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February 17, 2005

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Blanca S. Bayo, Director
Division of the Commission Clerk
and Administrative Services
Florida Public Service Commission
2540 Shumard Oak Blvd.
Tallahassee, FL 32399-0850

Re: Docket No. 010503-WU

Dear Ms. Bayo:

Enclosed for filing, on behalf of the Petitioners, are the original and 15 copies of the Rebuttal Testimony of Dr. V. Abraham Kurien in Docket No. 010503-WU.

Please indicate the time and date of receipt on the enclosed duplicate of this letter and return it to our office.

Sincerely,

Charles J. Beck
Deputy Public Counsel

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BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

ALOHA UTILITIES, INC.

DOCKET NO 010503-WU

REBUTTAL TESTIMONY

OF

V. ABRAHAM KURIEN, M.D.

IN RESPONSE TO TESTIMONIALS BY DR. AUDREY D. LEVINE PH.D AND MR. DAVID W. PORTER. P.E.

Q. COULD YOU PLEASE EXPLAIN WHY YOU DECIDED TO INTERVENE AND FILE DIRECT TESTIMONY IN THIS PROCEEDING?

A. As someone who experienced poor quality of water in his domestic plumbing, I was forced to take upon myself the burden of attempting to find ways of getting Aloha Utility involved in addressing whether its processing methods were adequate to create a product such that its quality did not deteriorate within domestic plumbing under reasonable and nationally recognized conditions of material structure and appropriateness of daily use of water. As part of my effort, I unearthed a great deal of evidence that was not previously

available to the customers or was unknown to regulatory agencies. While doing so, I discovered that the reasons for the poor quality of water in the domestic plumbing of some areas of Aloha's territory was not adequately investigated and appropriate interventions had not been instituted to improve the quality of water for over ten years after being brought to the attention of regulatory agencies.

Q. COULD YOU PLEASE INDICATE WHETHER YOU HAVE ANY EDUCATIONAL BACKGROUND OR EXPERIENCE THAT ENABLES YOU TO ADDRESS THIS ISSUE AND WHICH MAY CONTRIBUTE TO THE RESOLUTION OF THE PROBLEMS?

A. First of all, I like to indicate that I have no educational background in engineering of any kind, and specifically in water engineering. However, the aspects that I have chosen to comment about in this proceeding relate to fields of my educational background, namely chemistry, bacteriology and "circulation". I received a cum laude Batchelor of Science degree in chemistry from the University of Mysore in India in 1954 and taught analytical chemistry at college level. This involved identifying unknown substances through analytical methods. I received a Summa Cum Laude M.D. degree from the University of Edinburgh in Scotland in 1963 and graduated as the most distinguished graduate of the year and was awarded the Gold Medal for Medicine. A major part of medical training consists of the

understanding of bacteriology and therapeutics. I have undertaken postgraduate research into human circulation and am a Fellow of the Royal College of Physicians of Edinburgh and was an Assistant Professor at the University of Edinburgh between 1968-1970. I practiced Internal Medicine and Cardiology for twenty years in Connecticut and was on the Staff of the University of Connecticut as a Clinical Instructor. Thus I have a sound background and training in the methods of scientific investigation, the principles of diagnosis and treatment. I have published many articles in various peer-reviewed journals.

Q. CAN YOU NOW SPECIFICALLY ADDRESS TESTIMONY PROVIDED BY DR. AUDREY LEVINE AND MR. DAVID PORTER IN RESPONSE TO YOUR TESTIMONY IN DOCKET NO 010503-WU WITH REFERENCE TO THE STANDARDS AND THE POINTS AT WHICH THOSE STANDARDS MUST BE COMPLIED WITH TO IMPROVE THE QUALITY OF WATER IN THE DOMESTIC PLUMBING OF CUSTOMERS IN ALOHA'S TERRITORY?

A. I must first address the reason why I requested modification of Aloha's re-wording of the Tampa Bay Water Authority ("TBWA") standard.

The intermittent occurrence of black water and rotten egg smell in the homes of certain customers in Aloha Utilities' service territory has been well

documented for many years. No specific factors or combination of factors have so far been identified as responsible for these phenomena. There have been two **hypotheses** that have been advanced to account for these findings. Mr. Porter, the consultant engineer of Aloha, elaborated on the first hypothesis in his testimonial before the Public Service Commission in 1996 when he claimed that the only reason for the phenomenon of intermittent black water was the re-formation of hydrogen sulfide *in situ* and *de novo* in the domestic plumbing due to the action of sulfur reducing bacteria (SRB) on sulfate naturally present in the underground water. The re-generation of corrosive hydrogen sulfide in domestic plumbing was explained as being due to the removal of chlorine by water softeners and conditioners installed by customers in their homes, thereby reducing the disinfection capability of delivered water. Aloha Utilities has consistently maintained that the water it delivers at the domestic meter is "clean, clear and safe" and therefore it has no responsibility for what happens in domestic plumbing and finds no need to alter its method of processing in such a way as to provide greater stability for water in domestic plumbing. This set of reasoning is only a hypothesis, since Aloha has not demonstrated re-generation of *hydrogen sulfide from sulfate* as the primary reason for copper corrosion and rotten egg smell in its service territory. PSC staff has documented that black water **does occur** even in homes that have no water softeners or conditioners of any kind.

A second *hypothesis* can be inferred from research literature in which the effect of the **sole** use of chlorination for processing water has been studied, and from FDEP guidelines that have been proposed after extensive discussion among experts in the field of water processing for the prevention of copper corrosion and black water formation in domestic plumbing. Stated simply, this hypothesis maintains that the *sole use of chlorination* for processing source water that contains hydrogen sulfide above a certain level will result in turbidity caused by elemental sulfur formed during the process and that the amount of turbidity formed is proportional to the amount of hydrogen sulfide present in water, among other factors. This turbidity may be *associated with* formation of black water due to the production of copper sulfide in domestic plumbing containing copper. Both Mr. Porter and Dr. Levine, the university consultant of Aloha for the implementation of a new processing method, have observed that this association may be related "to increased chance for bacterial contamination" and "the lowering of the effectiveness of disinfection". Over a year ago, FDEP instituted new guidelines for **removal of elemental sulfur** when chlorination alone is used for processing source water that contains more than 0.3mg/l of hydrogen sulfide.

I indicated in my direct testimonial that the audit conducted by Dr. Levine documented the presence of hydrogen sulfide in the transmission system of Aloha contrary to the claim of Mr. Porter previously that there was no hydrogen sulfide in the transmission and distribution system of the Utility.

Dr. Levine has addressed this matter in her testimonial by saying, *"the only location in which detectable hydrogen sulfide was observed was at the inflow to the ground storage tank which is not in the "transmission" or distribution system"* (page 3, lines 5-7). Mr. Porter has addressed the same finding by saying, *"A slight hydrogen sulfide concentration (of 0.12mg/l) was found in the **partially** treated water flowing in a pipeline connecting two treatment plants with the main ground storage tank. This water does not flow into the distribution system"*(page 8, line 22- page 9, line 1). Both of them have concluded that I was mistaken in maintaining that hydrogen sulfide was detected at a level of 0.12mg/l in Aloha's "transmission" system.

The accuracy of my statement depends on how one defines *transmission* and *distribution* system. "Transmission system" is the system of pipes that *transmits* water from the wells to the storage tank. "Distribution system" is the system of pipes that *distributes* water from the wells or the storage tank to the customers.

The water in which hydrogen sulfide was detected above the 0.1mg/l level suggested as a standard had already been processed at the wells with the **sole** use of chlorination and was recorded to have only 0.01 mg/l of hydrogen sulfide when it was delivered into the "transmission" system. Further down in its travel in the "transmission" system a water sample was taken and found to have 0.12 mg/l of hydrogen sulfide. There are only two possible conclusions

as to why this happened. Mr. Porter prefers the explanation that the water was only "**partially treated**" at the wells and needed "**final treatment**" and the latter was undertaken at the storage tank and that the water in the outflow from the storage tank the same day contained no hydrogen sulfide when it was pumped into the "distribution system". Dr. Levine's explanation implies that this was an isolated finding. "This sample site was re-sampled **several times** in succession and did not have detectable hydrogen sulfide upon re-sampling"(page 3, lines 7-11). Both Dr. Levine and Mr. Porter were on this sampling tour along with Dr. John Gaul PhD, customer representative, but I was not. Therefore, I cannot verify the accuracy of that statement. However, the disparate explanation by the two testimonials in response to my reference to the audit report's conclusion raises serious concern as to what might be the real explanation.

The detection in the "transmission system" of Aloha Utilities of hydrogen sulfide above the level recommended as a standard is of serious concern to the customers. **My education in chemistry taught me that science is no respecter of persons or locations. Where conditions are suitable, reactions take place!** If significant concentration of hydrogen sulfide was found in one location of Aloha's system after the water left the treatment plant at a well, then the same event could occur at other sites in the "transmission" and "distribution" system into which finished water is introduced after using the same processing method. Whether the hydrogen sulfide detected was

present due to re-formation as I suggested in my testimonial or due to "**partial treatment**" of hydrogen sulfide in source water as Mr. Porter suggests in his testimonial, **the concern is that the method of treatment at the well is either inadequate to completely remove hydrogen sulfide from raw water or that the processing method used is easily reversible during the transport of water in Aloha's system from one location to another**. This raises the serious possibility that hydrogen sulfide may intermittently be delivered into the domestic plumbing and thereby cause corrosion. I realize that this is a hypothesis contrary to accepted "wisdom", but it is a testable hypothesis. Customers have reported black water in the pipes between the domestic meter and before delivered water enters their homes. This is well before any water softener or conditioner systems and therefore does not conform to Mr. Porter's complaints about such installations being responsible for re-formation of hydrogen sulfide in water the Utility has previously claimed was **adequately** treated. Now for the first time, Mr. Porter is admitting, what he must have known all along, that source water is only partially treated at first pass at the wells and requires **further treatment!** In reports submitted by Aloha's own technical staff during flushing procedures carried out by them, there is documented evidence of black and discolored water in Aloha's distribution system even when fire hydrants are flushed <u>on a daily basis</u> and large volumes of finished water were removed from the distribution system to raise free chlorine residual levels to 1.5 mgs/l (Exhibit VAK-19). These documents provide corroboration that finished water is not

adequately treated before discharge into the distribution system or that the processing method is easily reversible. Dr. Levine's proposal that there is no significance to an isolated finding is also not very valid, because when the degradation of water quality is intermittent, one does not expect to find evidence for it all the time!

Most of the water that Aloha supplies to its customers flows **directly** from wells to domestic plumbing without receiving a second **"final treatment prior to its being pumped into the distribution system"** (Mr. Porter; page 9, line 1). Such re-treatment is provided only when water is distributed from the storage tank. If a chlorine booster is necessary to **treat water further** in the ground storage tank (which has no water softener or water conditioner) before the water left the same day to travel along the distribution system to the customers, it would suggest that the chlorine decay in Aloha water is much higher than documented by monthly operation reports (MOR) submitted to the FDEP. What is responsible for this phenomenon? What impact does this have when most of the water supplied to homes goes directly from wells to domestic plumbing **without a second final treatment**? Are the levels in the MOR submitted to FDEP truly the lowest free chlorine residual in the distribution system or were most of the readings obtained from samples taken after the flushing procedure that raises free chlorine residuals?

It is this concern that prompted me to suggest that the total sulfide standard of 0.1mg/l should be complied with at the domestic meter to ensure that the water that enters the domestic plumbing does not have more total sulfides because such presence could cause significant copper corrosion.

Q. HOW DO YOU ANSWER THE TESTIMONIAL THAT THERE IS NO NEED TO MEASURE ELEMENTAL SULFUR LEVELS OR HAVE A STANDARD FOR ELEMENTAL SULFUR IN ADDITION TO THE STANDARD FOR HYDROGEN SULFIDE BECAUSE ACCORDING TO DR. LEVINE "THERE HAS BEEN NO VIOLATION OF THE BACTERIOLOGICAL STANDARD (TOTAL COLIFORM) WITHIN THE SEVEN SPRINGS SYSTEM" (PAGE 3, LINES 21-23)? "

A. As I indicated earlier, in their prior statements referred to in my direct testimony both Dr. Levine and Mr. Porter have suggested a role for turbidity induced by colloidal elemental sulfur in lowering bacterial disinfection capabilities. Both *now* argue that there is no factual evidence of lowered disinfection capability as demonstrated by the lack of high coliform colony (Dr. Levine; page 3, lines 21-23) and heterotrophic plate colony counts (Mr. Porter; page 9, line 22-24). It is also pointed out that the **reported levels** of free chlorine residuals in MOR submissions to FDEP show levels above 0.2 **mg/l, the minimum** required for **human pathogens** according to EPA requirements.

From the information that I have gathered from Aloha's own flushing program reports, there is evidence that free chlorine residuals have fallen below 0.2mg/l at a number of sites in Aloha's **distribution system** even when flushing is undertaken on a daily basis and that there has been discoloration of water in the distribution system on many days (Exhibit VAK-19). PSC Staff has documented black water in homes that have no water conditioner systems and should have adequate chlorine levels during periods of daily use, if such were present when water was delivered. Aloha has not provided any evidence to suggest that SRB, the bacteria considered responsible for the *in situ* and *de novo* regeneration of hydrogen sulfide in domestic plumbing, can be inactivated by the 0.2mg/l level of free chlorine residual. SRB is an **anaerobic organism** and its sensitivity to chlorine may well be different from that of human pathogens. **Anaerobic organisms** are more effectively inactivated by the presence of oxygen in the medium in which they live, as those who understand bacteriology know, and as indicated by Dr. Levine in her audit recommendations. Since the underground water that Aloha processes contains very little oxygen, it is likely that this organism is capable of being active even in "finished" Aloha water at all levels of its system, including the domestic plumbing. . The evidence that exists in a study done by FDEP, **"The Pasco County Black Water Study" performed by FDEP in 1998-9** (Exhibit VAK-20) showed significant growth of bacteria, I presume SRB, from 10-30 % of delivered water at the point of its entry to the domestic plumbing. **The most likely manner in which SRB is delivered into the**

closed system of the domestic plumbing is by its entry through the delivered water. The lower incidence of black water and rotten egg smell in aerated water systems may well be related to the reality that in aerated water, this bacterium is inactive.

Therefore, from the point of view of corrosiveness of metals the evidence suggesting the absence of human pathogens such as coliform bacteria or maintenance of adequate chlorine levels at FDEP standard of 0.2mg/l may not be adequate to exclude introduction of active SRB from the wells of Aloha into the domestic system. **Aeration may be necessary to inactivate this organism.**

Q. MR. PORTER STATES, "DR. LEVINE CONDUCTED SUSPENDED SOLIDS TESTING OF THE WATER SAMPLED FROM A NUMBER OF CUSTOMER METERS DURING HER WORK. IN EACH CASE, NO MEASURABLE QUANTITY OF SUSPENDED SOLIDS WAS FOUND". DOES THAT NOT SUGGEST THAT THE LEVELS OF ELEMENTAL SULFUR ARE VERY LOW?

A. The levels of suspended solids and their composition in a water processing system obviously are very variable according to Dr. Levine's testimonial (page 5, lines 3-4). These were semi-quantitatively tested for at the wells, not at other levels of Aloha's systems or in the domestic plumbing, as Mr. Porter

seems to suggest. Dr. Levine in fact demonstrated minute quantities of elemental sulfur by the use of scanning electron micrographs (SEM) at **Well 8** and significant amount of suspended solids when customers' whole house filters and water from hot water systems were tested (Exhibit VAK-21, Dr Levine's Phase II audit report pages 27-32). From the examination of installed whole house sediment filters, customers have reported wide variety of suspended solids in the water they receive from Aloha including sand, debris of other kinds and varying concentration of black material even before delivered water enters their homes (Exhibit VAK-22). The only suspended material we need to consider as an antecedent to metal corrosion, on the basis of hypotheses that have been advanced, is elemental sulfur. The amount of elemental sulfur produced in finished water is a function of the concentration of hydrogen sulfide in raw water and the amount of chlorine added, in addition to factors such as oxygen level in raw water and pH. At the pH of Aloha's source water, and with no oxygen present, it seems very likely that elemental sulfur is formed when the sole use of chlorination is the processing method and the ratio between hydrogen sulfide level and chlorine added is insufficient.

As Dr. Levine has pointed out, I concede that at the present moment, there is no accurate method to measure the levels of elemental sulfur in delivered water. However, scanning electron micrographs (SEM) can indicate the presence of sulfur particles and other aggregates consisting of sulfur,

phosphorus and many different metal elements at different stages of the water processing system and the domestic plumbing.

Dr. Levine spent enormous amounts of effort to do exactly that in processed water from **Well 8** and other areas in the transmission system and domestic plumbing, (Exhibit VAK-21). On 10/29/03 when **Well 8** was sampled, the hydrogen sulfide level in source water was 2.20 mg/l. On November 12, 2003 hydrogen sulfide level was 1.73 mg/l. Both these levels of hydrogen sulfide in source water are within the theoretical capacity of the chlorinator at that well to completely convert to sulfate without the production of elemental sulfur. Dr. Levine calculated the specific chlorine demand of hydrogen sulfide in **Well 8** on November 12, 2003 as 7.83mg/l. This suggests that the oxidation reaction of hydrogen sulfide in that well on that day had proceeded almost completely to sulfate. Theoretical value for chlorine demand of hydrogen sulfide for complete conversion from sulfide to sulfate is 8.33mg/l. (Exhibit VAK-23). Therefore, one would not have expected to see much colloidal elemental sulfur in finished water from that well on that day. However, the question that needs answering is: What happens when the amount of hydrogen sulfide in raw water exceeds the theoretical capacity of the amount of chlorine added or the maximum capacity of the chlorinator at any well to convert hydrogen sulfide to sulfate? The maximum theoretical capacity for conversion of hydrogen sulfide to sulfate at **Well 9** is only 2.6 mgs/l according to Dr. Levine. (Exhibit VAK-24). On 11/12/03 the amount

of hydrogen sulfide present in raw water from **Well 9** was only 2.43mg/l within the capacity of the chlorinator at that well. So on that day only minimal elemental sulfur would have been formed. However, would it have been possible for the chlorinator at **Well 9** to prevent formation of elemental sulfur (in greater quantity than was demonstrated in **Well 8** on 11/12/03) when the level of hydrogen sulfide was 3.95 mg/l in **Well 9** on 10/29/03 and the maximum theoretical capacity of the chlorinator at that well to convert to sulfate was only 2.6mg/l? **What might have happened during the 3 months of April –July in 2001, when the raw water in Well 9 was documented to have hydrogen sulfide levels between 3.5 –6.71 mg/l on twenty different occasions?** (Dr Levine's Phase I Report, page 10, Exhibit VAK-25) It does not seem unreasonable to conclude that theoretically during that season in 2001, there may have been 1-3 mgs/l of elemental sulfur in water processed from **Well 9**. If so, what is the implication of this for the production of black water and rotten egg smell in domestic plumbing served by water from that well if elemental sulfur is associated with black water? Scanning electron microphotographs provided by Dr. Levine in the Phase II Report show increasing quantities of suspended solids as water moves through Aloha's system from well to storage tank and finally reaches domestic plumbing after the domestic meter. Greater amount of suspended solids was demonstrated in the hot water system. (Exhibit VAK-21).

Production of SEM to detect presence of elemental sulfur in processed water is not an economically viable proposition and in any case it is not a quantitative method. Turbidity increase in finished water after processing has been suggested as a simpler method. **Turbidity measurements were not carried out during the sampling of water from any of Aloha's eight wells during Dr. Levine's audit nor were SEM made of water from Well 9 on 10/29/03 when hydrogen sulfide level was 3.95mg/l and beyond the capacity of the chlorinator to convert completely to sulfate.** That would have been more relevant than producing scanning electron micrographs of particulate matter from **Well 8** where the likelihood of elemental sulfur production was low on the day the water was sampled.

Q. YOU HAVE NOT ANSWERED THE CONCERNS RAISED BY MR. PORTER THAT YOU ARE ASKING FOR STANDARDS THAT ARE DIFFICULT AND EXPENSIVE TO ACHIEVE AND ARE NOT USED "ANYWHERE IN THIS NATION, PERHAPS IN THE WORLD" (PAGE 6, LINES 21-23).

A. I must agree that this observation may indeed be correct! However, scientific methodology also requires **stringent standards** to achieve therapeutic goals especially when there is no track record for a new method. The method that Aloha plans to adopt is not being used anywhere in this nation for oxidizing

hydrogen sulfide in source water to produce drinkable water. Perhaps, for that matter it is not used any where in the world!

When I used the words "standard" and "MCL", I was using the terminology the way it is used almost interchangeably in Exhibit D of the TBWA such as maximum contaminant level, goal, standard, compliance level and action level. (Exhibit VAK-26) **The important point is that TBWA requires action if the level of total sulfides exceeds 0.1mg/l and that action is to be taken by the TBWA and its member governments that are utilities and not allow customers to suffer the consequences that may arise.** It has been demonstrated by a number of utilities that black water and rotten egg smell can be significantly reduced by methodologies without strict measurement and conformity with standards for total sulfide and elemental sulfur levels, such as membrane technologies (Dunedin Municipal Utility) and aeration and biological oxidation (Pasco County Utility), manganese green sand and potassium permanganate oxidation (Port Richey Utility) along with more appropriate adjustment of pH levels. These methods obviously address the issues of black water and rotten egg smell through other effective interventions. Aloha does not use any of these methods now and did turn down the suggestion of increasing the pH of delivered water.

The new processing method using hydrogen peroxide that is being considered by Aloha utility as well as the current processing method of the **sole** use of

chlorination are **reversible oxidative methods** that can result in re-formation of hydrogen sulfide and the production of elemental sulfur. In the absence of the use of more successful methods for reducing copper corrosion, strict adherence to more stringent standards that lower the levels of these substances that have been considered to be significant factors in the production of black water and rotten–egg smell are necessary to improve water quality in certain areas of Aloha's territory. The directive given by the PSC to the Utility in April, 2002, was to implement a method that ensures a *significant* reduction of black water and rotten egg smell in domestic plumbing.

An essential approach to remediation in any system whether it is a material system or a living system requires that the correct diagnosis and causative agency should be established before a therapeutic strategy is recommended. If a "therapeutic trial" is being undertaken without an accurate diagnosis, (as Aloha is attempting to do at this time), it is important to establish that the levels of incriminated factors such as hydrogen sulfide, elemental sulfur and presence of SRB are adequately monitored and controlled, especially where the history of poor water quality is of long standing without effective intervention.

Q. DO YOU HAVE ANY ADDITIONAL COMMENTS?

A. **Yes. Mr. Porter has stated very categorically that I am mistaken in a number** of my statements (page 10, lines 14-18). I am always willing to be corrected about inaccurate statements, and would do so in this instance also if the shifting claims of Mr. Porter were true. Much has been made of the succinct, but important distinction that I made between the Tampa Bay Water Standard (goal) in exhibit D and the re-wording that Aloha has used for modification of the "98% hydrogen sulfide removal" standard. As I indicated in my direct testimony, Exhibit D makes no mention of *treatment facilities* at all, but indicates that the "water quality parameter" will be "sampled annually at a minimum at the Point(s) of Connection". Further down in Exhibit D on page 3, (Exhibit VAK-26), the Notes section says, "maximum average= not to exceed average value using a running four quarterly sample average". To me this represents the way TBWA arrives at the compliance level determination for itself. I assumed, correctly I maintain, that this means TBWA samples processed water **at least four times at its treatment facilities** to establish that it has complied with its own standard (goal). In fact Mr. Porter himself admitted this to be accurate in a document submitted by Aloha's attorney, Mr. Deterding, on March 29, 2004 to the PSC (Exhibit VAK-27). Testing was recommended at a *minimum* of annually only at the point(s) of connection. The responsibility, if desired or necessary, to sample more frequently at the points of connection was left to the member government utilities. **Aloha is requesting that the standard be reduced to an annual sampling at the treatment facility and claiming that such a frequency to be the norm at the TBWA. That is patently incorrect.**

Aloha Utilities wants to be left alone to produce potable water that does not remain drinkable in customer plumbing by the claim on the one hand that according to Florida Statutes its responsibility ends at the **outflow of the domestic meter**. Yet when it comes to ensuring that the water it delivers to the customers meets the TBWA performance standard (compliance level, action level, goal) which the Utility claims it is ready to meet, it no longer wants to do so at the domestic meter which is the point of delivery, but only at the treatment facility and only once a year. No other product can be sold in this country by the claim that it met standards at the production plant as automobile, home appliance and electronic product manufacturers know only too well. They have to meet standards at the point of delivery. There may not be a law so far that potable water should meet standards at the point of delivery, but no customer should have to put up with stinking black water for ten years with a claim from its producers that its water is "clean, clear and safe" at the point of delivery, without tests confirming that it has the ability to remain so.

