/29/2006	16:45	1.8	25,000	231	264.58	104.5	20,223	24,376	40,733	115.3	12,319	21,958	36,691	46,334	38,712	10.2	9.2	21	
	Sun	4/30/2006	16:35	8.9	122,000	228	266.69	107.4	53,171	24,429	40,822	119.6	58,374	22,016	36,789	46,445	38,805	10.0	10.0	21	
97	Mon	5/1/2006	14:55	11.3	157,000	232	269.34	92.9	65,516	24,495	40,931	115.8	79,913	22,096	36,922	46,591	38,927	8.7	8.1	18	
	Tue	5/2/2006	14:30	0.7	10,000	238	269.40	93.2	2,329	24,497	40,935	113.8	2,736	22,099	36,927	46,596	38,931	8.8	8.5	19	
	Wed	5/3/2006	13:30	10.9	151,000	231	271.99	100.0	63,062	24,560	41,040	116.6	73,816	22,172	37,050	46,733	39,045	8.7	8.6	17	
	Thu	5/4/2006	13:00	10.8	150,000	231	274.51	109.3	62,880	24,623	41,145	121.1	72,574	22,245	37,172	46,868	39,159	8.2	7.8	18	
	Fri	5/5/2006	13:25	4.1	57,000	232	275.47	121.3	24,895	24,648	41,187	124.1	26,917	22,272	37,217	46,920	39,202	2.6	2.4	12	Yes
	Sat	5/6/2006	17:25	9.2	130,000	236	277.63	101.1	58,409	24,706	41,285	106.4	59,848	22,332	37,317	47,038	39,301	4.1	4.5	12	
	Sun	5/7/2006	17:00	10.0	140,000	233	279.95	110.9	62,348	24,769	41,389	111.9	65,174	22,397	37,426	47,166	39,407	6.0	6.0	16	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	5/8/2006	06:55	8.6	121,000	234	281.87	111.6	54,125	24,823	41,479	113.4	56,130	22,453	37,519	47,276	39,499	6.2	7.0	19	
	Tue	5/9/2006	09:22	1.3	18,000	231	282.27	114.6	7,680	24,831	41,492	122.0	48,157	22,501	37,600	47,332	39,546	7.2	6.8	19	
	Wed	5/10/2006	11:00	11.2	154,000	229	284.89	107.9	68,884	24,899	41,607	112.5	32,353	22,534	37,654	47,433	39,631	7.2	9.2	19	
98	Thu	5/11/2006	09:30	7.9	81,000	171	286.72	110.2	47,900	24,947	41,687	111.8	50,368	22,584	37,738	47,531	39,713	9.1	8.0	18	
	Fri	5/12/2006	13:42	3.5	78,000	371	287.54	119.7	20,856	24,968	41,722	107.7	21,821	22,606	37,774	47,574	39,748	7.8	8.0	19	
	Sat	5/13/2006	17:00	9.8	136,000	231	289.82	110.8	59,864	25,028	41,822	115.6	63,176	22,669	37,880	47,697	39,851	7.8	7.8	20	
	Sun	5/14/2006	16:30	14.3	116,000	135	291.77	112.3	51,552	25,080	41,908	110.3	53,911	22,723	37,970	47,802	39,939	7.5	7.0	18	
	Mon	5/15/2006	08:50	2.0	42,000	350	292.46	118.2	38,066	25,118	41,972	118.7	18,977	22,742	38,002	47,860	39,987	7.2	7.2	17	
	Tue	5/16/2006	10:56	5.9	152,000	429	295.00	119.0	46,714	25,164	42,050	120.6	70,185	22,812	38,119	47,976	40,085	7.0	6.8	18	
	Wed	5/17/2006	08:20	0.0	0	NA	295.03	108.0	521	25,165	42,051	115.0	559	22,813	38,120	47,977	40,085	7.3	7.2	18	
99	Thu	5/18/2006	11:19	13.6	186,000	228	298.17	114.6	82,019	25,247	42,188	111.4	85,867	22,898	38,264	48,145	40,226	12.0	11.4	22	
	Fri	5/19/2006	13:21	9.0	138,000	256	300.50	110.4	63,408	25,310	42,294	115.2	61,938	22,960	38,367	48,271	40,330	10.0	10.2	18	
	Sat	5/20/2006	00:00	13.2	166,000	210	303.33	107.2	77,515	25,388	42,423	102.8	73,893	23,034	38,491	48,422	40,457	12.2	10.6	20	
	Sun	5/21/2006	17:30	1.4	19,000	226	303.66	105.4	8,348	25,396	42,437	105.0	7,932	23,042	38,504	48,438	40,471	10.4	10.6	22	
	Mon	5/22/2006	10:30	9.5	158,000	277	306.35	110.7	73,450	25,470	42,560	108.4	69,097	23,111	38,619	48,581	40,590	9.4	10.0	20	
	Tue	5/23/2006	11:30	10.7	119,000	185	308.35	111.7	54,007	25,524	42,650	109.4	52,368	23,164	38,707	48,687	40,679	2.8	2.4	14	Yes
	Wed	5/24/2006	09:45	5.4	76,000	235	309.62	116.3	33,438	25,557	42,706	110.4	35,312	23,199	38,766	48,756	40,736	3.6	3.6	15	
100	Thu	5/25/2006	08:00	13.6	193,000	237	312.03	110.2	84,656	25,642	42,848	113.9	90,522	23,289	38,917	48,931	40,882	6.0	5.8	16	
	Fri	5/26/2006	8:15	13.8	188,000	227	315.98	101.7	82,745	25,725	42,986	108.9	87,813	23,377	39,064	49,102	41,025	8.4	8.2	19	
	Sat	5/27/2006	18:40	12.0	165,000	229	318.75	96.5	69,210	25,794	43,102	109.1	74,684	23,452	39,189	49,246	41,145	9.1	10.2	21	
	Sun	5/28/2006	17:00	8.0	109,000	227	320.62	103.4	46,604	25,840	43,179	106.6	52,159	23,504	39,276	49,344	41,228	11.4	9.4	20	
	Mon	5/29/2006	17:15	14.8	203,000	229	324.05	100.9	83,946	25,924	43,320	103.5	97,140	23,601	39,438	49,526	41,379	9.0	8.2	20	
	Tue	5/30/2006	09:15	16.0	219,000	228	327.73	101.8	90,927	26,015	43,472	105.0	103,975	23,705	39,612	49,720	41,542	9.0	7.8	19	
	Wed	5/31/2006	09:20	10.3	142,000	230	330.12	101.4	59,031	26,074	43,570	106.1	67,133	23,772	39,724	49,847	41,647	9.0	7.4	18	
101	Thu	6/1/2006	10:24	7.7	105,000	227	331.89	103.1	43,715	26,118	43,643	108.5	49,588	23,822	39,807	49,940	41,725	9.0	7.6	18	
	Fri	6/2/2006	13:20	11.5	158,000	229	334.61	101.8	66,918	26,185	43,755	105.8	75,639	23,898	39,933	50,082	41,844	9.0	8.5	19	
	Sat	6/3/2006	16:30	11.7	158,000	225	337.27	95.0	65,391	26,250	43,864	100.0	23,250	23,921	39,972	50,171	41,918	12.4	11.8	22	
	Sun	6/4/2006	17:55	5.1	69,000	225	338.45	99.6	28,581	26,279	43,912	112.0	83,845	24,005	40,112	50,284	42,012	12.1	11.4	22	
	Mon	6/5/2006	10:00	6.5	86,000	221	339.94	96.2	35,449	26,314	43,971	109.4	41,918	24,047	40,182	50,361	42,077	12.4	11.8	23	
	Tue	6/6/2006	14:05	14.0	191,000	227	343.20	104.6	81,391	26,396	44,107	105.7	89,581	24,136	40,332	50,532	42,220	3.2	3.0	14	Yes
	Wed	6/7/2006	14:35	1.5	22,000	244	343.59	106.1	9,563	26,405	44,123	111.1	10,267	24,146	40,349	50,552	42,236	3.0	4.0	14	
102	Thu	6/8/2006	14:10	16.6	224,000	225	347.33	101.7	98,022	26,503	44,287	105.4	101,344	24,248	40,518	50,751	42,403	6.4	6.0	17	
	Fri	6/9/2006	14:10	1.3	25,000	321	347.75	89.9	11,090	26,514	44,306	110.5	12,251	24,260	40,539	50,774	42,422	7.0	6.6	17	
	Sat	6/10/2006	16:40	8.7	118,000	226	349.77	85.5	48,754	26,563	44,387	110.0	55,534	24,316	40,632	50,879	42,509	8.8	8.2	14	
	Sun	6/11/2006	16:55	11.3	156,000	230	352.41	95.6	62,393	26,625	44,492	110.9	75,916	24,392	40,759	51,017	42,625	11.1	9.8	19	
	Mon	6/12/2006	14:15	13.0	176,000	226	355.41	89.0	67,023	26,693	44,604	113.6	88,530	24,480	40,906	51,173	42,755	12.6	11.6	22	
	Tue	6/13/2006	09:30	0.3	5,000	278	355.49	84.1	1,536	26,694	44,606	111.8	2,160	24,482	40,910	51,176	42,758	11.6	11.0	21	
	Wed	6/14/2006	13:45	11.9	161,000	225	358.25	NA	64,065	26,758	44,713	122.2	80,973	24,563	41,045	51,321	42,879	8.0	3.6	20	
103	Thu	6/15/2006	06:30	3.1	44,000	237	359.00	NA	34,212	26,792	44,770	123.4	13,957	24,577	41,069	51,369	42,919	8.0	6.0	20	
	Fri	6/16/2006	6:25	10.6	146,000	230	361.85	107.1	73,513	26,866	44,893	115.1	44,022	24,621	41,142	51,487	43,018	9.0	4.5	14	
	Sat	6/17/2006	17:20	13.8	189,000	228	365.13	91.8	85,833	26,952	45,037	112.2	107,740	24,729	41,322	51,681	43,179	7.0	6.6	18	
	Sun	6/18/2006	00:00	21.8	300,000	229	369.72	89.5	107,102	27,059	45,216	108.8	128,809	24,858	41,538	51,917	43,377	9.8	10.0	20	
	Mon	6/19/2006	14:00	8.9	119,000	223	371.75	97.6	47,199	27,106	45,294	118.8	56,572	24,914	41,632	52,020	43,463	11.4	9.8	21	
	Tue	6/20/2006	06:45	0.1	2,000	333	371.78	97.9	628	27,107	45,295	120.3	855	24,915	41,633	52,022	43,464	10.1	9.8	19	
	Wed	6/21/2006	06:00	9.8	132,000	224	374.05	95.0	53,466	27,160	45,385	115.5	62,766	24,978	41,738	52,138	43,562	9.8	9.6	20	
104	Thu	6/22/2006	10:40	12.6	172,000	228	377.07	NA	80,892	27,241	45,520	106.8	81,171	25,059	41,874	52,300	43,697	10.0	9.9	20	
	Fri	6/23/2006	11:30	5.0	69,000	230	378.18	NA	32,100	27,273	45,574	113.7	28,155	25,087	41,921	52,360	43,747	9.9	8.0	22	
	Sat	6/24/2006	17:30	6.2	84,000	226	379.62	NA	39,804	27,313	45,640	119.4	37,728	25,125	41,984	52,438	43,812	11.0	10.0	22	
	Sun	6/25/2006	20:50	9.9	132,000	222	381.41	NA	63,558	27,376	45,746	99.8	60,431	25,185	42,085	52,562	43,916	9.8	9.7	20	
	Mon	6/26/2006	13:00	0.6	11,000	306	382.07	NA	3,852	27,380	45,753	105.0	3,795	25,189	42,091	52,569	43,922	10.4	10.0	20	
	Tue	6/27/2006	10:50	8.6	117,000	227	384.06	NA	55,212	27,435	45,845	116.0	2,029	25,191	42,095	52,627	43,970	3.0	2.4	14	Yes
	Wed	6/28/2006	13:16	4.8	67,000	233	385.31	99.5	30,816	27,466	45,897	120.2	79,830	25,271	42,228	52,737	44,062	3.6	3.6	14	
105	Thu	6/29/2006	13:00	7.6	107,000	235	387.09	96.8	40,702	27,507	45,965	116.5	49,113	25,320	42,310	52,827	44,137	4.8	4.6	15	
	Fri	6/30/2006	13:14	3.1	43,000	231	387.82	90.5	15,820	27,523	45,991	118.2	8,287	25,328	42,324	52,851	44,158	5.9	5.2	17	
	Sat	7/1/2006	18:57	9.6	133,000	231	390.20	90.2	54,147	27,577	46,081	115.6	72,214	25,401	42,445	52,978	44,263	8.0	7.4	16	
	Sun	7/2/2006	15:10	8.7	120,000	230	392.25	83.9	35,696	27,613	46,141	104.7	55,678	25,456	42,538	53,069	44,339	8.4	8.8	18	
	Mon	7/3/2006	09:30	3.4	46,000	225	393.02	81.5	14,795	27,627	46,166	102.9	20,665	25,477	42,572	53,104	44,369	10.0	9.5	20	
	Tue	7/4/2006	16:35	10.1	137,000	226	345.35	75.0	43,050	27,671	46,238	100.0	64,634	25,542	42,680	53,212	44,459	11.0	10.4	19	
	Wed	7/5/2006	14:10	6.3	86,000	228	396.83	67.4	25,090	27,696	46,280	103.3	41,471	25,583	42,750	53,279	44,515	12.0	11.8	24	
106	Thu	7/6/2006	14:39	4.8	62,000	215	397.91	66.4	17,395	27,713	46,309	116.3	29,888	25,613	42,800	53,326	44,554	12.4	11.4	22	
	Fri	7/7/2006	13:40	6.7	62,000	154	399.47	71.5	25,610	27,739	46,352	118.3	45,010	25,658	42,875	53,397	44,613	12.0	11.4	22	
	Sat	7/8/2006	19:36	4.0	84,000	350	400.40	76.9	15,159	27,754	46,377	113.2	26,430	25,684	42,919	53,438	44,648	10.2	10.2	21	
	Sun	7/9/2006	17:00	8.8	118,000	223	402.43	70.0	33,124	27,787	46,432	100.0	57,147	25,742	43,014	53,528	44,723	10.4	11.5	23	
	Mon	7/10/2006	10:35	6.9	94,000	227	404.03	78.1	25,645	27,813	46,475	105.4	44,722	25,786	43,089	53,599	44,782	3.2	2.6	14	Yes
	Tue	7/11/2006	14:00	12.4	174,000	234	406.91	70.0	51,300	27,864	46,561	106.8	75,257	25,862	43,215	53,725	44,888	4.8	5.0	16	
	Wed	7/12/2006	10:10	0.3	4,000	222	406.99	74.7	1,067	27,865	46,563	108.5	1,586	25,863	43,218	53,728	44,890	4.8	5.2	15	
107	Thu	7/13/2006	13:15	10.2	81,000	132	409.34	67.6	40,093	27,905	46,630	101.9	60,259	25,923	43,318	53,828	44,974	7.2	7.2	18	
	Fri	7/14/2006	11:00	7.9	169,000	357	411.18	68.4	30,401	27,935	46,680	100.1	27,042	25,950	43,364	53,886	45,022	8.2	9.0	19	
	Sat	7/15/2006	16:30	8.1	111,000	228	413.06	65.5	29,585	27,965	46,730	106.5	66,976	26,017	43,475	53,982	45,103	9.2	9.5	18	
	Sun	7/16/2006	16:40	7.2	96,000	222	414.71	65.0	26,062	27,991	46,773	105.0	41,201	26,059	43,544	54,050	45,159	9.4	9.5	19	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	7/17/2006	13:30	10.7	144,000	224	417.18	60.0	38,678	28,030	46,838	103.8	60,540	26,119	43,645	54,149	45,242	13.0	12.0	20	
	Tue	7/18/2006	14:10	5.2	69,000	221	418.38	59.3	17,833	28,048	46,868	106.8	30,187	26,149	43,696	54,197	45,282	11.0	10.0	19	
	Wed	7/19/2006	10:15	10.2	139,000	227	420.73	64.3	36,991	28,085	46,930	111.1	80,707	26,230	43,831	54,315	45,380	10.8	10.1	20	
108	Thu	7/20/2006	06:30	12.6	172,000	228	423.66	57.3	36,883	28,121	46,991	98.0	55,622	26,286	43,924	54,407	45,457	10.2	9.6	20	
	Fri	7/21/2006	11:00	7.5	103,000	229	425.41	58.6	28,308	28,150	47,039	116.7	45,019	26,331	43,999	54,480	45,519	3.0	2.4	14	Yes
	Sat	7/22/2006	11:25	11.4	158,000	231	428.03	63.7	38,588	28,188	47,103	116.9	73,559	26,404	44,122	54,593	45,612	4.9	4.7	16	
	Sun	7/23/2006	16:00	12.1	100,000	138	429.62	60.0	77,682	28,266	47,233	110.0	46,597	26,451	44,200	54,717	45,716	6.4	6.0	24	
	Mon	7/24/2006	09:10	1.6	89,000	927	431.21	53.2	10,272	28,276	47,250	113.4	43,318	26,494	44,272	54,770	45,761	7.6	7.5	19	
	Tue	7/25/2006	10:30	6.3	87,000	230	432.70	50.9	40,446	28,317	47,318	109.7	42,674	26,537	44,343	54,854	45,830	9.4	9.0	20	
	Wed	7/26/2006	13:35	11.3	152,000	224	435.30	49.7	72,546	28,389	47,439	116.2	74,335	26,611	44,468	55,000	45,953	10.6	9.8	21	
109	Thu	7/27/2006	10:10	14.3	193,000	225	438.60	45.1	91,806	28,481	47,592	111.9	95,040	26,706	44,626	55,187	46,109	12.2	11.4	22	
	Fri	7/28/2006	10:30	9.8	133,000	226	440.87	46.1	62,916	28,544	47,697	117.4	67,243	26,773	44,739	55,317	46,218	12.0	9.6	22	
	Sat	7/29/2006	16:55	7.2	97,000	225	442.54	43.9	46,224	28,590	47,775	111.4	98,582	26,872	44,904	55,462	46,339	10.4	9.4	21	
	Sun	7/30/2006	10:45	10.2	140,000	229	444.90	45.0	65,484	28,656	47,884	110.0	18,838	26,891	44,935	55,547	46,409	10.6	9.6	26	
	Mon	7/31/2006	12:45	14.8	193,000	217	448.29	47.0	95,016	28,751	48,043	115.5	99,522	26,990	45,101	55,741	46,572	13.2	11.8	23	
	Tue	8/1/2006	13:20	12.9	175,000	226	451.27	47.8	82,818	28,834	48,181	111.1	87,908	27,078	45,248	55,912	46,715	11.6	11.2	22	
	Wed	8/2/2006	11:14	8.1	109,000	224	453.14	NA	52,002	28,886	48,268	119.0	54,057	27,132	45,339	56,018	46,803	13.0	11.6	21	
110	Thu	8/3/2006	10:15	11.9	159,000	223	455.87	48.7	76,398	28,962	48,396	114.7	78,459	27,211	45,470	56,173	46,933	12.2	11.2	21	
	Fri	8/4/2006	14:55	17.0	228,000	224	459.77	54.7	109,140	29,071	48,578	103.7	110,557	27,321	45,654	56,392	47,116	2.8	2.6	14	Yes
	Sat	8/5/2006	19:40	15.4	214,000	232	463.36	53.0	98,868	29,170	48,743	107.9	89,073	27,410	45,803	56,580	47,273	6.4	6.0	18	
	Sun	8/6/2006	17:00	13.0	180,000	231	466.37	NA	83,460	29,253	48,883	90.0	75,074	27,486	45,929	56,739	47,406	8.8	8.8	26	
	Mon	8/7/2006	09:00	7.3	96,000	219	468.06	54.3	46,866	29,300	48,961	94.4	41,503	27,527	45,998	56,827	47,480	11.0	10.4	20	
	Tue	8/8/2006	09:55	12.0	169,000	235	471.55	NA	77,040	29,377	49,090	102.9	64,612	27,592	46,106	56,969	47,598	7.0	8.4	19	
