



# Public Health Assessment for

MAUNABO URBANO PUBLIC WELLS  
MAUNABO, PUERTO RICO  
EPA FACILITY ID: PRN000205831  
JANUARY 30, 2009

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
PUBLIC HEALTH SERVICE**

Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

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Prepared by:

Site and Radiological Assessment Branch  
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## Table of Contents

Summary .....	1
Background.....	1
Site Description and History.....	1
Figure 1 Location of Maunabo Municipal Wells.....	3
Figure 2 Maunabo Municipal Well #1.....	4
Figure 3 Maunabo Municipal Well #1 Filter Bank.....	4
Figure 4 Maunabo Municipal Well #2.....	5
Figure 5 Maunabo Municipal Well #3.....	5
Figure 6 Maunabo Municipal Well #4.....	6
Site Visit .....	6
Figure 7 View from road Overlooking Maunabo, Puerto Rico .....	7
Demographics, Land Use, and Natural Resource Use.....	7
Figure 8 Town of Maunabo with Demographic Data.....	8
Community Health Concerns.....	8
Evaluation of Environmental Contamination and Potential Exposure Pathways.....	9
Introduction.....	9
How does ATSDR determine which exposure situations to evaluate?.....	9
Assessing Health Effects.....	9
Completed Exposure Pathways .....	10
Table 1 Maximum Contaminant concentrations in on-site wells .....	11
Public Health Implications.....	11
Past Exposures .....	11
Current Exposures.....	11
Community Health Concerns Evaluation .....	12
Child Health Considerations .....	12
Public Comments .....	13
Table 2 Responses to Public Comments.....	13
Conclusions.....	14
Recommendations.....	15
Public Health Action Plan.....	15
Author .....	15
Reviewers of Report .....	15
Reference .....	16

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## List of Figures

Figure 1	Location of Maunabo Municipal Wells.....	3
Figure 2	Maunabo Municipal Well #1 .....	4
Figure 3	Maunabo Municipal Well #1 Filter Bank.....	4
Figure 4	Maunabo Municipal Well #2.....	5
Figure 5	Maunabo Municipal Well #3.....	5
Figure 6	Maunabo Municipal Well #4.....	6
Figure 7	View from road Overlooking Maunabo, Puerto Rico .....	7
Figure 8	Town of Maunabo with Demographic Data.....	8

## Summary

The Agency for Toxic Substances and Disease Registry (ATSDR) has prepared this public health assessment to evaluate the potential for contaminants at the Maunabo Urbano Public Wells, located in Maunabo, Puerto Rico, to harm people who were served by the public water system. By reviewing existing data, ATSDR determined that groundwater at the site is contaminated with trichloroethylene<sup>3</sup> (TCE), tetrachloroethylene<sup>4</sup> (PCE) and 1,2 dichloroethene<sup>6</sup> (DCE). ATSDR has determined that the Maunabo Urbano Public Wells pose no apparent public health hazard, based on its evaluation. This means that ATSDR has determined that even though the concentration of PCE exceeded EPA's Maximum Contaminant Level (MCL), the concentration was not sufficient to cause adverse health effects to members of the public including small children and pregnant women.