As a last statement, I want to indicate that I do understand very clearly the limits of my knowledge. I have based everything that I have stated in my testimonials on public and Aloha's records and statements by **experts** including Dr. Levine and Mr. Porter. As a person committed to scientific methodology, I maintain that there is a difference between a hypothesis and documented facts and that this differentiation must always be maintained. My interpretations of the data may be different from "accepted wisdom", but that is what scientific judgment and dialogue are all about. My scientific

knowledge base is solid and I do not venture out beyond my knowledge base to make **inappropriate categorical statements** about the cause of black water but merely request those who have regulatory responsibilities, to consider the totality of circumstantial evidence in a **new** way. The claim that the black residue seen in the toilet tanks of customers is the result of the corrosion of *black flotation ball*, as Mr. Porter told me when he visited my house in January, 2002 and that black water would disappear from customers' toilet tanks if *black flapper valves* were replaced by *red* valves, as Mr. Crouch another engineer of Aloha suggested at an Aloha Customer Workshop in June, 2004, came from consultants who have water engineering degrees and who were introduced at customer workshops as **experts**. Such nonscientific and absurd statements offered as facts were used for a long time and is still being used to prevent an adequate scientific investigation of black water and rotten egg smell in customers' plumbing.

Scientific investigations and appropriate therapeutic interventions by professionals who have no conflict of interest are always necessary to solve complex problems of water quality. It is very appropriate for regulatory agencies to always insist on expert consultations free of conflict-of-interest from extramural water processing professionals and engineers, especially when offers at good faith negotiations with utilities to solve issues have been rejected.

Q. WHAT IS YOUR SPECIFIC RECOMMENDATION TO THE COMMISSION IN THIS PROCEEDING?

A. I have presented enough evidence based on objective facts and data gathered from numerous sources **that stringent standards are essential** for Aloha's current method and the proposed new method to deliver water that will **significantly reduce** the incidence of black water and rotten egg smell in domestic plumbing. If Aloha is not willing to accept these logical standards, the Utility should be prepared to implement other well-recognized methods that even without the use of these strict standards have been associated with much lower incidence of these phenomena and have a well established track record of being able to deliver water that remains stable in domestic plumbing without a high incidence of black water and rotten-egg smell. Where such phenomena occur, and where Aloha has not provided remediation for ten years, the customers are now requesting the PSC to provide them with an opportunity to get better quality water by deletion of those territories from Aloha's service area.

Q. IS THAT THE END OF YOUR REBUTTAL TESTIMONY?

A. Yes, thank you.

INDEX OF EXHIBITS

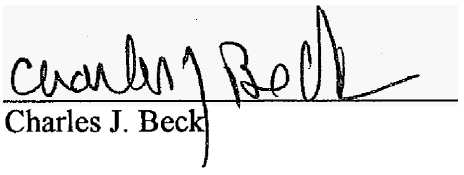
REBUTTAL TESTIMONY—V. ABRAHAM KURIEN

DOCKET NO. 010503-WU

EXHIBIT NAME		EXH. NO.
ALOHA'S OWN RECORDS OF FLUSHING REPORTS IN THE YEAR 1999 WITH AN ANALYIS OF THE FINDINGS BY DR. KURIEN	VAK-19	_____
THE PASCO COUNTY BLACK WATER STUDY, SUBMITTED BY VAN HOOFNAGLE, AUGUST 9, 1999 AND AN ANALYSIS OF THE FINDINGS BY DR. KURIEN	VAK-20	_____
PHASE II AUDIT REPORT BY DR. LEVINE, PAGES 27-32	VAK-21	_____
SCANNING ELECTRON MICROGRAPH, FIGURES 31, PHASE II REPORT	VAK-22	_____
PHASE II REPORT, PAGE 20, FIGURE 14b; CALCULATIONS	VAK-23	_____
PHASE I REPORT, PAGE 20	VAK-24	_____
PHASE I REPORT, PAGE 10	VAK-25	_____
TAMPA BAY WATER EXHIBIT D, ACTION LEVEL NOTES	VAK-26	_____
DOCKET NO. 020896-WS, PSC LETTER DATED MARCH 29, 2004 STAFF DATA REQUEST DATA SUBMISSION BY ALOHA UTILITIES, INC.	VAK-27	_____

DOCKET NO. 010503-WU
CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing has been furnished by U.S. Mail or hand-delivery to the following parties on this 17th day of February, 2005.



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New Port Richey, FL 34655

Wayne T. Forehand, Chairman
Citizens' Advisory Committee
1216 Arlinbrook drive
Trinity, FL 34655-4556

James Mitchell, Jr.
Riviera Home Owners Association
5957 Riviera Lane
New Port Richey, FL 34655

Ann Winkler
Riverside Village Estates, Unit 4
4417 Harney Court
New Port Richey, FL 34655

John Parese
Riverside Villas
4029 Casa del Sol Way
New Port Richey, FL 34655

EXHIBITS

REVIEW OF DATA ON FLUSHING IN ALOHA UTILITIES' SERVICE TERRITORY

DATA OBTAINED FROM ALOHA

Analysis by V. Abraham Kurien, M.D.

Data for 1999, 2000 and 2003 and 2004 were requested. Due to the enormity of data that had to be analyzed, I have concentrated on one year.

DETAILED REVIEW OF DATA FROM 1999

FINDINGS:

Flushing was conducted on a rotational basis, some areas being scheduled for flushing daily, others for three days a week, yet others for twice a week and a rare area only once a week.

During the year 1999 there was no flushing undertaken over weekends.

Data between May 17 and June 2, 1999 were not submitted: My concern is whether flushing was not undertaken during this 2 week period or whether the data was not submitted for other reasons

Between June and December 1999, discoloration of water was noted on a number of occasions: Colors ranged from black, yellow, brown, rusty and milky (M). Odor was also noted along with discoloration on one occasion.

It is noted that in areas where flushing was scheduled to be done daily, often such flushing was not undertaken regularly (at least there is no documentation that such was undertaken)

Even when flushing was done daily and free chlorine residuals brought up to 1.5 mg/l (which seems to have been the goal), often within 24 hours, the level of free chlorine had been fallen below 0.2 mg/l (minimum required by FDEP regulations) and on a number of occasions was **ZERO**.

The Report on 11/9/99 (Tuesday) reads:

Yellowish water from hydrant: flushed 20 minutes per Tony. Did not clear. Advised by Tony to go to bib at well. Water still yellowish w/small particles in water. Same at all hydrants. Tony said to check Friday (three days later) **for next schedule to see if still discolored"**

Reports show that yellow discoloration was noted at a number of hydrants on 11/10 Wednesday to Thursday, Friday, the following Monday, Tuesday, Wednesday and 11/17 Thursday. On 11/18/99 Friday, the water was noted to be yellow and milky. No abnormal color was noted 1/22-24: No records were found between 11/25-11/28 (presumably long weekend of Thanksgiving).

On 11/29 yellow color was noted again at a number of flushing locations including one at which there was an odor: yellow color on 12/1: on 12/2 color noted as Y(ellow) – A (air) (?reformation of hydrogen sulfide): on 12/6 water noted as brown at one flushing point and rusty at another point.

SUMMARY:

1. Even though there is a program for flushing on a predetermined schedule, such is often not carried out.

2. Even when flushing was carried out per schedule, often there was discoloration of water: The following colors were noted – black, yellow, brown, rusty and milky. Gas (unclear what it was noted and described as air): odor was noted in association with discoloration once.

3. The aim of flushing seems to have been to raise free chlorine residual to 1.5 mg/l of water. Even when flushing was carried out per schedule, often the free chlorine level before flushing was below the 0.2mg/l, the minimum required by FDEP. On a number of occasions the free chlorine level before flushing began was noted to be **Zero.**

4. In a number of locations where flushing was programmed on a daily basis, and free chlorine level was raised to 1.5 mg/l, after 24 hours free chlorine levels had fallen below 0.2mg/l and some times to **Zero**

5. In some instances even prolonged flushing was incapable of raising levels above the minimum required by FDEP.

6. In many instances large volumes of water were flushed (12,000 –45,000 gallons). The reason for this is not indicated and is assumed to be in response to customer complaints.

CONCLUSIONS:

The conclusion that the program of flushing as carried out Aloha in the year 1999, may not have been capable of delivering water that was "clean, clear and safe" at ALL TIMES is inescapable.

The flushing program was not capable maintaining the minimum free chlorine residual required by FDEP in certain areas, even for 24 hours after flushing had raised it to 1.5mg/l. The observation that no flushing was undertaken over the 48 hour weekend period raises the strong probability that intermittently in many areas Aloha's delivered water may have contained less than the minimum free chlorine residual for disinfection required by FDEP.

Clarity of water was also frequently compromised. Such loss of clarity occurring in the winter month of November when water utilization is usually higher than in summer due to the presence of "snow birds" raises the concern that in summer months when chlorine dissipates due to higher temperatures, loss of clarity due to the presence of suspended matter would have been even higher!

In the face of these findings, the production of intermittent black water and rotten egg smell in domestic plumbing in some areas of Aloha's service territory cannot any more be explained as exclusively due to some unique chemistry that is confined to domestic plumbing.

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	1.0	1.5	C	1500
Haverhill Cul De Sac	FH	D	1.5	1.5	C	100
Wyndham	BO	D	1.5	1.5	C	100
1441 Haverhill	FH	D	1.5	1.5	C	100
Cheltnam	FH	D	1.5	1.5	C	100
1050 Trafalger	FH	D	1.5	1.5	C	100
Daleside	FH	D	1.5	1.5	C	100
Grimsby	FH	D	1.5	1.5	C	100
Stroud & Dawsbury	FH	D	1.5	1.5	C	100
Stroud Court	BO	D	1.5	1.5	C	100
Wyndtree & Hooversham	FH	D	1.5	1.5	C	100
Farmingdale	FH	D	1.5	1.5	C	100
Forestedge	FH	D	1.5	1.5	C	100
Lake Haven Drive & Haden	FH	D	1.5	1.5	C	100
Cimmeron	FH	D	1.5	1.5	C	100
Central Park Avenue	FH	D	1.0	1.5	C	200
Aristocrate Drive	FH	D	1.5	1.5	C	100
East Bay	FH	D	1.5	1.5	C	100
Success Drive	FH	D	1.5	1.5	C	100
Any hydrant in new section	FH	MWF	1.5	1.5	C	100
Riveria & Cachette	FH	D	1.0	1.5	C	200
Riveria at boat deck	BO	D	0	1.5	C	400
Ground Squirrel	FH	MWF				
Arboretum	FH	TT				
Moon Shadow & Whisper Woods	FH	TT				
2822 San Pedro (Hills of San Jose)	BO	MWF				
O'Hara & Tori	BO	TT				
7238 Riverbank	FH	MWF	—	—	—	—
Sun Bank	FH	TT				
4540 Rowan Road	FH	MWF				
Onorio	FH	D				
Akuri	BO	MWF				
Jerrilyn	BO	TT				
Church of Shoot Street	BO	TT				
4818 Murcross	BO	TT				
Weasel	FH	MWF				
Florida Power	FH	TT				
Bostonian Loop	FH	W				
Harrow Place	FH	D				
Severn Place	FH	TT				
Gem Court	FH	MWF				
Alvernon	FH	MWF				
Villa Entrada	BO	MWF				

DATE: 6-4-09 NAME: Duane Medina

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL2*	*CLOSE CL2*	*START COLOR*	*GAL'S FLUSH*
Arlinbrook	FH	M W F	1.5	1.5	C	100
9033 Belmeadow	FH	M W F	1.5	1.5	C	100
8838 Belmeadow	FH	M W F	1.5	1.5	C	100
9129 Callaway	FH	M W F	1.5	1.5	B	300
2356 Troski	FH	M W F	1.5	1.5	C	100
Boomington & Hominy	FH	M W F	1.5	1.5	C	100
Spottswood	FH	M W F	1.0	1.5	C	500
Hagen Drive	FH	M W F	1.0	1.5	C	300
Fox Hollow Club House	FH	M W F	1.0	1.5	C	300
Hagen Drive	FH	M W F	1.5	1.5	C	100
Club House	BO	M W F	1.5	1.5	C	100
Ventura	FH	M W F	1.0	1.5	C	500
FOXWOOD:						
Tamarind	FH	M-TH				
Cross Vine	FH	M-TH				
WYNDGATE:						
Courtlia	FH	T-F				
Craighurst	FH	T-F				
Orchard Grove	FH	T-F				

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 6-4-14 NAME: Juan A Hinojosa

C

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CU?	CLOSE CU?	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	0.3	1.5	C	700
Haverhill Cul De Sac	FH	D	1.9	1.9	C	0
Wyndham	BO	D	2.0	2.0	C	0
1441 Haverhill	FH	D	2.1	2.1	C	0
Cheltnam	FH	D	1.7	1.7	C	0
1050 Trafalger	FH	D	2.0	2.0	C	0
Daleside	FH	D	2.0	2.0	C	0
Grimsby	FH	D	2.1	2.1	C	0
Stroud & Dawsbury	FH	D	0.3	1.8	C	700
Stroud Court	BO	D	0.3	1.8	C	300
Wyndtree & Hooversham	FH	D	1.5	1.5	C	0
Farmingdale	FH	D	1.8	1.8	C	0
Forestedge	FH	D	1.8	1.8	C	0
Lake Haven Drive & Haden	FH	D	1.2	1.5	C	300
Cimmeron	FH	D	0.5	1.2	C	500
Central Park Avenue	FH	D	1.5	1.5	C	0
Aristocrate Drive	FH	D	1.5	1.5	C	0
East Bay	FH	D	1.5	1.5	C	0
Success Drive	FH	D	1.7	1.7	C	0
Any hydrant in new section	FH	MWF	1.7	1.7	C	0
Riveria & Cachette	FH	D	1.0	1.8	C	400
Riveria at boat deck	BO	D	0.9	1.8	C	200
Ground Squirrel	FH	MWF	0.5	1.4	C	500
Arboretum	FH	TT				
Moon Shadow & Whisper Woods	FH	TT				
2822 San Pedro (Hills of San Jose)	BO	MWF	0.3	1.3	Y-C	900
O'Hara & Tori	BO	TT				
7238 Riverbank	FH	MWF	—	—	—	—
Sun Bank	FH	TT				
4540 Rowan Road	FH	MWF	0.8	1.4	C	500
Onorio	FH	D	0.8	1.3	C	200
Akuri	BO	MWF	1.0	1.0	C	0
Jerrilyn	BO	TT				
Church of Shoot Street	BO	TT				
4818 Murcross	BO	TT				
Weasel	FH	MWF	0.5	1.0	C	300
Florida Power	FH	TT				
Bostonian Loop	FH	W				
Harrow Place	FH	D	0.0	1.0	C	1400
Severn Place	FH	TT				
Gem Court	FH	MWF	1.3	1.3	C	0
Alvernon	FH	MWF	1.2	1.2	C	0
Villa Entrada	BO	MWF	0.2	1.0	C	500

DATE: 6-7-99 NAME: Juan Zeno

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL2*	*CLOSE CL2*	*START COLOR*	*GAL'S FLUSH*
Arlinbrook	FH	M W F				
9033 Belmeadow	FH	M W F	0.2	1.0		200
8838 Belmeadow	FH	M W F	0.3	1.0		100
9129 Callaway	FH	M W F	0.2	0.8		500
2356 Troski	FH	M W F	0.1	0.8		700
Boomington & Hominy	FH	M W F				
Spottswood	FH	M W F				
Hagen Drive	FH	M W F	0.4	1.0		300
Fox Hollow Club House	FH	M W F				
Hagen Drive	FH	M W F				
Club House	BO	M W F				
Ventura	FH	M W F				
FOXWOOD:						
Tamarind	FH	M-TH 1.0	1.2		C.	50
Cross Vine	FH	M-TH 1.2	1.2		C	0
WYNDGATE:						
Courtlia	FH	T-F				
Craighurst	FH	T-F				
Orchard Grove	FH	T-F				

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 6-7-99 NAME: Juan Z

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	1.5	1.5	C	4000
Haverhill Cul De Sac	FH	D	1.5	1.5	C	100
Wyndham	BO	D	1.5	1.5	C	100
1441 Haverhill	FH	D	1.5	1.5	C	100
Cheltnam	FH	D	1.5	1.5	C	100
1050 Trafalger	FH	D	1.5	1.5	C	100
Daleside	FH	D	1.5	1.5	C	100
Grimsby	FH	D	1.5	1.5	C	100
Stroud & Dawsbury	FH	D	1.5	1.5	C	100
Stroud Court	BO	D	0	1.5	C	1000
Wyndtree & Hooversham	FH	D	1.5	1.5	C	100
Farmingdale	FH	D	1.5	1.5	C	100
Forestedge	FH	D	1.5	1.5	C	100
Lake Haven Drive & Haden	FH	D	1.5	1.5	C	100
Cimmeron	FH	D	1.5	1.5	C	100
Central Park Avenue	FH	D	1.5	1.5	C	100
Aristocrate Drive	FH	D	1.5	1.5	C	100
East Bay	FH	D	1.5	1.5	C	100
Success Drive	FH	D	1.5	1.5	C	100
Any hydrant in new section	FH	MWF				
Riveria & Cachette	FH	D	1.5	1.5	C	100
Riveria at boat deck	BO	D	1.5	1.5	C	100
Ground Squirrel	FH	MWF				
Arboretum	FH	TT	1.5	1.5	C	100
Moon Shadow & Whisper Woods	FH	TT	0	1.5	C	2000
2822 San Pedro (Hills of San Jose)	BO	MWF				
O'Hara & Tori	BO	TT	0	1.5	C	2000
7238 Riverbank	FH	MWF	—	—	—	—
Sun Bank	FH	TT				
4540 Rowan Road	FH	MWF				
Onorio	FH	D				
Akuri	BO	MWF				
Jerrilyn	BO	TT				
Church of Shoot Street	BO	TT				
4818 Murcross	BO	TT				
Weasel	FH	MWF				
Florida Power	FH	TT				
Bostonian Loop	FH	W				
Harrow Place	FH	D				
Severn Place	FH	TT				
Gem Court	FH	MWF				
Alvernon	FH	MWF				
Villa Entrada	BO	MWF				

DATE: 6-10-01 NAME: Duane A. Dailey

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	1.0	1.5	C	1000
Haverhill Cul De Sac	FH	D	1.0	1.5	C	500
Wyndham	BO	D	1.5	1.5	C	100
1441 Haverhill	FH	D	1.5	1.5	C	100
Cheltnam	FH	D	1.5	1.5	C	100
1050 Trafalger	FH	D	1.5	1.5	C	100
Daleside	FH	D	1.5	1.5	C	100
Grimsby	FH	D	1.5	1.5	C	100
Stroud & Dawsbury	FH	D	1.5	1.5	C	500
Stroud Court	BO	D	1.5	1.5	C	100
Wyndtree & Hooversham	FH	D	1.5	1.5	C	100
Farmingdale	FH	D	1.5	1.5	C	1000
Forestedge	FH	D	1.5	1.5	C	100
Lake Haven Drive & Haden	FH	D	1.0	1.5	C	200
Cimmeron	FH	D	1.0	1.5	C	200
Central Park Avenue	FH	D	1.5	1.5	C	100
Aristocrate Drive	FH	D	1.5	1.5	C	100
East Bay	FH	D	1.5	1.5	C	100
Success Drive	FH	D	1.5	1.5	C	100
Any hydrant in new section	FH	MWF	1.5	1.5	C	100
Riveria & Cachette	FH	D	1.5	1.5	C	100
Riveria at boat deck	BO	D	1.5	1.5	C	100
Ground Squirrel	FH	MWF	1.5	1.5	C	100
Arboretum	FH	TT				
Moon Shadow & Whisper Woods	FH	TT				
2822 San Pedro (Hills of San Jose)	BO	MWF	1.5	1.5	C	100
O'Hara & Tori	BO	TT				
7238 Riverbank	FH	MWF	—	—	—	—
Sun Bank	FH	TT				
4540 Rowan Road	FH	MWF				
Onorio	FH	D				
Akuri	BO	MWF				
Jerrilyn	BO	TT				
Church of Shoot Street	BO	TT				
4818 Murcross	BO	TT				
Weasel	FH	MWF				
Florida Power	FH	TT				
Bostonian Loop	FH	W				
Harrow Place	FH	D				
Severn Place	FH	TT				
Gem Court	FH	MWF				
Alvernon	FH	MWF				
Villa Entrada	BO	MWF				

DATE: 6-11-99 NAME: John B. Williams

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

4200

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D				
Haverhill Cul De Sac	FH	D				
Wyndham	BO	D				
1441 Haverhill	FH	D 1.5		1.5	C	100
Chelmam	FH	D				
1050 Trafalger	FH	D 1.5		1.5	C	100
Daleside	FH	D 1.5		1.5	C	100
Grimsby	FH	D				
Stroud & Dawsbury	FH	D 1.5		1.5	C	100
Stroud Court	BO	D				
Wyndtree & Hooversham	FH	D				
Farmingdale	FH	D				
Forestedge	FH	D 1.5		1.5	C	100
Lake Haven Drive & Haden	FH	D 1.5		1.5	C	40
Cimmeron	FH	D				
Central Park Avenue	FH	D 1.5		1.5	C	40
Aristocrate Drive	FH	D				
East Bay	FH	D 1.5		1.5	C	40
Success Drive	FH	D				
Any hydrant in new section	FH	MWF				
Riveria & Cachette	FH	D 1.5		1.5	C	40
Riveria at boat deck	BO	D 0		1.5	C	100
Ground Squirrel	FH	MWF 1.5		1.5	C	40
Arboretum	FH	TT				
Moon Shadow & Whisper Woods	FH	TT				
2822 San Pedro (Hills of San Jose)	BO	MWF				
O'Hara & Tori	BO	TT				
7238 Riverbank	FH	MWF —		—	—	— —
Sun Bank	FH	TT				
4540 Rowan Road	FH	MWF				
Onorio	FH	D				
Akuri	BO	MWF				
Jerrilyn	BO	TT				
Church of Shoot Street	BO	TT				
4818 Murcross	BO	TT				
Weasel	FH	MWF				
Florida Power	FH	TT				
Bostonian Loop	FH	W				
Harrow Place	FH	D				
Severn Place	FH	TT				
Gem Court	FH	MWF				
Alvernon	FH	MWF				
Villa Entrada	BO	MWF				

DATE: 6-18-99 NAME: Duane C Medina

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FOX HOLLOW FLUSH SCHEDULE

ADDRESS							
	FH		M W F				
	FH		M W F				
	FH		M W F	1.5	C	100	
	FH		M W F	1.5	C	500	
2356 Troski *	FH		M W F	1.5	C	100	
Boomington & Hominy *	FH		M W F	1.5	C	100	
Spottswood *	FH		M W F	1.5	C	100	
			M W F				
Fox Hollow Club House	FH		M W F				
Hagen Drive	FH		M W F				
Club House	BO		M W F				
*	FH		M		C		
FOXWOOD: PAVILION				1.5	1.5	C	40
~~Fernand~~ HERMAN	FH		M-TH	0	1.5	C	1000
Cross Vine	FH		M-TH	1.5	1.5	C	100
BALA Ridge				1.5	1.5	C	40
WYNDGATE:							
Courtlia	FH		T-F	1.5	1.5	C	100
Craighurst	FH		T-F	1.5	1.5	C	100
Orchard Grove	FH		T-F	1.5	1.5	C	100
ALMOND WOOD				1.5	1.5	C	40

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 6-18-09 NAME: [illegible]

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	0.5	1.5	C	2000
Haverhill Cul De Sac	FH	D				
Wyndham	BO	D				
1441 Haverhill	FH	D	0.5	1.5	C	1000
Chelmam	FH	D				
1050 Trafalger	FH	D	1.5	1.5	C	100
Daleside	FH	D	1.5	1.5	C	100
Grimsby	FH	D	1.5	1.5	C	100
Stroud & Dawsbury	FH	D	1.5	1.5	C	100
Stroud Court	BO	D	1.5	1.5	C	100
Wyndtree & Hooversham	FH	D				
Farmingdale	FH	D				
Forestedge	FH	D	1.5	1.5	C	100
Lake Haven Drive & Haden	FH	D				
Cimmeron	FH	D				
Central Park Avenue	FH	D				
Aristocrate Drive	FH	D				
East Ridge	FH	D				
Success Drive	FH	D				
Any hydrant in new section	FH	MWF				
Riveria & Cachette	FH	D				
Riveria at boat deck	BO	D				
Ground Squirrel	FH	MWF				
Arboretum	FH	TT				
Moon Shadow & Whisper Woods	FH	TT				
2822 San Pedro (Hills of San Jose)	BO	MWF				
O'Hara & Tori	BO	TT				
7238 Riverbank	FH	MWF	—	—	—	— —
Sun Bank	FH	TT				
4540 Rowan Road	FH	MWF				
Onorio	FH	D				
Akuri	BO	MWF				
Jerrilyn	BO	TT				
Church of Shoot Street	BO	TT				
4818 Murcross	BO	TT				
Weasel	FH	MWF				
Florida Power	FH	TT				
Bostonian Loop	FH	W				
Harrow Place	FH	D				
Severn Place	FH	TT				
Gem Court	FH	MWF				
Alvernon	FH	MWF				
Villa Entrada	BO	MWF				