	Wed	8/9/2006	13:35	6.5	84,000	215	472.34	NA	41,730	29,419	49,160	95.7	30,155	27,622	46,156	57,041	47,658	2.8	2.7	14	Yes
111	Thu	8/10/2006	11:09	5.9	81,000	229	473.70	NA	37,878	29,457	49,223	108.7	32,335	27,654	46,210	57,111	47,717	4.2	4.0	15	
	Fri	8/11/2006	13:00	11.2	155,000	231	476.28	NA	71,904	29,529	49,343	91.5	63,276	27,717	46,316	57,246	47,830	6.0	5.8	14	
	Sat	8/12/2006	16:30	7.6	174,000	382	479.22	NA	48,792	29,578	49,425	72.6	57,849	27,775	46,413	57,353	47,919	8.0	8.0	18	
	Sun	8/13/2006	16:40	11.3	86,000	127	480.67	NA	72,546	29,650	49,546	70.0	27,990	27,803	46,460	57,453	48,003	9.0	9.0	26	
	Mon	8/14/2006	07:00	7.9	105,000	222	482.52	NA	50,718	29,701	49,631	84.1	47,400	27,851	46,539	57,552	48,085	9.6	9.0	18	
	Tue	8/15/2006	14:26	14.0	189,000	225	485.70	NA	89,880	29,791	49,781	72.5	84,000	27,935	46,679	57,725	48,230	9.8	9.2	19	
	Wed	8/16/2006	13:50	9.5	129,000	226	487.89	NA	60,990	29,852	49,883	73.3	57,000	27,992	46,774	57,843	48,329	9.6	9.4	22	
112	Thu	8/17/2006	14:21	7.9	105,000	222	489.74	52.4	50,718	29,902	49,967	74.4	47,400	28,039	46,854	57,942	48,410	9.0	9.0	20	
	Fri	8/18/2006	10:00	10.1	136,000	224	492.04	54.5	64,842	29,967	50,076	72.0	60,600	28,100	46,955	58,067	48,515	13.0	13.0	24	
	Sat	8/19/2006	17:15	13.8	219,000	264	495.20	NA	88,596	30,056	NA	85.3	82,800	28,182	47,093	58,238	48,658	11.5	11.0	20	
	Sun	8/20/2006	16:30	13.8	151,000	182	498.38	NA	88,596	30,145	50,372	70.0	82,800	28,265	47,232	58,410	48,802	10.2	10.0	26	
	Mon	8/21/2006	9:05	11.3	154,000	227	501.00	NA	72,546	30,217	50,493	75.3	67,800	28,333	47,345	58,550	48,919	11.0	9.8	20	
	Tue	8/22/2006	13:20	8.8	120,000	227	503.04	NA	56,496	30,274	50,587	76.1	52,800	28,386	47,433	58,659	49,010	2.8	2.6	14	Yes
	Wed	8/23/2006	9:20	9.3	128,000	229	505.18	NA	59,706	30,333	50,687	78.7	55,800	28,442	47,526	58,775	49,107	4.7	4.2	16	
113	Thu	8/24/2006	10:00	14.3	195,000	227	508.47	47.1	91,806	30,425	50,841	75.9	85,800	28,527	47,670	58,953	49,255	7.6	6.8	18	
	Fri	8/25/2006	10:15	13.9	189,000	227	511.69	45.5	89,238	30,514	50,990	72.3	83,400	28,611	47,809	59,125	49,399	10.0	9.2	20	
	Sat	8/26/2006	7:00	19.8	266,000	224	516.25	NA	127,116	30,641	51,202	73.1	118,800	28,730	48,008	59,371	49,605	9.8	9.4	20	
	Sun	8/27/2006	17:00	7.0	95,000	226	517.86	NA	44,940	30,686	51,277	70.0	42,000	28,772	48,078	59,458	49,678	10.8	9.6	20	
	Mon	8/28/2006	14:35	7.7	104,000	225	519.65	NA	49,434	30,736	51,360	74.8	46,200	28,818	48,155	59,554	49,757	10.2	9.4	20	
	Tue	8/29/2006	13:56	15.6	209,000	223	523.22	NA	100,152	30,836	51,527	74.7	93,600	28,911	48,311	59,747	49,919	10.2	9.6	20	
	Wed	8/30/2006	13:43	5.5	74,000	224	529.49	NA	35,310	30,871	51,586	70.3	33,000	28,944	48,367	59,816	49,976	10.0	9.4	21	
114	Thu	8/31/2006	9:45	4.5	60,000	222	525.54	NA	28,890	30,900	51,634	64.2	27,000	28,971	48,412	59,872	50,023	13.0	11.8	24	
	Fri	9/1/2006	14:00	12.2	168,000	230	528.42	NA	78,324	30,978	51,765	68.0	73,200	29,045	48,534	60,023	50,150	10.8	11.8	20	
	Sat	9/2/2006	17:42	0.5	4,000	133	528.52	NA	3,210	30,982	51,771	67.1	3,000	29,048	48,539	60,029	50,155	11.1	9.8	20	
	Sun	9/3/2006	16:45	9.3	76,000	136	530.66	NA	59,706	31,041	51,870	65.0	55,800	29,103	48,632	60,145	50,251	10.8	8.5	20	
	Mon	9/4/2006	10:23	7.9	158,000	333	532.49	NA	50,718	31,092	51,955	65.0	47,400	29,151	48,711	60,243	50,333	10.8	9.2	18	
	Tue	9/5/2006	14:16	5.2	70,000	224	533.71	NA	33,384	31,125	52,011	67.5	31,200	29,182	48,764	60,308	50,387	3.2	2.4	14	Yes
	Wed	9/6/2006	14:20	5.8	80,000	230	535.06	NA	37,236	31,163	52,073	62.8	34,800	29,217	48,822	60,380	50,447	3.4	3.2	16	
115	Thu	9/7/2006	9:30	4.0	56,000	233	536.01	NA	25,680	31,188	52,116	62.4	24,000	29,241	48,862	60,429	50,489	4.8	4.4	16	
	Fri	9/8/2006	13:10	7.0	104,000	248	537.75	NA	44,940	31,233	52,191	63.5	42,000	29,283	48,932	60,516	50,562	5.2	5.5	14	
	Sat	9/9/2006	16:30	4.0	47,000	196	538.55	NA	25,680	31,259	52,234	54.0	24,000	29,307	48,972	60,566	50,603	6.6	6.0	17	
	Sun	9/10/2006	10:15	10.0	140,000	233	540.89	NA	64,200	31,323	52,341	50.0	60,000	29,367	49,072	60,690	50,707	7.0	7.0	18	
	Mon	9/11/2006	13:30	9.0	122,000	226	542.88	NA	57,780	31,381	52,438	65.1	54,000	29,421	49,163	60,802	50,800	9.8	9.6	20	
	Tue	9/12/2006	14:46	2.5	32,000	213	543.55	NA	16,050	31,397	52,465	66.2	15,000	29,436	49,188	60,833	50,826	10.6	10.0	22	
	Wed	9/13/2006	13:10	11.4	155,000	227	546.21	NA	73,188	31,470	52,587	66.9	68,400	29,504	49,302	60,974	50,945	13.0	10.0	22	
116	Thu	9/14/2006	10:56	0.1	1,000	167	546.24	NA	642	31,471	52,588	66.9	600	29,505	49,303	60,976	50,946	12.4	10.8	27	
	Fri	9/15/2006	9:35	8.8	110,000	208	548.08	NA	56,496	31,527	52,683	NA	52,800	29,558	NA	61,085	51,037	10.0	9.4	28	
	Sat	9/16/2006	17:10	8.7	88,000	169	549.61	NA	55,854	31,583	52,776	60.3	52,200	29,557	49,390	61,140	51,083	10.4	9.4	19	
	Sun	9/17/2006	16:20	2.5	70,000	467	550.87	NA	16,050	31,599	52,803	60.0	15,000	29,572	49,415	61,171	51,109	10.8	9.8	22	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	9/18/2006	8:55	1.7	27,000	265	551.29	NA	10,914	31,610	52,821	61.6	10,200	29,582	49,432	61,192	51,127	10.8	9.6	20	
	Tue	9/19/2006	11:15	9.9	132,000	222	553.56	NA	63,558	31,674	52,927	56.6	59,400	29,642	49,532	61,315	51,229	3.2	2.6	14	Yes
	Wed	9/20/2006	8:55	4.8	69,000	240	554.70	NA	30,816	31,705	52,979	0.0	28,800	29,670	49,580	61,375	51,279	3.2	3.0	14	
117	Thu	9/21/2006	6:05	6.3	86,000	228	556.15	NA	40,446	31,745	53,046	58.8	37,800	29,708	49,643	61,453	51,345	5.0	4.8	20	
	Fri	9/22/2006	14:03	10.6	147,000	231	558.63	NA	68,052	31,813	53,160	59.7	63,600	29,772	49,749	61,585	51,455	7.2	6.6	18	
	Sat	9/23/2006	16:30	4.3	60,000	233	559.64	NA	27,606	31,841	53,206	55.5	25,800	29,798	49,792	61,638	51,499	7.7	7.0	21	
	Sun	9/24/2006	16:30	6.8	91,000	223	561.21	NA	43,656	31,884	53,279	50.0	40,800	29,838	49,860	61,723	51,570	9.0	8.4	NA	
	Mon	9/25/2006	9:30	11.2	153,000	228	563.81	51.2	71,904	31,956	53,399	0.0	67,200	29,906	49,973	61,862	51,686	11.0	10.0	22	
	Tue	9/26/2006	10:15	0.2	2,000	167	563.86	50.5	1,284	31,958	53,401	64.6	1,200	29,907	49,975	61,864	51,688	11.0	10.2	20	
	Wed	9/27/2006	13:41	11.0	149,000	226	566.43	0.0	70,620	32,028	53,519	0.0	66,000	29,973	50,085	62,001	51,802	10.4	9.8	20	
118	Thu	9/28/2006	6:45	3.4	48,000	235	567.24	0.0	21,828	32,050	53,556	0.0	20,400	29,993	50,119	62,043	51,837	10.0	9.9	20	
	Fri	9/29/2006	9:28	7.7	101,000	219	569.60	0.0	49,434	32,099	53,638	64.1	46,200	30,039	50,196	62,139	51,917	13.0	11.8	20	
	Sat	9/30/2006	21:20	9.5	130,000	228	571.23	48.7	60,990	32,160	53,740	62.6	57,000	30,096	50,292	62,257	52,016	11.8	16.6	20	
	Sun	10/1/2006	16:50	1.9	25,000	219	571.67	NA	12,198	32,173	53,761	55.0	11,400	30,108	50,311	62,280	52,036	12.0	11.2	20	
	Mon	10/2/2006	13:00	8.4	114,000	226	573.61	48.2	53,928	32,227	53,851	53.5	50,400	30,158	50,395	62,385	52,123	11.5	10.0	20	
	Tue	10/3/2006	13:45	5.3	2,000	6	573.67	0.0	34,026	32,261	53,908	107.0	31,800	30,190	50,448	62,451	52,178	12.0	9.0	20	
	Wed	10/4/2006	14:00	6.4	158,000	411	576.39	0.0	41,088	32,302	53,976	78.6	71,513	30,262	50,567	62,563	52,272	2.9	2.8	14	Yes
119	Thu	10/5/2006	13:20	3.4	48,000	235	577.15	0.0	21,828	32,323	54,013	0.0	19,310	30,281	50,600	62,604	52,306	NA	NA	NA	
	Fri	10/6/2006	9:20	6.9	97,000	234	578.78	0.0	44,298	32,368	54,087	104.4	40,142	30,321	50,667	62,689	52,377	5.0	5.0	15	
	Sat	10/7/2006	16:35	3.2	45,000	234	579.55	0.0	20,544	32,388	54,121	103.2	17,504	30,339	50,696	62,727	52,409	5.4	5.0	16	
	Sun	10/8/2006	16:05	6.8	92,000	225	581.11	NA	43,656	32,432	54,194	95.0	37,930	30,376	50,759	62,808	52,477	7.4	7.0	17	
	Mon	10/9/2006	16:00	3.6	51,000	236	581.97	NA	23,112	32,455	54,233	90.0	20,860	30,397	50,794	62,852	52,514	7.8	7.2	9	
	Tue	10/10/2006	10:00	6.7	87,000	216	583.52	47.0	43,014	32,498	54,305	91.2	37,640	30,435	50,857	62,933	52,581	9.2	8.0	18	
	Wed	10/11/2006	13:40	1.1	6,000	91	583.57	0.0	7,062	32,505	54,316	90.6	8,611	30,444	50,872	62,949	52,594	9.1	8.9	18	
120	Thu	10/12/2006	6:55	9.0	135,000	250	585.88	0.0	57,780	32,563	54,413	102.0	49,035	30,493	50,953	63,056	52,683	10.8	9.8	20	
	Fri	10/13/2006	18:30	0.3	4,000	222	585.98	0.0	1,926	32,565	54,416	100.2	851	30,493	50,955	63,058	52,686	10.9	10.3	18	
	Sat	10/14/2006	16:30	9.4	129,000	229	588.18	NA	60,348	32,625	54,517	95.0	53,113	30,547	51,044	63,172	52,780	10.0	10.0	20	
	Sun	10/15/2006	16:30	5.3	73,000	230	589.42	NA	34,026	32,659	54,574	90.0	29,820	30,576	51,093	63,236	52,834	9.8	9.2	20	
	Mon	10/16/2006	9:00	6.1	84,000	230	590.85	0.0	39,162	32,698	54,639	102.0	29,336	30,606	51,143	63,304	52,891	9.0	8.6	18	
	Tue	10/17/2006	13:00	1.2	15,000	208	591.14	0.0	7,704	32,706	54,652	96.3	11,388	30,617	51,162	63,323	52,907	3.0	2.6	13	Yes
	Wed	10/18/2006	9:40	8.7	123,000	236	593.18	0.0	55,854	32,762	54,746	92.9	48,327	30,665	51,242	63,427	52,994	4.8	4.8	16	
121	Thu	10/19/2006	10:00	0.2	4,000	333	593.26	0.0	1,284	32,763	54,748	97.3	1,346	30,667	51,245	63,430	52,996	5.2	4.8	16	
	Fri	10/20/2006	5:45	0.6	8,000	222	593.41	0.0	3,852	32,767	54,754	96.5	3,235	30,670	51,250	63,437	53,002	5.2	5.0	16	
	Sat	10/21/2006	10:30	9.3	129,000	231	595.50	0.0	59,706	32,827	54,854	100.6	52,082	30,722	51,337	63,549	53,095	7.5	2.0	14	
	Sun	10/22/2006	17:15	4.6	63,000	228	596.64	NA	29,532	32,856	54,903	95.0	25,246	30,747	51,379	63,604	53,141	7.8	6.8	26	
	Mon	10/23/2006	9:00	5.4	81,000	250	598.02	0.0	34,668	32,891	54,961	80.3	34,475	30,782	51,437	63,673	53,199	9.8	9.0	26	
	Tue	10/24/2006	9:25	0.8	4,000	83	598.11	0.0	5,136	32,896	54,970	105.6	249	30,782	51,437	63,678	53,203	10.0	9.4	20	
	Wed	10/25/2006	9:30	0.0	0	NA	598.14	0.0	0	32,896	54,970	96.8	104	30,782	51,437	63,678	53,204	9.9	9.5	20	
122	Thu	10/26/2006	16:00	17.3	246,000	237	598.38	0.0	111,066	33,007	55,155	108.1	47,951	30,830	51,517	63,837	53,336	11.0	10.6	20	
	Fri	10/27/2006	16:25	9.2	145,000	263	605.06	0.0	59,064	33,066	55,254	102.7	121,579	30,952	51,721	64,018	53,487	10.8	10.4	22	
	Sat	10/28/2006	16:20	3.2	23,000	120	605.18	0.0	20,544	33,087	55,288	104.0	3,426	30,955	51,726	64,042	53,507	10.8	10.2	20	
	Sun	10/29/2006	16:45	9.2	125,000	226	607.36	NA	59,064	33,146	55,387	95.0	51,926	31,007	51,813	64,153	53,600	10.2	9.6	18	
	Mon	10/30/2006	14:24	0.0	1,000	NA	607.42	0.0	0	33,146	55,387	104.7	548	31,008	51,814	64,153	53,601	10.2	9.6	20	
	Tue	10/31/2006	10:52	10.1	174,000	287	609.75	0.0	64,842	33,211	55,495	104.8	56,247	31,064	51,908	64,275	53,702	3.2	2.6	14	Yes
	Wed	11/1/2006	14:54	0.3	18,000	NA	609.83	0.0	1,926	33,213	55,499	106.7	7,469	31,071	51,921	64,284	53,710	3.2	2.8	14	
123	Thu	11/2/2006	14:04	9.6	84,000	146	612.07	0.0	61,632	33,274	55,602	108.1	3,210	31,075	51,926	64,349	53,764	4.6	4.6	14	
	Fri	11/3/2006	11:45	0.2	3,000	250	612.15	0.0	1,284	33,276	55,604	106.3	44,804	31,119	52,001	64,395	53,802	5.5	5.0	18	
	Sat	11/4/2006	16:30	5.8	82,000	236	613.56	0.0	37,236	33,313	55,666	103.0	33,451	31,153	52,057	64,466	53,861	6.5	6.0	16	
	Sun	11/5/2006	16:30	4.1	55,000	224	614.53	NA	26,322	33,339	55,710	95.0	22,128	31,175	52,094	64,514	53,902	7.5	6.8	18	
	Mon	11/6/2006	14:17	1.3	18,000	231	614.86	0.0	8,346	33,347	55,724	108.8	6,740	31,182	52,105	64,529	53,914	8.4	7.6	17	
	Tue	11/7/2006	16:30	8.0	111,000	231	616.77	0.0	51,360	33,399	55,810	106.0	45,133	31,227	52,180	64,626	53,995	9.3	8.2	18	
	Wed	11/8/2006	13:30	0.1	0	NA	616.80	0.0	642	33,399	55,811	97.9	261	31,227	52,181	64,626	53,996	9.5	9.1	22	
124	Thu	11/9/2006	13:00	8.5	116,000	227	618.70	0.0	54,570	33,454	55,902	93.7	48,645	31,276	52,262	64,730	54,082	10.0	9.2	20	
	Fri	11/10/2006	17:45	0.4	4,000	167	618.91	0.0	2,568	33,457	55,906	97.7	2,447	31,278	52,266	64,735	54,086	9.9	9.8	21	
	Sat	11/11/2006	16:30	10.0	90,000	150	621.24	0.0	64,200	33,521	56,014	100.6	57,045	31,335	52,361	64,856	54,188	9.2	9.0	18	
	Sun	11/12/2006	16:30	0.1	1,000	167	622.10	NA	642	33,521	56,015	95.0	616	31,336	52,362	64,857	54,189	9.4	9.0	20	
	Mon	11/13/2006	14:21	3.2	95,000	495	622.50	52.3	20,544	33,542	56,049	105.7	13,515	31,349	52,385	64,891	54,217	9.4	9.0	18	
	Tue	11/14/2006	13:00	8.0	109,000	227	623.43	0.0	51,360	33,593	56,135	101.2	49,041	31,398	52,467	64,992	54,301	3.0	2.6	14	Yes
	Wed	11/15/2006	10:46	0.1	1,000	167	623.43	0.0	642	33,594	56,136	109.9	442	31,399	52,468	64,993	54,302	3.0	2.4	20	
125	Thu	11/16/2006	9:50	8.3	117,000	235	625.90	0.0	53,286	33,647	56,225	103.1	47,482	31,446	52,547	65,094	54,386	4.8	4.2	16	
	Fri	11/17/2006	9:40	0.2	3,000	250	625.96	0.0	1,284	33,649	56,227	102.4	811	31,447	52,548	65,096	54,388	5.0	4.4	16	
	Sat	11/18/2006	19:17	10.5	147,000	233	628.44	0.0	67,410	33,716	56,340	97.4	62,452	31,510	52,653	65,226	54,496	7.2	6.2	18	
	Sun	11/19/2006	16:45	0.0	0	NA	628.50	NA	0	33,716	56,340	97.4	0	31,510	52,653	65,226	54,496	7.2	6.2	20	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer						Vessel ΔP (psi)			
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	A	B	System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV			psig	Yes/No