## Background

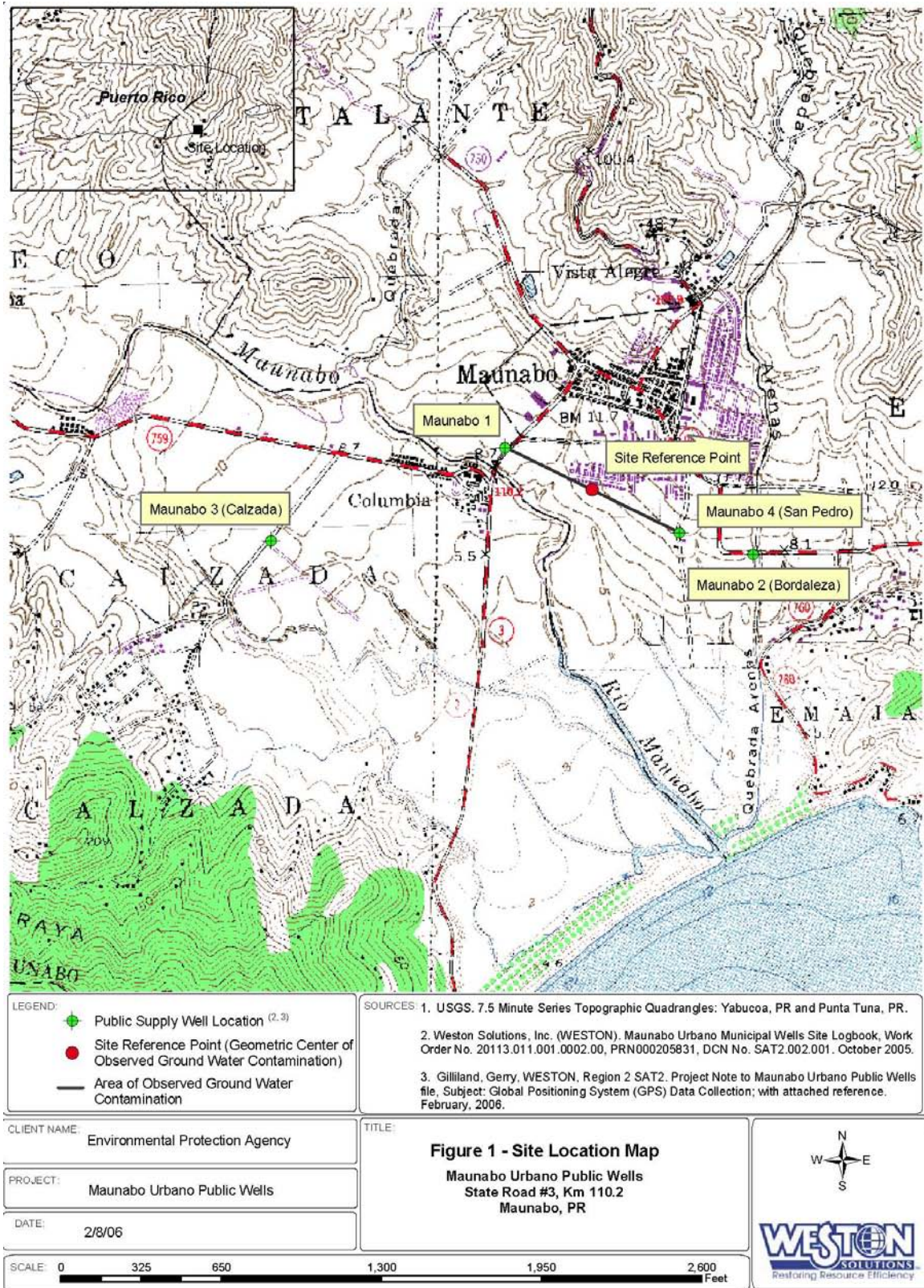
### Site Description and History

The Maunabo Urbano Public Wells were first listed on the National Priorities List (Superfund) list on April 19, 2006. The Maunabo Urbano Public Wells site consists of a TCE ground water plume with no identified source(s) of contamination. It is located in the municipality of Maunabo, Puerto Rico, on the southeastern corner of the island. The EPA is currently conducting work to better define the nature and extent of the contamination, but has not been able to identify either the source of contamination or the extent of the plume.

The Maunabo Urbano public water system consists of four ground water wells: Maunabo 1, Maunabo 2 (Bordaleza), Maunabo 3 (Calzada), and Maunabo 4 (San Pedro), locations are shown in Figure 1. Maunabo 1 went into service in 2001, while the other wells were in service prior to that time. Ground water samples collected by the system's operator, the Puerto Rico Aqueduct and Sewer Authority (PRASA), indicate that chlorinated solvents have been detected in Maunabo 1 since March 2002. At that time, the Puerto Rico Department of Health ordered PRASA to close the well because the concentration of one of the solvents exceeded the federal Maximum Contaminant Level (MCL). However, PRASA opted to treat the ground water with an activated carbon filtration tank at the wellhead rather than close the well in order to meet water supply needs. Since then, the detections of solvents in raw ground water samples from Maunabo 1 have exceeded the MCL on numerous occasions. Samples taken after treatment, including tap water samples collected along the distribution system down-line from Maunabo 1, indicate that the treatment was not effective. EPA had provided an alternate source of water, until the new three stage filter was installed. In the future, PRASA plans to replace the well system with a surface water reservoir to accommodate the expected population growth.