DATE: 6-22-99 NAME: Juan C Fuentes

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

30 gal

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Arlinbrook	FH	M W F				
9033 Belmeadow	FH	M W F				
8838 Belmeadow	FH	M W F O	1.0		C	400
9129 Callaway	FH	M W F O	1.0		C	2,000
2356 Troski	FH	M W F O	1.0		C	1000
Boomington & Hominy	FH	M W F O	1.0		C	2000
Spottswood	FH	M W F O	1.0		C	2000
~~Haven Drive~~ 50	FH	M W F O	1.0		C	1000
Fox Hollow Club House	FH	M W F O	1.0		C	2000
~~Haven Drive~~	FH	M W F				
Club House	BO	M W F O	1.0		C	1000
Ventura	FH	M W F				
FERRALYN		O	1.0		C	5000
FOXWOOD:						
Tamarind	FH	M-TH				
Cross Vine	FH	M-TH O	1.0		C	5000
BALSA Ridge						
WYNDGATE:						
Courtlia	FH	T-F				
Craighurst	FH	T-F				
Orchard Grove	FH	T-F				
ALHONDWOOD		O	1.0		C	5000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 6-22-99 NAME: Jane A Jodin

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	0.1	1.5	C	2200
Wyndham	BO	M/TH	1.5	1.5	C	400
1441 Haverhill	FH	D	2.0	2.0	C	600
Chelmam	FH	M/TH	1.5	1.5	C	600
1050 Trafalger	FH	T/F				
Daleside	FH	T/F				
Stroud & Dawsbury	FH	D	0.6	1.5	C	3000
Stroud Court	BO	D	0.3	1.5	C	300
Wyndtree & Hooversham	FH	M/TH	1.5	1.5	C	1400
Forestedge	FH	D	0.3	1.5	C	1200
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	T/F				
Riveria at boat deck	BO	D	0	1.0	C	3200
Ground Squirrel	FH	M-TH	1.1	1.5	C	1200
Arboretum	FH	M-TH	0.8	1.5	C	2300
2822 San Pedro (Hills of San Jose)	BO	MWF	0.4	1.5	C	2500
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
Akuri	BO	MWF				
Florida Power	FH	MWF				
Harrow Place	FH	D				
Severn Place	FH	TT				
Villa Entrada	BO	MWF	0.1	0.8		3000
Wood Bend	FH	TH				

DATE: 7-26-99 NAME: ALFREDO PARRA

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

SAN Rafael 1.0 1.0 C 3700

Gem CT 0 0.3 C 5300

Vista Verdi back fire Hydrant
0.3 0.5 C

4600

4210

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF				
9129 Callaway	FH	MWF				
2356 Troski	FH	MWF				
Bonnington & Hominy	FH	MWF				
Spottswood	FH	WF				
Hagen Drive	BO	MWF				
Ventura	FH	MWF				
Balsaridge	FH	MWF				
FOXWOOD:						
Terilind	FH	W/F				
Cross Vine	FH	W/F				
Daylilly	FH	MWF				
WYNDGATE:						
Courtlia	FH	MWF	0.2	1.0	C	2100
Craighurst	FH	MWF	0.5	1.0	C	2600
Orchard Grove	FH	MWF				
Heritage Springs:						
Almond Wood		MWF	0.	1.0	C	4300

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 7-26-99 NAME: ALFREDO PARRA

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	1.0	1.5	C	2,000
9129 Callaway	FH	MWF	1.0	1.5	C	1,000
2356 Troski	FH	MWF	1.0	1.5	C	4,000
Bonnington & Hominy	FH	MWF	0.4	1.5	C	2,000
Spottswood	FH	WF	0.5	1.5	C	4,000
Hagen Drive	BO	MWF	1.4	1.5	C	1,000
Ventura	FH	MWF	1.0	1.5	C	8,000
Balsaridge	FH	MWF	0.6	1.5	C	8,000
FOXWOOD:						
TERRYLYN Terilind	FH	W/F	0.6	1.5	C	4,000
Cross Vine	FH	W/F	1.0	1.5	C	9,000
Daylilly	FH	MWF	1.5	1.5	C	8,000
WYNDGATE:						
Courtlia	FH	MWF	0.7	1.5	C	~~8,000~~ 15,000
Craighurst	FH	MWF	0.8	1.5	C	5,000
Orchard Grove	FH	MWF	0.7	1.5	C	3,000
Heritage Springs:						
Almond Wood	D	MWF	0.8	1.5	C	9,000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 8/3/99 NAME: Rodney Strohmayer
Allison Gibson

3MIN. WINSLOW DR. 0.8 1.0 C 8,000

Ventura first reading was 1.0 3 min Later 0.9. then 8 min later got 1.5.

13,04.00

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D				
Wyndham	BO	M/TH				
1441 Haverhill	FH	D				
Cheltnam	FH	M/TH				
1050 Trafalger	FH	T/F				
Daleside	FH	T/F				
Stroud & Dawsbury	FH	D				
Stroud Court	BO	D				
Wyndtree & Hooversham	FH	M/TH				
Forestedge	FH	D				
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	T/F				
Riveria at boat deck	BO	D	1.0	1.6	@	1,000
Ground Squirrel	FH	M-TH				
Arboretum	FH	M-TH				
2822 San Pedro (Hills of San Jose)	BO	MWF				
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
Akuri	BO	MWF				
Florida Power	FH	MWF				
Harrow Place	FH	D	0.6	1.5	@	1500
Severn Place	FH	TT	0.7	1.5	@	1700
Villa Entrada	BO	MWF				
Wood Bend	FH	TH				

Porter Lake.

DATE: 8/3/99 NAME: Rod Strohmayer. Allison Gibson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

~~Royale oak.~~

4SHP Royale oak. 0.0 0.2 B 4,500

could not raise cl2 level above 0.2 after 4,500 gallons

VAK

FOX HOLLOW FLUSH SCHEDULE

	ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
	8838 Belmeadow	FH	MWF	1.0	1.5	C	2,000
	9129 Callaway	FH	MWF	1.1	1.5	C	2,000
	2356 Troski	FH	MWF	1.1	1.5	C	2,000
	Bonnington & Hominy	FH	MWF	0.9	1.5	C	2,000
	Spottswood	FH	WF	0.9	1.5	C	2,000
	Hagen Drive	BO	MWF	0.0	1.5	C	4,000
	Ventura	FH	MWF	0.0	1.5	C	4,000
	Balsaridge	FH	MWF	0.0	1.5	C	2,000
	FOXWOOD:						
30 MIN	~~Teriliad~~ TERRALYN	FH	W/F	0.0	1.5	C	12,000
	Cross Vine	FH	W/F	0.0	1.5	C	2,000
	Daylilly	FH	MWF	0.0	1.5	C	4,000
	WYNDGATE:						
	Courtlia	FH	MWF				
	Craighurst	FH	MWF				
	Orchard Grove	FH	MWF				
	Heritage Springs:						
1/25/1007	Almond Wood		MWF	0.6	1.5	C	5,000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 8/5/99 NAME: [signature]

WINDSLOE	I	0.0	1.5	C	TED	45 MIN
	II	0.0	1.5	C	TED	45 MIN
1137	ALMOND WOOD II	1.0	1.5	C	2,000	

47,000

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	1.5	1.5	C	2,000
9129 Callaway	FH	MWF	1.0	1.5	C	2,000
2356 ~~Tzoski~~ TOSKI	FH	MWF				
Bonnington & Hominy	FH	MWF				
Spottswood	FH	WF				
Hagen Drive	BO	MWF				
~~Ventura~~ VENTURI	FH	MWF				
Balsaridge	FH	MWF	0.0	1.5	C	2,000
FOXWOOD:						
~~Fortlind~~ TERRALYN	FH	W/F	0.0	1.5	C	3,000
Cross Vine	FH	W/F	0.0	1.5	C	2,000
Daylilly	FH	MWF	0.0	1.5	C	7,000
WYNDGATE:						
~~Guardia~~ COCTLEIGH	FH	MWF				
Craighurst	FH	MWF				
Orchard Grove	FH	MWF				
Heritage Springs:						
35 KIND Almond Wood		MWF	0.0	1.5	C	20,000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 8/9/99 NAME: [signature]

35 KIND	WINSLOE (TAMARIND)	0.2	1.5	C	18,000
	WINSLOE (LEFT)	0.0	1.5	C	5,000
	CASSIA	0.0	1.5	C	4,000

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	0.4	1.5	C	15,000 meter
Wyndham	BO	M/TH	1.4	1.5	C	250
1441 Haverhill	FH	D	1.5	1.5	C	50
Cheltnam ✓	FH	M/TH	1.5	1.5	C	50
1050 Trafalger	FH	T/F	1.5	1.5	C	50
Daleside	FH	T/F	1.5	1.5	C	50
Stroud & Dawsbury	FH	D	0.4	1.5	C	15,000
Stroud Court	BO	D	0.0	1.5	C	[redacted] 500
Wyndtree & Hooversham	FH	M/TH	1.5	1.5	C	50
Forestedge ✓	FH	D				
Country Place:						
Lake Haven Drive & Haden	FH	T/F	0.0	1.5	C	4,000
Cimmeron	FH	T/F	0.6	1.2	C	2600
Central Park Avenue	FH	T/F	1.0	1.5	C	1000
Aristocrate Drive	FH	T/F	1.6	1.5	C	2,100
East Bay	FH	T/F	0.9	1.5	C	1,400
Industrial:						
Success Drive	FH	T/F				
Riveria at boat deck	BO	D	0.2	[redacted] 1.0	C	[redacted] 2000 2 1/2
Ground Squirrel	FH	M-TH	.8	1.5	C	1200
Arboretum CAPTIVA 1128	FH	M-TH	0.8	2 WKS 1.5	C	2901 3 1/4 in 2 wks
2822 San Pedro (Hills of San Jose)	BO	MWF	0.9	1.5	C	3,700 3 1/2 HOURS 3/4 wks
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
Akuri AUKAI Daily	BO	MWF	0.7	1.6		500
Florida Power	FH	MWF	0.4	1.5		4700
Harrow Place	FH	D	0.7	1.5		4,100
Severn Place	FH	TT	1.0	1.5		900
Villa Entrada	BO	MWF	0.8	1.5	C	700
Wood Bend	FH	TH				

DATE: 8/24/99 NAME: Rodney Stokenyer

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

D. Royal Oaks 1.0 1.5 C 2,500

D. San Rafael 1.5 1.5 C 700

D. Vista Reder Dr. 0.8 1.5 C 2,700

D. Glen Ct. 1.0 1.5 C 2,400

D. San Pedro 0.5 1.5 C 19,000

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF				
9129 Callaway	FH	MWF				
2356 ~~Troski~~ TOSKI	FH	MWF				
Bonnington & Hominy	FH	MWF				
Sportswood	FH	WF				
Hagen Drive	BO	MWF				
~~Ventura~~ VENTURI	FH	MWF				
Balsaridge	FH	MWF	0.3	1.5	C	2,000
FOXWOOD:						
~~Feriliad~~ TERRAINN	FH	W/F	0.2	1.5	C	24,000
Cross Vine	FH	W/F	1.0	1.5	C	4,000
Daylilly	FH	MWF	0.3	1.5	C	2,000
WYNDGATE:						
~~Courtlia~~ CORTLEIGH	FH	MWF	0.7	1.0	C	12,000
Craighurst	FH	MWF				
Orchard Grove	FH	MWF				
Heritage Springs:						
Almond Wood	FH	MWF	0.2	1.5	C	12,000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 8/24/99 NAME: [signature]

FALLONFIELD BO		1.0	1.5	C	2,000
WINSLOE & TAMARIND	FH	0.4	1.0	C	72,000
WINSLOE (LEFT)	FH	0.4	1.0	C	24,000
CASSIA	FH	0.0	1.0	C	24,000
WYNGATE	BO	0.7	1.0	C	12,000

PER TONY

FOX HOLLOW FLUSH SCHEDULE

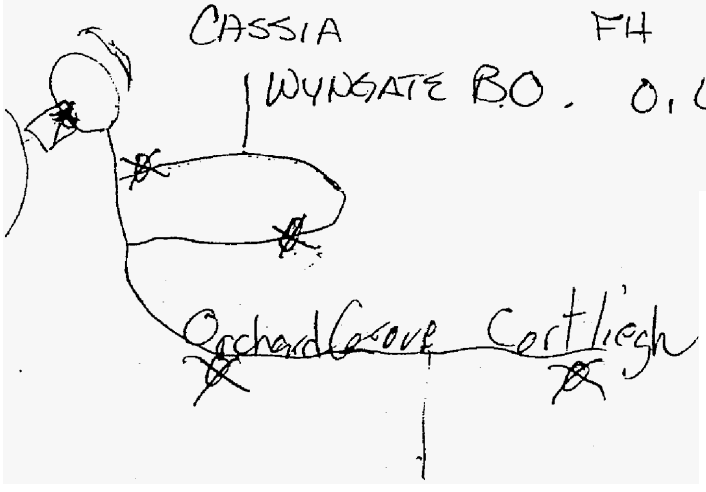
ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	1.5	1.5	C	1,000
9129 Callaway	FH	MWF	1.0	1.5	C	2,000
2356 ~~Froski~~ TOSKI	FH	MWF	0.7	1.5	C	4,000
Bonnington & Hominy	FH	MWF	0.9	1.5	C	2,000
Sportswood	FH	WF	0.6	1.5	C	2,000
Hagen Drive	BO	MWF	0.2	1.5	C	
~~Ventura~~ VENTURI	FH	MWF	0.2	1.3	C	2,000
Balsaridge	FH	MWF	0.4	1.5	C	6,000
FOXWOOD:						
~~Fernlind~~ TERRALYN	FH	W/F				
Cross Vine	FH	W/F	0.6	1.5	C	4,000
Daylilly	FH	MWF	0.5	1.5	C	4,000
WYNDGATE:						
~~Cassia~~ CORTLEIGH	FH	MWF	0.6	1.5	C	30,000
Craighurst	FH	MWF	~~0.5~~	1.0	2.5 C	2,000
Orchard Grove	FH	MWF	0.5		2.5 C	10,000
Heritage Springs:						
Almond Wood	FH	MWF	0.0	1.5	C	12,000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 8/23/99 NAME: [signature]

FALLONFIELD	BO	0.9	1.5	C	2,000
WINSLOE & TAMARIND	FH	0.5	1.5	C	24,000
WINSLOE (LEFT)	FH	0.4	1.0 PER TOWN	C	36,000
CASSIA	FH	0.4	1.0	C	30,000
WYNGATE BO.		0.6	3.0	C	45,000



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OUT

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D 0.0	1.5		C	3000
Wyndham	BO	M/TH 0.8	1.5		C	9000
1441 Haverhill	FH	D 1.5	1.5		C	500
Cheltnam	FH	M/TH				
1050 Trafalger	FH	T/F 1.0	1.5		C	700
Daleside	FH	T/F 6.0	4.5		C	900
Stroud & Dawsbury	FH	D 0.7	1.5		C	9000
Stroud Court	BO	D 0.4	1.5		C	900
Wyndtree & Hooversham	FH	M/TH 1.5	1.5		C	50
Forestedge	FH	D [illegible]			[illegible]	[illegible]
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	T/F				
Riveria at boat deck	BO	D 0.0	2.8		C	1400 2 hours 3/4 mile
Ground Squirrel	FH	M-TH 0.6	1.5		C	6000
D ~~Arboretum~~ CAPTIVA C.C.	FH	M-TH 0.0	1.		C	1800 2½ hours 3/4 mile
2822 San Pedro (Hills of San Jose)	BO	MWF				
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
~~Alari~~ AUKARI 8341	BO	MWF				
Florida Power	FH	MWF 0.0	1.3	1.3	C	3000
Harrow Place	FH	D 0.7	1.5		C	3000
Severn Place	FH	TT				
Villa Entrada	BO	MWF 0.3	1.5		C	2,100
Wood Bend	FH	TH				

DATE: 5/23/99 NAME: Rodney Stutsman

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

D. Royal Oak 0.7 1.5 C 6,200
D. San Rafael 1.0 1.5 C 900
D. Vista Veder Dr. 0.3 1.5 YOC 2,200
D. Gem Ct. 0.5 1.5 C 3,000
D. San Pedro.

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL. FLUSH
8838 Belmeadow	FH	MWF	1.2	1.5	C	2,000
9129 Callaway	FH	MWF	1.2	1.5	C	3,000
2356 Troski	FH	MWF	1.3	1.5	C	4,000
Bonnington & Hominy	FH	MWF	1.1	1.5	C	12,000
Sportswood	FH	WF	0.2	1.5	C	22,000
Hagen Drive	BO	MWF	0.1	1.5	C	6,000
Ventura	FH	MWF	0.4	1.5	C	19,000
Balsaridge	FH	MWF	0.3	1.5	C	16,000
FOXWOOD:						
~~Foxwood~~ TerraLyn	FH	W/F	0.4	1.5	C	20,000
Cross Vine	FH	0.5 W/F	0.5	1.5	C	14,000
Daylilly	FH	MWF	0.5	1.5	C	20,000
WYNDGATE:						
Courtlia	FH	MWF	0.8	1.5	C	6,000
Craighurst	FH	MWF	1.0	1.5	C	4,000
Orchard Grove	FH	MWF	0.5	1.5	C	3,000
Heritage Springs:						
Almond Wood		MWF	0.8	1.5	C	5,000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 9/2/99 NAME: Robert E. Johnson

Fellowship	1.0	1.5	C	600
Winsloe	0.3	1.0	C	9,000
Winsloe of Tamarinda	0.4	1.0	C	10,000
Wyndgate B.O.	1.0	1.5	C	C 6,000

318763

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
- Davenport & Mitchell Blvd.	FH	D	0.0	3.0	C	6,000
- Wyndham	BO	M/TH	3.0	3.0	C	500
- 1441 Haverhill	FH	D	3.0	3.0	C	500
- Chelmam	FH	M/TH	3.0	3.0	C	500
1050 Trafalger	FH	T/F	3.0	3.0	C	500
Daleside	FH	T/F				
- Stroud & Dawsbury	FH	D	0.0	2.0	C	2,000
- Stroud Court	BO	D	0.0	2.5	C	2,000
- Wyndtree & Hooversham	FH	M/TH	(BROKE USED 4TH HOUR.)		3.0	3.0 C 500
Forestedge	FH	D	BROKE			
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	T/F				
- Riveria at boat deck	BO	D	0.0	1.5	C	
- Ground Squirrel	FH	M-TH	3.0	3.0	C	500
- Arboretum CAPTIVA	FH	M-TH	0.2	3.0	C	
- 2822 San Pedro (Hills of San Jose)	BO	D	3.5	3.5	C	100
Tori Court	BO	TT				
- 4540 Rowan Road STILL	FH	TH	1.0	1.5	C	6,000
~~Akari~~ AURAEL	BO	~~M-TH~~ D	0.4	1.5	C	8,000
- Florida Power	FH	D	0.5	1.5	C	2,000
- Harrow Place	FH	D	0.4	1.5	C	6,000
- Severn Place	FH	D	1.5	1.5	C	500
- Villa Entrada	BO	D	0.4	1.5	C	8,000
- Wood Bend	FH	TH	2.5	3.5	C	500
- Royal Oak		D	0.5	1.5	C	12,000
- San Rafael		D	0.3	1.5	C	6,000
- Gem Court		D	0.2	1.5	C	8,000
~~San Pedro~~		D	SAME AS ABOVE			
- Vista Verde Drive		D	0.8	1.5	C	2,000

DATE: 9/2/99 NAME: [signature]

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

Letters/forms/flush schedule WYNDGATE

WYNDGATE BO 0.0 C
CORTLEIGH FH 0.0 1.5 C 12,000

[redacted]

Dan

Docket No. 010503-WU
Exhibit VAK-19
Page 26 of 60

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	0.0	1.5	C	
Wyndham	BO	M/TH	0.0	1.5	C	
1441 Haverhill	FH	D	0.0	1.5	C	
Cheltnam	FH	M/TH	0.3	1.5	C	
~~1050 Trafalger~~	~~FH~~	~~T/F~~		~~1.5~~		
~~Dateside~~	~~FH~~	~~T/F~~		~~1.5~~		
Stroud & Dawsbury	FH	D	0.5	1.5	C	
Stroud Court	BO	D	0.3	1.5	C	
Wyndtree & Hooversham	FH	M/TH	0.6	1.5	C	
Forestedge	FH	D	0.5	1.5	C	
Country Place:						
~~Lake Haven Drive & Haden~~	~~FH~~	~~T/F~~		~~1.5~~		
~~Cimmeron~~	~~FH~~	~~T/F~~		~~1.5~~		
~~Central Park Avenue~~	~~BO~~	~~T/F~~		~~1.5~~		
~~Aristocrate Drive~~	~~FH~~	~~T/F~~		~~1.5~~		
~~East Bay~~	~~FH~~	~~T/F~~		~~1.5~~		
Industrial:						
~~Success Drive~~	~~FH~~	~~T/F~~		~~1.5~~		
Riveria at boat deck	BO	D	1.0	1.5	C	
Ground Squirrel	FH	M-TH	0.8	1.5	C	
Arboretum	FH	M-TH	0.0	1.5	C	
2822 San Pedro (Hills of San Jose)	BO	MWF	0.8	1.5	C	
~~Tori Court~~	~~BO~~	~~TF~~		~~1.5~~		
~~4540 Rowan Road~~	~~FH~~	~~TH~~		~~1.5~~		
Akuri	BO	MWF	0.7	1.5	C	
~~Florida Power~~	~~FH~~	~~MWF~~		~~1.5~~	~~C~~	
Harrow Place	FH	D	0.5	1.5	C	
~~Severn Place~~	~~FH~~	~~TF~~		~~1.5~~		
Villa Entrada	BO	MWF	0.6	1.5	C	
~~Wood Road~~	~~FH~~	~~TH~~		~~1.5~~		

DATE: _____ *NAME:* _____

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

9050
Callaway
1009 Toski

1354
Davenport
mi DDlcSCA
59602

Dan

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL2*	*CLOSE CL2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	0.3	1.5	C	2000
9129 Callaway	FH	MWF	0.5	1.5	C	2500
2356 Troski	FH	MWF	0.2	1.5	C	1900
Bonnington & Hominy	FH	MWF	0.6	1.5	C	2000
Sportswood	FH	WF	0.5	1.5	C	1500
Hagen Drive	BO	MWF	0.5	1.5	C	2500
Ventura	FH	MWF	0.3	1.5	C	2000
Balsaridge	FH	MWF	0.5	1.5	C	1500
FOXWOOD:						
Terilind	FH	W/F	0.5	1.5	C	2000
Cross Vine	FH	W/F	0.3	1.5	C	1500
Daylilly	FH	MWF	0.0	1.5	C	1500
WYNDGATE:						
Courtlia	FH	MWF	0.0	1.5	C	2000
Craighurst	FH	MWF	0.3	1.5	C	1500
Orchard Grove	FH	MWF	0.5	1.5	C	1000
Heritage Springs:						
Almond Wood		MWF	0.0	1.5	C	4000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: _____ NAME: _____

Dan

Saturday 9-25-99

Riveria Boat Dock	1.0	1.5 C	500
Arboretum Captiva	0.5	1.5 C	2000
GroundSquirrel	0.8	1.5 C	1000
Aukura	1.0	1.5 C	1000
loyal oak	0.8	1.5 C	1200
Waverly Place	1.0	1.5 C	1000
Severin Place	0.9	1.5 C	1100
Gemcourt	.7	1.5 C	1500
Vista verdi Dr		1.5 C	
villa entrada	.5	1.5 C	2000
San Rafele	1.2	1.5 C	500
Hasan	0.5	1.5 C	2000
Winslor Tamind	1.0	1.5 C	500
Tirrlind	0.0	1.5 C	1500
AlmondwooD	0.0	1.5 C	2500
Davenport mitchell	0.0	1.5 C	3000
StrooD DewsBury	1.0	1.5 C	1000
Strod court	0.0	1.5 C	1500
wyndsatr B/O	0.0	1.5 C	4000
Courtlia	0.0	1.5 C	2500
San PeDro		1.5 C	

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL2*	*CLOSE CL2*	*START COLOR*	*GAL'S FLUSH*	
8838 Belmeadow	FH	MWF	1.0	1.5	CLR.	1000	2:35 - 2:45
9129 Callaway	FH	MWF	.8	1.5	CLR	1000	2:50 - 3:00
2356 Troski	FH	MWF	1.0	1.5	CLR.	1000	3:05 - 3:10
Bonnington & Hominy	FH	MWF	1.0	1.5	CLR.	1000	3:15 - 3:25
Spottswood	FH	WF	.8	1.5	CLR.	500	3:30 - 3:35
Hagen Drive	BO	MWF	~~.5~~	~~1.5~~ 1.0	CLR	2000	3:35 - 3:55
Ventura	FH	MWF					
Balsaridge	FH	MWF	1.0	1.5	CLR	500	2:25 - 2:30
FOXWOOD:							
Terilind	FH	W/F	.3	1.5	CLR	2500	1:35 - 1:50
Cross Vine	FH	W/F	.7	1.5	CLR	1000	1:55 - 2:10
Daylilly	FH	MWF	1.0	1.5	CLR	500	2:15 - 2:20
WYNDGATE:							
Courtlia	FH	MWF					
Craighurst	FH	MWF					
Orchard Grove	FH	MWF					
Heritage Springs:							
Almond Wood	D	~~MWF~~	.5	1.4	CLR	2000	1:00 - 1:20