	Mon	11/20/2007	9:45	0.4	4,000	167	625.57	NA	2,568	33,719	56,344	102.5	894	31,510	52,654	65,229	54,499	7.8	6.8	20	
	Tue	11/21/2007	12:12	9.4	131,000	232	630.81	NA	60,348	33,779	56,445	103.0	56,857	31,567	52,749	65,346	54,597	9.2	8.1	18	
	Wed	11/22/2007	9:40	0.1	1,000	NA	630.85	NA	642	33,780	56,446	110.0	4,180	31,571	52,756	65,351	54,601	9.4	8.6	20	
126	Thu	11/23/2007	16:34	9.1	124,000	227	632.49	NA	58,422	33,838	56,544	110.8	50,519	31,622	52,841	65,460	54,692	10.0	9.0	19	
	Fri	11/24/2007	14:20	1.3	19,000	244	633.34	NA	8,346	33,846	56,558	108.7	8,051	31,630	52,854	65,476	54,706	10.0	9.4	21	
	Sat	11/25/2007	16:45	8.4	114,000	226	635.31	NA	53,928	33,900	56,648	103.0	50,271	31,680	52,938	65,581	54,793	10.0	7.4	19	
	Sun	11/26/2006	18:00	1.5	21,000	NA	635.72	NA	9,630	33,910	56,664	103.2	9,253	31,690	52,954	65,599	54,809	9.8	8.8	19	
	Mon	11/27/2006	13:18	7.9	109,000	230	637.55	0.0	50,718	33,961	56,748	111.8	46,513	31,736	53,031	65,697	54,890	9.2	8.2	18	
	Tue	11/28/2006	9:17	0.2	3,000	250	637.63	0.0	1,284	33,962	56,751	110.7	812	31,737	53,033	65,699	54,892	9.2	8.2	18	
	Wed	11/29/2006	7:00	4.2	57,000	NA	638.61	0.0	26,964	33,989	56,796	105.7	23,971	31,761	53,073	65,750	54,934	9.2	8.0	19	Yes
127	Thu	11/30/2006	6:30	7.4	101,000	227	640.32	67.1	47,508	34,036	56,875	63.5	30,753	31,792	53,124	65,828	55,000	0.0	1.2	12	
	Fri	12/1/2006	9:40	0.1	2,000	333	640.43	0.0	642	34,037	56,876	69.6	2,000	31,794	53,128	65,831	55,002	0.0	1.2	10	
	Sat	12/2/2006	15:48	8.1	115,000	237	642.28	0.0	52,002	34,089	56,963	57.5	27,662	31,821	53,174	65,910	55,068	0.0	1.6	12	
	Sun	12/3/2006	16:15	0.0	0	NA	642.38	NA	0	34,089	56,963	57.0	27	31,821	53,174	65,910	55,068	0.0	1.6	9	
	Mon	12/4/2006	9:45	8.5	122,000	239	644.22	0.0	54,570	34,144	57,054	46.1	25,605	31,847	53,217	65,990	55,135	0.0	2.0	10	
	Tue	12/5/2006	10:00	0.4	0	NA	644.41	0.0	2,568	34,146	57,059	49.7	49,885	31,897	53,300	66,043	55,179	0.0	2.0	15	
	Wed	12/6/2006	6:45	0.0	3,000	NA	644.51	88.0	965	34,147	57,060	108.5	5,963	31,903	53,310	66,050	55,185	6.0	5.8	15	
128	Thu	12/7/2006	9:30	9.3	130,000	233	646.73	83.0	44,880	34,192	57,135	124.8	6,961	31,910	53,322	66,102	55,228	8.0	7.9	20	
	Fri	12/8/2006	9:15	0.1	1,000	167	646.81	78.1	998	34,193	57,137	124.4	1,350	31,911	53,324	66,104	55,230	9.4	8.0	20	
	Sat	12/9/2006	16:00	9.9	135,000	227	649.19	79.2	49,661	34,243	57,220	NA	68,583	31,980	53,438	66,222	55,329	0.8	8.7	20	
	Sun	12/10/2006	16:20	5.0	70,000	233	650.41	75.0	16,842	34,259	57,248	115.0	31,543	32,011	53,491	66,271	55,369	11.0	9.2	20	
	Mon	12/11/2006	10:20	5.4	72,000	222	651.69	77.6	24,039	34,283	57,288	111.3	38,319	32,050	53,555	66,333	55,422	10.6	9.0	20	
	Tue	12/12/2006	10:00	0.2	3,000	250	651.75	86.1	953	34,284	57,290	119.1	1,938	32,051	53,558	66,336	55,424	11.2	9.6	20	
	Wed	12/13/2006	8:45	2.8	39,000	232	652.16	80.1	12,743	34,297	57,311	126.1	19,414	32,071	53,591	66,368	55,451	12.0	9.8	20	
129	Thu	12/14/2006	9:37	7.0	94,000	224	654.09	87.2	31,414	34,329	57,363	125.4	47,630	32,119	53,670	66,447	55,517	11.2	9.4	20	
	Fri	12/15/2006	10:40	0.3	4,000	222	654.20	84.6	1,394	34,330	57,366	126.2	2,157	32,121	53,674	66,451	55,520	12.0	10.0	22	
	Sat	12/16/2006	16:44	8.6	118,000	229	656.22	85.7	39,320	34,369	57,431	126.3	57,643	32,178	53,770	66,548	55,601	10.6	9.0	19	
	Sun	12/17/2006	16:30	0.0	0	NA	656.77	85.7	0	34,369	57,431	126.3	200	32,179	53,771	66,548	55,601	10.6	9.0	19	
	Mon	12/18/2006	10:00	NA	NA	NA	658.27	77.6	14,176	34,369	57,431	111.3	71,018	32,250	53,889	66,619	55,660	10.0	9.4	14	
	Tue	12/19/2006	10:00	8.7	145,000	278	658.33	86.1	26,711	34,396	57,476	111.8	22,070	32,272	53,926	66,668	55,701	10.1	8.6	20	
	Wed	12/20/2006	9:00	5.4	49,000	151	659.61	93.9	25,288	34,421	57,518	112.8	348	32,272	53,927	66,693	55,723	10.0	8.6	18	Yes
130	Thu	12/21/2006	9:10	4.8	64,000	222	660.76	117.3	25,036	34,446	57,560	79.9	29,637	32,302	53,976	66,748	55,768	3.0	2.8	12	
	Fri	12/22/2006	10:43	0.3	6,000	333	660.90	122.4	2,400	34,449	57,564	94.9	1,739	32,303	53,979	66,752	55,772	3.0	2.6	16	
	Sat	12/23/2006	16:30	8.6	120,000	233	662.93	113.0	54,618	34,503	57,655	90.0	47,180	32,350	54,058	66,854	55,857	5.0	4.0	16	
	Sun	12/24/2006	16:30	4.4	63,000	NA	664.00	110.0	27,326	34,531	57,701	85.0	24,957	32,375	54,100	66,906	55,900	5.2	5.0	17	
	Mon	12/25/2006	16:00	5.5	75,000	227	665.37	90.0	32,444	34,563	57,755	100.0	30,790	32,406	54,151	66,969	55,953	7.0	6.5	17	
	Tue	12/26/2006	11:15	0.0	2,000	NA	665.37	109.2	359	34,563	57,756	95.6	298	32,407	54,152	66,970	55,954	7.4	6.6	18	
	Wed	12/27/2006	NM	9.3	128,000	229	667.58	99.9	55,041	34,619	57,848	94.5	54,252	32,461	54,242	67,079	56,045	9.1	8.2	19	
131	Thu	12/28/2006	9:20	0.2	3,000	250	667.69	99.2	1,471	34,620	57,850	99.9	1,436	32,462	54,245	67,082	56,048	9.2	8.6	20	
	Fri	12/29/2006	11:00	7.7	106,000	229	669.50	99.9	42,917	34,663	57,922	103.6	43,780	32,506	54,318	67,169	56,120	9.4	9.2	23	
	Sat	12/30/2006	17:00	2.1	28,000	222	670.60	113.4	11,388	34,674	57,941	112.4	11,736	32,518	54,338	67,192	56,139	9.4	9.0	22	
	Sun	12/31/2006	16:30	5.2	72,000	231	671.35	95.0	30,812	34,705	57,993	100.0	30,408	32,548	54,388	67,253	56,190	9.4	9.0	22	
	Mon	1/1/2007	21:30	5.1	70,000	229	672.63	89.4	30,849	34,736	58,044	94.8	29,811	32,578	54,438	67,314	56,241	7.5	5.6	7	
	Tue	1/2/2007	10:10	0.3	5,000	278	672.68	110.3	400	34,736	58,045	96.8	430	32,578	54,439	67,315	56,242	9.0	8.0	18	
	Wed	1/3/2007	9:45	8.7	121,000	232	674.74	106.0	51,224	34,788	58,130	98.4	48,541	32,627	54,520	67,415	56,325	8.3	7.4	18	
132	Thu	1/4/2007	9:40	0.2	2,000	167	674.82	102.4	1,104	34,789	58,132	97.5	1,047	32,628	54,522	67,417	56,327	8.4	7.6	18	
	Fri	1/5/2007	9:50	2.5	35,000	233	675.43	112.4	14,806	34,803	58,157	102.5	13,785	32,642	54,545	67,445	56,351	8.2	7.5	18	Yes
	Sat	1/6/2007	17:00	7.9	111,000	234	677.30	110.8	49,935	34,853	58,240	103.4	43,337	32,685	54,617	67,539	56,429	4.0	3.8	16	
	Sun	1/7/2007	17:00	2.8	40,000	238	677.97	100.0	18,614	34,872	58,272	100.0	14,929	32,700	54,642	67,572	56,457	4.0	4.0	16	
	Mon	1/8/2007	13:30	6.8	94,000	230	679.58	116.1	43,768	34,916	58,345	98.5	36,470	32,737	54,703	67,652	56,524	5.8	5.6	16	
	Tue	1/9/2007	13:00	0.1	2,000	333	679.66	126.1	863	34,917	58,346	104.6	716	32,737	54,704	67,654	56,525	6.0	6.0	18	
	Wed	1/10/2007	9:35	2.7	38,000	235	680.33	109.5	16,825	34,933	58,374	91.4	14,156	32,751	54,728	67,685	56,551	6.2	6.0	17	
133	Thu	1/11/2007	13:30	6.6	92,000	232	681.96	122.2	42,313	34,976	58,445	100.9	35,752	32,787	54,788	67,763	56,616	8.1	8.0	18	
	Fri	1/12/2007	13:22	0.2	2,000	167	682.04	117.5	775	34,977	58,446	99.5	139	32,787	54,788	67,764	56,617	8.0	7.8	19	
	Sat	1/13/2007	16:25	8.6	119,000	231	684.09	112.3	54,991	35,032	58,538	93.9	46,381	32,834	54,865	67,865	56,702	9.0	8.4	19	
	Sun	1/14/2007	17:00	0.0	NA	NA	684.15	110.0	712	35,032	58,539	95.0	566	32,834	54,866	67,867	56,703	9.0	8.6	19	
	Mon	1/15/2007	16:30	0.0	0	NA	684.19	110.6	573	35,033	58,540	90.0	460	32,835	54,867	67,868	56,704	9.2	9.0	16	
	Tue	1/16/2007	9:30	5.5	77,000	233	685.42	108.1	35,480	35,068	58,600	91.1	28,426	32,863	54,915	67,931	56,757	9.8	9.6	19	
	Wed	1/17/2007	9:20	9.3	128,000	229	687.63	108.3	59,436	35,128	58,699	85.3	46,709	32,910	54,993	68,038	56,846	9.6	9.4	20	
134	Thu	1/18/2007	14:00	0.2	2,000	167	687.78	112.1	1,038	35,129	58,701	83.7	847	32,911	54,994	68,039	56,847	9.4	9.2	19	
	Fri	1/19/2007	13:30	7.2	100,000	231	689.53	113.2	46,012	35,175	58,778	97.2	37,282	32,948	55,056	68,123	56,917	9.2	8.4	18	Yes
	Sat	1/20/2007	16:20	3.4	47,000	230	690.39	120.1	21,098	35,196	58,813	98.7	17,949	32,966	55,086	68,162	56,950	3.2	3.2	15	
	Sun	1/21/2007	17:00	0.0	5,000	NA	690.61	120.0	0	35,196	58,813	98.5	0	32,966	55,086	68,162	56,950	3.2	3.2	16	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[a]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
	Mon	1/22/2007	9:39	9.0	123,000	228	692.62	123.7	57,329	35,253	58,909	101.6	47,151	33,013	55,165	68,266	57,037	5.7	5.2	16	
	Tue	1/23/2007	9:46	0.2	2,000	167	692.76	115.2	1,600	35,255	58,911	107.5	3,481	33,017	55,171	68,271	57,041	5.8	5.6	17	
	Wed	1/24/2007	9:36	0.3	4,000	222	692.91	118.2	1,816	35,257	58,914	107.6	1,531	33,018	55,174	68,275	57,044	6.0	5.8	18	
135	Thu	1/25/2007	9:30	9.3	129,000	231	695.11	117.2	57,557	35,314	59,010	102.2	51,323	33,069	55,259	68,384	57,135	8.0	7.8	15	
	Fri	1/26/2007	13:30	0.3	5,000	278	695.33	111.9	1,307	35,316	59,013	105.2	1,000	33,070	55,261	68,386	57,137	8.2	7.6	18	
	Sat	1/27/2007	17:00	8.3	113,000	227	697.35	112.9	48,399	35,364	59,094	105.7	45,888	33,116	55,338	68,480	57,216	8.8	9.0	18	
	Sun	1/28/2007	16:30	2.0	20,000	167	697.87	105.7	12,638	35,377	59,115	102.2	11,993	33,128	55,358	68,505	57,236	9.0	9.0	12	
	Mon	1/29/2007	7:00	1.3	9,000	115	697.96	113.0	304	35,377	59,115	98.7	303	33,129	55,358	68,505	57,237	9.0	8.9	19	
	Tue	1/30/2007	6:49	8.1	129,000	265	700.21	120.2	54,948	35,432	59,207	101.1	52,098	33,181	55,445	68,612	57,326	9.2	8.8	19	
	Wed	1/31/2007	9:06	0.4	5,000	208	700.41	116.6	2,077	35,434	59,210	101.4	1,958	33,183	55,449	68,617	57,329	9.6	9.0	19	
136	Thu	2/1/2007	9:24	0.7	9,000	214	700.70	113.5	4,700	35,439	59,218	101.9	3,797	33,186	55,455	68,625	57,337	9.4	9.0	20	
	Fri	2/2/2007	19:25	9.3	129,000	231	702.97	114.6	55,981	35,495	59,312	109.7	50,710	33,237	55,540	68,732	57,426	9.0	8.4	19	
	Sat	2/3/2007	16:35	0.3	4,000	222	703.14	120.5	1,659	35,496	59,315	106.7	1,484	33,239	55,542	68,735	57,428	9.0	8.6	21	
	Sun	2/4/2007	16:25	9.2	126,000	228	705.33	115.0	44,991	35,541	59,390	130.0	49,700	33,288	55,625	68,830	57,507	9.0	8.0	21	
	Mon	2/5/2007	16:00	0.1	2,000	333	705.52	83.5	1,464	35,543	59,392	98.2	1,322	33,290	55,627	68,832	57,510	8.8	8.2	18	
	Tue	2/6/2007	13:44	6.4	89,000	232	707.16	112.7	49,171	35,592	59,474	102.0	33,481	33,323	55,683	68,915	57,579	3.4	2.8	16	Yes
	Wed	2/7/2007	9:33	5.7	81,000	237	708.63	118.2	36,105	35,628	59,535	104.3	31,035	33,354	55,735	68,982	57,635	5.0	4.6	14	
137	Thu	2/8/2007	9:25	0.5	6,000	200	708.97	112.6	2,362	35,630	59,539	103.7	2,106	33,356	55,739	68,987	57,639	5.2	4.8	18	
	Fri	2/9/2007	10:25	8.9	125,000	234	711.14	107.2	54,891	35,685	59,630	96.9	49,252	33,405	55,821	69,091	57,726	7.2	7.6	18	
	Sat	2/10/2007	1:30	10.3	141,000	228	713.71	93.2	61,209	35,746	59,733	88.5	57,026	33,463	55,916	69,209	57,824	8.0	7.5	18	
	Sun	2/11/2007	17:05	0.0	0	NA	713.87	93.0	0	35,746	59,733	88.0	0	33,463	55,916	69,209	57,824	8.0	7.5	17	
	Mon	2/12/2007	9:20	0.3	5,000	278	713.97	105.6	1,087	35,748	59,735	93.4	1,032	33,464	55,918	69,211	57,826	8.8	8.2	18	
	Tue	2/13/2007	9:40	8.4	117,000	232	716.00	110.3	50,466	35,798	59,819	94.7	46,407	33,510	55,996	69,308	57,907	8.0	7.0	18	
	Wed	2/14/2007	10:00	0.3	3,000	167	716.26	108.6	1,589	35,800	59,821	95.6	1,370	33,511	55,998	69,311	57,910	8.2	7.2	19	
138	Thu	2/15/2007	10:00	9.1	126,000	231	713.49	104.4	54,711	35,854	59,913	94.2	49,760	33,561	56,081	69,415	57,997	7.6	6.8	18	
	Fri	2/16/2007	9:13	0.1	2,000	333	718.69	109.1	6,324	35,861	59,923	104.2	904	33,562	56,082	69,423	58,003	8.0	7.6	18	Yes
	Sat	2/17/2007	17:08	10.8	151,000	233	721.35	113.9	65,576	35,926	60,033	86.3	57,638	33,620	56,179	69,546	58,106	5.0	9.6	16	
	Sun	2/18/2007	16:30	5.6	80,000	238	722.75	113.0	33,865	35,960	60,090	85.0	28,367	33,648	56,226	69,608	58,158	6.0	5.2	17	
	Mon	2/19/2007	16:20	5.4	73,000	225	724.12	110.0	33,290	35,993	60,145	90.0	28,549	33,677	56,274	69,670	58,210	8.0	7.0	20	
	Tue	2/20/2007	14:06	6.1	86,000	235	725.64	111.0	38,441	36,032	60,210	100.3	32,948	33,710	56,329	69,741	58,269	8.2	8.2	19	
	Wed	2/21/2007	13:38	3.8	51,000	224	726.57	112.2	23,072	36,055	60,248	99.2	25,129	33,735	56,371	69,789	58,310	9.0	8.2	20	
139	Thu	2/22/2007	13:00	6.6	92,000	232	728.16	113.4	41,885	36,097	60,318	98.5	29,617	33,764	56,420	69,861	58,369	9.5	9.1	18	
	Fri	2/23/2007	13:15	3.6	49,000	227	729.07	114.6	22,090	36,119	60,355	99.4	18,437	33,783	56,451	69,902	58,403	9.1	8.9	20	
	Sat	2/24/2007	16:35	10.4	143,000	229	731.60	118.5	66,072	36,185	60,465	87.6	53,752	33,836	56,541	70,021	58,503	7.6	7.4	19	
	Sun	2/25/2007	16:45	0.0	0	NA	739.95	118.0	0	36,185	60,465	87.0	0	33,836	56,541	70,021	58,503	7.6	7.4	19	
	Mon	2/26/2007	9:45	0.2	3,000	250	731.81	123.8	700	36,186	60,467	101.9	592	33,837	56,542	70,023	58,504	9.0	8.4	20	
	Tue	2/27/2007	10:10	9.5	132,000	232	734.09	112.1	59,466	36,245	60,566	96.6	49,082	33,886	56,624	70,131	58,595	8.4	7.6	18	
	Wed	2/28/2007	9:46	0.1	2,000	333	734.19	109.5	939	36,246	60,567	99.3	781	33,887	56,625	70,133	58,596	8.6	7.6	18	
140	Thu	3/1/2007	16:00	5.3	74,000	233	735.51	111.6	7,373	36,253	60,580	83.7	5,917	33,893	56,635	70,146	58,608	3.0	2.2	15	Yes
	Fri	3/2/2007	12:55	5.0	72,000	240	736.77	125.0	33,103	36,286	60,635	71.4	23,008	33,916	56,674	70,202	58,654	4.6	3.2	16	
	Sat	3/3/2007	16:59	3.1	43,000	231	737.57	120.7	22,267	36,309	60,672	87.1	16,101	33,932	56,701	70,241	58,686	5.0	3.6	16	
	Sun	3/4/2007	16:30	6.5	90,000	231	739.11	115.5	42,302	36,351	60,743	85.0	31,617	33,964	56,753	70,315	58,748	6.0	5.0	18	