The contaminants of concern are industrial solvents, including trichloroethylene<sup>3</sup> (TCE), tetrachloroethylene<sup>4</sup> (PCE) and cis-1,2-dichloroethene<sup>6</sup> (DCE). Of these, PCE has been reported to have been above federal MCLs in drinking water supplies. Ground water and distribution water samples collected by EPA in October 2005 confirmed the presence of PCE and cis-1,2-DCE in Maunabo 1 and in post-treatment samples along the distribution line. These most recent results also indicate the presence of a related compound, 1,1-DCE, in Maunabo 4, which may indicate the spreading of contamination. Since early

2007, PRASA has installed a new three stage activated charcoal filter system at well #1 (see Figure 3). . In the future, PRASA plans to replace the well system with a surface water reservoir to accommodate the expected population growth, which will not be affected by remnants of the groundwater plume.



**Figure 1** Location of Maunabo Municipal Wells





**Figure 2** Maunabo Municipal Well #1



**Figure 3** Maunabo Municipal Well #1 Filter Bank



**Figure 4 Maunabo Municipal Well #2**



**Figure 5 Maunabo Municipal Well #3**



**Figure 6 Maunabo Municipal Well #4**

### **Site Visit**

In May 2007, representatives from ATSDR traveled to Puerto Rico to meet with representatives from Maunabo, local officials, state and federal regulators, and members of the public. Representatives from PRASA who had originally scheduled to meet with ATSDR, cancelled and declined to discuss issues surrounding the well contamination or the filter bank.

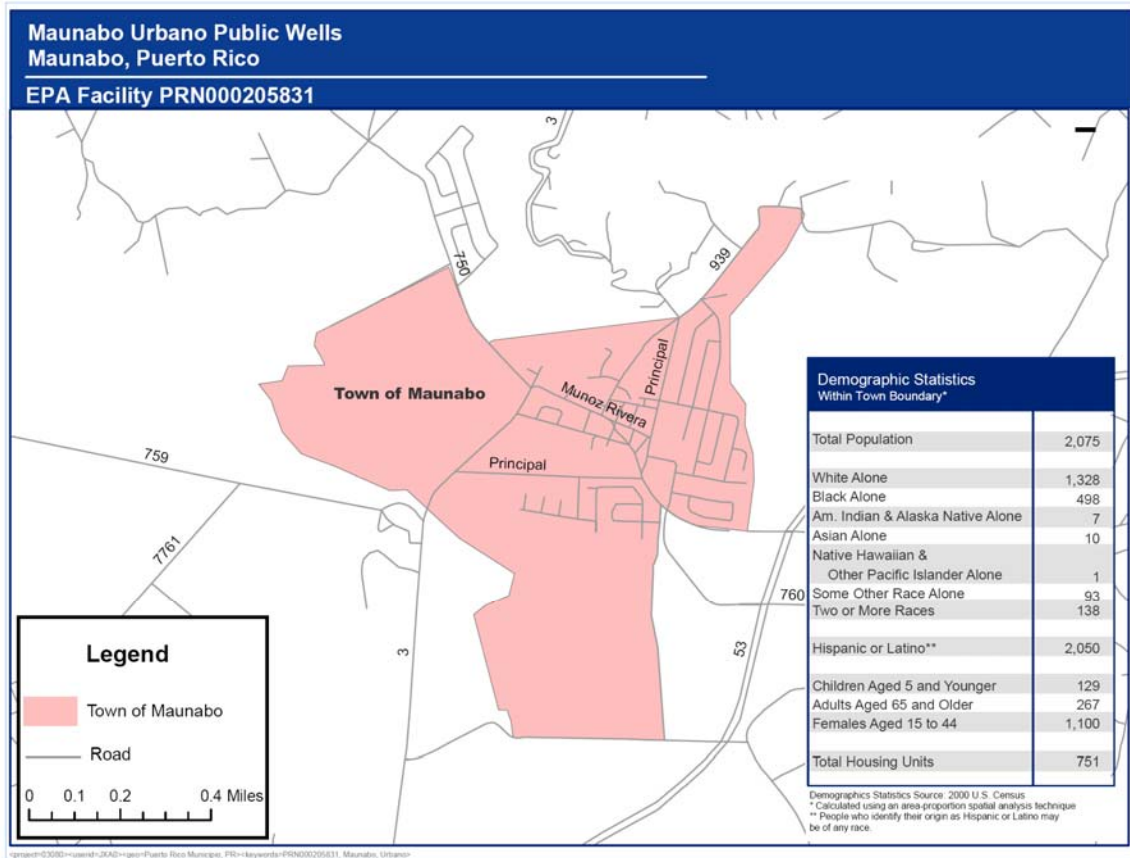


**Figure 7 View from road Overlooking Maunabo, Puerto Rico**

### **Demographics, Land Use, and Natural Resource Use**

The Maunabo Urbano water system serves a total population of approximately 14,000 people apportioned equally among the four public supply wells, which are mixed prior to distribution. Therefore, the contaminated wells in this system, Maunabo 1 and 4, serve all 14,000 people.

Figure 8 shows a demographic breakdown of the town.



**Figure 8 Town of Maunabo with Demographic Data**

### Community Health Concerns

ATSDR was not able to identify any concern among members of the Maunabo community. There seems to be little concern from members of the community served by the affected wells.

# Evaluation of Environmental Contamination and Potential Exposure Pathways

## Introduction

ATSDR's public health assessment process emphasizes the importance of exposure pathways, or the different ways that people can come in contact with environmental contaminants. The release of a chemical into the environment does not always result in human exposure. Human exposure to a substance depends on whether a person comes in contact with the environmental contaminant, for example by breathing, eating, drinking, or touching a substance containing it. If an individual does not come in contact with a contaminant, then exposure and resulting health effects cannot occur (see Figure 9). Furthermore, the release of a contaminant from a site does not always mean that the substance will have a negative impact on the health of a member of the off-site community. However, even if the site is inaccessible to the general public, contaminants can move through the environment to locations where people could come into contact with them.

### *How does ATSDR determine which exposure situations to evaluate?*

ATSDR scientists evaluate site conditions to determine if people could have been or could be exposed to site-related contaminants. ATSDR identifies whether exposure to a contaminated medium (soil, water, air, or food) has occurred, is occurring, or may occur through ingestion, dermal (skin) contact, or inhalation when evaluating exposure pathways. An exposure pathway could involve air, surface water, groundwater, soil, dust, or even plants and animals. ATSDR identifies an exposure pathway as completed or potential, or eliminates the pathway from further evaluation. Completed exposure pathways exist if all the elements of a human exposure pathway are present. A potential exposure pathway exists when one or more of the elements are missing but available information indicates possible human exposure. An incomplete exposure pathway exists when one or more of the elements are missing and available information indicates that human exposure is unlikely to occur<sup>1</sup>.

#### **Elements of an Exposure Pathway**

- 1.) The *source* is the place where the chemical is released.
- 2.) The *environmental medium* (such as groundwater, soil, surface water, or air) transports the contaminants.
- 3.) The *point of exposure* is the place where people come into contact with the contaminated medium.
- 4.) The *route of exposure* (for example, ingestion, inhalation, or dermal contact) is the way the contaminant enters the body.
- 5.) The *receptor population* is a population that is potentially exposed to contaminants at an exposure point.

### *Assessing Health Effects*

As previously noted, this assessment is focused on human exposure to groundwater via public water supplies. Exposure does not always result in harmful health effects. The type and severity of health effects that a person can experience depend on the dose, which is based on age at exposure, the exposure rate (how much), the frequency and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of contaminants). Once a person is exposed, characteristics such as his or her age, gender, nutritional status, genetics, lifestyle, and health status influence how he

or she absorbs, distributes, metabolizes, and excretes the contaminant. The likelihood that adverse health outcomes will actually occur depends on site-specific conditions, individual lifestyle, and genetic factors that may affect the route, magnitude, and duration of actual exposure.

More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual at <http://www.atsdr.cdc.gov/HAC/HAGM/> or by contacting ATSDR at 1-888-CDC-INFO. An interactive program that provides an overview of the process ATSDR uses to evaluate whether people will be harmed by hazardous materials is available at <http://www.atsdr.cdc.gov/training/public-health-assessment-overview/html/index.html>.

### **Completed Exposure Pathways**

This public health assessment focuses on exposures to volatile organic compound releases to the environment by way of groundwater. As stated earlier in this section, exposure pathways are complete when contaminants are traceable through the five elements comprising an exposure pathway.

The Maunabo Urbano Public Wells site is thought to consist of TCE in a ground water plume with no identified source(s) of contamination. Ground water and distribution water samples collected by EPA in October 2005 confirm the presence of PCE<sup>4</sup> and cis-1,2-DCE<sup>6</sup> in Maunabo 1 and in post-treatment samples along the distribution line, but not TCE. These most recent results also indicate the presence of a related compound, 1,1-DCE<sup>5</sup>, in Maunabo 4, which may indicate the spreading of contamination. In early 2007, PRASA installed a new three stage activated charcoal filter system at well #1 (see Figure 3).