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 10/22/99 NAME: Yvonne Robinson

3343 50

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH	
Davenport & Mitchell Blvd.	FH	D	1.0	1.6	CLR	2000	8:20-8:40
Wyndham	BO	M/TH					
1441 Haverhill	FH	D	2.0	2.0	CLR	500	8:45-8:50
Chelmam	FH	M/TH					
1050 Trafalger	FH	T/F	1.6	1.6	CLR	500	8:55-9:00
Daleside	FH	T/F	1.8	1.6	CLR	500	9:00-9:05
Stroud & Dawsbury	FH	D	1.4	1.5	CLR	500	9:15-9:20
Stroud Court	BO	D	1.4	1.7	CLR	1500	9:10-9:25
Wyndtree & Hoversham	FH	M/TH	BROKEN				
Forestedge	FH	D	BROKEN				
Country Place:							
Lake Haven Drive & Haden	FH	T/F	1.0	1.5	CLR	1500	9:40-9:45
Cimmeron	FH	T/F	1.0	1.5	CLR	3000	10:10-10:20
Central Park Avenue	FH	T/F	1.7	1.7	CLR	1000	10:00 10:05
Aristocrate Drive	FH	T/F	1.6	1.6	CLR	1000	9:55-10:00
East Bay	FH	T/F	1.4	1.6	CLR	1500	9:50-9:55
Industrial:							
Success Drive	FH	T/F	1.6	1.6	CLR	500	9:25-9:30
Riveria at boat deck	BO	D	1.5	1.5	CLR	-298350	8:10-8:15
Ground Squirrel	FH	M-TH					
~~Arboretum~~ CAPTIVA	FH	M-TH	1.5	1.5	CLR	500	8:00-8:05
2822 San Pedro (Hills of San Jose)	BO	V.V.	MWF				
Tori Court	BO	TT					
4540 Rowan Road	FH	TH					
Akuri C.I. - S.S.	BO	MWF	1.0	1.4	CLR	3000	11:35-12:05
Harrow Place H.L.	FH	D	.5	1.4	Yellow	4000	10:50-11:30
Severn Place	FH	TT					
Villa Entrada	BO	MWF	.4	1.5	CLR	1500	10:30-10:45
Wood Bend	FH	TH					

DATE: 10-22-99 NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH	
Davenport & Mitchell Blvd.	FH	D	1.0	1.8	CL.	1500	9:10-9:30
Wyndham	BO	M/TH	1.8	1.9	CL	500	9:35-9:40
1441 Haverhill	FH	D	2.0	2.0	CL.	300	9:40-943
Chelmam	FH	M/TH	.9	2.0	YELLOW	500	9:45-9:50
1050 Trafalger	FH	T/F					
Daleside	FH	T/F					
Stroud & Dawsbury	FH	D	.6	1.5	CLR	2000	9:55-10:15
Stroud Court	BO	D	.8	1.5	CLR	1000	10:00-10:10
Wyndtree & Hooversham	FH	M/TH	- BROKEN				
Forestedge	FH	D	- BROKEN				
Country Place:							
Lake Haven Drive & Haden	FH	T/F					
Cimmeron	FH	T/F					
Central Park Avenue	FH	T/F					
Aristocrate Drive	FH	T/F					
East Bay	FH	T/F					
Industrial: G.B.							
Success Drive	FH	T/F	1.0	2.0	CLR	1000	
Riveria at boat deck	BO	D	1.7		CLR.	(295940)	
Ground Squirrel	FH	M-TH					
~~Arboretum~~ CAPTIVA	FH	M-TH	.7		CLR.	500	
2822 San Pedro (Hills of San Jose)	BO	MWF					
Tori Court V.V.	BO	TT					
4540 Rowan Road SHELL	FH	TH					
Akuri	BO	MWF					
ALMONDWOOD		D	.6	1.6	CLR.	3000	10:30-11:00
Harrow Place HERITAGE	FH	D					
Severn Place	FH	TT					
Villa Entrada	BO	MWF					
Wood Bend	FH	TH	1.5	1.8	YELLOW	500	11:30-11:40

DATE: 10-21-99 NAME: Yvonne M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

3068

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	.5	2.0	Y	1500
Wyndham	BO	M/TH	2.1	2.1	C	300
1441 Haverhill	FH	D	2.0	2.2	C	300
Chelmam	FH	M/TH	2.0	2.1	Y	400
1050 Trafalger	FH	T/F	—	—	—	—
Daleside	FH	T/F	—	—	—	—
Stroud & Dawsbury	FH	D	1.0	2.2	C	800
Stroud Court	BO	D	.7	2.1	C	500
Wyndtree & Hooversham	FH	M/TH	BROKEN			
Forestedge	FH	D	BROKEN			
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	D/F	2.0	2.0	C	100
Riveria at boat deck	BO	D	.7	2.8	C	- 313590
Ground Squirrel	FH	M-TH	1.4	1.6	C	200
Arboretum CAPTIVA	FH	M-TH	.6	1.2	C	6000
2822 San Pedro (Hills of San Jose)	BO	MWF	.4	1.5	C	1000
Tori Court	BO	TT	—	—	—	—
4540 Rowan Road	FH	TH	—	—	—	—
Akuri	BO	MWF	1.3	1.5	C	500
			—	—	—	—
Harrow Place	FH	D	.5	1.5	C	2500
Severn Place	FH	TT	—	—	—	—
Villa Entrada	BO	MWF	.4	1.5	C	1500
Wood Bend	FH	TH	—	—	—	—

DATE: 11-1-99 NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

379 GV

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	2.0	2.0	C	200
9129 Callaway	FH	MWF	2.0	2.0	C	200
2356 Troski	FH	MWF	1.5	2.0	C	300
Bonnington & Hominy	FH	MWF	2.0	2.0	C	300
Sportswood	FH	WF				
Hagen Drive	BO	MWF	1.0	2.0	C	500
Ventura	FH	MWF	1.8	2.0	C	100
Balsaridge	FH	MWF	2.8	2.8	C	200
FOXWOOD:						
Terilind	FH	W/F	—	—	—	—
Cross Vine	FH	W/F	—	—	—	—
Daylilly	FH	MWF	3.0	3.0	C	300
WYNDGATE:						
Courtlia	FH	MWF	1.1	1.8	Y	1000
Craighurst	FH	MWF	1.0	1.6	Y	1000 – *
Orchard Grove	FH	MWF	1.0	1.6	C	3000
Heritage Springs:						
Almond Wood		MWF	3.5	3.5	C	500

* FIRE HYDRANT MOVED / 5 MIN. FLUSH W/ MUD

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11-1-99 NAME: Yvonne Robinson

1-20

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D				
Wyndham	BO	M/TH				
1441 Haverhill	FH	D				
Cheltnam	FH	M/TH				
1050 Trafalger	FH	T/F				
Daleside	FH	T/F				
Stroud & Dawsbury	FH	D				
Stroud Court	BO	D				
Wyndtree & Hooversham	FH	M/TH				
Forestedge	FH	D				
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	T/F				
Riveria at boat deck	BO	D				
Ground Squirrel	FH	M-TH				
Arboretum	FH	M-TH				
2822 San Pedro (Hills of San Jose)	BO	MWF				
Tori Court	BO	TT	.5	1.5		1000
4540 Rowan Road	FH	TH	.8	1.5	C	2500
Akuri	BO	MWF				
Harrow Place	FH	D				
Severn Place	FH	TT				
Villa Entrada	BO	MWF				
Wood Bend	FH	TH	1.3	1.6	R	600

DATE: 11.1.99 NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
Davenport & Mitchell Blvd.	FH	D	1.0	2.0	C	1500
Wyndham	BO	M/TH	—	—	—	—
1441 Haverhill	FH	D	1.0	1.5	C	300
Chelmam	FH	M/TH	—	—	—	—
1050 Trafalger	FH	T/F	1.5	1.5	C	300
Daleside	FH	T/F	1.0	1.5	C	500
Stroud & Dawsbury	FH	D	1.2	1.5	C	500
Stroud Court	BO	D	1.5	1.5	C	200
Wyndtree & Hooversham	FH	M/TH	—	—	—	—
X Forestedge BROKEN	FH	D	—	—	—	—
Country Place:						
Lake Haven Drive & Haden	FH	T/F	1.0	1.4	C	3000
Cimmeron	FH	T/F	.5	1.5	C	4500
Central Park Avenue	FH	T/F	1.0	1.5	C	900
Aristocrate Drive	FH	T/F	1.5	1.5	C	300
East Bay	FH	T/F	1.5	1.5	C	900
Industrial:						
Success Drive	FH	T/F	.4	2.0	C	900
Riveria at boat deck	BO	D	1.6		C	311570
Ground Squirrel	FH	M-TH				
Arboretum	FH	M-TH				
2822 San Pedro (Hills of San Jose)	BO	MWF	.8	1.6	C	100
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
Akuri	BO	MWF	1.5	1.5	C	100
Harrow Place	FH	D	1.3	1.5	C	800
Severn Place	FH	TT				
Villa Entrada	BO	MWF	.1	1.5	C	1500
Wood Bend	FH	TH				

DATE: 11-3/99 *NAME:* Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

311570

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL2*	*CLOSE CL2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	1.3	1.5	Y	900
9129 Callaway	FH	MWF	1.0	1.5	Y	1500
2356 Troski	FH	MWF	.7	1.5	Y	500
Bonnington & Hominy	FH	MWF	1.5	1.5	B	200
Sportswood	FH	WF	1.2	1.5	B	400
Hagen Drive	BO	MWF	1.0	1.6	C	1500
Ventura	FH	MWF	1.5	1.5	C	200
Balsaridge	FH	MWF	1.4	1.5	C	200
FOXWOOD:						
Terilind	FH	W/F	.6	1.5	C	1500
Cross Vine	FH	W/F	1.4	1.5	C	300
Daylilly	FH	MWF	1.4	1.5	C	600
WYNDGATE:						
Courtlia	FH	MWF	1.5	1.5	C	200
Craighurst	FH	MWF	1.3	1.5	C	300
Orchard Grove	FH	MWF	1.3	1.5	C	600
Heritage Springs:						
Almond Wood		MWF	.6	1.7	C	3000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11/3/99 NAME: Glenn Robinson

FLUSH SCHEDULE

	ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
*	Davenport & Mitchell Blvd.	FH	D	.8	1.6	C	1700
*	Wyndham	BO	M/TH	1.0	1.6	C	300
*	1441 Haverhill	FH	D	1.5	1.5	C	300
*	Chelmam	FH	M/TH	1.5	1.5	Y	300
	1050 Trafalger	FH	T/F	—	—	—	—
	Daleside	FH	T/F	—	—	—	—
*	Stroud & Dawsbury	FH	D	1.7	1.7	C	300
*	Stroud Court	BO	D	1.6	1.6	C	300
*	Wyndtree & Hoversham BROKEN	FH	M/TH	—	—	—	—
*	Forestedge BROKEN	FH	D	—	—	—	—
	Country Place:						
	Lake Haven Drive & Haden	FH	T/F	—	—	—	—
	Cimmeron	FH	T/F	—	—	—	—
	Central Park Avenue	FH	T/F	—	—	—	—
	Aristocrate Drive	FH	T/F	—	—	—	—
	East Bay	FH	T/F	—	—	—	—
	Industrial:						
*	Success Drive	FH	D	.8	2.0	C	500
*	Riveria at boat deck	BO	D	1.5		C	-0320000-
—	Ground Squirrel	FH	M-TH	1.3	1.5	C	500
—	~~Arboretum~~ CAPTIVA	FH	M-TH	1.8	1.8	C	6000
—	2822 San Pedro (Hills of San Jose)	BO	MWF	.9	1.6	C	300
	Tori Court	BO	TT	—	—	—	—
	4540 Rowan Road	FH	TH	—	—	—	—
—	Akuri	BO	MWF	1.7	1.7	C	100
—	Harrow Place	FH	D	1.1	1.5	Y	2500
	Severn Place	FH	TT	—	—	—	—
—	Villa Entrada	BO	MWF	.4	1.5	Y	2000
	Wood Bend	FH	TH	—	—	—	—

DATE: 11-8-99 MONDAY NAME: Howard M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

27350

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
8838 Belmeadow	FH	MWF				
9129 Callaway	FH	MWF				
2356 Troski	FH	MWF				
Bonnington & Hominy	FH	MWF				
Sportswood	FH	WF				
Hagen Drive	BO	MWF				
Ventura	FH	MWF				
Balsaridge	FH	MWF				
FOXWOOD:						
Terilind	FH	W/F				
Cross Vine	FH	W/F				
Daylilly	FH	MWF				
WYNDGATE:						
Courtlia	FH	MWF	1.1	1.5	C	500 Yard
Craighurst	FH	MWF	1.1	1.5	C	500 Yard
Orchard Grove	FH	MWF	1.2	1.6	C	1500 Yard
Heritage Springs:						
Almond Wood		MWF	.1	.6	Y	36000

OKAY PER TONY

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11-8-99
MONDAY

NAME: [signature]

3000

300
120
6000
3

FLUSH SCHEDULE

	ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH	
8	Davenport & Mitchell Blvd.	FH	D	.5	1.5	C	1500	
	Wyndham	BO	M/TH					
3	1441 Haverhill	FH	D	1.6	1.6	C	200	
	Chelmam	FH	M/TH					
4	1050 Trafalger	FH	T/F	1.0	1.5	C	500	
5	Daleside	FH	T/F	1.5	1.5	C	300	
6	Stroud & Dawsbury	FH	D	.9	1.6	C	800	
7	Stroud Court	BO	D	1.4	1.6	C	300	
	Wyndtree & Hooversham BROKEN	FH	M/TH					
	Forestedge BROKEN	FH	D					
	Country Place:							
9	Lake Haven Drive & Haden	FH	T/F	1.7	2.0	Y	6000	*
13	Cimmeron	FH	T/F	1.3	2.0	Y	800	
12	Central Park Avenue	FH	T/F	2.0	2.0	Y	300	
10	Aristocrate Drive	FH	T/F	2.0	2.0	Y	1000	
11	East Bay	FH	T/F	2.0	2.0	Y	600	
	Industrial:							
8	Success Drive	FH	~~T/F~~	1.6	1.6	C	200	
1	Riveria at boat deck	BO	D	.4	1.5	C- 321270-		
17	Ground Squirrel	FH	M-TH					
18	~~Arboretum~~ CAPTIVA	FH	M-TH	1.0	1.5	C	1000	
	2822 San Pedro (Hills of San Jose)	BO	MWF	.4	1.7	C	1000	
16	Tori Court	BO	TT	.9	1.5	Y	400	
	4540 Rowan Road	FH	TH	1.0	1.5	Y	800	
	Akuri	BO	MWF					
8	~~ALMADEN WOOD~~	~~FH~~	D	.1	2.0	C	1500	
15	Harrow Place	FH	D	1.0	1.5	C	1000	
14	Severn Place	FH	TT	.9	1.5	C	400	
	Villa Entrada	BO	MWF					
	Wood Bend	FH	TH	.9	1.6	X	3000	TOOK 10 MIN. TO CLEAR

DATE: 11/9/99 TUESDAY NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

X yellowish water from hydrant, flushed 20 min. per Tony. Did not clear. Advised by Tony to go to hose bib at well. water still yellowish w/ small particles in water. Same at all hydrants. Tony said to check Friday for next schedule to see if still discolored

711370

FOX HOLLOW FLUSH SCHEDULE

	ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
26	8838 Belmeadow	FH	MWF	1.0	1.5	C	900
25	9129 Callaway	FH	MWF	1.0	2.0	C	1000
24	2356 Troski	FH	MWF	1.4	2.0	C	300
23	Bonnington & Hominy	FH	MWF	1.5	1.5	C	300
22	Sportswood	FH	WF	1.4	1.5	C	600
21	Hagen Drive	BO	MWF	.5	1.5	C	2000
20	Ventura	FH	MWF	.9	1.5	Y	900
19	Balsaridge	FH	MWF	1.3	1.6	Y	300
	FOXWOOD:						
16	Terilind	FH	W/F	.4	1.8	Y	9000
17	Cross Vine	FH	W/F	1.4	1.5	Y	200
18	Daylilly	FH	MWF	1.6	1.6	Y	300
	WYNDGATE:						
7	Courtlia	FH	MWF	1.0	1.5	C	1000 9:50
8	Craighurst	FH	MWF	1.1	1.5	C	1000
6	Orchard Grove	FH	MWF	.4	1.5	C	2000 9:45
	Heritage Springs:						
15	Almond Wood		MWF	.6	1.5	C	2500
—	HILLS OF SAN JOSE		D	1.0	1.9	C	1000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11-10-99
WEDNESDAY

NAME: Glorae Robinson

PEACHTREE SUBDIVISION
FOXHOLLOW
BONNINGTON & HOMINY
STORM DRAIN REPAIR

279

FLUSH SCHEDULE

	ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
2	Davenport & Mitchell Blvd.	FH	D	.5	2.0	C	1500
	Wyndham	BO	M/TH				
3	1441 Haverhill	FH	D	2.2	2.2	C	200
	Cheltnam	FH	M/TH				
	1050 Trafalger	FH	T/F				
	Daleside	FH	T/F				
4	Stroud & Dawsbury	FH	D	.3	1.9	C	1300
5	Stroud Court	BO	D	.5	2.1	C	1000
	Wyndtree & Hooversham BROKEN	FH	M/TH				
	Forestedge BROKEN	FH	D				
	Country Place:						
	Lake Haven Drive & Haden	FH	T/F				
	Cimmeron	FH	T/F				
	Central Park Avenue	FH	T/F				
	Aristocrate Drive	FH	T/F				
	East Bay	FH	T/F				
	Industrial:						
9	Success Drive	FH	T/F	1.5	1.5	C	200
1	Riveria at boat deck	BO	D	1.6	1.4	C	-322080
15	Ground Squirrel	FH	M-TH	1.9	1.9	C	200
14	~~Arboretum~~ CAPTIVA	FH	M-TH	1.5	1.5	C	10000
13	2822 San Pedro (Hills of San Jose)	BO	MWF	PERFORMED TEST ON 11/9/99			
	Tori Court	BO	TT				
	4540 Rowan Road	FH	TH				
12	Akuri	BO	MWF	1.5	1.5	C	200
11	Harrow Place	FH	D	.9	1.5	C	2500
	Severn Place	FH	TT				
10	Villa Entrada	BO	MWF	1.5	1.7	C	200
	Wood Bend	FH	TH				

DATE: 11-10-99 WEDNESDAY NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

#11 STARTED OUT .9 / AFTER FLUSH FOR 10 MIN. DROPPED TO .5 STAYED .5 FOR 5 MIN. / AFTER 25 MIN. 1.5

038

FLUSH SCHEDULE

	ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
2 —	Davenport & Mitchell Blvd.	FH	D	1.0	2.0	C	1500
3 —	Wyndham	BO	M/TH	1.6	1.9	C	300
4 —	1441 Haverhill	FH	D	2.0	2.0	C	900
5 —	Chelmam	FH	M/TH	1.5	1.8	Y	300
	1050 Trafalger	FH	T/F				
	Daleside	FH	T/F				
6 —	Stroud & Dawsbury	FH	D	1.0	1.9	C	500
7 —	Stroud Court	BO	D	1.3	2.0	C	1000
	Wyndtree & Hooversham BROKEN	FH	M/TH				
	Forestedge BROKEN	FH	D				
	Country Place:						
	Lake Haven Drive & Haden	FH	T/F				
	Cimmeron	FH	T/F				
	Central Park Avenue	FH	T/F				
	Aristocrate Drive	FH	T/F				
	East Bay	FH	T/F				
	Industrial:						
8 —	Success Drive	FH	T/F	1.3	1.5	C	300
1 —	Riveria at boat deck	BO	D	1.6	1.6	C	-032340-
11 —	Ground Squirrel	FH	M-TH	1.0	1.6	C	300
10 —	~~Arboretum~~ CAPTIVA	FH	M-TH	2.0	2.0	C	1000
	2822 San Pedro (Hills of San Jose)	BO	MWF				
12 —	Tori Court	BO	TT	2.8	3.0	Y	300
13 —	4540 Rowan Road	FH	TH	.7	1.3	Y	1000
	Akuri	BO	MWF				
9 —	~~ALMONDWOOD~~	FH	D	.4	1.8	C	2500
	Harrow Place	FH	D				
—	Severn Place	FH	TT				
	Villa Entrada	BO	MWF				
—	Wood Bend	FH	TH				

PULLED ALOHA PER JACK TO ALOHA P.

DATE: 11-11-99 THURSDAY

NAME: Yvonne M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

DID NOT GET DONE PER JACK ON ALOHA SIDE FOR P.D.

231640

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	.9	1.7	C	3000
Wyndham	BO	M/TH				
1441 Haverhill	FH	D	1.3	1.8	C	400
Cheltnam	FH	M/TH				
1050 Trafalger	FH	T/F	1.7	1.7	C	300
Daleside	FH	T/F	1.3	1.6	C	400
Stroud & Dawsbury	FH	D	1.0	1.5	C	600
Stroud Court	BO	D	1.4	1.6	C	500
Wyndtree & Hooversham BROKEN	FH	M/TH				
Forestedge BROKEN	FH	D				
Country Place:						
Lake Haven Drive & Haden	FH	T/F	1.3	1.6	C	1600
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	T/F	.5	1.9	C	500
Riveria at boat deck	BO	D	1.16	1.16	C -0.322620-	
Ground Squirrel	FH	M-TH				
~~Arboretum~~ CAPTIVA	FH	M-TH				
2822 San Pedro (Hills of San Jose)	BO	MWF	1.0	1.5	C	300
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
Akuri	BO	MWF	1.2	1.5	C	500
Harrow Place	FH	D	1.1	1.5	C	2500
Severn Place	FH	TT				
Villa Entrada	BO	MWF	1.2	1.5	C	500
Wood Bend	FH	TH	1.1	1.5	Y	1000

DATE: 11-12-99 FRIDAY NAME: Yvonne M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

35820

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF				
9129 Callaway	FH	MWF	.8	1.5	C	300
2356 Troski	FH	MWF	1.4	1.4	C	600
Bonnington & Hominy	FH	MWF	.9	1.5	C	300
Sportswood	FH	WF	1.0	1.6	C	600
Hagen Drive	BO	MWF	.7	1.5	C	2000
Ventura	FH	MWF	.9	1.5	Y	900
Balsaridge	FH	MWF	1.1	1.5	Y	700
FOXWOOD:						
Terilind	FH	W/F	.4	1.5	C	9000
Cross Vine	FH	W/F	.6	1.5	C	300
Daylilly	FH	MWF	.6	1.6	C	6000
WYNDGATE:						
Courtlia	FH	MWF	1.8	1.8	C	300
Craighurst	FH	MWF	1.9	2.0	C	300
Orchard Grove	FH	MWF	2.0	2.0	C	1000 9:10
Heritage Springs:						
Almond Wood		MWF	.4	1.6	C	2500

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11-12-99
FRIDAY

NAME: Grace Robinson

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	0	1.9	C-O	2500
Wyndham	BO	M/TH	2.2	2.2	C	200
1441 Haverhill	FH	D	2.0	2.0	Y	200
Chelmam	FH	M/TH	1.9	2.1	Y	200
1050 Trafalger	FH	T/F	—	—	—	—
Daleside	FH	T/F	—	—	—	—
Stroud & Dawsbury	FH	D	.7	1.6	C	2000
Stroud Court	BO	D	.4	1.8	C	1500
Wyndtree & Hooversham BROKEN	FH	M/TH				
Forestedge BROKEN	FH	D				
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	D	1.5	1.6	C	300
Riveria at boat deck	BO	D	2.0	2.0	C	C-326420
Ground Squirrel	FH	M-TH	1.7	1.7	C	300
Arboretum CAPTIVA BROKEN	BO	M-TH	.9	1.5	C	500
2822 San Pedro (Hills of San Jose)	BO	MWF	1.6	1.6	C	100
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
Akuri	BO	MWF	1.7	1.7	C	200
Harrow Place	FH	D	.6	1.5	Y	3500
Severn Place	FH	TT				
Villa Entrada	BO	MWF	1.2	1.8	Y	1000
Wood Bend	FH	TH				