US EPA Arsenic Demonstration Project at Stevensville - Daily System Operation Log Sheet (Continued)

				Well House #1 Reading				Instrument Panel													
								Vessel A Flow Meter/Totalizer				Vessel B Flow Meter/Totalizer									
Week No.	Day of Week	Date	Time	Opt Hours Well 1	Daily Flow Totalizer	Avg Flowrate	APU Electric Meter	Flow Rate for Vesel A	Daily Flow Totalizer A	Cum. Flow Totalizer A	Bed Volume Totalizer A	Flow Rate for Vessel B	Daily Flow Totalizer B	Cum. Flow Totalizer B	Bed Volume Totalizer B	System Cum. Volume Treated	System Total Bed Volumes Treated[(a)]	Vessel ΔP (psi)		System ΔP (psi)	System Back-wash
				hr	gal	gpm	KWH	gpm	gal	Kgal	BV	gpm	gal	Kgal	BV	Kgal	BV	A	B	psig	Yes/No
141	Mon	3/5/2007	14:00	0.0	61,000	NA	739.20	125.9	303	36,351	60,744	99.5	261	33,964	56,754	70,315	58,749	7.4	5.4	18	
	Tue	3/6/2007	9:30	8.6	58,000	112	741.26	111.6	55,195	36,407	60,836	98.8	43,877	34,008	56,827	70,414	58,831	9.2	7.0	20	
	Wed	3/7/2007	9:40	0.3	4,000	222	741.42	114.2	1,260	36,408	60,838	102.7	1,147	34,009	56,829	70,417	58,833	9.0	6.6	20	
	Thu	3/8/2007	7:00	1.3	18,000	231	741.83	112.5	10,095	36,418	60,855	88.8	8,208	34,017	56,843	70,435	58,849	9.0	6.8	19	
	Fri	3/9/2007	10:35	9.6	84,000	146	744.15	124.5	60,327	36,478	60,956	94.5	48,355	34,065	56,924	70,544	58,940	8.9	6.2	20	
	Sat	3/10/2007	22:45	10.6	195,000	307	746.68	105.8	65,502	36,544	61,065	90.5	54,581	34,120	57,015	70,664	59,040	10.0	9.0	22	
	Sun	3/11/2007	16:30	0.4	0	-	746.81	105.8	0	36,544	61,065	90.5	0	34,120	57,015	70,664	59,040	10.0	9.0	22	
142	Mon	3/12/2007	14:00	1.1	20,000	303	747.10	116.6	9,558	36,553	61,081	93.9	9,723	34,130	57,031	70,683	59,056	10.4	8.4	20	
	Tue	3/13/2007	13:30	8.7	120,000	230	749.15	115.1	52,614	36,606	61,169	100.0	41,909	34,172	57,101	70,778	59,135	9.8	7.8	20	
	Wed	3/14/2007	14:00	0.3	4,000	222	749.25	116.8	3,782	36,610	61,175	95.4	1,503	34,173	57,104	70,783	59,139	9.8	7.6	20	
	Thu	3/15/2007	NM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	Fri	3/16/2007	14:00	6.7	135,000	336	751.55	120.6	61,766	36,671	61,278	95.9	49,338	34,222	57,186	70,894	59,232	9.6	7.0	22	
	Sat	3/17/2007	22:20	13.1	140,000	178	753.93	116.1	64,619	36,736	61,386	87.7	47,103	34,270	57,265	71,006	59,326	5.2	5.0	15	Yes
	Sun	3/18/2007	16:30	1.8	36,000	333	754.44	110.6	12,269	36,748	61,407	85.0	15,155	34,285	57,290	71,033	59,349	5.4	5.2	16	
143	Mon	3/19/2007	13:00	8.2	105,000	213	756.38	112.6	50,822	36,799	61,492	99.1	42,012	34,327	57,360	71,126	59,426	8.0	7.0	18	
	Tue	3/20/2007	14:45	0.0	1,000	NA	756.44	112.9	20,351	36,820	61,526	94.0	21,299	34,348	57,396	71,168	59,461	8.0	7.2	20	
	Wed	3/21/2007	11:00	9.5	131,000	230	758.65	113.7	16,997	36,837	61,554	94.2	30,381	34,378	57,447	71,215	59,500	9.5	9.0	20	
	Thu	3/22/2007	13:10	0.1	1,000	167	758.73	115.2	20,800	36,857	61,589	103.8	641	34,379	57,448	71,236	59,518	9.6	8.9	20	
	Fri	3/23/2007	9:25	8.7	121,000	232	760.76	110.8	53,109	36,910	61,678	101.8	46,939	34,426	57,526	71,336	59,602	8.0	7.0	18	
	Sat	3/24/2007	16:50	0.2	4,000	333	760.85	116.9	719	36,911	61,679	103.5	639	34,427	57,527	71,338	59,603	8.6	7.0	18	
	Sun	3/25/2007	17:30	8.1	112,000	230	762.73	110.0	48,570	36,960	61,760	97.0	42,589	34,469	57,598	71,429	59,679	8.8	7.0	18	
144	Mon	3/26/2007	9:10	2.6	37,000	237	763.38	109.1	16,900	36,977	61,788	98.0	11,992	34,481	57,618	71,458	59,703	8.0	7.0	18	
	Tue	3/27/2007	14:20	1.0	13,000	217	767.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	Wed	3/28/2007	NM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	Thu	3/29/2007	8:10	12.7	180,000	236	766.66	0.0	7,007	36,984	61,800	94.3	9,569	34,491	57,634	71,474	59,717	6.0	5.4	16	
	Fri	3/30/2007	7:25	0.4	5,000	208	766.78	0.0	1	36,984	61,800	99.9	1,957	34,493	57,638	71,476	59,719	6.0	5.6	18	
	Sat	3/31/2007	17:00	9.8	136,000	231	769.10	0.0	0	36,984	61,800	98.2	53,262	34,546	57,727	71,530	59,763	7.4	6.8	18	
	Sun	4/1/2007	17:00	0.6	9,000	250	769.27	0.0	1	36,984	61,800	98.0	3,440	34,549	57,732	71,533	59,766	7.8	7.0	19	