Environmental sampling and analyses of groundwater indicated the presence of PCE and DCE in the groundwater at the Maunabo 1<sup>2</sup>. The most recent samples taken by EPA in 2005, did not exceed EPA's Maximum Contaminant Levels (MCLs) for any of the substances measured; however, PRASA has reported maximum concentrations of PCE, and 1,2-DCE detected in Maunabo 1 from 2002 to 2004 were 16.4 micrograms per liter ( $\mu\text{g/L}$ ) and 4.3  $\mu\text{g/L}$ , respectively<sup>2</sup>.

People who drank water from the Maunabo municipal water system between 2002 and 2004 were exposed to PCE and DCE. Children typically drink two to four eight-ounce glasses of tap water daily, while adults drink about six eight-ounce glasses of tap water daily.

In addition to this oral exposure from drinking water, people were also exposed to PCE and DCE by inhalation and through skin contact when they shower or bathe in municipal water for these three years. While showering, PCE and DCE will evaporate from the water to bathroom air and people will have brief exposures from breathing the air. Small amounts of PCE and DCE will also be absorbed through the skin when showering or bathing.

**Table 1 Maximum Contaminant concentrations in on-site wells**

Well Number	1,1-DCE <sup>5</sup>	cis-1,2-DCE <sup>6</sup>	PCE <sup>4</sup>	TCE <sup>3</sup>
Maunabo 1	ND	4.3	16.4	0.54
Maunabo 2	ND	ND	ND	ND
Maunabo 3	ND	ND	ND	ND
Maunabo 4	0.59	ND	ND	ND
Comparison Values				
EMEG child <sup>†</sup>	90	3,000	100	2,000
MCL <sup>‡</sup>	7	70	5	5

\*values expressed as micrograms per liter; data from the EPA Hazard Ranking System (HRS) report Feb. 2006.

<sup>†</sup>EMEG – ATSDR non-enforceable Environmental Media Exposure Guideline (in this case from chronic childhood exposures)<sup>3, 4, 5, 6</sup>

<sup>‡</sup>MCL – maximum contaminant level, a legally enforceable concentration of contaminants in drinking water.

## Public Health Implications

### *Past Exposures*

Municipal water data shows that water supplied to residents of Maunabo was periodically contaminated from 2002 to 2004. It is reasonable to assume that people drank and showered in that water, so they were exposed to contamination. The question is, were they exposed at levels that could cause harmful effects. ATSDR's chronic oral Minimal Risk Level (MRL) for 1,1-DCE<sup>5</sup> is 9 µg/kg/day, and for a 50 kg adult that drank 6 glasses of tap water, their daily dose would have been 0.26 µg/kg/day, which is less than ATSDR's MRL. ATSDR's MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. Cis-1,2-dichloroethene<sup>6</sup> and PCE<sup>4</sup> do not have chronic MRLs, and the doses are orders of magnitude below acute MRLs; therefore, non-cancerous health effects are not likely.

### *Current Exposures*

The evaluation performed by ATSDR at the Maunabo Urbano Public Wells site was not able to verify that water treatment was adequate. Current exposures to PCE and DCE appear to be at levels that would be safe for small children based on the analysis in the following section, Child Health Considerations. PRASA did not verify that the filters installed in 2007 at Maunabo #1 were effective. In 2006, prior to the installation of the new filter bank, EPA did not detect elevated levels of TCE, PCE or DCE in drinking water. Given that the most recent samples have been below EPA's MCLs for DCE and PCE, Maunabo municipal water supplies appear to be safe for drinking, showering and bathing.



***Community Health Concerns Evaluation***

Members of the community in Maunabo did not express any concerns about water quality to ATSDR. We were expressly told that water quality was not perceived as a problem.

**Child Health Considerations**

In communities faced with water contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. A child's higher intake rate relative to the child's lower body weight results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health. Even though PCE has intermittently exceeded the MCL of 5 µg/L, it has not exceeded ATSDR's chronic environmental media exposure guidelines (EMEGs) for small children of 100 µg/L. EMEGs are media-specific comparison values used to select chemical contaminants of potential concern at hazardous waste sites. In this case, the most conservative value was selected for chronic exposure (i.e., long term) by small children, since infants would not remain an infant over one year. Estimated doses for small children did not exceed ATSDR's chronic, intermediate or acute MRLs. ATSDR has determined that current exposure to PCE and DCE were at concentrations that would be safe for small children.

## Public Comments

**Table 2 Responses to Public Comments**

#	Comment	Page	ATSDR Response
1	Please verify that alternate water is still being provided following the installation of the new three stage carbon filter system in 2007.	Page 1	PHA states that alternate water was (i.e., past tense) supplied until the new filters were installed.
2	The most recent samples collected by EPA were in 2005, not 2006. Also, TCE was detected in the post-treatment samples at a concentration of 0.54 ug/L during the 2005 sampling event.	Page 9, fourth paragraph	Corrected date. TCE was an order of magnitude below the MCL of 5 ppb, so it was not discussed.
3	Low levels of TCE were also detected in the municipal water system between 2002 and 2004. This should be discussed here.	Page 9, fifth paragraph	TCE levels were not approaching any level of health concern. No change.
4	MRL should be defined here as, "An estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancerous health effects over a specified duration of exposure."	Page 10, first paragraph	Added suggested language.
5	The sentence, "Current exposures to PCE and DCE appear to be at levels that would be safe for small children," is not supported. It should be revised to say, "Current exposures to PCE and DCE appear to be at levels that would be safe for small children based on the analysis in the following section, Child Health Considerations."	Page 10, second paragraph	Added suggested language.
6	The child's intake rate is not higher than the adult's. The intake rate is higher relative to the child's body weight. Please clarify. Also, please explain in more detail what the EMEG is, how it is developed, and specifically how it is protective of children. Additionally, an explanation of how is an EMEG different from the MRL would be helpful.	Page 11	Added the following language: "EMEGs are media-specific comparison values used to select chemical contaminants of potential concern at hazardous waste sites. In this case, the most conservative value was selected for chronic exposure (i.e., long term) by small children, since infants would not remain an infant over one year."

## Conclusions

ATSDR has evaluated the volatile organic compounds PCE and DCE in the Maunabo Urbano Public Wells and the community of Maunabo, Puerto Rico which is served by this water system. The source(s) of these volatile organic compounds are unknown.

Current conditions related to the groundwater indicate that the groundwater is the primary source of drinking water for this community through the municipal water system maintained and run by PRASA.

Using the protocols developed by ATSDR to evaluate pathways of exposure to populations around potentially contaminated or contaminated sites, ATSDR concludes that:

1. Past Conditions – The Maunabo Urbano Public Wells have exceeded EPA’s MCLs for PCE and DCE in the past. However, exceedences were intermittent and did not exceed ATSDR’s health based comparison values.
2. Current – ATSDR considers this site to be no apparent public health hazard. This designation means that although people may have been exposed to PCE and DCE, the exposure concentrations were at levels that would not result in any adverse health effects, and that concentrations have been dropping even before installation of the filters.
3. Future – In the future, PRASA plans to replace the well system with a surface water reservoir to accommodate the expected population growth, which would prevent any further contamination from the unidentified groundwater source.
4. Even though a new filter bank has been installed to remove volatile organic compounds, there has been no validation data provided by PRASA to ensure the filters are working as planned.

## **Recommendations**

ATSDR has evaluated the issues associated with the organic contaminants associated with the Maunabo Urbano Public Wells. Based on concerns received by ATSDR, the following recommendations are made:

1. EPA and PRASA should regularly monitor water quality downstream of the filters on Maunabo #1.
2. PRASA should perform the regular maintenance on the filter bank on Maunabo #1, to ensure there is no VOC breakthrough, until the surface water reservoir comes on line.

## **Public Health Action Plan**

1. ATSDR will review and evaluate new data received from USEPA/PRASA or any other source and update our assessment, as necessary.
2. If the information changes the conclusions of our evaluation, we will update this public health assessment accordingly.

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## Reference

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- <sup>1</sup> ATSDR (2005) Public health assessment guidance manual (Update). Atlanta: U.S. Department Of Health and Human Services. Available at: <http://www.atsdr.cdc.gov/HAC/PHAManual/index.html>. Last accessed 29 October 2007.
- <sup>2</sup> EPA (2006). EPA Hazard Ranking System (HRS) Form for Maunabo Urbano Public Wells CERCLIS Site PRN000205831, February 2006.
- <sup>3</sup> ATSDR (1998). Toxicological Profile for Trichloroethylene (TCE). Agency for Toxic Substances and Disease Registry, Atlanta GA, September 1998.
- <sup>4</sup> ATSDR (1997). Toxicological Profile for Tetrachloroethylene (PCE). Agency for Toxic Substances and Disease Registry, Atlanta GA, September 1997.
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- <sup>6</sup> ATSDR (1996). Toxicological Profile for 1,2-Dichloroethene (1,2-DCE). Agency for Toxic Substances and Disease Registry, Atlanta GA, August 1996.