DATE: 11-15-99 MONDAY

NAME: Yvonne M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

35520

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF				
9129 Callaway	FH	MWF				
2356 ~~Froski~~ TOSKI	FH	MWF				
Bonnington & Hominy	FH	MWF				
Sportswood	FH	WF				
Hagen Drive	BO	MWF	0.7	1.0	C	1000
~~Ventura~~ VENTURI	FH	MWF	0.8	1.5	C	1000
Balsaridge	FH	MWF	0.7	1.5	C	1000
FOXWOOD:						
~~Terilind~~ TERALYN	FH	W/F	0.4	1.5	C	4000
Cross Vine	FH	W/F	0.9	1.5	C	1000
Daylilly	FH	MWF	1.0	1.5	C	1000
WYNDGATE:						
~~Courtlia~~ CARTRIGHT	FH	MWF	.4	1.6	C	1500
Craighurst	FH	MWF	1.0	1.5	C	500
Orchard Grove	FH	MWF	.8	1.5	C	2500
Heritage Springs:						
Almond Wood		MWF	0.7	1.7	C	2,000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11-15-99
MONDAY

NAME: Allison Gibson

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	T.
Davenport & Mitchell Blvd.	FH	D	1.2	2.1	C	150
Wyndham	BO	M/TH	—	—	C	300
1441 Haverhill	FH	D	2.1	2.1	—	—
Chelmam	FH	M/TH	—	—	Y	300
1050 Trafalger	FH	T/F	2.1	2.1	Y	300
Daleside	FH	T/F	1.8	1.8	C	1000
Stroud & Dawsbury	FH	D	1.3	1.6	C	1500
Stroud Court	BO	D	1.0	1.6		
Wyndtree & Hooversham	BROKEN FH	M/TH				
Forestedge	BROKEN FH	D				
Country Place:					Y-m	1000
Lake Haven Drive & Haden	FH	T/F	1.1	1.7	C-m	1000
Cimmeron	FH	T/F	1.4	1.6	C-m	200
Central Park Avenue	FH	T/F	1.7	1.7	C-m	200
Aristocrate Drive	FH	T/F	1.7	1.7	Y-m	300
East Bay	FH	T/F	1.6	1.6		
Industrial:					C	300
Success Drive	FH	T/F	1.6	1.6	C - 0328400 -	
Riveria at boat deck	BO	D	2.0	2.0	C	500
Ground Squirrel	FH	M-TH	1.0	1.5		
Arboretum CAPTIVA	FH	M-TH				
2822 San Pedro (Hills of San Jose)	BO	MWF	—	—	—	—
Tori Court	BO	TT	1.9	1.9	Y	300
4540 Rowan Road	FH	TH	—	—	—	—
Akuri	BO	MWF	—	—	—	—
ALMONDWOOD			.6	1.7	C	2500
Harrow Place	FH	D	1.8	1.6	C	1500
Severn Place	FH	TT	1.8	1.8	Y	300
Villa Entrada	BO	MWF	—	—	—	—
Wood Bend	FH	TH	—	—	—	—

DATE: 11-16-99
TUESDAY

NAME: Vonne M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

3416 OR

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL2*	*CLOSE CL2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	1.7	1.9	Y	700
9129 Callaway	FH	MWF	1.8	1.8	Y	900
2356 Troski	FH	MWF	1.6	1.6	Y	900
Bonnington & Hominy	FH	MWF	1.3	1.8	Y	1200
Sportswood	FH	WF	1.7	1.7	Y	900
Hagen Drive	BO	MWF	1.2	1.6	C	1500
Ventura	FH	MWF	1.3	1.7	C	500
Balsaridge	FH	MWF	1.6	1.8	C	300
FOXWOOD:						
Terilind	FH	W/F	.5	1.9	C	1000
Cross Vine	FH	W/F	1.9	1.9	C	300
Daylilly	FH	MWF	1.6	1.9	C	1500
WYNDGATE:						
Courtlia	FH	MWF	1.3	1.6	C	500
Craighurst	FH	MWF	1.6	1.6	C	300
Orchard Grove	FH	MWF	1.4	1.6	C	1700
Heritage Springs:						
Almond Wood		MWF	.8	1.7	C	2000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11-17-99
WEDNESDAY

NAME: Joyce M. Robinson

3321 bell

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	1.8	1.8	C	1500
Wyndham	BO	M/TH	—	—	—	—
1441 Haverhill	FH	D	1.9	1.9	C	300
Chelmam	FH	M/TH	—	—	—	—
1050 Trafalger	FH	T/F	—	—	—	—
Daleside	FH	T/F	—	—	—	—
Stroud & Dawsbury	FH	D	1.3	1.8	C	1500
Stroud Court	BO	D	1.1	1.8	C	1500
Wyndtree & Hooversham BROKEN	FH	M/TH	—	—	—	—
Forestedge BROKEN	FH	D	—	—	—	—
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	D	1.9	1.9	C	300
Riveria at boat deck	BO	D	1.8	1.5	C	033D800
Ground Squirrel	FH	M-TH	1.8	1.8	C	100
Arboretum CAPTIVA	FH	M-TH	1.4	1.8	C	600
2822 San Pedro (Hills of San Jose)	BO	MWF	1.9	1.9		200
Tori Court	BO	TT	—	—	—	—
4540 Rowan Road	FH	TH	—	—	—	—
Akuri	BO	MWF	1.6	1.10	C	200
Harrow Place	FH	D	1.0	1.5	C	2500
Severn Place	FH	TT	—	—	—	—
Villa Entrada	BO	MWF	.8	1.7	C	1300
Wood Bend	FH	TH	—	—	—	—

DATE: 11-17-99 WEDNESDAY

NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	.6	1.8	C	2000
Wyndham	BO	M/TH	1.7	1.3	C	200
1441 Haverhill	FH	D	1.7	1.8	C	200
Cheltnam	FH	M/TH	1.4	1.8	Y	700
1050 Trafalger	FH	T/F	—	—	—	—
Daleside	FH	T/F	—	—	—	—
Stroud & Dawsbury	FH	D	1.3	1.4	C	1000
Stroud Court	BO	D	1.4	1.6	C	1000
Wyndtree & Hooversham BRDWLK	FH	M/TH	—	—	—	—
Forestedge BRDWLK	FH	D	—	—	—	—
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	TH	1.9	2.0	C	300
Riveria at boat deck	BO	D	1.7	1.7	C	2000
Ground Squirrel	FH	M-TH	1.8	1.6	C	2000
Arboretum CAPTIVA	FH	M-TH	.7	1.5	C	600
2822 San Pedro (Hills of San Jose)	BO	MWF	—	—	—	—
Tori Court	BO	TT	1.0	1.6	Y	300
4540 Rowan Road	FH	TH	.6	1.5	Y	2000
Akuri	BO	MWF	—	—	—	—
ALMOND WOODS	FH	D	.7	1.6	C	3000
Harrow Place	FH	D	.6	1.5	C	2300
Severn Place	FH	TT	1.8	1.8	C	300
Villa Entrada	BO	MWF	—	—	—	—
Wood Bend	FH	TH	1.4	1.4	Y	1000

700

16900
332870
349770

TOOK 8 MIN. TO GET WATER TO RUN CLEAR

DATE: 11-18-99 THURSDAY NAME: Yvonne M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

	ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
	Davenport & Mitchell Blvd.	FH	D	.5	1.6	C	5000
	Wyndham	BO	M/TH	—	—	—	—
	1441 Haverhill	FH	D	1.6	1.8	C	300
	Cheltnam	FH	M/TH	—	—	—	—
T.TH	1050 Trafalger	FH	T/F	1.4	1.7	C	400
T.TH.	Daleside	FH	T/F	1.5	1.6	Y	700
	Stroud & Dawsbury	FH	D	.7	1.6	C	1000
	Stroud Court	BO	D	.9	1.5	C	1500
	Wyndtree & Hooversham BROKEN	FH	M/TH	—	—	—	—
	Forestedge BROKEN	FH	D	—	—	—	—
	Country Place:						
—	Lake Haven Drive & Haden	FH	T/F	1.1	1.7	C-M	1500
—	Cimmeron	FH	T/F	1.2	1.5	C-M	3000
—	Central Park Avenue	FH	T/F	1.4	1.7	Y-M	1000
—	Aristocrate Drive	FH	T/F	1.0	1.7	C-M	1000
—	East Bay	FH	T/F	1.2	1.6	Y-M	1000
	Industrial:						
—	Success Drive	FH	T/F	1.6	1.6	C	500
	Riveria at boat deck	BO	D	1.5	1.5	C	-0334820-
	Ground Squirrel	FH	M-TH	—	—	—	—
	Arboretum	FH	M-TH	—	—	—	—
M.TH —	2822 San Pedro (Hills of San Jose)	BO	MWF	.3	1.7	C	500
	Tori Court	BO	TT	—	—	—	—
	4540 Rowan Road	FH	TH	—	—	—	—
T.T. —	Akuri	BO	MWF	1.1	1.5	—	1500
—	Harrow Place	FH	D	1.0	1.5	C	2000
	Severn Place	FH	TT	—	—	—	—
—	Villa Entrada	BO	MWF	1.1	1.6	C	1000
	Wood Bend	FH	TH	—	—	—	—

DATE: 11-19-99 FRIDAY NAME: Yvonne M. Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

3849

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
8838 Belmeadow	FH	MWF				
9129 Callaway	FH	MWF				
2356 ~~Tenski~~ TOSKI	FH	MWF				
Bonnington & Hominy	FH	MWF				
Spottswood	FH	WF				
Hagen Drive	BO	MWF				
~~Ventura~~ VENTURA	FH	MWF	0.3	1.5	C	6000
Balsaridge	FH	MWF	0.4	1.5	C	1000
FOXWOOD:						
~~Ferilind~~ TERRALYN	FH	W/F	0.3	1.5	C	8000
Cross Vine	FH	W/F	0.5	1.5	C	8000
Daylilly	FH	MWF	0.4	1.5	C	1000
WYNDGATE:						
~~Courtlia~~ COURTLEIGH	~~FH~~ BO	MWF	0.7	1.5	C	6000
Craighurst	FH	MWF	0.4	1.5	C	500
Orchard Grove	FH	MWF	0.4	1.5	C	1000
Heritage Springs:						
Almond Wood		MWF	0.4	1.5	C	1000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11/19/99 NAME: Allison Gibson

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	0.8	1.5	C	500
9129 Callaway	FH	MWF	0.5	1.5	C	500
2356 ~~Trotki~~ TOSKI	FH	MWF	1.5	1.5	C	500
Bonnington & Hominy	FH	MWF	1.2	1.5	C	1000
Spottswood	FH	WF	1.2	1.5	C	1000
Hagen Drive	BO	MWF	0.6	1.5	C	500
~~Ventura~~ VENTURI	FH	MWF	1.6	1.6	C	500
Balsaridge	FH	MWF	1.0	1.5	C	1000
FOXWOOD:						
~~Ferilind~~ TERRALYN	FH	W/F	1.0	1.5	C	1000
Cross Vine	FH	W/F	1.2	1.5	C	1500
Daylilly	FH	MWF	1.0	1.5	C	1500
WYNDGATE:						
~~Courtlie~~ CARTRIGH	FH	MWF	0.8	1.8	C	1500
Craighurst	FH	MWF	0.8	1.5	C	500
Orchard Grove	FH	MWF	0.5	1.5	C	1000
Heritage Springs:						
Almond Wood	FH	MWF	0.4	1.7	C	1000

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 11/29/99 MON

NAME: [signature]

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	.2	1.8	C	2500
Wyndham	BO	M/TH	1.4	1.7	C	300
1441 Haverhill	FH	D	1.7	1.7	Y	300
Chelmam	FH	M/TH	1.7	1.7	Y-O	300
1050 Trafalger	FH	T/TH	1.6	1.6	C	400
Daleside	FH	T/TH	1.6	1.6	Y	300
Stroud & Dawsbury	FH	D	1.2	1.6	Y	1200
Stroud Court	BO	D	1.1	1.7	C	1000
Wyndtree & Hooversham	FH	BROKEN	—	—	—	—
Forestedge	FH	BROKEN	—	—	—	—
Country Place:			—	—	—	—
Lake Haven Drive & Haden	FH	T/F	1.3	1.6	Y	500
Cimmeron	FH	T/F	1.2	1.6	C	1000
Central Park Avenue	FH	T/F	1.4	1.6	C	400
Aristocrate Drive	FH	T/F	1.6	1.6	Y	300
East Bay	FH	T/F	1.6	1.6	Y	300
Industrial:			—	—	—	—
Success Drive	FH	D	1.6	1.6	Y	300
Riveria at boat deck	BO	D	.1		C	[illegible] 34408D
Ground Squirrel	FH	M-TH	1.1	1.5	C	700
CAPTIVA	BO	M-TH	1.0	1.5	C	1000
2822 San Pedro (Hills of San Jose)	BO	M/TH	.1	1.6	C	500
Tori Court	BO	TT	1.6	1.7	Y	700
4540 Rowan Road	FH	TH	1.3	1.6	Y	1000
Akuri	BO	T/TH	1.5	1.5	C	200
			—	—	—	—
Harrow Place	FH	D	1.0	1.5	Y	4000
Severn Place	FH	TT	1.5	1.5	Y	300
Villa Entrada	BO	MWF	1.0	1.5	Y	1000
Wood Bend	FH	TH	1.3	1.6	Y	700

DATE: 11-29-99 MONDAY NAME: Yvonne M Robinson

FH=Fire Hydrant BO=Blow Off

C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

	ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
48	Davenport & Mitchell Blvd.	FH	D	1.0	1.5	C	1000
	Wyndham	BO	M/TH				
50	1441 Haverhill	FH	D	2.0	2.2	C	500
	Cheltnam	FH	M/TH				
40	1050 Trafalger	FH	T/TH	1.8	1.8	C	500
40	Daleside	FH	T/TH	1.7	1.7	C	500
46	Stroud & Dawsbury	FH	D	1.3	1.3	C	1000
46	Stroud Court	BO	D	1.0	1.5	C	500
	Wyndtree & Hooversham	FH	BROKEN				
	Foresteage	FH	BROKEN				
	Country Place:						
54	Lake Haven Drive & Haden	FH	T/F	1.5	1.5	C	500
56	Cimmeron	FH	T/F	1.4	1.6	C	500
56	Central Park Avenue	FH	T/F	1.5	1.5	C	500
58	Aristocrate Drive	FH	T/F	1.5	1.5	C	500
58	East Bay	FH	T/F	1.5	1.7	C	500
	Industrial:						
50	Success Drive	FH	D	1.8	1.8	C	500
624	Riveria at boat deck	BO	D	0.8	0.9	C	
	Ground Squirrel	FH	M-TH				
	CAPTIVA	BO	M-TH				
	2822 San Pedro (Hills of San Jose)	BO	M/TH				
42	Tori Court	BO	TT	1.0	1.5	C	500
	4540 Rowan Road	FH	TH				
52	~~Abari~~ AURAEI	BO	T/TH	1.5	1.5	C	500
50	Harrow Place	FH	D	0.9	1.5	C	1000
50	Severn Place	FH	TT	1.3	1.5	C	500
	Villa Entrada	BO	MWF				
	Wood Bend	FH	TH				

DATE: 11/30/99 NAME: Allison Gibson

~~FH~~=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	.6	2.1	C	2000
Wyndham	BO	M/TH				
1441 Haverhill	FH	D	2.1	2.1	C	200
Chelmam	FH	M/TH				
1050 Trafalger	FH	T/TH				
Daleside	FH	T/TH				
Stroud & Dawsbury	FH	D	.9	1.5	C	1500
Stroud Court	BO	D	.7	1.5	C	2000
Wyndtree & Hooversham	FH	BROKEN				
Forestedge	FH	BROKEN				
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrate Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	D	2.0	2.0	Y	300
Riveria at boat deck	BO	D	.8	1.7	C	-0- 2475 GAL
Ground Squirrel	FH	M-TH	1.6	1.6	C	200
CAPTIVA	BO	M-TH	.9	1.5	C	1000
2822 San Pedro (Hills of San Jose)	BO	M/TH				
Tori Court	BO	TT				
4540 Rowan Road	FH	TH				
Akuri	BO	T/TH				
Harrow Place	FH	D	.8	1.5	C	2000
Severn Place	FH	TT				
Villa Entrada	BO	MWF	1.3	1.6	C	1000
Wood Bend	FH	TH				

DATE: 12-1-99 WEDNESDAY NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH	
8838 Belmeadow	FH	MWF	1.4	1.5	C	400	
9129 Callaway	FH	MWF	1.4	1.6	C	400	
2356 Troski	FH	MWF	1.5	1.5	Y	300	
Bonnington & Hominy	FH	MWF	1.2	1.6	C	600	
Sportswood	FH	WF	1.1	1.5	Y	400	
Hagen Drive	BO	MWF	1.1	1.5	C	1300	
Ventura	FH	MWF	1.3	1.5	C	1000	
Balsaridge	FH	MWF	1.6	1.6	C	200	
FOXWOOD:							
Terilind	FH	W/F	.7	1.5	C	4500	
Cross Vine	FH	W/F	.9	1.5	C	300	
Daylilly	FH	MWF	1.4	1.6	Y	600	
WYNDGATE:							
Courtlia	FH	MWF	.7	1.5	C	1050	
Craighurst	FH	MWF	.4	1.5	C	1500	11:15
Orchard Grove	FH	MWF	.6	1.5	C	4500	11:10
Heritage Springs:							
Almond Wood		MWF	.1	1.6	C	2000	

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 12-1-99
WEDNESDAY

NAME: Yvonne Robinson

FLUSH SCHEDULE

ADDRESS	TYPE	DAYS DONE	START CL2	CLOSE CL2	START COLOR	GAL'S FLUSH
Davenport & Mitchell Blvd.	FH	D	1.0	1.9	C	2000
Wyndham	BO	M/TH	1.6	1.10	C	300
1441 Haverhill	FH	D	1.6	1.7	C	500
Cheltnam	FH	M/TH	1.7	1.7	V	300
1050 Trafalger	FH	T/TH	1.7	1.7	C	300
Daleside	FH	T/TH	1.4	1.6	Y	300
Stroud & Dawsbury	FH	D	1.1	1.5	C	1500 ~~6:50~~
Stroud Court	BO	D	1.2	1.5	C	1500 8:55
Wyndtree & Hooversham	FH	BROKEN				
Forestedge	FH	BROKEN				
Country Place:						
Lake Haven Drive & Haden	FH	T/F				
Cimmeron	FH	T/F				
Central Park Avenue	FH	T/F				
Aristocrats Drive	FH	T/F				
East Bay	FH	T/F				
Industrial:						
Success Drive	FH	D	.8	1.5	Y-A	1000
Riveria at boat deck	BO	D	1.3	1.5	C	-034X070-
Ground Squirrel	FH	M-TH	1.0	1.6	C	500
CAPTIVA	BO	M-TH	1.5	1.5	C	500
2822 San Pedro (Hills of San Jose)	BO	M/TH	1.2	1.5	C	300
Tori Court	BO	TT	1.3	1.6	Y	300
4540 Rowan Road	FH	TH	.8	1.7	N	2000 ~~10:50~~
Akuri	BO	T/TH	1.2	1.6	C	300
ALMONDWOOD	FH	D	.9	1.7	C	6000
Harrow Place	FH	D	.8	1.5	C	2500 ~~9:50~~
Severn Place	FH	TT	1.6	1.6	C	300
Villa Entrada	BO	MWF	.7	1.7	C	1500
Wood Bend	FH	TH				

1500
4000
2100
11
18700
346
366 700

DATE: 12-2-99 NAME: Yvonne Robinson

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

FLUSH SCHEDULE

	ADDRESS	TYPE	DAYS DONE	START CL/2	CLOSE CL/2	START COLOR	GAL'S FLUSH
—	Davenport & Mitchell Blvd.	FH	D	0.3	1.0	Clear	7,800 gals
—	Wyndham	BO	M/TH	0.5	1.5	Clear	— B.O.
—	1441 Haverhill	FH	D	0.6	1.0	Clear	5,400
—	Chelmam	FH	M/TH	0.8	1.2	Brown/clear	2,000
+	1050 Trafalger	FH	T/F				
+	Daleside	FH	T/F				
—	Stroud & Dawsbury	FH	D	0.4	1.3	Rusty	1,200
—	Stroud Court	BO	D	0.6	1.4	Clear	— B.O.
—	Wyndtree & Hooversham	FH	M/TH	—	—	no cover/valve	— no top
—	Forestedge	FH	D	Does not open — opened hydrant down Road & 1.0			
	Country Place:						
	Lake Haven Drive & Haden	FH	T/F				
	Cimmeron	FH	T/F				
	Central Park Avenue	FH	T/F				
	Aristocrate Drive	FH	T/F				
	East Bay	FH	T/F				
	Industrial:						
	Success Drive	FH	T/F				
	Riveria at boat deck	BO	D	0.8	1.0	Clear	—
	Ground Squirrel	FH	M-TH	0.3	1.0	clear	2,000
	Arboretum	FH	M-TH	0.4	1.2	clear	1,500
	2822 San Pedro (Hills of San Jose)	BO	MWF	0.5	1.0	clear	—
	Tori Court	BO	TT				
	4540 Rowan Road	FH	TH				
	Akuri	BO	MWF	0.5	1.0	clear	— B.O.
—	Harrow Place	FH	D	0.8	1.5	clear	—
	Severn Place	FH	TT	[redacted]			—
—	Villa Entrada	BO	MWF	0.5	1.0	clear	
	Wood Bend	FH	TH				

DATE: 12/6/99 NAME: Tec Oldham

FH=Fire Hydrant BO=Blow Off
C=Clear Y=Yellow B=BlackO=Odor A=Air/Milky

NO HYDRANT OR BLOW OFF WILL BE TURNED OFF WITH ANY DISCOLORED WATER COMING THROUGH IT!! CONTACT SUPERVISOR IF YOU CAN'T GET IT CLEAR!!

4083400
4076600
7800

3200

FOX HOLLOW FLUSH SCHEDULE

ADDRESS	*TYPE*	*DAYS DONE*	*START CL/2*	*CLOSE CL/2*	*START COLOR*	*GAL'S FLUSH*
8838 Belmeadow	FH	MWF	0.8	1.7	clear	900
9129 Callaway	FH	MWF	0.6	1.5	clear	1100
2356 Troski	FH	MWF	0.6	1.8	clear	1000
Bonnington & Hominy	FH	MWF	0.7	1.8	clear	1100
Sportswood	FH	WF	[illegible]		[illegible]	[illegible]
Hagen Drive	BO	MWF	0.6	1.2	clear	1400
Ventura	FH	MWF	0.4	1.5	clear	1700
Balsaridge	FH	MWF	0.8	1.0	clear	500
FOXWOOD:						
Terilind	FH	W/F				
Cross Vine	FH	W/F				
Daylilly	FH	MWF	0.7	1.2	clear	200
WYNDGATE:						
Courtlia	FH	MWF	0.5	1.0	clear	1200
Craighurst	FH	MWF	0.5	1.0	clear	1200
Orchard Grove	FH	MWF	0.4	1.2	clear	1000
Heritage Springs:						
Almond Wood		MWF	0.4	1.2	clear	1800 gals.

FH=Fire Hydrant BO=Blow Off D=Daily

C=Clear Y=Yellow B=Black O=Odor A=Air/Milky

DATE: 12/6/99 NAME: Ted Oldham

(K)

THE PASCO COUNTY BLACK WATER STUDY

PREPARED BY:

VAN HOOFNAGLE, P.E.
ADMINISTRATOR
DRINKING WATER PROGRAM
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

AUGUST 9, 1999

Project Description

- Background
- Approach
- The Study
- Conclusions
- Attachments

THE SOUTHWEST PASCO COUNTY TECHNICAL ASSISTANCE AND RESEARCH PROJECT

Background

Over the past few years, the Department of Environmental Protection has received numerous complaints about the quality of water being provided by a utility in southwest Pasco County. The Public Service Commission, the Department of Health, and a number of state legislatures also have been involved.

In general, the consumers complained that the water tasted and smelled poorly and contained a black sediment that plugged filter screens and stained laundry. Tests indicated that the offensive taste and odor were caused by hydrogen sulfide. The sediment in the black water was determined to be copper sulfide, a corrosion product formed by hydrogen sulfide and the copper in the home plumbing.

The Department reviewed the history of the water utility and determined that it was in compliance with the standards set in Chapter 62-550, F.A.C., Drinking Water Standards, Monitoring, and Reporting. The utility had exceeded the copper action levels prescribed by the rules and had implemented a treatment program to mitigate the corrosive properties of the water. As of the writing of this report, the water provided by the utility no longer exceeds the copper action level, and the utility is in full compliance with all standards.

In spite of the fact that the water provided by the utility met all standards, there was obviously an aesthetic problem with the water that needed correcting. The Public Service Commission (PSC) ordered the utility to perform an engineering study to determine what could be done to make the water more palatable. The utility's engineer proposed adding packed tower aeration to the treatment process to remove the hydrogen sulfide. Some of the utility's customers objected because the additional treatment would cause the cost of the water to rise. The customers want the utility to pay for the additional treatment and not pass the cost along. The PSC is still trying to resolve the issue.