(a) Bed volume = 160 ft^3. or 1,196.88 gallons total for both vessels

(b) Pre-chlorination started November 9, 2004

(c) System switched to post-chlorination on April 18, 2005 due to high pressure readings across the vessels and system switched back to pre-chlorination on April 20, 2005.

(d) The power was shut off so the electric meter was re-set on September 6, 2005.

(e) MBF-122B valve on Vessel B was broken, therefore no flow went through vessel B and all flow went through vessel A on September 10 and September 11, 2005.

(f) System back online December 13, 2005

(g) Totalizer for Vessel A not working since January 13, 2006. Therefore, starting January 13, 2006, cumulative volume treated and cumulative bed volumes treated are calculated from the Well 1 flow totalizer.

(h) Totalizer for Vessel A was replaced and is working as of March 7, 2006.

NM = Not Measured

NA = Not Available

APPENDIX B

ANALYTICAL DATA

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD

Sampling Date		07/07/04[c]		07/13/04			07/20/04			07/27/04		08/03/04			08/18/04[e]	
Sampling Location / Parameter	Unit	IN	TT	IN	TA	TB	IN	TA	TB	IN	TT	IN	TA	TB	IN	TT
Bed Volume	10^3	–	1.0	–	1.6	1.7	–	2.2	2.3	–	2.9	–	3.3	3.4	–	4.5
Alkalinity	mg/L[a]	166	158	NA[d]	172	172	164	168	180	167	171	158	158	162	164	160
Fluoride	mg/L	0.8	0.8	NA[d]	0.9	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8
Sulfate	mg/L	5.3	5.3	NA[d]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	3.7	3.7
Orthophosphate	mg/L[b]	<0.10	<0.10	NA[d]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silica (as SiO_2)	mg/L	14.6	14.4	NA[d]	13.2	13.2	8.5	14.4	13.6	14.2	13.7	14.6	14.4	13.9	14.5	14.5
NO_3-(N)	mg/L	<0.20	<0.20	NA[d]	<0.04	0.09	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Turbidity	NTU	1.1	1.1	NA[d]	0.3	0.7	0.6	0.4	0.4	0.5	0.3	1.0	0.6	0.2	1.3	0.7
pH	–	8.0	8.0	NA[d]	7.9	7.9	8.1	8.0	8.0	8.2	8.0	8.1	7.9	7.9	7.7	7.8
Temperature	ºC	17.0	16.1	NA[d]	16.8	16.5	21.6	16.1	16.0	21.7	16.2	18.0	16.4	16.1	18.4	18.4
DO	mg/L	2.9	4.3	NA[d]	1.8	0.9	0.9	1.0	0.7	1.1	4.8	2.5	2.1	NA	NA	NA
ORP	mV	-64	-63	NA[d]	-50	-50	-112	-42	12	-119	-43	-122	-43	-18	-134	-7
Total Hardness	mg/L[a]	97.7	129.1	–	–	–	–	–	–	103.1	104.1	–	–	–	109.4	109.7
Ca Hardness	mg/L[a]	52.5	53.9	–	–	–	–	–	–	61.9	61.5	–	–	–	65.8	66.0
Mg Hardness	mg/L[a]	45.2	75.2	–	–	–	–	–	–	41.2	42.6	–	–	–	43.6	43.7
As (total)	µg/L	20.2	0.3	NA[d]	0.7	0.3	18.9	1.1	0.6	20.8	1.8	23.8	2.9	1.5	22.0	3.8
As (total soluble)	µg/L	19.4	0.2	–	–	–	–	–	–	21.7	1.8	–	–	–	22.0	4.0
As (particulate)	µg/L	0.8	0.1	–	–	–	–	–	–	<0.1	<0.1	–	–	–	<0.1	<0.1
As (III)	µg/L	20.2	0.2	–	–	–	–	–	–	22.4	2.1	–	–	–	22.3	3.7
As (V)	µg/L	<0.1	<0.1	–	–	–	–	–	–	<0.1	<0.1	–	–	–	<0.1	0.3
Total Fe	µg/L	234	116	NA[d]	<25	<25	248	<25	<25	210	<25	273	<25	<25	220	<25
Dissolved Fe	µg/L	210	80	–	–	–	–	–	–	201	<25	–	–	–	222	<25
Total Mn	µg/L	1.9	1.5	NA[d]	1.2	0.8	3.8	3.0	2.4	1.4	2.5	6.0	4.0	3.5	1.5	4.4
Dissolved Mn	µg/L	2.3	1.5	–	–	–	–	–	–	1.5	2.6	–	–	–	1.6	4.1

(a) As $CaCO_3$. (b) As PO_4. (c) Water quality parameters sampled on July 9, 2004. (d) Sampling error, no data available for this location. (e) Original arsenic speciation result for TT was re-analyzed.
IN = inlet; TA = after vessel A; TB = after vessel B; TT = after vessels combined.
NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		08/31/04			09/22/04[c]		10/07/04			10/19/04		10/26/04		11/03/04		
Sampling Location / Parameter	Unit	IN	TA	TB	IN	TT	IN	TA	TB	IN	TT	IN	TT	IN	TA	TB
Bed Volume	10^3	–	5.5	5.7	–	7.4	–	8.2	8.6	–	9.2	–	9.6	–	9.8	10.2
Alkalinity	mg/L[a]	171	171	171	166	166	166 166	166 162	166 162	162	162	164	164	164	164	164
Fluoride	mg/L	0.6	0.6	0.7	0.5	0.6	0.7 0.9	0.8 0.9	0.8 0.8	0.7	0.8	0.5	0.6	0.6	0.5	0.5
Sulfate	mg/L	5.3	5.3	<5.0	3.3	3.4	–	–	–	4.0	4.0	4.0	4.0	–	–	–
Orthophosphate	mg/L[b]	<0.10	<0.10	<0.10	<0.06	<0.06	<0.06 <0.06	<0.06 <0.06	<0.06 <0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Silica (as SiO_2)	mg/L	14.6	14.5	14.4	14.7	14.2	14.5 14.2	14.3 14.2	14.3 13.9	14.4	14.3	14.6	14.4	14.1	14.2	14.1
NO_3-(N)	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	–	–	–	<0.04	<0.04	<0.04	<0.04	–	–	–
Turbidity	NTU	0.9	0.3	0.5	0.6	0.1	0.8 0.7	0.3 0.5	0.6 0.5	0.9	0.3	0.5	0.1	0.7	0.4	0.4
pH	–	8.0	8.0	8.0	8.0	8.1	8.0	8.2	8.3	8.0	8.1	7.7	7.8	7.6	7.6	7.7
Temperature	ºC	18.0	17.9	17.7	15.4	15.5	15.4	15.4	15.4	15.7	15.8	14.9	14.7	18.5	18.4	18.6
DO	mg/L	NA	NA	NA	2.2	3.8	2.2	0.8	1.0	1.8	5.4	1.6	5.5	1.6	2.6	2.2
ORP	mV	-99	-10	53	-14	-62	-140	-63	-44	-126	-76	-132	-74	-148	-112	-83
Total Hardness	mg/L[a]	–	–	–	112.4	109.3	–	–	–	110.3	114.8	116.7	111.0	–	–	–
Ca Hardness	mg/L[a]	–	–	–	66.6	65.2	–	–	–	55.8	62.3	63.6	57.9	–	–	–
Mg Hardness	mg/L[a]	–	–	–	45.8	44.1	–	–	–	54.5	52.5	53.1	53.1	–	–	–
As (total)	µg/L	22.4	8.6	5.9	20.6	11.1	19.2 25.8	13.1 11.9	9.2 12.1	18.4	13.2	19.4	13.3	20.2	14.8	12.9
As (total soluble)	µg/L	–	–	–	20.9	NA	–	–	–	–	–	19.0	13.1	–	–	–
As (particulate)	µg/L	–	–	–	<0.1	–	–	–	–	–	–	0.4	0.2	–	–	–
As (III)	µg/L	–	–	–	12.8/ 12.3	10.2	–	–	–	14.9	13.1	19.7	13.2	–	–	–
As (V)	µg/L	–	–	–	8.1/ 7.6	–	–	–	–	–	–	<0.1	<0.1	–	–	–
Total Fe	µg/L	193	<25	<25	271	<25	236 315	77 <25	<25 <25	208	<25	210	<25	273	68	38
Dissolved Fe	µg/L	–	–	–	161/ 150	–	–	–	–	–	–	180	<25	–	–	–
Total Mn	µg/L	1.5	5.3	5.4	2.7	6.7	3.0 2.7	17.9 6.8	6.2 9.6	1.5	5.7	1.5	5.8	1.6	6.2	6.4
Dissolved Mn	µg/L	–	–	–	3.1	–	–	–	–	–	–	1.6	5.9	–	–	–