Approach

The Drinking Water Section of the Department of Environmental Protection in Tallahassee conducted literature research to determine if there were any cheap and simple solutions to the black water and odor problems. A number of articles indicated that the color and odor conditions are caused by sulfate reducing bacteria in hot water heaters. It is believed that the bacteria convert sulfur and sulfates in the water to hydrogen sulfide, which is the odor smelled by the occupants. The hydrogen sulfide in turn reacts with the copper in the home water distribution system to create copper sulfide -- the black substance in the water. The articles suggested that generation of the hydrogen sulfide can be reduced by eliminating or reducing the number of bacteria in the hot water heater. This might be done by raising the temperature in the hot water heater to 160^0 F or greater, by disinfecting the water heater and distribution system, and by removing the sacrificial anode from the hot water heater.

It was decided to conduct a study to determine if there were any actions homeowners themselves could take to reduce or eliminate the problems. Thirty-five families agreed to participate in a study, and the Department provided funds.

Many of the residents who had been complaining did not trust the utility, DEP or the Health Department to conduct an impartial study. We decided to find an impartial organization that had the capability to do the work. Florida Rural Water Association was chosen because of its experience with water problems and because it has a staff of highly qualified circuit riders. In June 1998, the Department contracted with the Florida Rural Water Association (FRWA) to conduct the research.

The Department recognizes that asking home owners to maintain their hot water heater temperatures at 160^0 F or greater is not practical from both safety and economical considerations. And, removing the sacrificial anodes will void the hot water heater warranties. So, FRWA was asked to undertake a research project to determine if something else would be effective in controlling the bacterial growth. It was finally decided that FRWA should flush and disinfect the hot water heater and pipes, elevate the temperature of the water heaters for a few hours, and replace the magnesium anodes with aluminum anodes. The water purveyor in the area believed that home point-of-entry water conditioning devices might contribute to the problem, so FRWA was asked to **disconnect the water softeners in some of the homes to be studied.**

FRWA hired a local licensed plumber to do the physical work on the home water systems and a local laboratory certified by the Florida Department of Health to perform analyses on drinking water samples. FRWA circuit riders were responsible for contacting the participating families, taking the water samples, performing certain field analyses of the water samples and delivering the water samples to the laboratory.

The Study

In late June and early July 1998, the circuit riders took initial baseline water samples from an exterior tap, an interior cold water tap and an interior hot water tap in 35 homes. The circuit riders analyzed the samples for pH, calcium hardness, alkalinity, orthophosphate residual, chlorine residual, and temperature. Samples were sent to the laboratory, which analyzed the samples for color, the presence of sulfur bacteria, sulfates, hydrogen sulfide, and copper.

During June and July 1998 the plumber performed a schedule of tasks on the hot water systems of 29 of the 35 homes in the study. In five houses designated as Group 1, the plumber disconnected the home water conditioning unit for the duration of the test, replaced the magnesium anode in the water heater with an aluminum one, disinfected the water heater using chlorine bleach, and raised the temperature to 160^0 F for a few hours. In ten homes designated as Group 2, the plumber replaced the anode, disinfected the heater, and raised the temperature for a few hours. In 12 homes designated as Group 3, he disinfected the heater and raised the temperature only. The final seven homes, Group 4, had no work done. The water from these homes was analyzed so a baseline could be maintained.

In August 1998 and March 1999, the Association circuit riders returned to the homes, sampled the water again, performed the same analyzes as were done on the initial

samples, and took samples to the laboratory. Also, in March 1999 the circuit riders asked each study participant a few questions about what they had observed.

Conclusions

The results of the study are inconclusive and mixed. None of the potential remedies seemed to have any lasting effect on the black water and odor problem. The presence or absence of water conditioning units in the homes appeared to have no effect on the generation of the hydrogen sulfide and the subsequent reaction with the copper pipes. The water conditioning units did not remove the orthophosphate from the water that was being added by the utility to inhibit copper corrosion. This had been a concern of the utility.

Home Units -

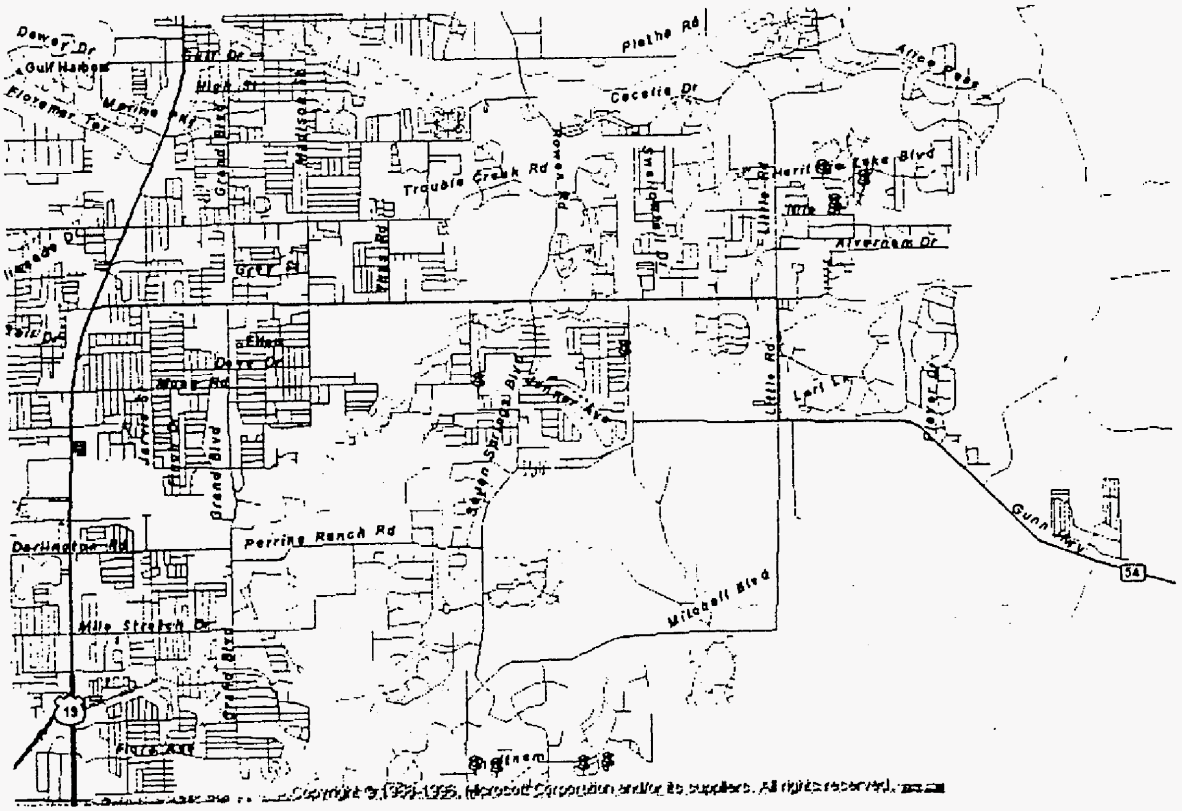
Attachments

Attached to this report is a list of the families that participated in the study, copies of the raw data that were gathered, and copies of the exit interviews that were conducted by the Florida Rural Water Association in March 1999. Also, for future reference there are five appendices with publications about hydrogen sulfide and sulfate at the end of this report.

Names and Addresses of Participants

- ***List Sorted Alphabetically***
- ***List Sorted by Address***
- ***List Sorted by Study Group***

The Southwest Pasco County Study Area



Alfa last name

PASCO COUNTY STUDY

Last Name	First Name	Address	Group	Softener	Odor	Color
Bauer	Bill	4720 Sheffield Dr.	1	Y	Y	Y
Carlson	Amy	7052 Fallbrook Ct.	3	Y	Y	Y
Chavolich	Elaine	7409 Cheltnam Ct.	2	Y	Y	Y
Christodoulou	Chris	4324 Haverhill Dr.	3	Y	Y	N
Corelli	Vince	7644 Albacore Dr.	3	Y	Y	Y
Elorfi	Abdel	2215 Egret Walk Ct.	4	N	Y	Y
French	William	1868 Kinsmere Dr.	1	Y	Y	Y
Fuhrman	Stewart	1400 Haverhill Dr.	4	N	Y	Y
Gerdon	Pat	6913 Old Gate Cir.	4	N	Y	Y
Green	Lynn	7254 Forest Edge Ct.	3	Y	Y	Y
Hagerty	Robert	1445 Hoversham Dr.	3	Y	Y	Y
Hammett	Kay	4420 Whitetail Ln.	1	Y	Y	Y
Hershkowitz	Joel	5940 Cachette De Riviera Ct.	4	Y	Y	Y
Irwin	James	7106 Fallbrook Ct.	2	Y	N	Y
Kahle	Rence	8812 Napa Loop	3	N	Y	Y
Layland	Carol	8117 Meadow View Dr.	2	N	Y	Y
Lucchesis	Joe	7643 Albacore Dr.	2	Y	Y	Y
Magnuson	R.E.	4736 Vicksburg Ct.	2	Y	N	Y
Mazunek	Sharon	7239 Forest Edge Ct.	2	N	Y	Y
Millian	Susan	1234 Middlesex Dr.	1	Y	Y	Y
Mock	Barbara	1223 Middlesex Dr.	2	N	Y	Y
Moyer	Dace	1235 Middlesex Dr.	3	Y	N	Y
Napolitano	Gary	8205 Silversmith Pl.	1	Y	Y	Y
Oko	James	1202 Middlesex Dr.	4	Y	N	Y
Olenszyk	John	4818 Gristmill Cir.	4	N	N	Y
Parsons	Frank	1317 Middlesex Dr.	2	Y	N	Y
Reis	Richard	1415 Hoversham Dr.	3	Y	N	Y
Silver	Helen	1105 Trafalgar Dr.	3	Y	Y	Y
Sokol	Jackie	5902 Cachette De Riviera Ct.	3	Y	Y	Y
St. Amo	Norma	6809 Willets Ave.	2	Y	Y	Y
Van Emmerick	Edward	1530 Haverhill Dr.	2	N	N	Y
Vento	Stephen	1456 Haverhill Dr.	3	N	Y	CPVC
Weber	Mike	1022 Trafalgar Dr.	4	N	N	Y
Wells	Paul	1442 Stroud Ct.	3	Y	Y	Y

Group 1: Drain/disinfect water heater, turn up temp, replace anode, disconnect POE device.
Group 2: Drain/disinfect water heater, turn up temp, replace anode.
Group 3: Drain/disinfect water heater, turn up temp.
Group 4: Nothing.

REANALYSIS OF DATA FROM PASCO COUNTY BLACKWATER STUDY 1998 DEPT.OF ENVIRONMENTAL PROTECTION

BY V.ABRAHAM KURIEN, M.D

Total number of homes in study: 34

Houses with softener systems : 24

Houses without softener systems: 10

Group 1: Drain/Disinfect heater: turn up temperature: replace Anode: disconnect softener: 5 Homes with softeners

Group 2: Drain/Disinfect heater: turn up temperature: replace Anode: 10 Homes: 6 with softeners, 4 without

Group 3: Drain/Disinfect heater: turn up temperature: 11 homes With softeners, 1 without

Group 4: Do nothing: 2 homes with softeners and 5 without

A total of 173 **bacteriological tests** were done on two dates 7/8/98 and (POST INTERVENTION) 8/27/98

66 SAMPLES were tested at point of entry before softeners:
41 tests were done on cold water outflow
66 tests were done on hot water outflow

SITE :	DATE:	HOUSES WITH SOFTENERS		HOUSES WITHOUT SOFTENERS	
	7/08/98	+VE 3/24	-VE 21/24	+VE 1/10	-VE 9/10
		12.5%	**87.5%**	**10.0%**	**90.0%**
POE	8/27/98	+VE 4/22	-VE 18/22	+VE 3/10	-VE 7/10
		18.2%	**81.8%**	**30.0%**	**70.0%**
	COMBINED	+VE 7/46	-VE 39/46	+VE 4/20	-VE16/20
		15.2%	**84.8%**	**20.0%**	**80.0%**
**	7/08/98	+VE 6/7	-VE 1/7	+VE 1/2	-VE 1/2
		85.7%	**14.3%**	**50.0%**	**50.0%**
COLD	8/27/98	+VE 6/22	-VE 16/22	+VE 2/10	-VE 8/10
		27.3%	**72.7%**	**20.0%**	**80.0**
	COMBINED	+VE 12/29	-VE 15/29	+VE 3/12	-VE 9/12
		41.3%	**58.7%**	**25.0%**	**75.0%**

***notice the significant reduction in number of samples*

SITE	DATE	HOUSES WITH SOFTENERS		HOUSES WITHOUT SOFTENERS	
	7/08/98	+VE 18/24	-VE 6/24	+VE 7/10	-VE 3/10
		75.0%	**25.0%**	**70.0%**	**30.0%**
HOT	8/27/98	+VE 17/22	-VE 5/22	+VE 7/10	-VE 3/10
		77.3%	**22.7%**	**70.0%**	**30.0%**
	COMBINED	+VE 35/46	-VE 11/46	+VE 14/20	-VE 6/20
		76.0%	**24.0%**	**70.0%**	**30.0%**

FINDINGS

1.POSITIVE BACTERIAL CULTURES OF BETWEEN 10-30% (AVERAGE 15.2-20.0%) AT THE POINT OF ENTRY IS OF EXTREME CONCERN AND RAISE THE POSSIBILITY THAT DISTRIBUTED WATER CONTAINS BACTERIA THAT CAN COVERT SULFATES INTO SULFIDES WITHIN DOMESTIC PLUMBING.

2.THESE DATA SUGGEST THAT SOFTENERS DO NOT INCREASE FREQUENCY OF BACTERIAL INVASION OF HOT WATER.

3.The data raises the possibility that the frequency of bacterial invasion in cold water is higher with softeners: however the number of samples analyzed were markedly smaller than for POE and HOT water tests ON 7/8/98

ANALYSED IN A DIFFERENT WAY, IS THE LIKELIHOOD OF A HOME WITH SOFTENER HAVING BACTERIA IN HOT WATER GREATER THAN THAT OF A HOME WITHOUT SOFTENER?

OF THE 24 HOMES WITH SOFTENERS, 18 WERE +VE : 75%

OF THE 10 HOMES WITHOUT SOFTENERS, 7 WERE +VE : 70%

THE ANSWER IS AN EMPHATIC NEGATIVE

CONCLUSIONS:

A. The samples are probably too small to draw conclusions unless appropriate statistical methods are used.

B. The suggestion that Softeners increase the risk for bacterial invasion is without foundation

C. There is no evidence to suggest that altering the hot water in the ways used in this study makes any difference to bacterial invasion.

D. THE MOST SIGNIFICANT FINDING IS THE PRESENCE OF BACTERIA AT THE POINT OF ENTRY INTO THE HOMES IN 10-30%. IT MUST BE ASSUMED THAT DISTRIBUTED WATER FROM ALOHA UTILITIES INTERMITTANTLY CONTAINS BACTERIA, *Divibrio sulfuricans, that is capable of converting Sulfates to sulfides and thereby causing the blackwater phenomenon.*

A testable Hypothesis: The water supplied by Aloha Utilities may contain on an intermittent basis Divibrio Sulphuricans, the anaerobic sulfate reducing bacteria, in addition to small amounts of sulfides as recently demonstrated.

This could be due to inadequately sustained chlorination of wells from which underground water containing the bacteria and hydrogen sulfide is extracted. A second possibility is the lack of sustained levels of residual chlorine in distributed water due to deficiencies in the process of chlorination or in adequately sustained automatic monitoring of chlorine residuals.

The background grayish discoloration of water in toilet tanks is due to the presence of small amounts of sulfides in distributed water reacting with copper in the domestic plumbing. The major events of blackwater appearing in domestic systems must be considered to be due to bacterial colonization of domestic plumbing, most likely to occur in the hot water systems and increased production of sulfides within the plumbing leading to aggressive copper sulfide formation.

Use of activated charcoal filters may accentuate bacterial colonization by removal of chlorine. Softeners, which are not coupled with activated charcoal filters, are not likely to facilitate bacterial colonization.

Effective treatment for getting rid of blackwater MUST address the issue of bacterial presence in distributed water along with elimination of residual sulfides. Without it any sterilization of domestic plumbing system will have only a very transient effect, if any, as documented by this study. Recolonization by bacteria from distributed water will cause recurrence of 'black water' due to corrosion of pipes.

New Port Richey,
March 28, 2002

Abe Kurien

Black Water Formation

Black water is a term used to describe water containing dark, suspended material. The occurrence of black water has been widely reported in the service area of the Seven Springs Water System. It is frequently associated with hot water lines, but has also been reported in cold water lines within residences. The black material causes staining of laundry and fixtures. As part of the Phase II testing, an effort was made to identify potential explanations for black water by characterizing particles present in the treated water from each well and in the distribution system samples. In addition, two samples of black water were obtained to provide a comparison between water entering the residence and black water.

Treated well water

For the each of the two sample events conducted for this study, the concentration of particles in the treated water was fairly low. There was no measureable hydrogen sulfide in any of the treated water samples and they all contained an adequate chlorine residual. The suspended solids concentration was below the detection limits of the test (< 1 mg/L).

Particles from samples of treated well water were concentrated about 25 fold using centrifugation. The particles were resuspended in water, preserved with chemical fixative, dehydrated, collected on a filter with a pore size of 0.01 μm, coated, and analyzed using electron microscopy coupled with X-Ray analysis to determine the particle size and elemental composition of the particles. In most cases, the particle density was extremely low.

Examples of the particles isolated from treated water from well 8 are shown in Figure 24. The number of particles in all of the well samples was extremely low (<100/mL). The smaller, spherical particles (< 1 μm) were composed of iron, sulfur, and phosphate, whereas the larger particles (> 5 μm) contained a higher proportion of sulfur. The particle size of the sulfur-rich particles varied from 0.1 to over 10 μm. These particles are small enough to remain suspended in the water, but could accumulate in locations that have low velocities and a long residence time (dead-ends).

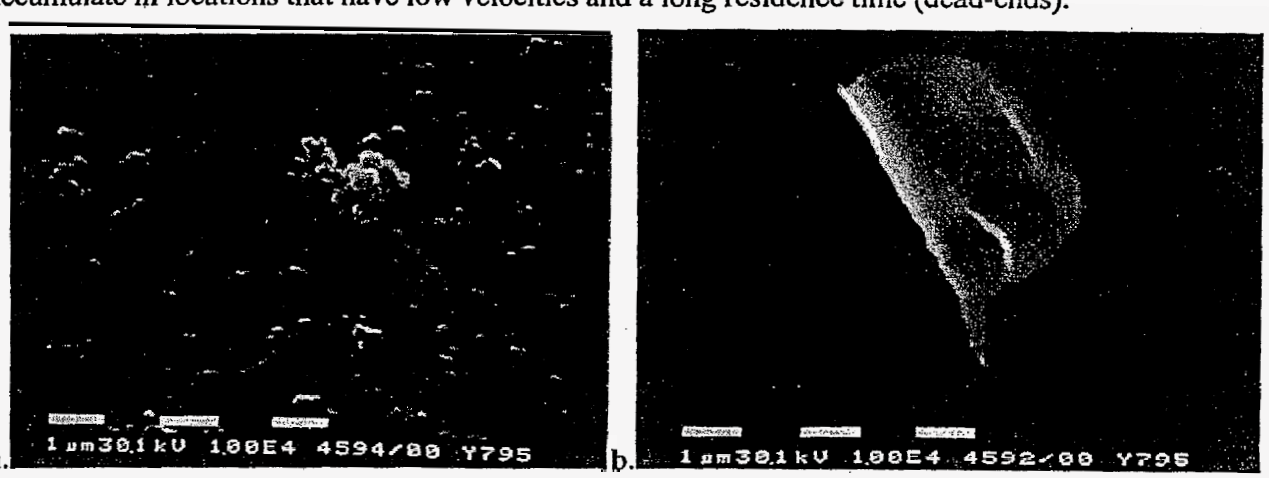


Figure 24. Comparison of electron micrographs of particles isolated from treated water from well 8. a) particles consisting of iron-phosphorus-sulfur; b) particles consisting of sulfur and organic material. The scale in the micrograph is depicted by the white bar (1 μm).

Distribution system samples

A comparison of particles isolated from the Main Plant inflow is shown in Figure 25. Again, the concentration of particles was fairly low and the composition of the particles was similar to that observed for samples from the treated well water. The smaller particles contained iron and sulfur with trace amounts of phosphorus, whereas the larger particles consisted of calcium-sulfur precipitates.

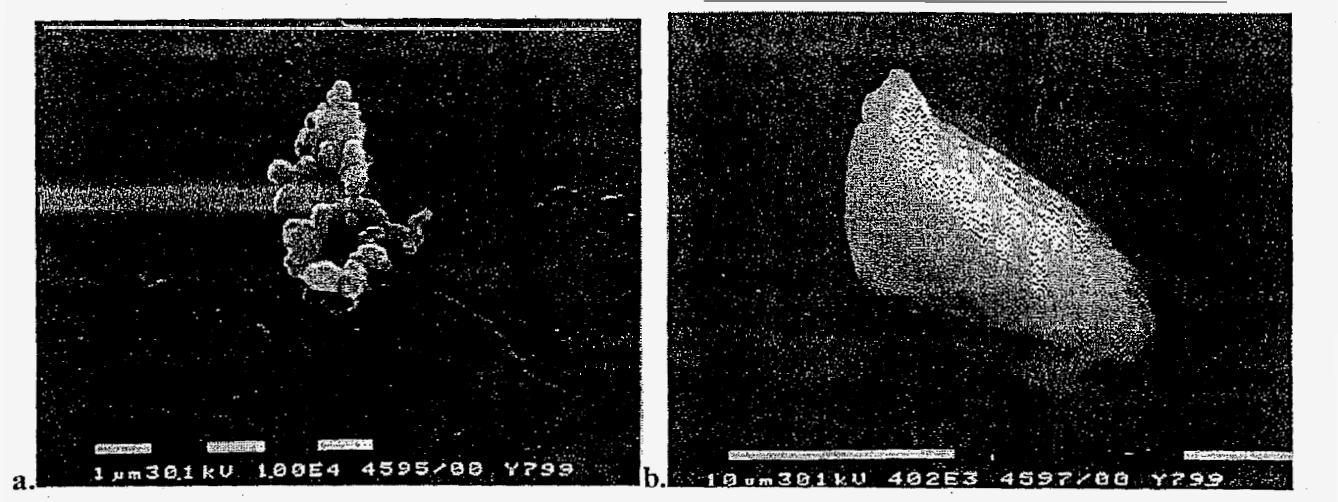


Figure 25. Comparison of electron micrographs of particles isolated from treated water from the main plant inflow. a) particles consisting of iron-phosphorus-sulfur; b) particles consisting of sulfur and calcium. The scale in the micrograph is depicted by the white bar (1 µm for a and 10 µm for b).

A comparison of the dominant elements identified in particles from the distribution system (treated well water, main plant, and distribution system samples) and the percent of particles that contained each element is shown in Figure 26. Calcium, silica, chloride, sulfur, and iron were the dominant constituents of the particles isolated from the distribution system. Calcium, copper, iron, silica, and sulfur were the most frequently detected elements. Aluminum, chloride, potassium, and magnesium were detected less frequently. All particles that contained phosphorus also contained calcium and copper and most contained iron. The presence of sulfur in a particle also corresponded to the presence of varying amounts of iron and calcium. All particles that contained copper also contained calcium, iron, sulfur, and silica.

The formation of particles in the distribution system results from chemical solubility reactions that occur within the pipeline and result in the formation of insoluble particles. Calcium, iron, and sulfur are all present in the untreated water. In this study, the concentration of silica was not measured, however its source is either from the wells or from exposure to concrete piping materials. The phosphorus is added to the water as a corrosion inhibitor and it functions as a complexing and sequestering agent for metals and minerals. The concentration of aluminum was not measured as part of this study, but it is probably associated with the source of silica. Trace levels of copper were detected in the distribution system samples and ranged from 0.04 to 0.14 mg/L. The source of the copper is either from the water pipes or from the fixtures in the home (Neff et al. 1987).

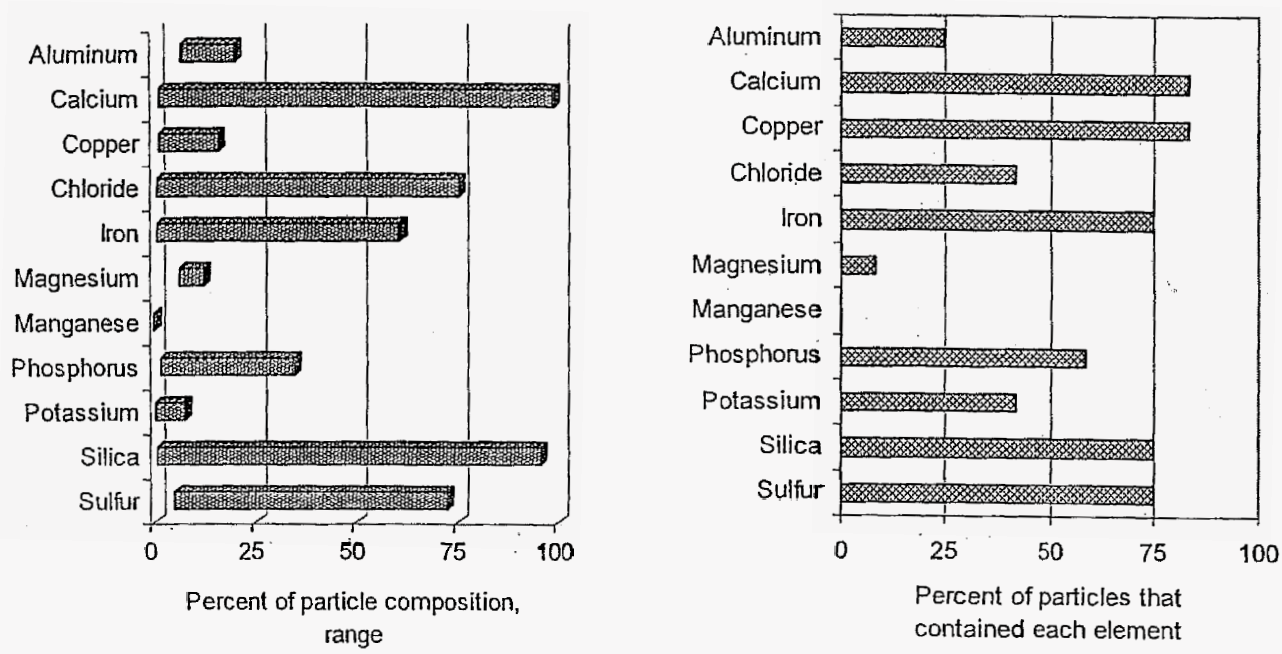


Figure 26. Comparison of distribution of dominant elements in particles isolated from the distribution system (well water, main plant, distribution system samples). a) relative percent of particle composition, b) percent of particles that contained each element.

Black water samples from residential plumbing

This study was focused on analysis of untreated water, treated water, and distribution system water. Therefore, analysis of black water samples was not a primary objective of the study. Preliminary information on black water characteristics was obtained from two sites. During the distribution system sampling, samples of black water were collected on an ad hoc basis from two residences (D-2 and D-7). In one case (D-2b) the sample was from the hot water tank, in the other case (D-7b), the sample was from a hot water faucet that serves the bathtub. The samples were characterized in parallel with the other distribution system samples and particles were examined to evaluate particle size and particle composition. In general, the chemical composition of the samples of black water was similar to the samples of water entering the residences with the exception of the quantity of iron and copper associated with the particles. A comparison of iron and copper levels in the water entering the residence and the black water samples is shown in Figure 27. As shown, in both cases, the black water contained significantly higher levels of copper and iron. In both cases, there was a slight increase in the sulfate concentration associated with the black water (~5 mg/L).

Very few particles were detected in the distribution system samples and the majority of the particles were similar in composition to the particles isolated from the treated well water and the main plant (see Figures 24 and 25). Examples of particles isolated from distribution samples D-2 and D-7 are shown in Figure 28. The particles from D-2 are composed of silica, aluminum, sulfur, iron, phosphorus, copper and calcium. Particles isolated from D-7 are composed of phosphorus, sulfur,- calcium, and silica.

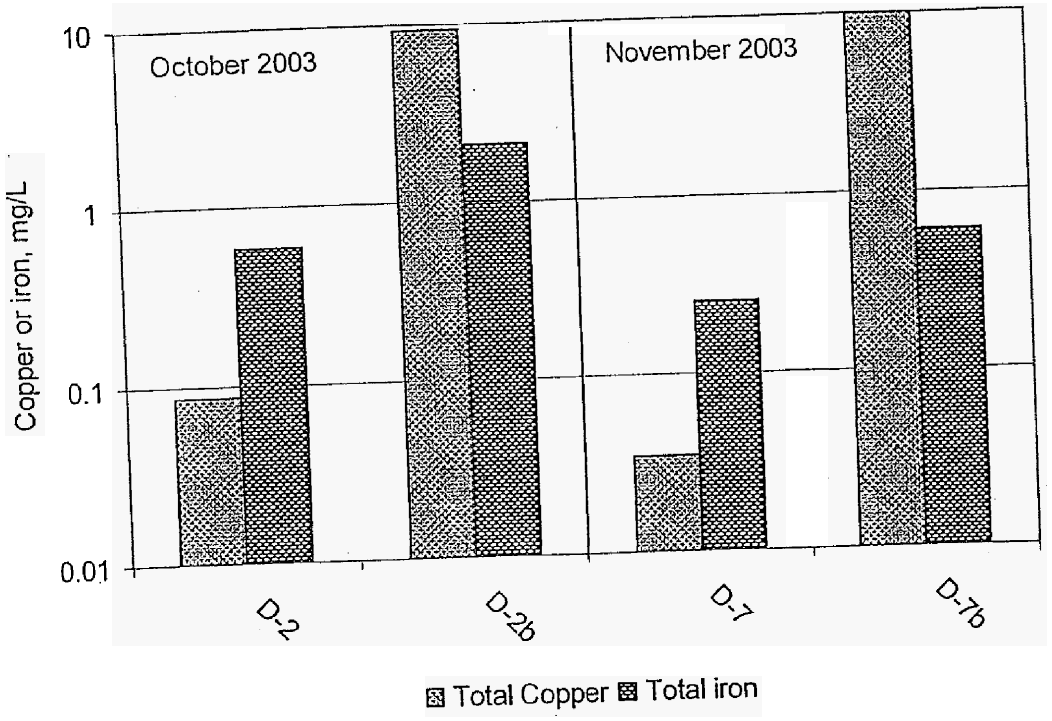


Figure 27. Comparison of total copper and total iron associated with distribution system water (D-2 and D-7) and black water from hot water tank(D-2b) and hot water faucet (D-7b).

a. b.

Figure 28. Comparison of electron micrographs of particles isolated from distribution system samples D-2 and D-7. a.) Particles isolated from D-2 consist of silica-aluminum-sulfur-iron-phosphorus-copper-calcium. b.) Particles isolated from D-7 consist of phosphorus- sulfur- - calcium-silica. The scale in the micrograph is depicted by the white bar (10 µm).

Samples of black water were processed for examination by electron microscopy. Examples of particles isolated from sample D-2b are shown in Figure 29. This sample was dominated by the presence of aluminum. The spherical particles are composed of aluminum, copper, phosphorus, and iron. Examples of particles isolated from sample D-7b are shown in Figure 30. There was no evidence of aluminum in the particles from sample D-7b and the dominant elements in the particles were copper, sulfur, and phosphorus.

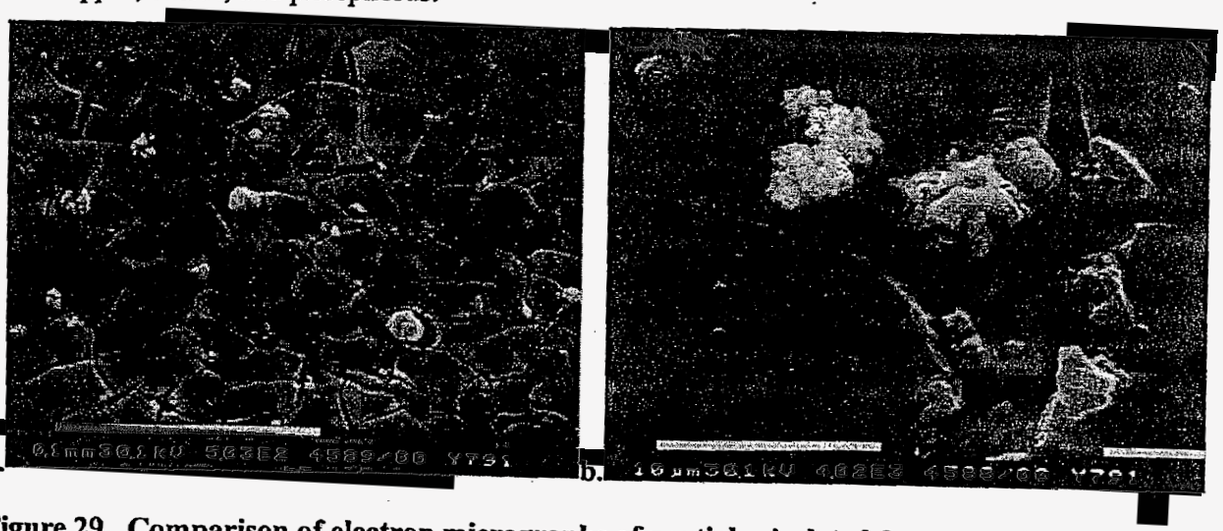


Figure 29. Comparison of electron micrographs of particles isolated from sample D-2b. Particles consist of aluminum-copper-sulfur-iron-phosphorus-calcium. The smaller particles are predominantly aluminum-phosphorus. The scale in the micrographs is depicted by the white bar (100 μm or10 μm).

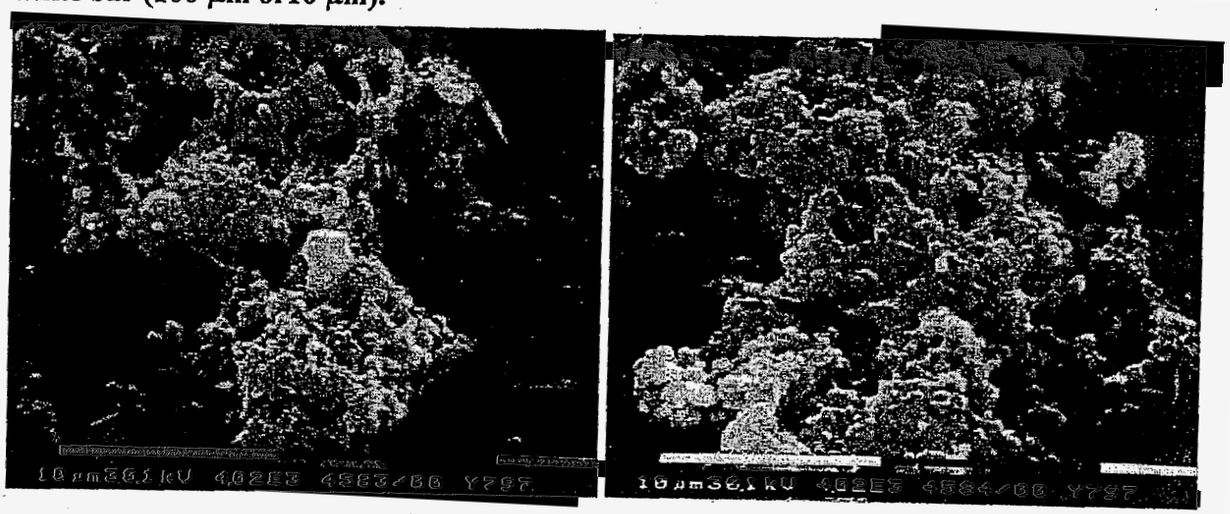


Figure 30. Comparison of electron micrographs of particles isolated from sample D-7b. Particles consist of copper-sulfur- phosphorus with some calcium and iron present. The scale in the micrographs is depicted by the white bar (10 μm).

An additional analysis was conducted on particles isolated from a whole house water filter obtained from a residence in the Seven Springs service area. The particles were removed from the filter and processed for electron microscopy. Examples of the particles isolated from the filter are shown in Figure 31. The dominant elements in the particles were iron, phosphorus, calcium, and sulfur.

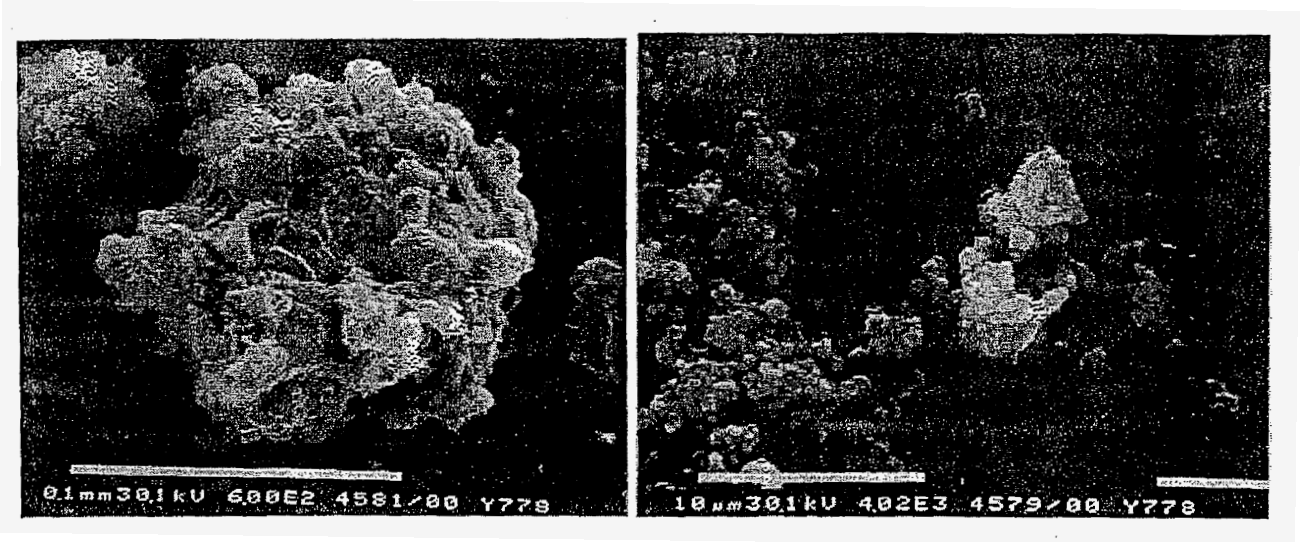


Figure 31. Comparison of electron micrographs of particles isolated from a household water filter that is used to filter water entering the house. Particles consist of iron-phosphorus-calcium or iron-sulfur with trace amounts of copper. The scale in the micrographs is depicted by the white bar (100 µm or10 µm).

A comparison of the elemental composition of particles isolated from the filter is shown in Figure 32. The dominant element in the particles was iron. Calcium, copper, chloride, iron, and phosphorus were identified in all of the particles.

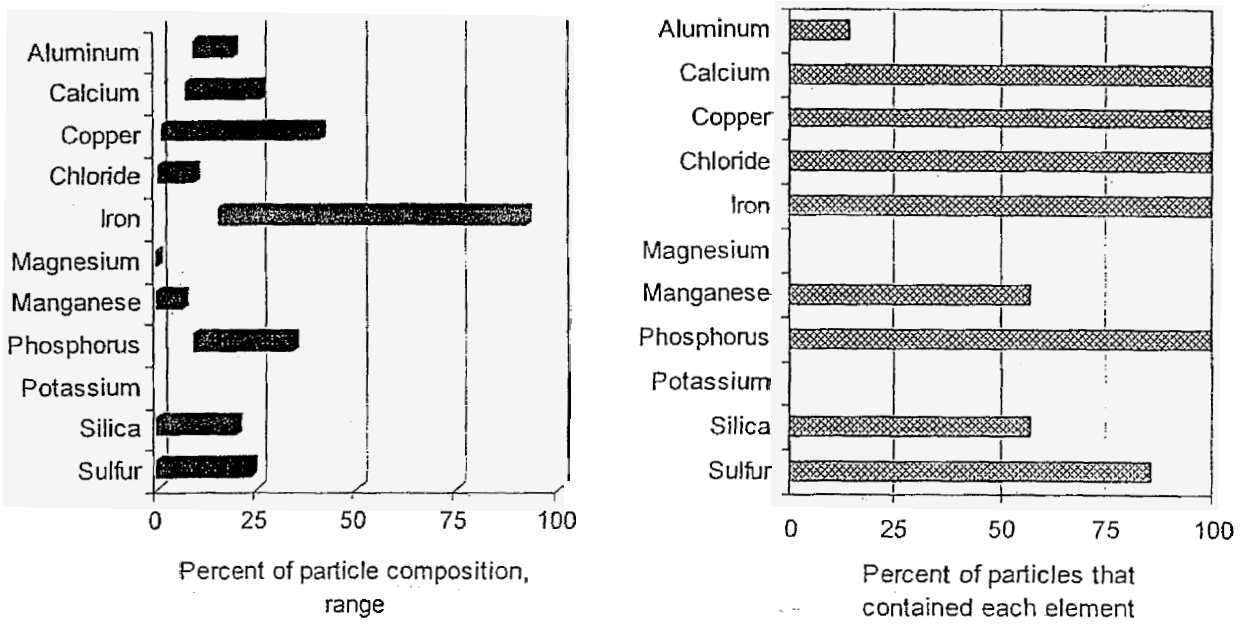
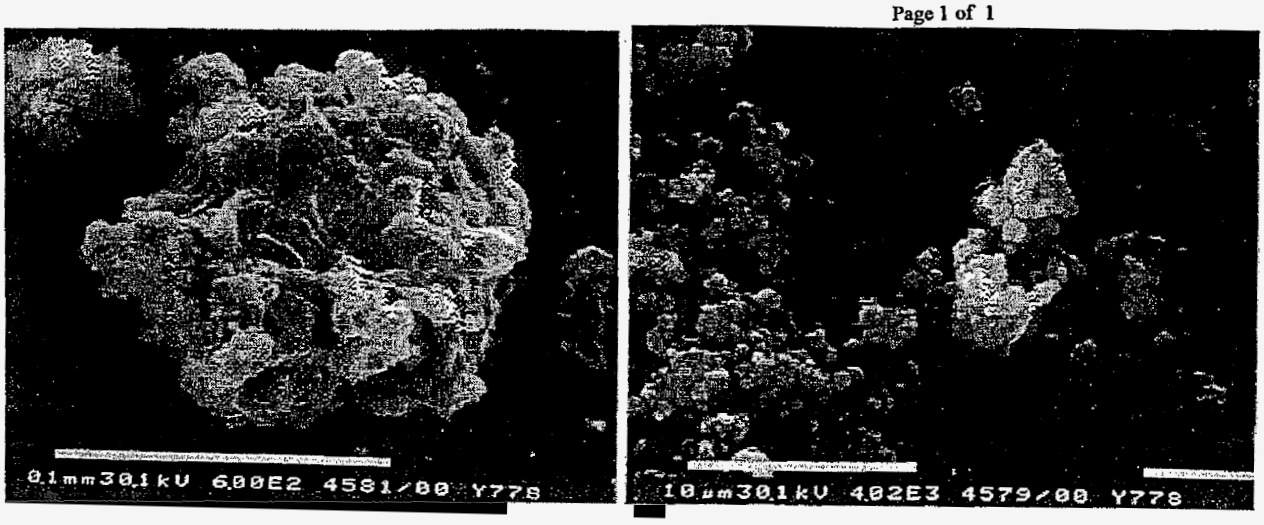


Figure 32. Comparison of distribution of dominant elements in particles isolated from a water filter installed on the inflow to a residence a) relative percent of particle composition, b) percent of particles that contained each element.



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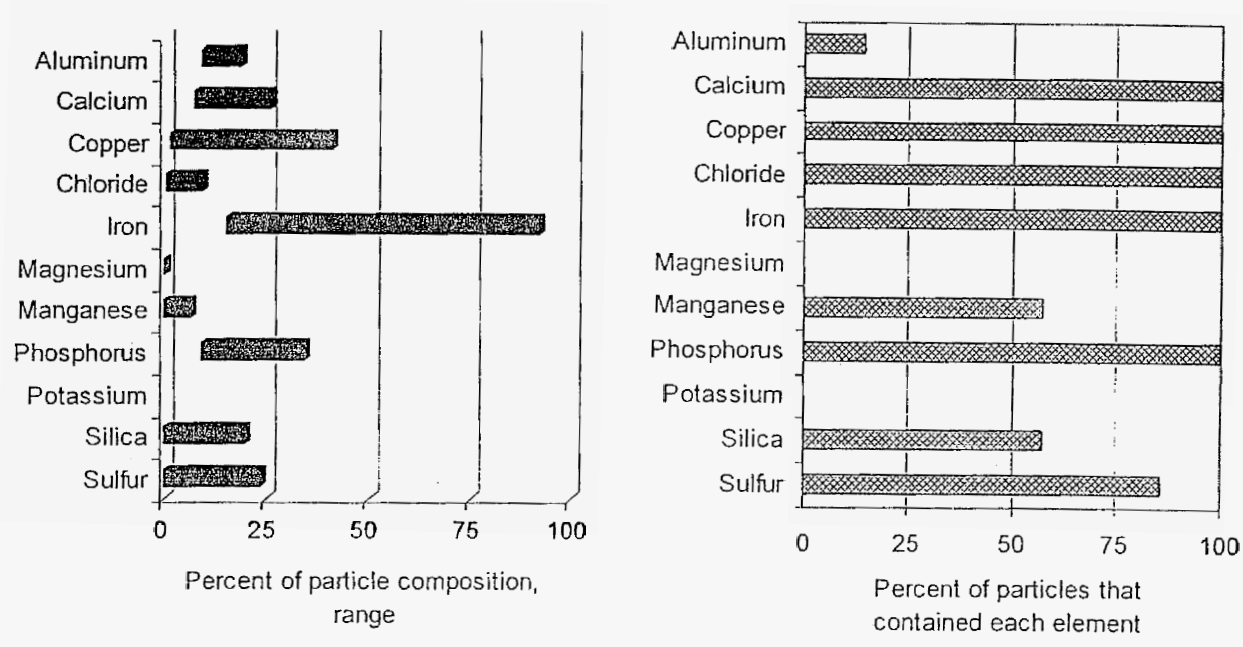

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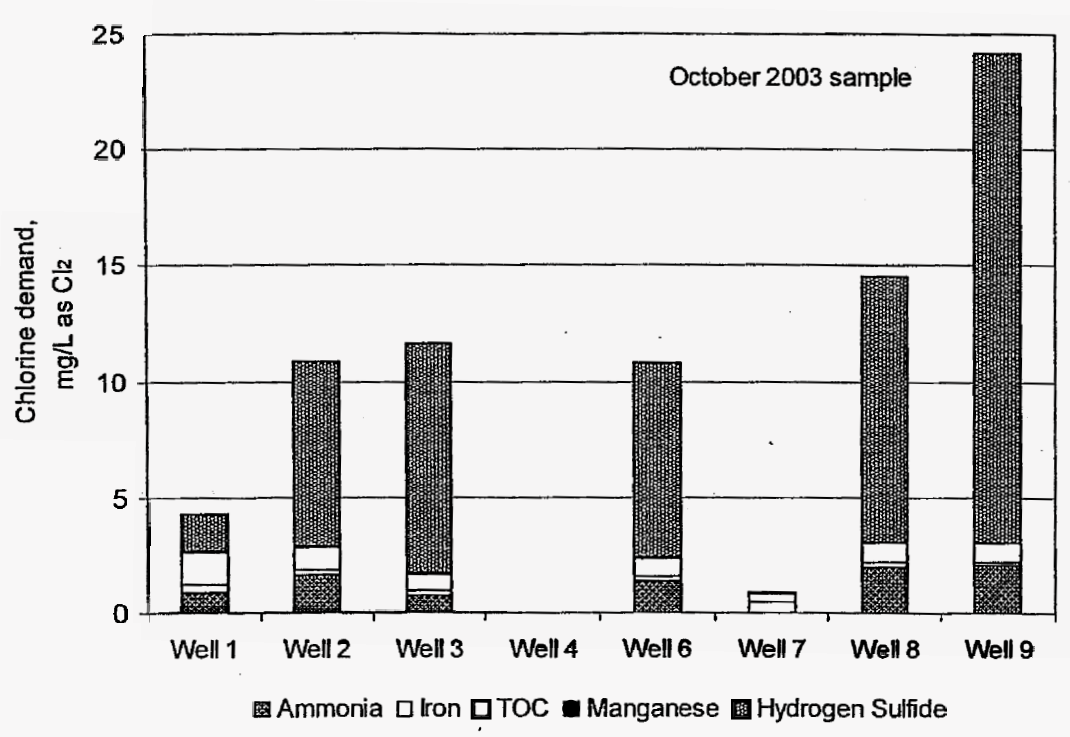
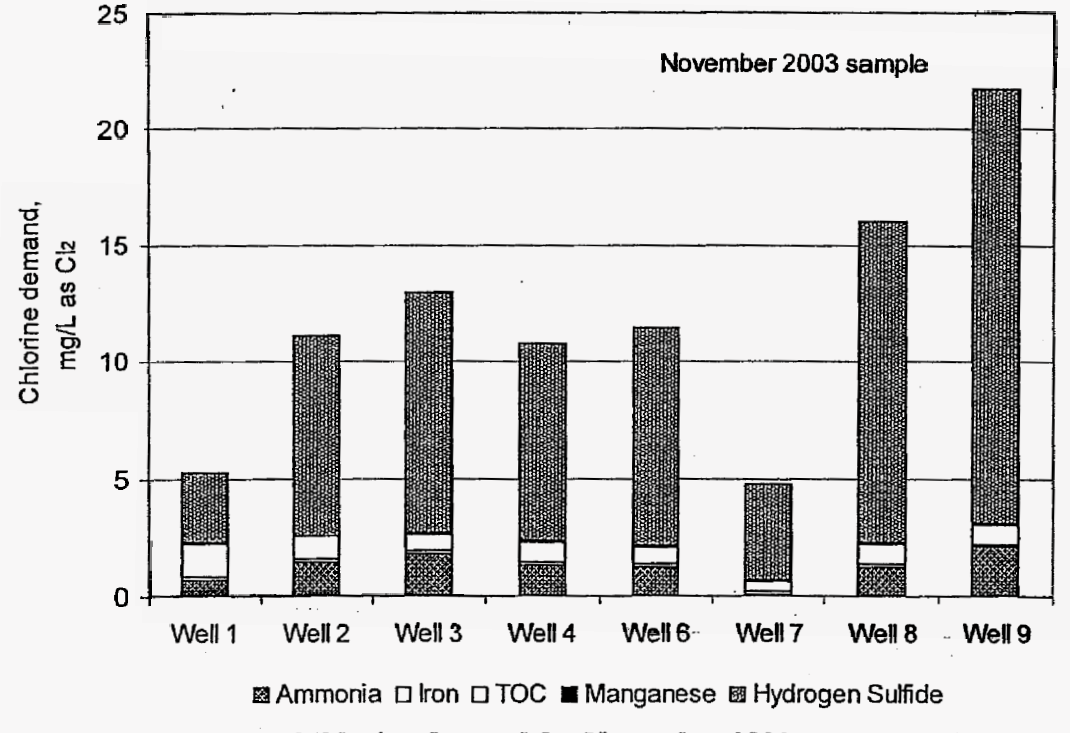


a. Comparison of chlorine demand for October 2003 water samples.



b. Comparison of chlorine demand for November 2003 water samples.