(a) As $CaCO_3$. (b) As PO_4. (c) (/) indicates re-run data with original result/re-run result.
IN = inlet; TA = after vessel A; TB = after vessel B; TT = after vessels combined.
NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		11/09/04[c]	11/16/04[g]			11/23/04	12/01/04 [e][g]				12/07/04[g]		12/15/04[g]		
Sampling Location Parameter	Unit	TT	IN	AC	TT	TT	IN	AC	TA	TB	AC	TT	IN	AC	TT
Bed Volume	10^3	10.1	–	–	10.5	10.7	–	–	11.2	11.2	–	11.3	–	–	11.7
Alkalinity	mg/L[a]	152	176	176	164	162	158 162	154 162	154 162	154 162	166	166	163	167	163
Fluoride	mg/L	0.6	0.7	0.7	0.7	0.8	0.8 0.9	1.1 0.9	1.0 0.2	0.8 0.9	0.9	0.8	0.8	0.9	0.9
Sulfate	mg/L	3.1	1.5	2.7	3.1	3.5	–	–	–	–	6.0	6.0	3.7	3.7	3.7
Orthophosphate	mg/L[b]	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06 <0.06	1.6[f]/4.1 1.3[f]	<0.06 <0.06	<0.06 <0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Silica (as SiO_2)	mg/L	14.9	15.9	14.6	15.4	15.4	14.6 14.3	14.3 14.4	14.6 14.5	14.6 14.8	15.0	14.8	15.8	14.9	14.7
NO_3-(N)	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	–	–	–	–	<0.04	<0.04	<0.04	<0.04	<0.04
Turbidity	NTU	0.3	3.0	0.5	0.4	0.1	1.5 1.1	0.2 0.1	0.1 0.2	0.2 0.1	0.3	0.2	0.5	0.6	0.2
pH	–	7.8	7.7	NA[d]	7.7	NA[d]	7.4	NA[d]	7.4	7.2	NA[d]	NA[d]	8.1	7.8	7.3
Temperature	ºC	18.0	18.4	NA[d]	17.9	NA[d]	15.2	NA[d]	15.5	15.5	NA[d]	NA[d]	15.2	14.9	15.5
DO	mg/L	5.8	4.7	NA[d]	2.1	NA[d]	4.2	NA[d]	1.7	1.4	NA[d]	NA[d]	5.5	NA[d]	5.6
ORP	mV	286	160	NA[d]	126	NA[d]	101	NA[d]	114	120	NA[d]	NA[d]	-119	NA[d]	88
Free Chlorine	mg/L	–	–	–	–	–	–	–	–	–	–	–	–	0.4	–
Total Chlorine	mg/L	–	–	–	–	–	–	–	–	–	–	–	–	0.1	–
Total Hardness	mg/L[a]	98.8	98.6	95.5	92.5	111.9	–	–	–	–	96.4	112.1	114.4	113.3	107.8
Ca Hardness	mg/L[a]	56.6	50.2	48.4	47.7	66.1	–	–	–	–	54.8	67.5	67.3	66.7	63.9
Mg Hardness	mg/L[a]	42.2	48.4	47.1	44.8	45.8	–	–	–	–	41.6	44.6	47.1	46.6	43.9
As (total)	µg/L	14.7	19.0	19.9	12.0	0.9	18.3 18.8	0.4 0.4	0.4 0.4	0.3 0.3	22.1	0.6	20.0	18.8	0.3
As (total soluble)	µg/L	14.6	19.0	12.2	11.9	0.9	–	–	–	–	15.2	0.7	20.0	19.0	0.2
As (particulate)	µg/L	0.1	<0.1	7.7	0.1	<0.1	–	–	–	–	6.9	<0.1	<0.1	<0.1	<0.1
As (III)	µg/L	14.8	18.4	0.2	10.4	0.4	–	–	–	–	1.6	1.3/ <0.1	20.3	<0.1	0.5
As (V)	µg/L	<0.1	0.6	12.0	1.5	0.5	–	–	–	–	13.6	<0.1	<0.1	18.0	<0.1
Total Fe	µg/L	108	802/ 775	268	<25	<25	261 264	<25 <25	<25 <25	<25 <25	212	<25	229	229	<25
Dissolved Fe	µg/L	61	777/ 796	<25	<25	<25	–	–	–	–	<25	<25	156	173/ 179	<25
Total Mn	µg/L	10.1	9.8	2.1	11.5	4.3	2.6 2.6	2.5 2.5	2.0 2.1	3.0 3.0	1.5	2.0	2.5	1.6	2.0
Dissolved Mn	µg/L	10.4	14.3	0.3	11.2	4.1	–	–	–	–	0.2	1.9	2.1	1.7	1.5

(a) As $CaCO_3$. (b) As PO_4. (c) Pre-chlorination started November 9, 2004. (d) Weekly onsite water quality parameters not measured. (e) Weekly onsite water quality parameters measured on December 2, 2004. ORP measured on December 3, 2004. (f) Samples were analyzed outside of hold time. (g) (/) indicates re-run data with original result/re-run result.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined.
NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		01/04/05[c]				01/11/05[c]		01/20/05[c]			01/26/05		02/01/05[f]			
Sampling Location / Parameter	Unit	IN	AC	TA	TB	AC	TT	IN	AC	TT	AC	TT	IN	AC	TA	TB
Bed Volume	10^3	–	–	12.8	12.6	–	12.8	–	–	13.2	–	13.5	–	–	14.1	13.7
Alkalinity	mg/L[a]	165	–	160	165	170	161	172	172	172	174	176	171	–	180	180
Fluoride	mg/L	0.8	–	0.7	0.7	0.9	0.9	1.0	1.0	1.0	0.9	0.27	0.8	–	0.8	0.8
Sulfate	mg/L	–	–	–	–	4.0	4.0	4.0	4.0	4.0	4.0	4.9/<1.0	–	–	–	–
Orthophosphate	mg/L[b]	<0.06	–	<0.06	<0.06	<0.06	<0.06	<0.05	<0.05	<0.05	0.1	0.1	<0.05	–	<0.05	<0.05
Silica (as SiO_2)	mg/L	15.2	–	15.2	15.3	15.0	14.8	13.6	13.6	14.1	13.6	13.1	13.6	–	13.5	13.4
NO_3-(N)	mg/L	–	–	–	–	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.5/0.4	–	–	–	–
Turbidity	NTU	0.6	–	0.2	0.1	<0.1	0.2	1.3	0.2	<0.1	0.2	<0.1	0.4	–	<0.1	<0.1
pH	–	7.4	–	7.2	7.7	7.7	7.7	7.4	7.6	7.4	7.5	7.4	NA[e]	–	NA[e]	NA[e]
Temperature	ºC	15.8	–	16.1	16.0	17.4	17.6	16.8	15.4	15.3	15.5	15.4	NA[e]	–	NA[e]	NA[e]
DO	mg/L	3.3	–	1.4	1.3	1.6	4.4	4.9	1.8	3.1	2.6	4.8	NA[e]	–	NA[e]	NA[e]
ORP	mV	-116	–	84	83	256	294	177	398	380	184	344	NA[e]	–	NA[e]	NA[e]
Free Chlorine	mg/L	–	0.04	–	–	1.1	–	–	0.4	–	0.5	–	–	0.5	–	–
Total Chlorine	mg/L	–	0.0	–	–	1.4	–	–	2.0	–	0.7	–	–	0.7	–	–
Total Hardness	mg/L[a]	–	–	–	–	97.3	92.9	96.3	97.1	103.0	90.2	90.2	–	–	–	–
Ca Hardness	mg/L[a]	–	–	–	–	57.8	56.7	55.4	55.7	60.0	53.8	53.6	–	–	–	–
Mg Hardness	mg/L[a]	–	–	–	–	39.5	36.2	40.9	41.4	43.0	36.4	36.6	–	–	–	–
As (total)	µg/L	16.0	–	1.2	0.4	18.7	0.4	17.4	17.5	0.6	22.6	0.4	18.0	–	0.3	0.1
As (total soluble)	µg/L	–	–	–	–	12.8	0.2	18.1	11.2	0.5	13.4	0.4	–	–	–	–
As (particulate)	µg/L	–	–	–	–	5.9	0.2	<0.1	6.3	0.1	9.2	<0.1	–	–	–	–
As (III)	µg/L	–	–	–	–	0.3	0.4	18.6	0.2	0.5	0.5	0.4	–	–	–	–
As (V)	µg/L	–	–	–	–	12.5	<0.1	<0.1	11.0	<0.1	12.9	<0.1	–	–	–	–
Total Fe	µg/L	239	–	<25	<25	241	<25	216	225	<25	325	<25	396	–	<25	<25
Dissolved Fe	µg/L	–	–	–	–	<25	<25	181	<25	<25	<25	<25	–	–	–	–
Total Mn	µg/L	1.7	–	1.3	2.6	1.6	1.2	1.9	1.8	1.1	2.2	1.0	11.0/9.8	–	1.4	1.1
Dissolved Mn	µg/L	–	–	–	–	0.1	1.2	1.5	0.2	0.8	0.2	1.0	–	–	–	–

(a) As $CaCO_3$. (b) As PO_4. (c) Due to problems with pre-chlorination, the system switched to post-chlorination from December 29, 2004 to January 5, 2005. The system switched back to pre-chlorination from January 6, 2005 to January 7, 2005 and then to post-chlorination from January 8, 2005 to January 11, 2005. Finally the system switched back to pre-chlorination on January 12, 2005.
(e) Weekly onsite water quality parameter not measured. (f) (/) indicates re-run data with original result/re-run result.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined.
NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		02/15/05[c]			03/02/05				03/16/05			03/31/05			
Sampling Location / Parameter	Unit	IN	AC	TT	IN	AC	TA	TB	IN	AC	TT	IN	AC	TA	TB
Bed Volume	10^3	–	–	14.3	–	–	15.5	14.8	–	–	15.6	–	–	16.9	15.9
Alkalinity	mg/L[a]	187	174	178	174 174	161 161	178 174	165 169	183	183	178	167	176	158	167
Fluoride	mg/L	0.8	0.9	0.8	0.8 0.9	0.8 0.8	0.8 0.8	0.8 0.8	0.8	0.8	0.8	0.9	0.9	0.9	1.0
Sulfate	mg/L	4.0	4.0	4.0	–	–	–	–	4.0	4.0	4.0	–	–	–	–
Orthophosphate	mg/L[b]	<0.05	<0.05	<0.05	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silica (as SiO_2)	mg/L	15.3	15.0	15.2	15.0 15.2	14.9 15.1	14.9 15.1	15.1 15.0	15.1	14.9	14.7	14.9	15.0	15.0	14.7
NO_3-(N)	mg/L	0.1	<0.05	0.1	–	–	–	–	<0.05	<0.05	<0.05	–	–	–	–
Turbidity	NTU	0.9	0.3	<0.1	0.7 0.7	0.1 0.1	<0.1 <0.1	<0.1 <0.1	0.8	0.3	0.3	1.6	0.6	0.3	<0.1
pH	–	8.1	7.9	7.8	7.9	7.6	7.5	7.5	7.8	7.6	7.6	7.4	7.5	7.4	7.5
Temperature	ºC	16.3	14.4	15.1	14.3	15.2	15.4	15.5	15.3	15.2	15.5	15.0	15.3	15.2	15.3
DO	mg/L	4.3	1.1	3.8	5.4	2.1	1.3	1.1	5.8	2.0	5.6	2.8	3.2	2.9	3.0
ORP	mV	9	557	612	-87	603	592	614	-73	60	-10	213	215	212	213
Free Chlorine	mg/L	–	0.7	–	–	1.0	–	–	–	0.9	–	–	0.1	–	–
Total Chlorine	mg/L	–	2.2	–	–	1.2	–	–	–	1.3	–	–	1.4	–	–
Total Hardness	mg/L[a]	106.3	100.4	99.1	–	–	–	–	103.2	103.5	101.2	–	–	–	–
Ca Hardness	mg/L[a]	66.2	59.0	56.5	–	–	–	–	59.0	60.1	55.6	–	–	–	–
Mg Hardness	mg/L[a]	40.1	41.4	42.6	–	–	–	–	44.2	43.4	45.6	–	–	–	–
As (total)	µg/L	21.7	21.8	0.5	21.6 21.4	21.8 21.6	0.8 0.6	0.4 0.4	22.1	20.8	0.7	18.1	17.2	0.7	0.4
As (total soluble)	µg/L	21.7	11.9	0.2	–	–	–	–	21.8	14.4	0.6	–	–	–	–
As (particulate)	µg/L	<0.1	9.9	0.3	–	–	–	–	0.3	6.4	1.7	–	–	–	–
As (III)	µg/L	22.7	0.5	0.4	–	–	–	–	22.5	0.5	0.6	–	–	–	–
As (V)	µg/L	<0.1	11.4	<0.1	–	–	–	–	<0.1	13.9	<0.1	–	–	–	–
Total Fe	µg/L	377	313	<25	327 297	228 224	<25 <25	<25 <25	458	309	<25	230	239	<25	<25
Dissolved Fe	µg/L	398	<25	<25	–	–	–	–	495	<25	<25	–	–	–	–
Total Mn	µg/L	4.1	1.6	<0.1	3.0 2.5	3.3 2.0	0.5 <0.1	0.1 <0.1	4.0	2.2	8.5	1.7	1.8	<0.1	<0.1
Dissolved Mn	µg/L	4.2	0.3	0.2	–	–	–	–	5.3	0.3	<0.1	–	–	–	–

(a) As $CaCO_3$. (b) As PO_4. (c) Onsite water quality parameters taken on February 10, 2005.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		04/13/05			04/25/05				05/11/05[c]			05/24/05			
Sampling Location / Parameter	Unit	IN	AC	TT	IN	AC	TA	TB	IN	AC	TT	IN	AC	TA	TB
Bed Volume	10^3	–	–	16.9	–	–	18.4	17.0	–	–	18.5	–	–	20.4	18.5
Alkalinity	mg/L[a]	178	178	178	178	186	182	178	198	185	176	178 183	183 178	183 178	178 178
Fluoride	mg/L	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8 0.8	0.8 0.8	0.8 0.8	0.8 0.8
Sulfate	mg/L	3.3	3.4	3.1	–	–	–	–	4.2	4.3	4.3	–	–	–	–
Orthophosphate	mg/L[b]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05
Silica (as SiO_2)	mg/L	15.6	15.2	15.6	15.4	14.8	15.2	14.8	15.3	14.7	15	8.6 14.4	14.2 14.7	14.4 14.4	14.2 14.4
NO_3-(N)	mg/L	<0.05	<0.05	0.6	–	–	–	–	<0.05	<0.05	<0.05	–	–	–	–
Turbidity	NTU	0.5	0.4	0.3	0.4	0.3	0.1	<0.1	0.7	0.8	0.3	0.5 0.5	0.2 0.3	0.4 0.4	0.2 0.4
pH	–	8.0	7.9	8.3	7.7	7.6	7.6	7.5	7.7	7.6	7.5	7.6	7.6	7.5	7.5
Temperature	ºC	15.0	14.9	14.8	14.6	15.2	15.4	15.3	16.1	15.6	15.2	15.4	15.5	15.3	15.5
DO	mg/L	5.6	3.2	4.2	6.1	3.3	2.5	2.2	3.1	2.1	2.1	4.2	4.1	4.6	3.2
ORP	mV	-80	307	313	-62	-50	-43	-44	220	210	166	21	165	201	220
Free Chlorine	mg/L	–	0.2	–	–	0.8	–	–	–	0.4	–	–	0.5	–	–
Total Chlorine	mg/L	–	1.4	–	–	1.0	–	–	–	0.5	–	–	0.7	–	–
Total Hardness	mg/L[a]	99.7	98.7	96.8	–	–	–	–	97.9	101.0	95.7	–	–	–	–
Ca Hardness	mg/L[a]	58.1	57.4	56.3	–	–	–	–	57.6	58.7	55.1	–	–	–	–
Mg Hardness	mg/L[a]	41.6	41.3	40.5	–	–	–	–	40.3	42.0	40.6	–	–	–	–
As (total)	µg/L	17.6	17.3	0.6	19.9	19.9	0.9	0.6	18.2	19.1/ 20.3	7.7/ 7.7	20.1 19.3	19.6 20.4	1.3 1.0	0.7 0.4
As (total soluble)	µg/L	17.8	12.4	0.6	–	–	–	–	18.7	18.7/ 20.8	1.5/ 1.6	–	–	–	–
As (particulate)	µg/L	<0.1	4.9	<0.1	–	–	–	–	<0.1	0.4/ <0.1	6.2/ 6.1	–	–	–	–
As (III)	µg/L	18.1	0.4	0.4	–	–	–	–	19.4	18.6/ 20.0	0.3/ 0.5	–	–	–	–
As (V)	µg/L	<0.1	12.0	0.2	–	–	–	–	<0.1	0.1/ 0.8	1.2/ 1.1	–	–	–	–
Total Fe	µg/L	267	281	<25	208	223	30	<25	304	258/ 202	361/ 293	204 197	208 242	<25 <25	<25 <25
Dissolved Fe	µg/L	218	32	<25	–	–	–	–	249	204/ 200	<25/ <25	–	–	–	–
Total Mn	µg/L	1.7	1.6	0.1	1.3	1.4	0.3	<0.1	2.3	1.9/ 1.8	1.9/ 1.8	1.4 1.5	1.5 1.5	<0.1 <0.1	<0.1 <0.1
Dissolved Mn	µg/L	1.7	0.3	<0.1	–	–	–	–	2.7	1.9/ 2.0	0.3/ 0.3	–	–	–	–

(a) As $CaCO_3$. (b) As PO_4. (c) (/) indicates re-run data with original result/re-run result.

IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		06/09/05				06/22/05			07/05/05[d]				07/19/05[e]			
Sampling Location / Parameter	Unit	IN	AC	TA	TB	IN	AC	TT	IN	AC	TA	TB	IN	AC	TT	PT
Bed Volume	10^3	–	–	21.6	19.3	–	–	21.5	–	–	24.9	21.7	–	–	24.1	–
Alkalinity	mg/L[a]	176	176	176	176	176	176	176	185	180	180	176	176	176	176	–
Fluoride	mg/L	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.1	–
Sulfate	mg/L	–	–	–	–	4	5	4	–	–	–	–	5	5	5	–
Orthophosphate	mg/L[b]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	–
Silica (as SiO_2)	mg/L	15.0	15.3	15.5	15.3	14.8	14.8	15.0	15.3	15.2	15.3	14.9	14.4	14.1	14.1	–
NO_3-(N)	mg/L	–	–	–	–	<0.05	<0.05	<0.05	–	–	–	–	<0.05	<0.05	0.1	–
Turbidity	NTU	1.2	0.4	0.3	0.2	1.1	0.6	0.6	0.5	1.5	0.6	0.2	1.1	0.7	<0.1	–
pH	–	8.0	7.8	7.9	7.9	8.1	7.7	7.7	8.1	8.1	7.9	7.9	7.6	7.5	7.5	7.5
Temperature	ºC	20.0	16.0	16.4	16.2	16.4	15.8	15.8	16.8	17.4	17.6	17.4	17.3	17.2	17.0	12.0
DO	mg/L	NA[c]	NA[c]	NA[c]	NA[c]	7.1	3.3	6.1	4.3	3.2	1.5	1.4	6.1	3.4	6.1	–
ORP	mV	NA[c]	NA[c]	NA[c]	NA[c]	-91	450	435	-29	304	368	383	65	165	242	–
Free Chlorine	mg/L	–	0.6	–	–	–	0.3	–	–	0.1	–	–	–	0.6	–	0.3
Total Chlorine	mg/L	–	0.3	–	–	–	0.5	–	–	1.4	–	–	–	0.7	–	0.6
Total Hardness	mg/L[a]	–	–	–	–	95.9	98.1	97.4	–	–	–	–	91.4	98.2	103	–
Ca Hardness	mg/L[a]	–	–	–	–	56.1	57.6	55.2	–	–	–	–	56.5	58.8	63.5	–
Mg Hardness	mg/L[a]	–	–	–	–	39.7	40.4	42.2	–	–	–	–	34.9	39.4	39.2	–
As (total)	µg/L	19.0	18.8	1.1	0.6	20.8	22.2	1.0	18.3	17.7	1.8	0.9	20.9	20.8/ 22.3	3.5	–
As (total soluble)	µg/L	–	–	–	–	20.2	14.4	1.0	–	–	–	–	17.8	19.2/ 19.9	1.1	–
As (particulate)	µg/L	–	–	–	–	0.6	7.8	<0.1	–	–	–	–	3.0	1.7/2.3	2.4	–
As (III)	µg/L	–	–	–	–	21.4	0.6	0.6	–	–	–	–	18.7	19.7/ 20.7	1.0	–
As (V)	µg/L	–	–	–	–	<0.1	13.8	0.4	–	–	–	–	<0.1	<0.1/ <0.1	0.1	–
Total Fe	µg/L	239	224	<25	<25	228	333	<25	205	209	<25	<25	254	232/219	<25	–
Dissolved Fe	µg/L	–	–	–	–	197	<25	<25	–	–	–	–	192	197/184	<25	–
Total Mn	µg/L	1.7	1.6	0.1	0.1	1.7	1.7	0.9	1.6	1.5	1.2	0.6	2.2	1.6	0.4	–
Dissolved Mn	µg/L	–	–	–	–	1.6	0.5	1.0	–	–	–	–	1.7	1.6	0.4	–

(a) As $CaCO_3$. (b) As PO_4. (c) Meter was not working and could not calibrate DO and ORP. (d) Water quality measurements taken on July 7, 2005. (e) (/) indicates re-run data with original result/re-run result.

IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		08/03/05					08/16/05[c]				08/30/05				
Sampling Location Parameter	Unit	IN	AC	TA	TB	PT	IN	AC	TT	PT	IN	AC	TA	TB	PT
Bed Volume	10^3	–	–	27.3	23.8	–	–	–	26.2	–	–	–	29.4	25.7	–
Alkalinity	mg/L[a]	163	167	167	172	–	172	167	167	–	167	154	167	167	–
Fluoride	mg/L	0.8	0.8	0.8	0.8	–	0.8	0.8	0.8	–	0.9	0.8	0.8	0.8	–
Sulfate	mg/L	–	–	–	–	–	4	4	4	–	–	–	–	–	–
Orthophosphate	mg/L[b]	<0.05	<0.05	<0.05	<0.05	–	<0.05	<0.05	<0.05	–	<0.05	<0.05	<0.05	<0.05	–
Silica (as SiO_2)	mg/L	14.4	14.2	14.4	14.1	–	15.2	15.1	14.7	–	23.4	18.8	18.5	18.9	–
NO_3-(N)	mg/L	–	–	–	–	–	0.1	0.4	<0.05	–	–	–	–	–	–
Turbidity	NTU	1.3	0.9	0.2	<0.1	–	0.4	0.9	0.1	–	0.3	0.2	<0.1	0.5	–
pH	–	7.8	7.5	7.5	7.6	7.4	7.1	7.6	7.4	7.4	8.1	7.7	7.9	7.9	7.6
Temperature	ºC	17.3	17.3	17.2	17.2	17.0	16.9	16.9	16.2	16.9	17.1	16.8	18.0	18.5	16.8
DO	mg/L	6.6	2.9	3.1	2.6	–	5.1	2.1	4.2	–	4.7	2.3	1.1	1.3	–
ORP	mV	-103	-144	-23	-3	–	-121	-143	30	–	-120	326	394	395	–
Free Chlorine	mg/L	–	0.1	–	–	0.1	–	0.1	–	0.2	–	0.2	–	–	0.1
Total Chlorine	mg/L	–	0.2	–	–	0.3	–	0.0	–	0.8	–	1.6	–	–	1.1
Total Hardness	mg/L[a]	–	–	–	–	–	107.0	102.0	160.0	–	–	–	–	–	–
Ca Hardness	mg/L[a]	–	–	–	–	–	58.7	57.2	90.0	–	–	–	–	–	–
Mg Hardness	mg/L[a]	–	–	–	–	–	48.4	44.9	70.0	–	–	–	–	–	–
As (total)	µg/L	18.9	19.3	3.1	1.0	–	19.7	18.5	3.0	–	18.6	19.2	1.9	1.1	–
As (total soluble)	µg/L	–	–	–	–	–	19.1	18.5	2.0	–	–	–	–	–	–
As (particulate)	µg/L	–	–	–	–	–	0.6	<0.1	1.0	–	–	–	–	–	–
As (III)	µg/L	–	–	–	–	–	19.6	18.7	1.3	–	–	–	–	–	–
As (V)	µg/L	–	–	–	–	–	<0.1	<0.1	0.7	–	–	–	–	–	–
Total Fe	µg/L	473	304	<25	<25	–	211	219	<25	–	220	222	<25	<25	–
Dissolved Fe	µg/L	–	–	–	–	–	157	189	<25	–	–	–	–	–	–
Total Mn	µg/L	2.7	2.1	0.8	0.3	–	1.5	1.6	1.1	–	1.5	1.4	0.7	0.7	–
Dissolved Mn	µg/L	–	–	–	–	–	1.7	1.7	0.7	–	–	–	–	–	–

(a) As $CaCO_3$. (b) As PO_4. (c) Onsite water quality measurements taken on August 15, 2005.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		09/21/05				10/05/05					10/12/05			
Sampling Location Parameter	Unit	IN	AC	TT	PT	IN	AC	TA	TB	PT	IN	AC	TT	PT
Bed Volume	10^3	–	–	29.4	–	–	–	33.0	28.7	–	–	–	31.1	–
Alkalinity	mg/L[a]	167	176	176	–	158	167	176	176	–	176	172	167	–
Fluoride	mg/L	0.8	0.8	0.8	–	0.8	0.8	0.8	0.8	–	0.8	0.8	0.8	–
Sulfate	mg/L	4.0	4.0	4.0	–	3.7	3.7	3.7	3.7	–	3.8	3.8	3.8	–
Orthophosphate	mg/L[b]	<0.05	<0.05	<0.05	–	<0.05	<0.05	<0.05	<0.05	–	–	–	–	–
Total P (as P)	µg/L	–	–	–	–	–	–	–	–	–	19.0	19.1	<10.0	–
Silica (as SiO_2)	mg/L	11.9	12.0	11.9	–	13.7	15.2	14.3	13.7	–	13.3	14.5	14.3	–
NO_3-(N)	mg/L	<0.05	<0.05	<0.05	–	0.2	0.2	<0.05	<0.05	–	<0.05	<0.05	<0.05	–
Turbidity	NTU	0.6	0.7	0.3	–	0.4	0.2	<0.1	0.3	–	0.4	0.3	<0.1	–
pH	–	8.1	8.0	8.0	7.8	7.5	7.7	7.3	7.3	7.1	8.1	8.0	7.8	7.7
Temperature	ºC	16.4	16.2	16.1	16.6	16.0	16.1	16.2	16.5	15.9	15.9	15.9	15.7	15.8
DO	mg/L	5.6	4.4	5.3	–	6.1	4.8	2.5	1.6	–	5.0	2.6	4.3	–
ORP	mV	-122	-136	76	–	190	246	225	211	–	42	503	539	–
Free Chlorine	mg/L	–	0.2	–	0.1	–	0.0	–	–	0.1	–	0.3	–	0.1
Total Chlorine	mg/L	–	0.0	–	1.2	–	0.0	–	–	2.1	–	0.8	–	0.7
Total Hardness	mg/L[a]	90.9	95.9	95.7	–	–	–	–	–	–	100	99.4	98.8	–
Ca Hardness	mg/L[a]	53.9	56.6	55.1	–	–	–	–	–	–	57.2	57.0	56.6	–
Mg Hardness	mg/L[a]	37.0	39.3	40.6	–	–	–	–	–	–	43.1	42.5	42.1	–
As (total)	µg/L	18.0	18.0	2.0	–	16.7	16.8	6.1	2.3	–	25.2	21.5	1.8	–
As (total soluble)	µg/L	18.2	18.4	2.1	–	–	–	–	–	–	26.0	12.3	1.7	–
As (particulate)	µg/L	<0.1	<0.1	<0.1	–	–	–	–	–	–	<0.1	9.2	0.1	–
As (III)	µg/L	17.0	18.2	0.9	–	–	–	–	–	–	15.7	0.4	0.4	–
As (V)	µg/L	1.2	0.2	1.2	–	–	–	–	–	–	10.3	11.9	1.2	–
Total Fe	µg/L	205	210	<25	–	223	214	<25	<25	–	217	210	<25	–
Dissolved Fe	µg/L	45	196	<25	–	–	–	–	–	–	251	<25	<25	–
Total Mn	µg/L	1.4	1.5	0.4	–	1.2	1.2	1.3	0.2	–	1.6	1.6	1.6	–
Dissolved Mn	µg/L	1.6	1.7	0.4	–	–	–	–	–	–	1.6	0.2	1.5	–

(a) As $CaCO_3$. (b) As PO_4.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		12/13/05[b]				01/03/06				02/06/06[c] [d]			
Sampling Location Parameter	Unit	IN	AC	TT	PT	IN	AC	TT	PT	IN	AC	TT	PT
Bed Volume	10^3	–	–	32.2	–	–	–	33.0	–	–	–	34.6	–
Alkalinity	mg/L[a]	180	176	176	–	176	172	167	–	168	164	155	–
Fluoride	mg/L	0.8	0.7	0.7	–	0.7	0.7	0.7	–	0.7	0.7	0.7	–
Sulfate	mg/L	3.6	3.7	3.7	–	3.9	4.0	4.0	–	3.7	3.8	3.8	–
Total P (as P)	µg/L	28.6	12.9	<10.0	–	14.2	16.4	<10.0	–	13.3	<10.0	17.2	–
Silica (as SiO_2)	mg/L	15.6	18.3	17.1	–	14.5	14.4	14.4	–	14.5	15.1	15.0	–
NO_3-(N)	mg/L	<0.05	<0.05	<0.05	–	<0.05	<0.05	<0.05	–	<0.05	<0.05	<0.05	–
Turbidity	NTU	1.0	1.5	0.2	–	0.4	0.3	0.1	–	1.5	0.5	0.3	–
pH	–	7.9	7.8	7.6	7.6	7.7	7.6	7.5	7.4	7.6	7.6	7.5	7.6
Temperature	ºC	15.1	15.2	15.1	14.9	15.0	15.2	15.2	15.1	15.2	15.2	15.2	15.3
DO	mg/L	4.3	4.1	2.9	–	6.6	3.5	3.11	–	4.2	5.6	3.1	–
ORP	mV	-130	160	160	–	-95	155	253	–	10	110	145	–
Free Chlorine	mg/L	–	0.2	–	0.0	–	0.4	–	0.2	–	0.2	–	0.2
Total Chlorine	mg/L	–	0.3	–	0.0	–	0.5	–	0.4	–	0.3	–	0.3
Total Hardness	mg/L[a]	93.1	92.1	90.0	–	104	103	101	–	96.6	101	98.6	–
Ca Hardness	mg/L[a]	45.6	44.6	44.3	–	60.5	59.8	59.0	–	54.5	59.0	55.6	–
Mg Hardness	mg/L[a]	47.5	47.4	45.7	–	43.7	43.0	42.5	–	42.2	42.2	43.1	–
As (total)	µg/L	18.1	17.4	1.1	–	19.5	18.9	1.5	–	20.9	21.0	2.4	–
As (total soluble)	µg/L	17.4	17.2	1.1	–	20.8	13.8	1.6	–	20.2	12.9	2.2	–
As (particulate)	µg/L	0.6	0.2	<0.1	–	<0.1	5.1	<0.1	–	0.7	0.1	0.2	–
As (III)	µg/L	17.1	17.0	0.7	–	20.2	0.3	0.2	–	19.8	0.3	0.4	–
As (V)	µg/L	0.3	0.2	0.4	–	0.6	13.5	1.3	–	0.4	12.5	1.8	–
Total Fe	µg/L	454	376	<25	–	250	233	<25	–	331	212	<25	–
Dissolved Fe	µg/L	479	363	<25	–	221	<25	<25	–	287	<25	<25	–
Total Mn	µg/L	5.1	3.8	0.2	–	2.3	1.8	0.2	–	2.8	1.3	<0.1	–
Dissolved Mn	µg/L	5.7	3.8	0.1	–	2.4	0.6	0.8	–	2.7	<0.1	<0.1	–

(a) As $CaCO_3$. (b) Treatment plant was switched off between November 3, 2005 and December 12, 2005 due to drilling of new well in well house No. 1 and was placed back online December 13, 2005. (c) Samples at the AC and TT locations were switched but the results have been corrected to reflect the change. (d) Onsite water quality parameters taken on February 27, 2006.

IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		03/05/06[b]				04/10/06				5/05/06				
Sampling Location / Parameter	Unit	IN	AC	TT	PT	IN	AC	TT	PT	IN	AC	TA	TB	PT
Bed Volume	10^3	–	–	35.8	–	–	–	37.9	–	–	–	–	37.2	–
Alkalinity	mg/L[a]	174	166	166	–	167	163	158	–	167	158	167	167	–
Fluoride	mg/L	0.8	0.8	0.8	–	0.9	0.9	0.9	–	0.9	0.9	0.9	0.8	–
Sulfate	mg/L	4.1	4.1	4.1	–	4.5	4.5	4.4	–	–	–	–	–	–
Total P (as P)	µg/L	14.7	23.6	<10.0	–	18.1	14.6	<10.0	–	18.1	20.2	24.1	<10.0	–
Silica (as SiO_2)	mg/L	14.0	14.3	14.3	–	14.1	13.8	13.6	–	14.7	15.2	15.3	15.1	–
NO_3-(N)	mg/L	<0.05	<0.05	<0.05	–	<0.05	<0.05	<0.05	–	–	–	–	–	–
Turbidity	NTU	5.4	7.3	4.2	–	2.4	1.1	0.6	–	0.9	0.9	1	0.9	–
pH	–	7.6	7.6	7.5	7.5	7.7	7.6	7.6	7.5	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]
Temperature	ºC	15.3	15.3	NA	15.5	15.1	15.2	15.3	15.2	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]
DO	mg/L	4.4	3.7	2.1	–	4.1	3.1	3.1	–	NA[c]	NA[c]	NA[c]	NA[c]	–
ORP	mV	-2	180	222	–	-79	74	141	–	NA[c]	NA[c]	NA[c]	NA[c]	–
Free Chlorine	mg/L	–	0.3	–	0.3	–	0.4	–	0.2	–	NA[c]	–	–	NA[c]
Total Chlorine	mg/L	–	0.4	–	0.4	–	0.5	–	0.3	–	NA[c]	–	–	NA[c]
Total Hardness	mg/L[a]	101	102	101	–	95.4	96.3	91.9	–	–	–	–	–	–
Ca Hardness	mg/L[a]	57.0	57.9	58.0	–	57.9	58.5	55.5	–	–	–	–	–	–
Mg Hardness	mg/L[a]	44.0	44.0	43.5	–	37.5	37.8	36.3	–	–	–	–	–	–
As (total)	µg/L	19.4	21.6	1.9	–	18.9	18.6	1.8	–	20.1	20.2	6.8	3.8	–
As (total soluble)	µg/L	19.2	12.8	1.7	–	18.2	12.5	1.6	–	–	–	–	–	–
As (particulate)	µg/L	0.2	8.8	0.1	–	0.7	6.0	0.1	–	–	–	–	–	–
As (III)	µg/L	20.3	0.4	0.4	–	17.9	0.2	0.2	–	–	–	–	–	–
As (V)	µg/L	<0.1	12.4	1.3	–	0.3	12.3	1.4	–	–	–	–	–	–
Total Fe	µg/L	212	233	<25	–	280	218	<25	–	194	191	<25	<25	–
Dissolved Fe	µg/L	209	<25	<25	–	163	<25	<25	–	–	–	–	–	–
Total Mn	µg/L	1.7	1.7	<0.1	–	4.8	3.6	<0.1	–	1.5	1.5	0.7	0.5	–
Dissolved Mn	µg/L	1.6	0.4	0.1	–	3.4	0.8	<0.1	–	–	–	–	–	–

(a) As $CaCO_3$. (b) Samples were taken on 03/05/06 and did not arrive to the laboratories until the 03/07/06. Therefore some analytes may be out of hold time. (c) Water quality parameters not taken.

IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		5/17/06						06/28/06				07/23/06[c]			
Sampling Location Parameter	Unit	IN	AC	TA	TB	TT	PT	IN	AC	TT	PT	IN	AC	TT	PT
Bed Volume	10^3	–	–	–	38.1	40.1	–	–	–	44.0	–	–	–	45.7	–
Alkalinity	mg/L[a]	171	171	–	–	159	–	167	167	167	–	–	–	–	–
Fluoride	mg/L	0.7	0.7	–	–	0.8	–	0.7	0.8	0.8	–	–	–	–	–
Sulfate	mg/L	4.0	4.0	–	–	4.0	–	4.0	4.0	4.0	–	–	–	–	–
Total P (as P)	µg/L	<10.0	<10.0	–	–	<10.0	–	17.0	16.9	<10.0	–	22.6	29.7	<10.0	–
Silica (as SiO_2)	mg/L	15.4	14.6	–	–	15.4	–	15.3	14.7	14.7	–	–	–	–	–
NO_3-(N)	mg/L	<0.05	<0.05	–	–	<0.05	–	<0.05	<0.05	<0.05	–	–	–	–	–
Turbidity	NTU	0.8	0.7	–	–	0.8	–	0.8	0.7	0.7	–	–	–	–	–
pH	–	7.6	7.6	7.6	7.6	7.6	7.5	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
Temperature	ºC	15.6	15.5	15.4	15.4	15.4	15.5	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
DO	mg/L	4.1	5.2	4.7	5.1	6.1	–	NA[b]	NA[b]	NA[b]	–	NA[b]	NA[b]	NA[b]	–
ORP	mV	-40	-64	-71	-94	-110	–	NA[b]	NA[b]	NA[b]	–	NA[b]	NA[b]	NA[b]	–
Free Chlorine	mg/L	–	0.2	–	–	–	0.2	–	–	–	NA[b]	–	–	–	NA[b]
Total Chlorine	mg/L	–	0.3	–	–	–	0.3	–	–	–	NA[b]	–	–	–	NA[b]
Total Hardness	mg/L[a]	98.3	101	–	–	97.1	–	103	102	100	–	92.9	93.3	96.3	–
Ca Hardness	mg/L[a]	54.7	56.8	–	–	54.7	–	58.9	58.1	56.6	–	54.5	54.7	56.6	–
Mg Hardness	mg/L[a]	43.6	43.9	–	–	42.4	–	43.8	43.5	43.5	–	38.4	38.7	39.7	–
As (total)	µg/L	21.4	21.2	–	–	4.4	–	21.2	20.8	3.2	–	21.2	21.5	3.3	–
As (total soluble)	µg/L	21.4	21.1	–	–	4.6	–	19.8	14.1	3.1	–	19.9	13.6	3.2	–
As (particulate)	µg/L	<0.1	0.1	–	–	<0.1	–	1.4	6.7	0.1	–	1.3	7.9	<0.1	–
As (III)	µg/L	19.7	20.0	–	–	1.8	–	17.6	0.1	0.1	–	18.1	0.2	0.2	–
As (V)	µg/L	1.7	1.1	–	–	2.7	–	2.1	14.0	3.0	–	1.7	13.4	3.0	–
Total Fe	µg/L	294	258	–	–	<25	–	424	237	<25	–	401	228	<25	–
Dissolved Fe	µg/L	279	250	–	–	<25	–	376	30.9	<25	–	315	<25	<25	–
Total Mn	µg/L	2.0	1.6	–	–	<0.1	–	4.7	2.0	0.7	–	3.1	1.7	0.1	–
Dissolved Mn	µg/L	1.9	1.6	–	–	<0.1	–	3.9	0.4	0.1	–	3.1	0.3	0.3	–

(a) As $CaCO_3$. (b) Water quality parameters not taken. (c) Only speciation and metal samples will be taken beginning 07/23/06.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		08/16/06				09/19/06				10/17/06			
Sampling Location Parameter	Unit	IN	AC	TT	PT	IN	AC	TT	PT	IN	AC	TT	PT
Bed Volume	10^3	–	–	48.3	–	–	–	51.2	–	–	–	52.9	–
Alkalinity	mg/L[(a)]	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Total P (as P)	µg/L	28.2	19.7	11.0	–	13.3	18.6	<10.0	–	–	–	–	–
Silica (as SiO_2)	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
NO_3-(N)	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Turbidity	NTU	–	–	–	–	–	–	–	–	–	–	–	–
pH	–	NA[(b)]	NA[(b)]	NA[(b)]	NA[(b)]	7.5	7.5	7.5	7.5	7.6	7.5	7.5	7.5
Temperature	ºC	NA[(b)]	NA[(b)]	NA[(b)]	NA[(b)]	18.8	18.6	18.5	18.5	15.9	15.9	16.1	16.1
DO	mg/L	NA[(b)]	NA[(b)]	NA[(b)]	–	6.4	4.4	4.1	–	4.4	3.1	1.7	–
ORP	mV	NA[(b)]	NA[(b)]	NA[(b)]	–	220	205	110	–	120	118	80	–
Free Chlorine	mg/L	–	–	–	NA[(b)]	–	–	–	0.1	–	–	–	0.1
Total Chlorine	mg/L	–	–	–	NA[(b)]	–	–	–	0.3	–	–	–	0.2
Total Hardness	mg/L[(a)]	99.2	102	95.5	–	101	106	108	–	–	–	–	–
Ca Hardness	mg/L[(a)]	60.1	61.4	57.2	–	56.1	59.7	60.8	–	–	–	–	–
Mg Hardness	mg/L[(a)]	39.1	40.3	38.2	–	45.2	46.4	47.7	–	–	–	–	–
As (total)	µg/L	22.8	22.9	6.7	–	21.1	21.3	6.9	–	23.2	21.8	5.9	–
As (total soluble)	µg/L	21.4	20.8	6.6	–	20.7	13.9	6.9	–	20.8	20.4	6.0	–
As (particulate)	µg/L	1.4	2.1	0.1	–	0.5	7.4	<0.1	–	2.4	1.4	<0.1	–
As (III)	µg/L	20.9	20.9	2.3	–	18.4	0.5	1.2	–	18.4	19.0	1.1	–
As (V)	µg/L	0.6	<0.1	4.2	–	2.3	13.4	5.7	–	2.4	1.4	4.8	–
Total Fe	µg/L	206	206	<25	–	215	212	<25	–	232	224	<25	–
Dissolved Fe	µg/L	202	198	<25	–	207	<25	<25	–	222	209	<25	–
Total Mn	µg/L	1.6	1.4	0.2	–	1.8	1.7	0.7	–	1.6	1.4	0.3	–
Dissolved Mn	µg/L	1.5	1.4	0.2	–	1.6	0.4	0.8	–	1.7	1.6	0.4	–

(a) As $CaCO_3$. (b) Water quality parameters not taken.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		11/12/06				12/24/06				01/21/07			
Sampling Location Parameter	Unit	IN	AC	TT	PT	IN	AC	TT	PT	IN	AC	TT	PT
Bed Volume	10^3	–	–	54.2	–	–	–	55.9	–	–	–	57.0	–
Alkalinity	mg/L[(a)]	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Total P (as P)	µg/L	13.3	10.1	–	–	–	–	–	–				–
Silica (as SiO_2)	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
NO_3-(N)	mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Turbidity	NTU	–	–	–	–	–	–	–	–	–	–	–	–
pH	–	7.6	7.6	7.5	7.5	7.6	7.6	7.5	7.6	7.6	7.5	7.5	7.5
Temperature	ºC	15.1	15.3	15.4	15.4	15.1	15.0	15.0	15.2	15.0	15.2	15.3	15.2
DO	mg/L	6.4	6.0	2.1	–	7.7	6.4	3.1	–	4.6	5.1	3.1	–
ORP	mV	110	117	47	–	110	90	66	–	-101	-41	-114	–
Free Chlorine	mg/L	–	0.1	–	0.1	–	0.2	–	0.2	–	0.2	–	0.1
Total Chlorine	mg/L	–	0.2	–	0.3	–	0.4	–	0.3	–	0.3	–	0.2
Total Hardness	mg/L[(a)]	–	–	–	–	–	–	–	–	–	–	–	–
Ca Hardness	mg/L[(a)]	–	–	–	–	–	–	–	–	–	–	–	–
Mg Hardness	mg/L[(a)]	–	–	–	–	–	–	–	–	–	–	–	–
As (total)	µg/L	22.9	21.9	5.7	–	23.6	22.5	3.8	–	22.0	23.2	6.4	–
As (total soluble)	µg/L	21.2	20.5	5.2	–	21.8	13.9	4.1	–	22.2	13.2	6.5	–
As (particulate)	µg/L	1.7	1.4	0.5	–	1.8	8.6	<0.1	–	<0.1	10.1	<0.1	–
As (III)	µg/L	20.5	20.9	0.6	–	20.6	0.1	<0.1	–	20.6	0.5	0.4	–
As (V)	µg/L	0.7	<0.1	4.6	–	1.2	13.8	4.0	–	1.7	12.6	6.0	–
Total Fe	µg/L	226	198	<25	–	216	238	<25	–	888	294	25.4	–
Dissolved Fe	µg/L	156	190	<25	–	209	<25	<25	–	733	32.3	<25	–
Total Mn	µg/L	2.1	1.7	<0.1	–	1.5	1.4	<0.1	–	14.1	2.4	0.2	–
Dissolved Mn	µg/L	4.8	2.8	<0.1	–	1.5	0.4	<0.1	–	14.0	0.8	0.5	–

(a) As $CaCO_3$. (b) Water quality parameters not taken.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.

Table B-1. Analytical Results from Long-Term Sampling, Stevensville, MD (Continued)

Sampling Date		03/07/07				04/02/07			
Sampling Location / Parameter	Unit	IN	AC	TT	PT	IN	AC	TT	PT
Bed Volume	10^3	–	–	58.8	–	–	–	59.8	–
Alkalinity	mg/L[(a)]	–	–	–	–	–	–	–	–
Fluoride	mg/L	–	–	–	–	–	–	–	–
Sulfate	mg/L	–	–	–	–	–	–	–	–
Total P (as PO_4)	mg/L	–	–	–	–	–	–	–	–
Silica (as SiO_2)	mg/L	–	–	–	–	–	–	–	–
NO_3-(N)	mg/L	–	–	–	–	–	–	–	–
Turbidity	NTU	–	–	–	–	–	–	–	–
pH	–	7.5	7.5	7.5	7.5	7.6	7.5	7.5	7.5
Temperature	ºC	15.1	15	15	15	16.4	16.2	16.1	16.1
DO	mg/L	4.5	3.3	2.7	–	6.4	5.2	3.8	–
ORP	mV	-40	-22	-61	–	-40	-60	-86	–
Free Chlorine	mg/L	–		–	0.2	–	0.2	–	0.2
Total Chlorine	mg/L	–		–	0.4	–	0.2	–	0.3
Total Hardness	mg/L[(a)]	–	–	–	–	–	–	–	–
Ca Hardness	mg/L[(a)]	–	–	–	–	–	–	–	–
Mg Hardness	mg/L[(a)]	–	–	–	–	–	–	–	–
As (total)	µg/L	21.5	20.8	4.1		21.5	20.8	4.7	–
As (total soluble)	µg/L	19.7	21.0	4.3		20.3	13.9	4.6	–
As (particulate)	µg/L	1.8	<0.1	<0.1		1.1	6.9	<0.1	–
As (III)	µg/L	15.2	19.4	<0.1		17.7	0.6	0.4	–
As (V)	µg/L	4.5	1.6	4.2		2.7	13.3	4.2	–
Total Fe	µg/L	211	191	<25		208	196	<25	–
Dissolved Fe	µg/L	65.2	192	<25		208	<25	<25	–
Total Mn	µg/L	2.5	1.6	<0.1		1.6	1.3	<0.1	–
Dissolved Mn	µg/L	1.6	1.6	<0.1		1.6	0.3	<0.1	–

(a) As $CaCO_3$.
IN = inlet; AC = after pre-chlorination; TA = after vessel A; TB = after vessel B; TT = after vessels combined; PT = plant tap after adsorption vessels. NA = data not available.