Figure 14. Summary of chlorine demand for water from the Seven Springs Water system.

CALCULATIONS OF THE CHLORINE DEMAND OF HYDROGEN SULFIDE IN ALOHA WELLS

Its significance in
Relation to the production of Sulfate and Elemental Sulfur
From Oxidation of Hydrogen Sulfide
With the **sole** use of Chlorine

V. Abraham Kurien, M.D.

Oxidation of 1 mg of hydrogen sulfide to elemental sulfur requires only 2.08 mg of chlorine, where as 8.33 mgs of chlorine is required to oxidize hydrogen sulfide to sulfate (Dr Levine, Phase II Report, page 16). **2 .08 and 8.33** are referred to as the chlorine demand of hydrogen sulfide for its oxidation to elemental sulfur and sulfate respectively.

When the chlorine demand specific to hydrogen sulfide alone is calculated as Dr Levine did during her technical review of Aloha, it gives an idea about approximately how far the oxidation of hydrogen sulfide has proceeded in the treated source water. When the calculated value of chlorine demand is closer to **2.08** more elemental sulfur can be assumed to have been produced in the treated water, where as when the number is closer to **8.33** it is more reasonable to assume that most of the hydrogen sulfide has been oxidized to sulfate.

Thus the chlorine demand number (expressed as mg/l of water to oxidize 1 mg/l of hydrogen sulfide) is an approximate indication of what percentage of hydrogen sulfide has been oxidized to sulfate and what percentage has been oxidized only to elemental sulfur. At a chlorine demand of **5.0 – 5.5,** it is reasonable to assume that 50% of the hydrogen sulfide has been oxidized to sulfate and the rest has been oxidized only as far as elemental sulfur. **This is only an approximate theoretical calculation since other species of sulfur are also produced during the oxidation of hydrogen sulfide by the sole use of chlorination.**

In the specific case of well 8 on 11.12.03, according to the sampling reports and calculations submitted by Dr Levine, we know that the calculated amount of chlorine that was added to each liter of raw water from well 8 was 18.9 mg (page 18, Phase II report). Of this 3.5 mg/l was left behind as chlorine residual (page 55). Therefore the oxidizable materials in the raw water that day consumed 15.4 mg of chlorine. Of this according to Dr Levine's calculations, as shown in figure 14b (page 20) 1.9 mg was used up by ammonia and total oxidizable carbon(TOC). The rest 13.5 mg was consumed in the oxidation of hydrogen sulfide.

The amount of hydrogen sulfide in that well was 1.73mg/l of raw water (page 55). All of this was oxidized as there was less than 0.01 mg/l of hydrogen sulfide was detected in the finished water.

When the number 13.5 is divided by 1.73 a number close to **7.83** is obtained, which is the chlorine demand of hydrogen sulfide in that well on that day at the time the sample was taken. Since this number is close to **8.33**, the chlorine demand for the conversion of **all** hydrogen sulfide to sulfate, we conclude that most of the hydrogen sulfide in that well was converted to sulfate on that day and that only minimal elemental sulfur was formed. Dr Levine confirmed this by the scanning electron microscope photographs that showed few particles of colloidal sulfur.

On the contrary on 10/29/03 there was **3.95** mg/l of hydrogen sulfide present in the raw water in well 9. The total amount of chlorine injected was 24.60 mg/l close to the maximum amount of chlorine that can be injected at that well (Dr Levine, Phase I report, page 20). The chlorine residual was 2.70mg/l. Chlorine consumed at that well was 21.90/l of raw water. Approximately 3.0 mg/l of chlorine was consumed by ammonia and total oxidizable carbon (TOC) as per Dr Levine (page 20, figure 14.b Phase II report).

18.9 mg/l of chlorine (21.90 -3.0) was consumed by 3.95 mg/l of hydrogen sulfide as only less than 0.01 mg/l of hydrogen sulfide was present in the "finished" water. The chlorine demand of hydrogen sulfide in raw water is calculated as 18.9 divided by 3.95 giving a value of **4.78** mg/l.

Theoretically this means that almost 50% of hydrogen sulfide was oxidized only as far as elemental sulfur. Dr Levine has indicated that even if the maximum available chlorine at well 9, which is 25mg/l was used, after providing for a free chlorine residual of 3mg/l, only 2.6 mg of hydrogen sulfate could be oxidized to sulfate by the remaining available chlorine of 22 mg/l. The rest, 1.35mg/l will remain as hydrogen sulfide itself or some other form of sulfur other than sulfate.

Since **no** hydrogen sulfide was detected in the finished water at the plant, what was the fate of the hydrogen sulfide in raw water? To what extent was hydrogen sulfide oxidized to elemental sulfur and sulfate? The calculation of the specific chlorine demand for hydrogen sulfide alone shows that with a chlorine demand number of **4.78**, only 50% of the total oxidized hydrogen sulfide was converted to sulfate. The rest must have been oxidized only as far as elemental sulfur.

This would mean that, if elemental sulfur and sulfate levels could have been measured in the finished water at well 9 on 10/29/03, one would have obtained a result close to 2.0 mg/l for elemental sulfur and 2.0 mg for sulfate.

If scanning electron micrography were undertaken on finished water from Well 9 on 10.29.03, it would have certainly showed more numerous particles of colloidal sulfur than was seen in the SEMs from water processed at well 8. Unfortunately, the sample of finished water from well 9 was not used for obtaining SEMs.

Any time hydrogen sulfide level in raw water from well 9 was over 2 .6 mg/l there would have been elemental sulfur in finished water from that well. Every one of the 20 samples of raw water from well 9 collected during the April –July 2001 period had a concentration of hydrogen sulfide that was greater than 3.0 mg/l and therefore the finished would have definitely contained elemental sulfur.

Since the statistical mean of chlorine demand for hydrogen sulfide from the 15 samples of water obtained from Aloha 's 8 wells on 10/29/03 and 11/12/03 was 5.5 mg/l, (page 21, Fig.15 Phase II Report) it is highly likely that a significant number (10/15) of those finished water samples would have contained elemental sulfur. As Dr Levine's calculations show (page 20, Fig.14 and b) 7/10 of these samples that had chlorine demand values around 5.0 – 5.5 were drawn on 10/29/03 when SEM studies were not done!

#38

Aloha Utilities

Seven Springs Water System

Technical Review of Production and Distribution of Drinking Water in the Seven Springs Water System

Phase I
Analysis of monitoring and operations data

Submitted to
Attorney Jack Shreve
Attorney Steven C. Burgess
Office of Public Counsel
111 W. Madison Street # 812
Tallahassee, FL 32399-1400

Submitted by
Dr. Audrey D. Levine, P.E.
Associate Professor
Department of Civil and Environmental Engineering
University of South Florida
4202 East Fowler Ave., ENB 118
Tampa, FL 33620

August 2003

Table 3. Comparison of the theoretical chlorine dose available at each well in the Seven Springs Water system.

Well	Maximum available chlorine dose, mg/L
1	8.3
2	20.8
3	41.7
4	41.7
Main plant: wells 1-4	27.8
6	18.5
7	18.5
8	25.0
9	25.0

Typically, the reaction products from chlorination of hydrogen sulfide include a combination of sulfur species including sulfate and elemental sulfur, depending on water quality variables such as pH, temperature, iron, manganese, and organic carbon. Process operation is constrained by regulatory limits on residual chlorine in the distribution system. It is critical that the residual chlorine in the distribution system be below 4 mg/L.

The theoretical chlorine requirements can be estimated from water quality data. For discussion purposes, the chlorination requirements for well 9 can be estimated as follows. Based on the limited dataset available for well 9, sulfide levels vary from about 2.4 to 6.6 mg/L. Iron levels vary from about 0.02 to 0.4 mg/L. Assuming a residual chlorine level of 3 mg/L in the treated water and worst case for iron (0.4 mg/L), the chlorine dose necessary to oxidize the iron and sulfide as a function of sulfide concentration is shown in Figure 21.

As shown, for sulfide levels up to about 2.6 mg/L, there is adequate chlorination capacity to completely oxidize the sulfide to either sulfur or sulfate and maintain a chlorine residual of about 3 mg/L. If all of the sulfide is oxidized to elemental sulfur, there is adequate chlorination capacity at well 9 to oxidize up to about 11 mg/L of sulfide and still maintain a chlorine residual of about 3 mg/L. In reality, the reaction chemistry is complex and it is likely that both sulfate and elemental sulfur are formed from sulfide oxidation. The detection of a chlorine residual in the treated water is evidence that sulfide oxidation has occurred, however the reaction products can only be determined by conducting a mass balance on sulfur in the system.

It is important to note that oxidation of sulfide to either sulfate or elemental sulfur acts to eliminate the sulfide odor. However, oxidation reactions do not remove the sulfur and either form of sulfur (sulfate or sulfur) can revert back to sulfide under conditions of low dissolved oxygen, low chlorine residual, the presence of metal catalysts, and/or when growth conditions are favorable for sulfur reducing bacteria. Sulfate is naturally present in all groundwater and the levels of sulfate in the water from the Seven Springs System are fairly low. Thus, oxidation of sulfide will eliminate odors but does not eliminate the potential for conversion to other forms of sulfur.

#38

Aloha Utilities

Seven Springs Water System

Technical Review of Production and Distribution of Drinking Water in the Seven Springs Water System

Phase I
Analysis of monitoring and operations data

Submitted to
Attorney Jack Shreve
Attorney Steven C. Burgess
Office of Public Counsel
111 W. Madison Street # 812
Tallahassee, FL 32399-1400

Submitted by
Dr. Audrey D. Levine, P.E.
Associate Professor
Department of Civil and Environmental Engineering
University of South Florida
4202 East Fowler Ave., ENB 118
Tampa, FL 33620

August 2003

Table 2. Comparison of measured sulfide levels in untreated well water from wells that serve the Seven Springs Water system.

	November 1996	February 2001
Well	Hydrogen sulfide, mg/L	Hydrogen Sulfide, mg/L
1		< 0.10
2		0.68
3		1.78
4		0.46
6		0.94
7		< 0.10
8	0.7	1.50
9	2.4	3.85

A pilot study was conducted in 2001 to test the effectiveness of an ion exchange treatment technology (MIEX) for removal of hydrogen sulfide from well 9. During the pilot study, sulfide levels were measured either once or twice daily. A summary of sulfide levels associated with untreated water from well 9 between April and July 2001 is shown in Figure 10. As shown, there was significant variability in the sulfide levels over the short time span of the study. All of the reported sulfide levels were above 3 mg/L and in some cases levels were over 6 mg/L. It should be noted that this study was conducted during the drought and the degree to which drought conditions influenced sulfide levels is not known. Routine monitoring of hydrogen sulfide in the raw water would be useful to determine if the 2001 data represent "typical" values.

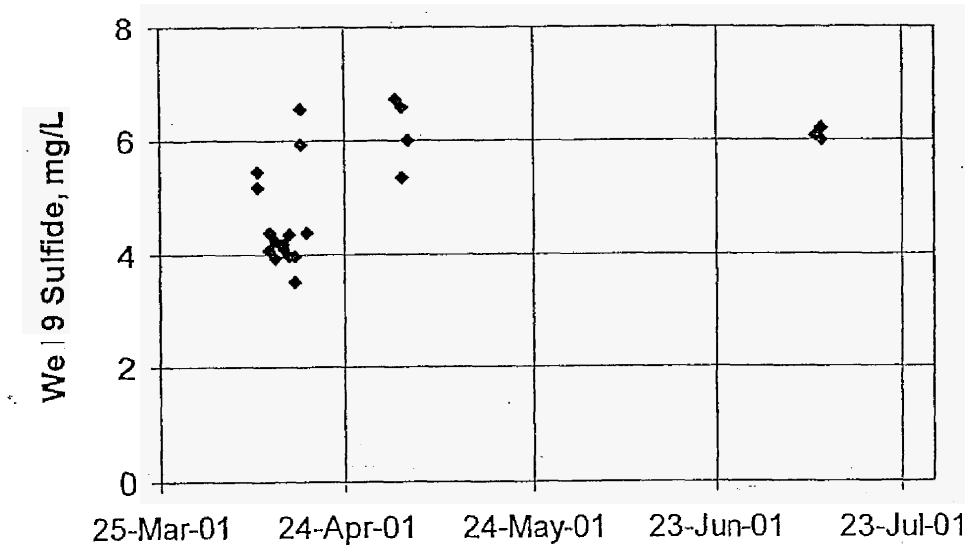


Figure 10. Summary of hydrogen sulfide levels in untreated water from well 9 during a pilot study conducted to evaluate the effectiveness of ion exchange treatment (Data from Porter, 2002).

EXHIBIT D

SUPPLEMENTAL WATER QUALITY PARAMETERS

Water supplied from the Authority's System shall be sampled annually at a minimum, at the Point(s) of Connection for the following parameters. The Quality Water definition and the supplemental parameters listed below define the water quality to be provided by the Authority:

Contaminant	Goal
Sulfides	0.1 mg/l
Total Hardness	300 mg/l as $CaCO_3$
Alkalinity	40 mg/l as $CaCO_3$ (minimum value)

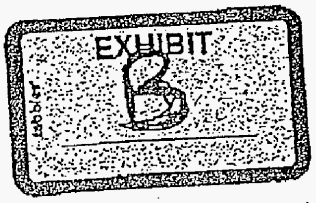
Note: Supplemental parameters are not currently included in S.F.D.E.P. 62-550.

The results of the annual sampling program shall be provided to all the Member Governments in a report format. The cost of the annual sampling program shall be borne by the Authority as an Operation, Maintenance and Administrative Cost to be shared equitably among its Members. In the event that the annual sampling program indicates the maximum contaminant level from the table is exceeded for one or more parameter, the Authority shall follow the retesting and mitigative measures currently defined in State and Federal regulations.

Within 60 days of February 23,1998, or the next following regularly scheduled meeting of the Authority's Board of Directors, the Authority and Member Governments shall propose a list of a minimum of 19 Supplemental Water Quality parameters and assigned levels for Board approval. Such list, when approved by the Board, shall supplement this Exhibit D. Any Member Government that does not concur with the amended list of parameters or their assigned levels, shall be entitled to seek relief by the arbitration process established in Section 19 of the Contract. The standards for the arbitration process shall be:

1. Whether cost-effective alternative water supplies can be developed consistent with Master Water Plan objectives, including diversity of supply sources, and

2. Whether Quality Water delivered by the Authority would not cause a particular Member Government utility to adopt new treatment techniques beyond modified chemical dosages and/or optimization of existing unit processes, to meet a moderately altered source of Quality Water.



PINELLAS COUNTY FLA.
OFF.REC.BK 10155 PG 404

In the event that a Member Government requests sampling for additional parameters or an increase in sampling frequency, the cost associated with the sampling will be borne solely by that Member Government and not by the Authority. If scheduling permits, the Authority may provide the sampling services at cost to the Member Government or the Member Government may perform the additional testing.

Sampling shall be conducted in accordance with the procedures defined in the current regulations for the Primary and Secondary Drinking Water Standards and/or according to Standard Methods, latest edition, for those parameters for which testing procedures are not defined in the regulations.

The Authority shall evaluate each new supply element to ensure that:

1. Quality Water is provided that at a minimum, meets all Federal and State drinking water quality standards with the exception of corrosion control and disinfection so as to protect public health and safety and provide water as aesthetically-pleasing as is currently supplied.

2. Individual Member Governments will continue to provide additional treatment to meet their individual utility-specific water quality goals and customer expectations for level of service.

3. Member Governments, acting through the Authority, may provide for common water quality goal-related elective standards more stringent than Federal and State drinking water standards, and.

4. Cost-effective alternative water supplies are developed consistent with Master Water Plan objectives, including diversity of supply sources, and

5. Quality Water delivered by the Authority would not cause a particular Member Government utility to adopt new treatment techniques beyond modified chemical dosages and/or optimization of existing unit processes, to meet a moderately altered source of Quality Water.

Prior to the initiation of any new supply element, a formal review against the criteria set forth above shall be performed by the Authority to evaluate anticipated finished water quality, impacts to existing system water supply quality, and impacts to current member government-specific water treatment practices and costs. This review shall include the presentation of an anticipated raw water operating schedule that defines for each individual Member Government the predominant raw water source, potential significant additional raw water sources, water quality parameters and anticipated levels, and frequency of significant water quality changes.

Table 3

Exhibit D Supplemental WQPs
Proposed Compliance and Action Levels

Parameter	Compliance Level (See Note 1)	Action Level (See Note 2)
Field Conductivity	850 mhos/cm (max-avg)	850 mhos/cm (max)
Field Temperature	35°C (max-avg)	35°C (max)
Total Alkalinity	40 mg/L as $CaCO_3$ (min-avg)	40 mg/L as $CaCO_3$(min)
Total Sulfide	0.1 mg/L (max-avg)	0.1 mg/L (max)
Total Hardness	300 mg/L as $CaCO_3$ (max-avg)	300 mg/L as $CaCO_3$ (max)
Calcium Hardness	50 mg/L as $CaCO_3$ (min-avg) and 250 mg/l as $CaCO_3$ (max-avg)	50 mg/L as $CaCO_3$ (min) or 250 mg/L as $CaCO_3$ (max)
Color	15 CU	15 CU (max)
TOC	3.6 mg/L (max-avg)/6.5 mg/L (max)	3.6 mg/L (max)
Iron	0.15 mg/L (max-avg)	0.15 mg/L (max)
Turbidity	1 NTU (max-avg)	1 NTU (max)
Odor	2 TON (max-avg) / 3 TON (max)	2 TON (max)
Fluoride	0.8 mg/L (max-avg)	0.8 mg/L (max)
pH	7.4 units (min-avg)	7.4 units (min)
Nitrite	1 mg/L as N (max-avg)	1 mg/L as N (max)
Nitrate	10 mg/L as N (max-avg)	10 mg/L as N (max)
TDS	500 mg/L (max-avg)	500 mg/L (max)
Ammonia	1 mg/L as N (max-avg)	1 mg/L as N (max)
Total Phosphorus	1 mg/L (max-avg)	1 mg/L (max)
Orthophosphate	1 mg/L as P (max-avg)	1 mg/L as P (max)

Notes:

1 Compliance Notes
(max-avg) = a not-to-exceed average value using a running four quarterly sample average
(min-avg) = a must-exceed average value using a running four quarterly sample average
(max) = a not-to-exceed value
(min) = a must-exceed value
NA = compliance level has not been set

2 Action Level Notes
(max) = a value that, if exceeded, requires the Authority to take certain actions
(min) = a value that, if not exceeded, requires the Authority to take certain actions
NA = action level has not been set

ORIGINAL #80

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Docket No. 010503-WU
Exhibit VAK-27
Page 1 of 3

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March 29, 2004
VIA HAND DELIVERY

Rosanne Gervasi, Esquire
Legal Division
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850

Re: Aloha Utilities, Inc.; PSC Docket No. 020896
Our File No. 26038.37

Dear Rosanne:

Thank you and the staff for allowing us the additional time that Aloha needed in order to review the questions posed by the staff and to investigate with vendors and suppliers the various alternatives proposed in Dr. Levine's report. As you know, our engineers also had numerous discussions with Dr. Levine in order to get clarifications of her proposals and her comments and suggestions. Her input has been fully incorporated into our responses.

I am attaching hereto the responses to the staff questions, both on the responses and the cost estimates, the summary of estimates for both capital and operational costs prepared by David Porter, and our rough calculation of the rate impact each of the alternatives would have. Keep in mind that there are many assumptions underlying both David's analysis and the rate impact analysis. We have tried to detail the major assumptions within this information and within David's responses to each of your specific numbered inquiries, but there are always so many assumptions underlying a conceptual estimate such as this before design or permitting is undertaken, that we cannot begin to explain each of those underlying assumptions. However, we do believe that the attached is a good conceptual response and analysis of each of the options outlined in Dr. Levine's reports and our understanding of her recommendations as further clarified through our subsequent discussions with her and

with the various vendors of material, supplies and equipment related to those options.

If the Commission staff intends to utilize any of the information from this report and distribute it at the customer service hearing, we caution you to make sure that its conceptual nature is clearly noted and the major assumptions underlying it are also included.

If you have any further questions in this regard, please do not hesitate to contact me.

Sincerely,

ROSE, SUNDSTROM & BENTLEY, LLP

E. Marshall Deterding
For The Firm

FMD\tms
cc: Marshall Willis, CPA
Mr. Tom Walden
Stephen Watford, President
David Porter, P.E.

Docket 020896-WS
PSC Letter Dated February 20, 2004
Staff Data Request
Data Submission by Aloha Utilities, Inc.

Due to time constraints, the cost data was developed based on limited data and, therefore, must be considered conceptual in nature. This cost analysis provides a means of comparing the treatment alternatives based on similar design assumptions. More accurate cost information will result from discussing regulatory requirements with the FDEP as the project design work is undertaken.

It has been assumed when preparing these estimates that the PSC Commissioners would revise their Order in Docket 010503-WU to require Aloha to produce a finished water that is consistent with hydrogen sulfide performance standards required by Tampa Bay Water, i.e. that the average concentration of hydrogen sulfide is no more than 0.1 mg/L based on an annual average of 4 quarterly samples collected at the point of entry into the distribution system at each water plant. This limitation is consistent with the goals of Tampa Bay Water which supplies water to numerous water systems in this region as Dr. Levine discusses in her Water Audit Report.

We have assumed that the FDEP required conversion of Aloha's existing water plants from free chlorine disinfection to the sequential use of free chlorine followed by chloramine disinfection to make Aloha's water compatible with Tampa Bay Water/Pasco County water would be required to be completed by January 2005. It is important to note that this date represents a slip from an October 2004 target conversion date provided to Aloha Utilities several months ago by Pasco County. The revised date was only recently provided to Aloha by Pasco County. Therefore, the January 2005 conversion date has been assumed for the purposes of developing the responses herein. As Aloha has discussed with the Staff and the Commission previously, Aloha must convert its water treatment systems to chloramine disinfection by January 2005 to allow its water to be compatible with water supplied by Pasco County (Tampa Bay Water). Therefore, any process chosen for the hydrogen sulfide treatment step must be able to be implemented by January 2005 also.

Each of the options presented, and the related cost data, include the addition of treatment technology to produce a finished water with an average hydrogen sulfide concentration of 0.1 mg/L as described above and to implement the change from free gaseous chlorine disinfection to the use of liquid chlorine (sodium hypochlorite) as a primary disinfectant followed by chloramine as a secondary disinfectant which will be required to be completed as part of the modification of the plants.

Each of the treatment technologies Dr. Levine recommended in her report are capable of reducing the hydrogen sulfide concentration of Aloha's raw water to very low levels. We agree with Dr. Levine that when the hydrogen sulfide concentration of the finished water is reduced, and the other benefits provided by her recommended processes are realized, the potential for water odor and/or color generation in our customer's homes may be reduced.

When developing our response, we felt that it was necessary to consult with Dr. Levine to obtain her council on our application of her recommendations and to insure that our interpretation of her recommendations and our application of them was correct. We have provided her with draft cost estimation documents and draft answers to your questions as we were developing them to allow her to critique our work and to obtain her input. Based on our conversations with Dr. Levine she supports our positions as reported here.

1. Dr. Levine's report presents an excellent overview of each of these technologies, therefore, we will not repeat that information here. Below, we provide our view of what advantages and disadvantages each of the processes proposed by Dr. Levine exhibit in Aloha's opinion: