HRS DOCUMENTATION RECORD--REVIEW COVER SHEET

Name of Site: Maunabo Urbano Public Wells

Date Prepared: March 2006

Contact Persons

Site Investigations: Denise Zeno (212) 637-4319
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Pathways, Components, or Threats Not Scored

The Surface Water, Soil Exposure, and Air Pathways were not scored because no data were available on which to base these pathway scores. The site score is sufficient to list the site on the Ground Water Pathway score.

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HRS DOCUMENTATION RECORD

Name of Site: Maunabo Urbano Public Wells

CERCLIS ID No.: PRN000205831

EPA Region: 2 Date Prepared: March 2006

Street Address of Site:* State Road 3, Km 110.2

County and State: Maunabo, Puerto Rico 00707

General Location in the State: southeastern Puerto Rico

Topographic Map: Yabucoa, PR

Latitude:* 18° 00' 20.2" North Longitude:* 65° 54' 05.1" West

[Figure 1; Ref. 3, p. 1; 4, p. 1; 5, pp. 10, 12; 37, p. 1]

* The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, placed, or otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

Scores

Ground Water Pathway	100.00
Surface Water Pathway	Not Scored
Soil Exposure Pathway	Not Scored
Air Pathway	Not Scored
HRS SITE SCORE	50.00

WORKSHEET FOR COMPUTING HRS SITE SCORE
Maunabo Urbano Public Wells

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	100.00	10,000
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	Not Scored	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	Not Scored	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	Not Scored	
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	Not Scored	
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	Not Scored	
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$	10,000	
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root	50.00	

GROUND WATER MIGRATION PATHWAY SCORESHEET, Table 3-1
Maunabo Urbano Public Wells

GROUND WATER MIGRATION PATHWAY Factor Categories & Factors	MAXIMUM VALUE	VALUE ASSIGNED
Likelihood of Release to an Aquifer		
Aquifer: Maunabo Alluvial Valley aquifer		
1. Observed Release	550	550
2. Potential to Release		
2a. Containment	10	
2b. Net Precipitation	10	
2c. Depth to Aquifer	5	
2d. Travel Time	35	
2e. Potential to Release [lines 2a (2b+2c+2d)]	500	
3. Likelihood of Release (higher of lines 1 and 2e)	550	550
Waste Characteristics		
4. Toxicity/Mobility	*	100
5. Hazardous Waste Quantity	*	100
6. Waste Characteristics	100	10
Targets		
7. Nearest Well	50	50
8. Population		
8a. Level I Concentrations	**	34,970
8b. Level II Concentrations	**	3,497
8c. Potential Contamination	**	521
8d. Population (lines 8a+8b+8c)	**	38,988
9. Resources	5	0
10. Wellhead Protection Area	20	20
11. Targets (lines 7+8d+9+10)	**	39,058
12. Aquifer Score (lines 3x6x11 divided by 82,500)	100	100
13. Ground Water Migration Pathway Score (S_{gw})	100	100.00

* Maximum value applies to waste characteristics category.
** Maximum value not applicable.

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2.	EPA. Superfund Chemical Data Matrix, SCDM Data Versions: 1/27/2004, Appendices B-I (Hazardous Substances Factor Values), B-II (Hazardous Substances Benchmarks), and C (Synonyms); and 3/17/2004, Trichloroethylene (TCE) updates. January and March 2004. [59 pages]
3.	EPA. Superfund Information Systems, CERCLIS Database, Maunabo Urbano Public Wells: Site Information. From http://www.epa.gov/superfund. December 12, 2005 [1 page]
4.	U.S. Department of the Interior Geological Survey (USGS). Yabucoa Quadrangle, Puerto Rico, 7.5-Minute Series (Topographic). 1982. [1 page]
5.	Gilliland, Gerry, Weston Solutions, Inc. (Weston). Latitude and Longitude Coordinates Worksheet, Maunabo Urbano Public Wells, Maunabo, PR. February 10, 2006. [12 pages]
6.	Puerto Rico Aqueduct and Sewer Authority (PRASA). Water Quality Reports, System: Maunabo Urbano, PWS ID: 4815, Years: 1998-2004. From http://www.acueductospr.com. December 12, 2005. [60 pages]
7.	PRASA. Map: Active and Standby Wells of Puerto Rico. October 27, 2005. [1 page]
8.	Gilliland, Gerry, Weston. Project Note to Maunabo Urbano Public Wells site file, Subject: Attached Analytical Data, Maunabo Well 1; with attached data sheets. December 12, 2005. [258 pages]
9.	Gilliland, Gerry, Weston. Project Note to Maunabo Urbano Public Wells site file, Subject: Attached Analytical Data, Maunabo Wells 2, 3, and 4; with attached data sheets. December 12, 2005. [33 pages]
10.	Gilliland, Gerry, Weston. Project Note to Maunabo Urbano Public Wells site file, Subject: Attached Analytical Data, Maunabo Water System Distribution Samples; with attached data sheets. December 12, 2005. [941 pages]
11.	Zeno, Denise, EPA. Email Message to Scott Snyder, Subject: Maunabo Wells - Analytical Data for Well #1; with attachments. October 3, 2005. [5 pages]
12.	Rivera, Olga I., Puerto Rico Department of health (PRDOH). Letter to Irma Lopez, PRASA, Re: Maunabo - Maunabo Well 1 Treatment Installed for Removal of VOCs, PWSID 4815. September 7, 2004. [3 pages]
13.	Snyder, Scott, Weston. Maunabo Urbano Municipal Wells Site Logbook, Work Order No. 20113.011.001.0002.00, PRN000205831, DCN No. SAT2.002.001. October 2005. [67 pages]
14.	Gilliland, Gerald V., Weston. Letter to Denise Zeno, EPA, Subject: [Attached] Sampling Trip Report, Work Assignment No. 002, Maunabo Urbano Municipal Wells PA/SI, Contract No. EP-W-05-048. November 3, 2005. [14 pages]
15.	EPA Hazardous Waste Support Section. Record of Communication and attached CLP Data Assessment, Subject: CLP [Organic] Data Package for Quality Assurance Review, Site: Maunabo Urbano Municipal, Case #: 34787. November 2005. [145 pages]

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17.	Roman-Mas, Angel, USGS. Atlas of Ground-Water Resources in Puerto Rico and the U.S. Virgin Islands, Section 2.4.1: Naguabo-Maunabo Region (pp. 97-104). Water Resources Investigations Report 94-4198. Prepared in cooperation with EPA. 1996. [10 pages]
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20.	PRASA. Well System Report, Region: Guayama; excerpts. October 20, 1986. [4 pages]
21.	USGS. Ground-water Site Inventory for Puerto Rico, Site type = Spring, Ground Water, County = Maunabo. From http://waterdata.usgs.gov/pr/nwis. November 23, 2005. [6 pages]
22.	Gilliland, G., Weston. Table: Well Specifications, Maunabo Urbano Public Wells, Maunabo, Puerto Rico. February 2006. [2 pages]
23.	Gilliland, Gerry, Weston. Project Note to Maunabo Urbano Public Wells site file, Subject: Calculation of Hydraulic Conductivity, Maunabo alluvial deposits. December 9, 2005. [1 page]
24.	EPA. Safe Drinking Water Information System (SDWIS), List of Water Systems in SDWIS, State: Puerto Rico, County: Maunabo. From http://oaspub.epa.gov/enviro. December 12, 2005. [1 page]
25.	Molina-Rivera, Wanda L., USGS. Estimated Water Use in Puerto Rico, 1995. Open-File Report 98-276. Prepared in cooperation with PRASA, Puerto Rico Department of Natural and Environmental Resources (PRDNER), and Puerto Rico Environmental Quality Board (PREQB). 1998. [35 pages]
26.	PREQB. Final Wellhead Protection Program. April 1991. [158 pages]
27.	EPA. Region 2 Water, Wellhead Protection Program. From http://www.epa.gov/region02/water/whp.htm. December 31, 2003. [1 page]
28.	Environmental Data Resources Inc. (EDR). The EDR Radius Map with GeoCheck®, Maunabo Urbano Municipal Wells, State Road 3, Km 110.2, Maunabo, PR 00707, Inquiry number 1526949.1s. October 6, 2005. [40 pages]
29.	EPA Contract Laboratory Program. Statement of Work for Analysis of Low Concentration Organic, OLC03.2, Exhibit C: Target Compound List and Contract Required Quantitation Limits. December 2000. [13 pages]
30.	Lama Gattas, Rafael, PRASA. Letter to Gerald V. Gilliland, WESTON, Re: Maunabo Wells; with enclosure. January 4, 2006. [9 pages]

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Reference Number	Description of the Reference
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32.	McPhaul, John, Caribbean Business. Government took reins of water authority, faced strike. From Water Industry News, http://www.waterindustry.org/Water-Facts/puerto%20rico-4.htm. January 3, 2005. [2 pages]
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34.	Gilliland, Gerry, Weston. Phone Conversation Record of conversation with Oneida Santiago, PR Department of Health (PRDOH) Potable Water Program, Subject: Maunabo Urbano Water System (ID # PR0004815). February 13, 2006. [1 page]
35.	Gomez-Gomez, Fernando, USGS. Email Message with attachments to Gerald Gilliland, Weston, Subject: USGS information request: Maunabo Urbano Well (also included). February 17, 2006. [5 pages]
36.	Renken, Robert A. et al, USGS. Geology and Hydrogeology of the Caribbean Islands Aquifer System of the Commonwealth of Puerto Rico and the U.S. Virgin Islands. USGS Professional Paper 1419. 2002. [150 pages]
37.	Gilliland, Gerry, Weston. Project Note with attachment to Maunabo Urbano Public Wells site file, Subject: Collection of Global Positioning System (GPS) Data. February 8, 2006. [36 pages]
38.	Mello, Gilberto, Weston. Maunabo Urbano Municipal Wells Site Logbook, Work Order No. 20113.011.001.0002.00, PRN000205831, DCN No. SAT2.002.002. December 2005. [18 pages]
39.	Standowski, Jason, Weston. Maunabo Urbano Municipal Wells Site Logbook, Work Order No. 20113.011.001.0002.00, PRN000205831, DCN No. SAT2.002.003. December 2005. [6 pages]
40.	Snyder, Scott, Weston. Letter to Denise Zeno, EPA, Subject: [Attached] Sampling Trip Report – Investigation of Possible Sources, Work Assignment No. 002, Maunabo Urbano Municipal Wells, Contract No. EP-W-05-048. December 28, 2005. [37 pages]
41.	EPA Hazardous Waste Support Section. Record of Communication and attached CLP Data Assessment, Subject: CLP [Organic] Data Package for Quality Assurance Review, Site: Maunabo Urbano Municipal Wells, Case #: 34936. February 2006. [343 pages]

INTRODUCTION

The Maunabo Urbano Public Wells site (CERCLIS ID No. PRN000205831) consists of a ground water plume with no identified source(s) of contamination. It is located in the municipality of Maunabo, Puerto Rico [Ref. 3, p. 1]. The geographic coordinates of the site are 18° 00' 20.2" north latitude and 65° 54' 05.1" west longitude [Ref. 4, p. 1; 5, pp. 1, 2, 3, 10, 11, 12].

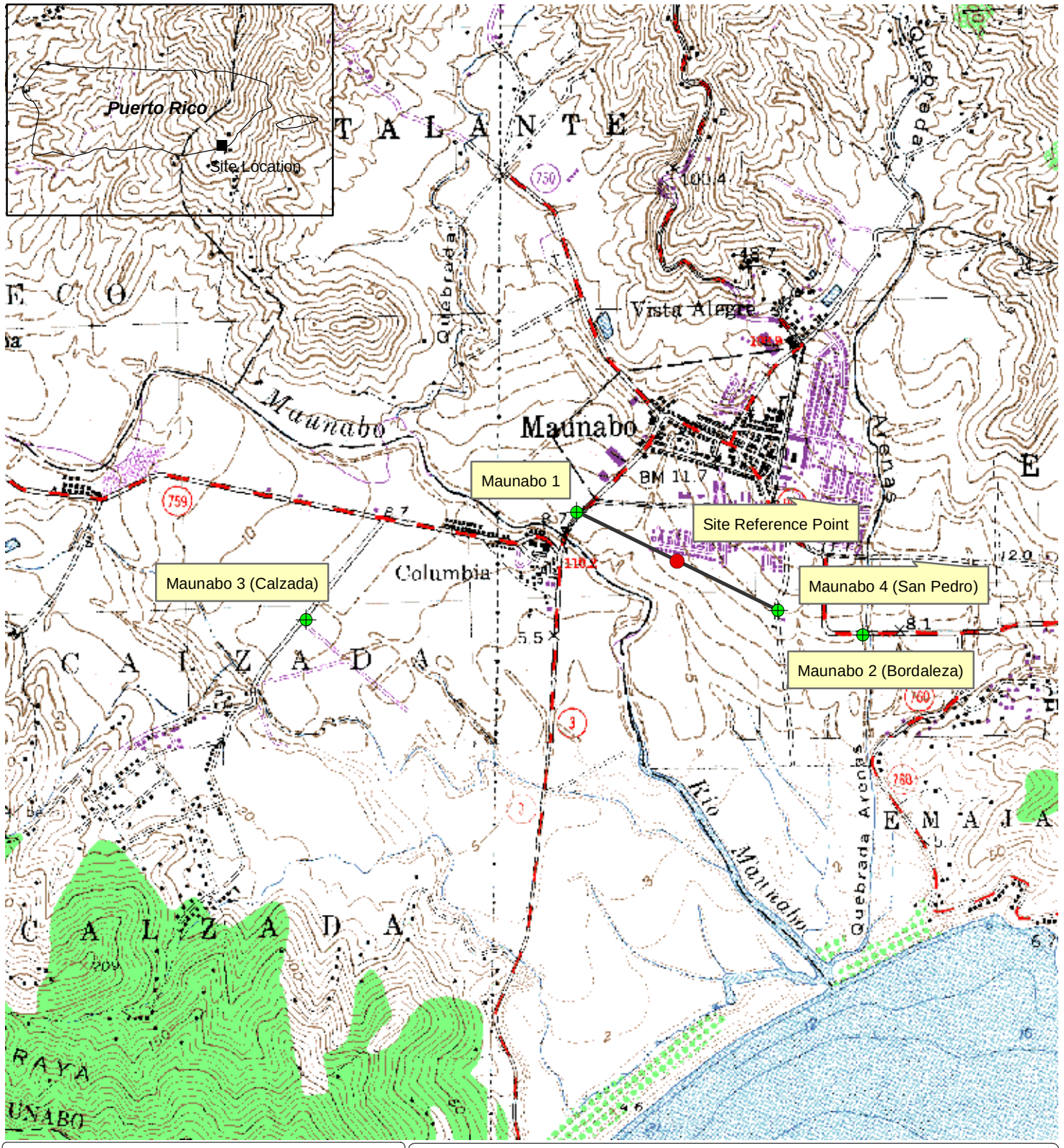
The Maunabo Urbano public water system (ID No. PR0004815) consists of four ground water wells: Maunabo 1, Maunabo 2 (Bordaleza), Maunabo 3 (Calzada), and Maunabo 4 (San Pedro). Maunabo 1 went into service in 2001, while the other wells were in service prior to that time [Ref. 6, pp. 1, 2, 10, 11, 18, 27, 36, 44, 53; 7, p. 1]. Ground water samples collected by the system's operator, Puerto Rico Aqueduct and Sewer Authority (PRASA), indicate that the chlorinated solvents tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,2-dichloroethylene (DCE) have been detected in Maunabo 1 since March 2002 [Ref. 8, pp. 3 through 22, 24, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 75, 77, 79, 81, 83, 85, 87, 91, 92, 95 through 111, 116 through 121, 123, 125, 126, 127, 129 through 132, 134, 135, 137, 141, 146, 154, 171, 172, 177, 179, 180, 181, 183, 185, 206, 214, 218, 222, 230, 238, 246, 254]. The maximum concentrations of PCE, TCE, and 1,2-DCE detected in Maunabo 1 from 2002 to 2004 were 16.4 micrograms per liter (µg/L), 1.6 µg/L, and 4.3 µg/L, respectively [Ref. 8, pp. 17, 21, 33, 39]. Another compound, 1,1-DCE, was detected in the well on a more intermittent basis [Ref. 8, pp. 6, 89, 93, 94, 95, 97, 187, 191]. Samples collected from Maunabo 2, Maunabo 3, and Maunabo 4 over the same time period indicate that chlorinated solvents were generally not present in those wells, with a few minor exceptions in 2004 [Ref. 9, pp. 2 through 7, 11 through 19, 23 through 33]. Tap water samples of distributed water show that the contaminants detected in Maunabo 1 entered the drinking water system at various times [Ref. 10, pp. 2 through 22, 24 through 41, 46, 49, 52, 53, 56 through 68, 70 through 78, 80, 85 through 89, 93, 95, 96, 116, 120, 127, 131, 132, 162, 163, 166, 167, 171, 175, 187, 194, 195, 218, 229, 230, 249, 264, 268 through 292, 303, 304, 305, 307, 308, 310 through 323, 325 through 334, 340, 341, 342, 344, 349, 350, 351, 370, 374, 378, 379, 383, 384, 385, 399, 415, 418, 422, 426, 431, 439, 446, 450, 454, 458, 465, 469, 477, 481, 485, 486, 488 through 505, 507, 508, 509, 520, 521, 524 through 537, 539, 540, 549, 555, 556, 557, 562, 569, 573, 579, 580, 583, 584, 594, 595, 597, 607, 608, 611, 613, 615, 620, 623, 624, 627, 628, 632, 636, 640, 644, 648, 652, 664, 672, 680, 683, 691, 695, 697 through 711, 713, 714, 715, 720, 726, 727, 728, 730 through 739, 742, 743, 753, 759, 761, 762, 770, 782, 790, 798, 799, 804, 807, 839, 842, 843, 846, 859, 867, 891, 895, 914, 925, 929, 933, 937, 941].

In March 2002, the Puerto Rico Department of Health (PRDOH) ordered PRASA to close the well because the PCE concentration exceeded the Maximum Contaminant Level (MCL) of 5 µg/L [Ref. 11, pp. 1, 5]. However, PRASA opted to treat the ground water with carbon filtration tanks at the wellhead rather than close the well [Ref. 11, p. 1; 12, pp. 1, 2; 13, pp. 4, 6, 7]. Since then, the detections of PCE in raw ground water samples from Maunabo 1 have exceeded the MCL on numerous occasions [Ref. 8, pp. 3 through 22, 24, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 119, 121, 127, 129, 131, 132, 134, 135, 137, 146, 154, 171, 177, 179, 181, 183, 185, 206, 218, 222, 230, 238, 254]. Post-treatment samples, including tap water samples collected along the distribution system down-line from Maunabo 1, indicate that the treatment has not always been effective and that contaminated drinking water is reaching the consumers in this system [Ref. 8, pp. 76, 78, 80, 82, 84, 86, 88, 90, 133, 136, 138, 170, 178, 182, 184, 186, 191, 210, 226, 234, 242, 250, 258; 10, pp. 2 through 22, 24 through 41, 46, 49, 52, 53, 56 through 68, 70 through 78, 80, 85 through 89, 93, 95, 96, 116, 120, 127, 131, 132, 162, 163, 166, 167, 171, 175, 187, 194, 195, 218, 229, 230, 249, 264, 268 through 292, 303, 304, 305, 307, 308, 310 through 323, 325 through 334, 340, 341, 342, 344, 349, 350, 351, 370, 374, 378, 379, 383, 384, 385, 399, 415, 418, 422, 426, 431, 439, 446, 450, 454, 458, 465, 469, 477, 481, 485, 486, 488 through 505, 507, 508, 509, 520, 521, 524 through 537, 539, 540, 549, 555, 556, 557, 562, 569, 573, 579, 580, 583, 584, 594, 595, 597, 607, 608, 611, 613, 615, 620, 623, 624, 627, 628, 632, 636, 640, 644, 648, 652, 664, 672, 680, 683, 691, 695, 697 through 711, 713, 714, 715, 720, 726, 727, 728, 730 through 739, 742, 743, 753, 759, 761, 762, 770, 782, 790, 798, 799, 804, 807, 839, 842, 843, 846, 859, 867, 891, 895, 914, 925, 929, 933, 937, 941]. During an inspection in August 2004, PRDOH observed that the treatment cylinders at Maunabo 1 lacked the necessary filter medium [Ref. 12, pp. 1, 3].

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 [Ref. 13, pp. 3 through 14; 14, pp. 4, 8, 10, 11, 12; 15, pp. 77, 78, 89, 90, 92, 93, 95, 96; 29, p. 9]. These most recent results also indicated the presence of 1,1-DCE in Maunabo 4 and an unrelated compound, methyl tert-butyl ether (MTBE), in Maunabo 1, as well as both compounds being detected in some distribution samples [Ref. 15, pp. 77, 86, 89, 92, 95, 98, 101; 29, p. 9]. Maunabo 2

and Maunabo 3 showed non-detect background concentrations for PCE, cis-1,2-DCE, 1,1-DCE, and MTBE [Ref. 15, pp. 80 through 84; 29, p. 9]. EPA validated the organics data for the October 2005 sampling event according to Standard Operating Procedure (SOP) HW-13 (Revision 3) July 2001, USEPA Region II Data Validation SOP for Statement of Work OLC03.2 [Ref. 15, pp. 2, 7 through 34]. MTBE was not used in scoring the Maunabo Urbano Public Wells site.

The Maunabo Urbano water system serves a total population of 13,988 people [Ref. 24, p. 1; 34, p. 1]; for the purposes of HRS scoring, this population is apportioned equally among the four public supply wells (i.e., 3,497 per well). Therefore, the contaminated wells in this system, Maunabo 1 and Maunabo 4, are apportioned a population of almost 7,000 people between them [Ref. 6, p. 53; 7, p. 1; 13, pp. 4, 8, 9; 22, p. 2; 24, p. 1]. Wellhead Protection Areas are delineated for the public supply wells, so the area of observed ground water contamination lies within a designated Wellhead Protection Area [Ref. 26, pp. 29 through 45; 27, p. 1].



LEGEND:

- Public Supply Well Location [2, 3]
- Site Reference Point (Geometric Center of Observed Ground Water Contamination)
- Area of Observed Ground Water Contamination

SOURCES:

1. USGS. 7.5 Minute Series Topographic Quadrangles: Yabucoa, PR and Punta Tuna, PR.
2. Weston Solutions, Inc. (WESTON). Maunabo Urbano Municipal Wells Site Logbook, Work Order No. 20113.011.001.0002.00, PRN000205831, DCN No. SAT2.002.001. October 2005.
3. Gilliland, Gerry, WESTON, Region 2 SAT2. Project Note to Maunabo Urbano Public Wells file, Subject: Global Positioning System (GPS) Data Collection; with attached reference. February, 2006.

CLIENT NAME: Environmental Protection Agency

PROJECT: Maunabo Urbano Public Wells

DATE: 2/8/06

TITLE:

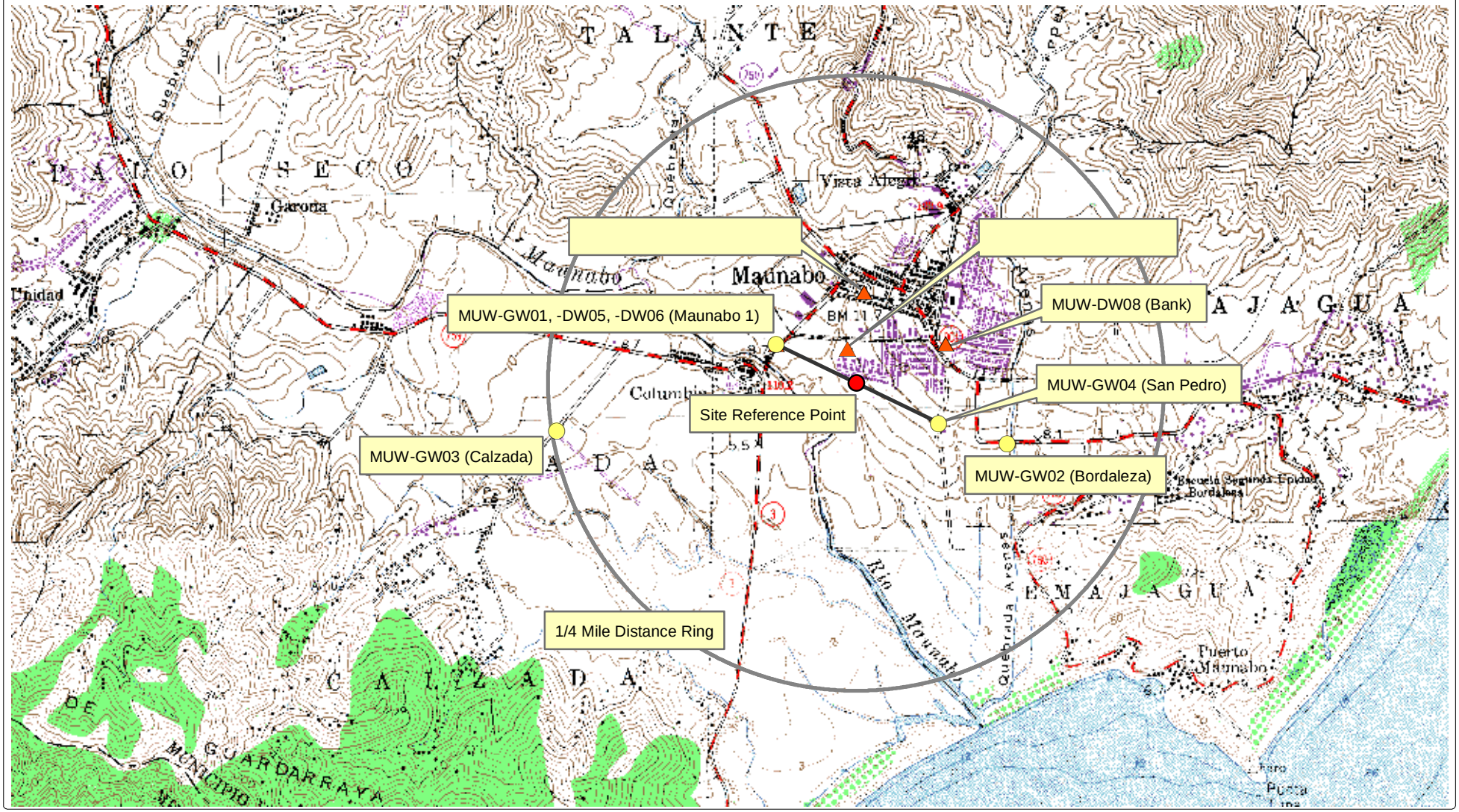
Figure 1 - Site Location Map

Maunabo Urbano Public Wells
State Road #3, Km 110.2
Maunabo, PR

N
W E
S

SCALE: 0 325 650 1,300 1,950 2,600 Feet

WESTON SOLUTIONS
Restoring Resource Efficiency



LEGEND:

- Distribution Water Samples (2,3)
- Ground Water Samples (2,3)
- Area of Observed Ground Water Contamination
- Site Reference Point (Geometric Center of Observed Ground Water Contamination)

N
W E
S

WESTON SOLUTIONS
Restoring Resource Efficiency

CLIENT NAME: Environmental Protection Agency

PROJECT: Maunabo Urbano Public Wells

DATE: 2/8/06

SCALE: 0 355 710 1,420 2,130 2,840 Feet

TITLE:

Figure 2 - Sample Location Map

Maunabo Urbano Public Wells
State Road #3, Km 110.2
Maunabo, PR

SOURCES:

1. USGS. 7.5 Minute Series Topographic Quadrangles: Yabucoa, PR and Punta Tuna, PR.

2. Weston Solutions, Inc. (WESTON). Maunabo Urbano Municipal Wells Site Logbook, Work Order No. 20113.011.001.0002.00, PRN000205831, DCN No. SAT2.002.001. October 2005.

3. Gilliland, Gerry, WESTON, Region 2 SAT2. Project Note to Maunabo Urbano Public Wells file, Subject: Global Positioning System (GPS) Data Collection; with attached reference. February, 2006.

SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

Number of the source: 1

Source Type: Other

Name and description of the source: Ground Water Plume - Maunabo, Puerto Rico

Source 1 is considered a contaminated ground water plume of unknown volume without an identified source. Ground water samples collected by PRASA indicate that PCE, TCE, and 1,2-DCE have been detected in public supply well Maunabo 1 since March 2002 [Ref. 8, pp. 3 through 22, 24, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 75, 77, 79, 81, 83, 85, 87, 91, 92, 95 through 111, 116 through 121, 123, 125, 126, 127, 129 through 132, 134, 135, 137, 141, 146, 154, 171, 172, 177, 179, 180, 181, 183, 185, 206, 214, 218, 222, 230, 238, 246, 254]. The maximum concentrations of PCE, TCE, and 1,2-DCE detected in Maunabo 1 from 2002 through 2004 were 16.4 micrograms per liter (µg/L), 1.6 µg/L, and 4.3 µg/L, respectively [Ref. 8, pp. 17, 21, 33, 39]. Another compound, 1,1-DCE, was detected in the well on a more intermittent basis [Ref. 8, pp. 6, 89, 93, 94, 95, 97, 187]. In March 2002, PRDOH ordered PRASA to close the well because the PCE concentration exceeded the MCL of 5 µg/L [Ref. 11, pp. 1, 5]. However, PRASA opted to treat the ground water with carbon filtration tanks at the wellhead rather than close the well [Ref. 11, p. 1; 12, pp. 1, 2; 13, pp. 4, 6, 7]. Since then, the detections of PCE in raw ground water samples from Maunabo 1 have exceeded the MCL on numerous occasions [Ref. 8, pp. 3 through 22, 24, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 119, 121, 127, 129, 131, 132, 134, 135, 137, 146, 154, 171, 177, 179, 181, 183, 185, 206, 218, 222, 230, 238, 254]. Samples collected from public supply wells Maunabo 2, Maunabo 3, and Maunabo 4 from 2002 to 2004 indicate that chlorinated solvents were generally not present in those wells, with a few minor exceptions in 2004 [Ref. 9, pp. 2 through 7, 11 through 19, 23 through 33].

Ground water sampling by EPA in October 2005 confirmed the presence of PCE and cis-1,2-DCE in Maunabo 1 [Ref. 13, p. 4; 14, pp. 4, 8, 10; 15, pp. 77, 78; 29, p. 9]. These most recent results also indicated the presence of 1,1-DCE in Maunabo 4 [Ref. 15, p. 86; 29, p. 9]. Maunabo 2 and Maunabo 3 showed non-detect background concentrations for PCE, cis-1,2-DCE, and 1,1-DCE [Ref. 15, pp. 80 through 84; 29, p. 9]. EPA validated the organics data for the October 2005 sampling event according to Standard Operating Procedure (SOP) HW-13 (Revision 3) July 2001, USEPA Region II Data Validation SOP for Statement of Work OLC03.2 [Ref. 15, pp. 2, 7 through 34].

No surface source of the ground water contaminants has yet been identified [Ref. 28, pp. 1 through 6]. In December 2005, EPA conducted an investigation of possible sources of the ground water contamination in Maunabo [Ref. 13, pp. 16 through 49; 38, pp. 2 through 18; 39, pp. 2 through 6; 40, pp. 1 through 37]. Facilities that were investigated include the former Maunabo landfill, PRASA's wastewater treatment plant that is located very close to Maunabo Well 1, two nearby service stations, and five light industrial facilities owned by Puerto Rico Industrial Development Corporation (PRIDCO) [Ref. 40, pp. 2 through 12, 15 through 18]. Surface soil, subsurface soil, and ground water samples were collected from soil borings advanced using direct-push methodology. Monitoring wells located at the two nearby service stations and the former Maunabo landfill were sampled using EPA Region 2's Low-Flow Groundwater Sampling Procedures [Ref. 38, pp. 2 through 18; 39, pp. 2 through 6; 40, pp. 2, 3, 4]. Soil borings were screened for VOCs using a TVA-1000™ combination photoionization detector (PID) and flame ionization detector (FID) and a Multi-RAE Plus PID [Ref. 40, p. 3]. Field screening using the PID indicated no elevated levels of organic vapors in any of the soil borings [Ref. 13, pp. 18, 21, 25, 28, 33, 37, 42, 46]. Confirmatory laboratory analysis for several samples from each investigated possible source indicated non-detect values for the chlorinated solvents present in the Maunabo Urbano water supply system (i.e., PCE, 1,1-DCE, and 1,2-DCE); metabolites such as vinyl chloride were also not detected [Ref. 40, pp. 5 through 18; 41, pp. 11 through 49, 61 through 99, 139 through 195, 243 through 257, 272 through 287, 306 through 308, 314 through 325, 341 through 343].

Location of the source, with reference to a map of the site:

The ground water plume is identified by contamination found in public supply wells Maunabo 1 and Maunabo 4. For the purpose of this report, those two wells represent a minimum of the plume extent (i.e., area of observed ground water contamination). The well locations and area of observed ground water contamination are shown in Figure 1. The municipality of Maunabo is located in the southeastern portion of Puerto Rico [Ref. 4, p. 1; 7, p. 1; 14, p. 8].

Containment

Release to ground water:

Based on evidence of both hazardous substance migration (contamination detected in ground water samples collected from two public supply wells) and due to the fact that there is nothing to prevent the plume from migrating further, a containment factor of 10 is assigned [Ref. 1, p. 51596; Ref. 14, pp. 4, 8; 15, pp. 77, 78, 86]. No evidence of a slurry wall, liner, maintained and engineered cover, or other containment features were present during the site reconnaissance or subsequent sampling of the public wells [Ref. 13, pp. 3 through 10, 28 through 35].

2.2.2 Hazardous Substances Associated with the Ground Water Plume

EPA Preliminary Assessment/Site Inspection
Ground Water Samples: October 2005

Note: EPA validated the organics data listed below according to Standard Operating Procedure (SOP) HW-13 (Revision 3) July 2001, USEPA Region II Data Validation SOP for Statement of Work OLC03.2 [Ref. 15, p. 2].

Hazardous Substance	Sample Number	Concentration (µg/L)	SQL (µg/L)	Reference(s)
1,1-DCE	MUW-GW04	0.59	0.50	14, p. 14; 15, pp. 7 through 34, 86; 29, p. 9
	MUW-GW02	ND *	0.50	14, p. 14; 15, pp. 7 through 34, 80; 29, p. 9
	MUW-GW03	ND *	0.50	14, p. 14; 15, pp. 7 through 34, 83; 29, p. 9
cis-1,2-DCE	MUW-GW01	1.7	0.50	14, p. 13; 15, pp. 7 through 34, 77; 29, p. 9
	MUW-GW02	ND *	0.50	14, p. 14; 15, pp. 7 through 34, 80; 29, p. 9
PCE	MUW-GW01	4.0	0.50	14, p. 13; 15, pp. 7 through 34, 78; 29, p. 9
	MUW-GW02	ND *	0.50	14, p. 14; 15, pp. 7 through 34, 81; 29, p. 9
	MUW-GW03	ND *	0.50	14, p. 14; 15, pp. 7 through 34, 84; 29, p. 9

µg/L - micrograms per liter
SQL - sample quantitation limit
DCE - dichloroethylene
PCE - tetrachloroethylene
ND - contaminant not detected
* - background concentration (see Section 3.1.1 of this HRS documentation record)

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

The information available is not sufficient to evaluate Tier A source hazardous waste quantity; therefore, hazardous constituent quantity is not scored (NS).

Hazardous Constituent Quantity (C) Value: NS

2.4.2.1.2 Hazardous Wastestream Quantity

The information available is not sufficient to evaluate Tier B source hazardous waste quantity; therefore, hazardous wastestream quantity is not scored.

Hazardous Wastestream Quantity (W) Value: NS

2.4.2.1.3 Volume

Because there are two wells with samples showing contamination in the ground water but the volume of the contaminated area has not been determined, the volume of the ground water contamination is considered to be greater than 0 cubic yards but unknown [Ref. 14, pp. 4, 8; 15, pp. 77, 78, 86]. Therefore, volume (V) is assigned a value of >0 but unknown [Ref. 1, p. 51591].

Dimension of source (yd^3): >0

Volume (V) Assigned Value: >0

2.4.2.1.4 Area

Tier D is not evaluated for source type "other" [Ref. 1, Table 2-5].

Area of source (ft^2): N/A

Area (A) Assigned Value: 0

2.4.2.1.5 Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source 1 is >0 but unknown for Tier C - Volume [Ref. 1, p. 51591].

Source Hazardous Waste Quantity Value: >0

SITE SUMMARY OF SOURCE DESCRIPTIONS

Source Number	Source Hazardous Waste Quantity Value	Containment: Ground Water	Containment: Surface Water	Containment: Gas	Containment: Air Particulate
1	>0	10	NS	NS	NS

NS = Not Scored

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 General Considerations

The principal aquifer in Maunabo is the Maunabo Alluvial Valley (MAA) intergranular aquifer [Ref. 16, pp. 4, 19, 43; 17, p. 101; 19, p. 5; 31, pp. 1, 5; 35, p. 1]. It consists of poorly sorted sand, silt, clay, and gravel alluvium, including lenticular deposits of sand, gravel, and cobbles [Ref. 17, p. 101; 18, pp. 2, 3; 19, p. 5; 31, p. 5]. The aquifer is limited in lateral extent to a portion of the Maunabo basin, where PRASA accounts for all ground-water withdrawals [Ref. 16, pp. 19, 43; 17, pp. 98 through 103; 18, p. 2; 25, p. 21; 31, pp. 5, 7]. It is bounded on the southeast by the Caribbean Sea and on all other sides by plutonic or metavolcanic rocks with low hydraulic conductivity [Ref. 16, p. 43; 17, pp. 100, 101, 102; 18, pp. 2, 4, 5; 31, pp. 2, 4]. The bedrock in this region is not used for water supply due to its low yield, so the bedrock surface forms the base and boundary of the MAA aquifer [Ref. 16, pp. 4, 5, 6; 17, p. 101; 31, pp. 5, 7].

The MAA aquifer ranges to as much as 200 feet in thickness, and the water table occurs as shallow as 2 feet below ground surface in this unconfined, surficial aquifer [Ref. 16, pp. 4, 19, 70; 17, p. 101; 19, p. 5; 20, pp. 1, 2, 3; 21, pp. 3, 6; 22, p. 2; 31, pp. 5, 7, 9]. The aquifer is not homogeneous in terms of its hydraulic conductivity [Ref. 17, p. 102], but there are no known aquifer discontinuities within its limited lateral extent [Ref. 16, pp. 19, 43; 17, pp. 98 through 103]. The hydraulic conductivity of the alluvial deposits ranges from approximately 1.8×10^{-3} centimeters per second (cm/s) to 3.5×10^{-2} cm/s [Ref. 17, p. 101; 23, p. 1; 31, pp. 12]. Ground water in the Maunabo basin flows toward the streams and southeast toward the Caribbean Sea [Ref. 17, p. 103; 31, pp. 23, 24]. Ground-water pumpage causes up to 34 feet of drawdown in the aquifer, leading to some flow reversal [Ref. 20, pp. 1, 2, 3; 22, p. 2; 31, pp. 12, 13, 14, 23, 24; 35, p. 2]. There is no evidence of karst for the MAA aquifer, whereas USGS does describe evidence of karst for other formations in Puerto Rico [Ref. 16, pp. 4, 19; 17, pp. 100, 101; 18, p. 3; 19, p. 5; 31, pp. 1, 2, 5, 36; 36, pp. 2, 5, 7, 44, 45, 63, 68, 76, 103, 105 through 122].

The four active Maunabo public supply wells are finished in alluvial deposits (i.e., the MAA aquifer) to depths ranging from 80 to 125 feet below ground surface [Ref. 16, pp. 4, 19, 43; 17, p. 101; 18, pp. 2, 3; 19, p. 5; 20, pp. 2, 3, 4; 21, pp. 2, 4, 5; 22, pp. 1, 2; 30, pp. 1 through 9; 31, p. 5; 35, pp. 1, 2]. The Maunabo Urbano water system serves a total population of 13,988 people [Ref. 24, p. 1; 34, p. 1]; for the purposes of HRS scoring, this population is apportioned equally among the four public supply wells (i.e., 3,497 per well). Therefore, the contaminated wells in this system, Maunabo 1 and Maunabo 4, are apportioned a population of almost 7,000 people between them [Ref. 6, p. 53; 7, p. 1; 13, pp. 4, 8, 9; 22, p. 2; 24, p. 1; 34, p. 1]. Wellhead Protection Areas are delineated for the public supply wells, so the area of observed ground water contamination lies within a designated Wellhead Protection Area [Ref. 26, pp. 29 through 45; 27, p. 1].

Stratum 1 (shallowest)

Stratum Name: Maunabo Alluvial Valley (MAA) aquifer

Description: The aquifer consists of poorly sorted sand, silt, clay, and gravel alluvium, including lenticular deposits of sand, gravel, and cobbles [Ref. 16, pp. 4, 19, 43; 17, p. 101; 18, pp. 2, 3; 19, p. 5; 20, pp. 2, 3, 4; 21, pp. 2, 4, 5; 22, pp. 1, 2]. The alluvial deposits range to as much as 200 feet in thickness, and the water table occurs as shallow as 2 feet below ground surface in this unconfined aquifer [Ref. 16, pp. 4, 19, 70; 17, p. 101; 19, p. 5; 20, pp. 1, 2, 3; 21, pp. 3, 6; 22, p. 1]. The hydraulic conductivity of the alluvial deposits ranges from approximately 1.8×10^{-3} cm/s to 3.5×10^{-2} cm/s [Ref. 17, p. 101; 23, p. 1]. The MAA aquifer is limited in lateral extent to the Maunabo basin, where PRASA accounts for all ground-water withdrawals [Ref. 16, pp. 19, 43; 17, pp. 98 through 103; 18, p. 2; 25, p. 21; 31, pp. 5, 7].

Stratum 2

Stratum Name: Plutonic Bedrock

Description: Plutonic rocks consisting mainly of granodiorite and quartz diorite underlie the alluvial deposits in the Maunabo basin [Ref. 17, p. 100; 18, pp. 2, 3, 5]. The plutonic bedrock in this region is not used for water supply due to its low yield, so the bedrock surface forms the base and boundary of the MAA aquifer [Ref. 16, pp. 4, 5, 6; 17, p. 101; 31, pp. 5, 7]. The ground water contribution from the bedrock to the alluvial aquifer is relatively small compared to the total quantity of water in the valley [Ref. 17, p. 103].

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

Aquifer Being Evaluated: Maunabo Alluvial Valley (MAA) aquifer

An observed release is documented for the Maunabo Urbano Public Wells site. Chemical analyses for samples collected from the Maunabo 1 public supply well from 2002 to 2004 show the continued presence of chlorinated solvents in ground water and distributed water [see below].

In March 2002, the Puerto Rico Department of Health (PRDOH) ordered PRASA to close the well because the PCE concentration exceeded the Maximum Contaminant Level (MCL) of 5 µg/L [Ref. 11, pp. 1, 5]. However, PRASA opted to treat the ground water with carbon filtration tanks at the wellhead rather than close the well [Ref. 11, p. 1; 12, pp. 1, 2; 13, pp. 4, 6, 7]. Since then, the detections of PCE in raw ground water samples from Maunabo 1 have exceeded the MCL on numerous occasions [Ref. 8, pp. 3 through 22, 24, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 119, 121, 127, 129, 131, 132, 134, 135, 137, 146, 154, 171, 177, 179, 181, 183, 185, 206, 218, 222, 230, 238, 254]. Post-treatment samples, including tap water samples collected along the distribution system down-line from Maunabo 1, indicate that the treatment has not always been effective and that contaminated drinking water is reaching the consumers in this system [Ref. 8, pp. 76, 78, 80, 82, 84, 86, 88, 90, 133, 136, 138, 170, 178, 182, 184, 186, 191, 210, 226, 234, 242, 250, 258; 10, pp. 2 through 22, 24 through 41, 46, 49, 52, 53, 56 through 68, 70 through 78, 80, 85 through 89, 93, 95, 96, 116, 120, 127, 131, 132, 162, 163, 166, 167, 171, 175, 187, 194, 195, 218, 229, 230, 249, 264, 268 through 292, 303, 304, 305, 307, 308, 310 through 323, 325 through 334, 340, 341, 342, 344, 349, 350, 351, 370, 374, 378, 379, 383, 384, 385, 399, 415, 418, 422, 426, 431, 439, 446, 450, 454, 458, 465, 469, 477, 481, 485, 486, 488 through 505, 507, 508, 509, 520, 521, 524 through 537, 539, 540, 549, 555, 556, 557, 562, 569, 573, 579, 580, 583, 584, 594, 595, 597, 607, 608, 611, 613, 615, 620, 623, 624, 627, 628, 632, 636, 640, 644, 648, 652, 664, 672, 680, 683, 691, 695, 697 through 711, 713, 714, 715, 720, 726, 727, 728, 730 through 739, 742, 743, 753, 759, 761, 762, 770, 782, 790, 798, 799, 804, 807, 839, 842, 843, 846, 859, 867, 891, 895, 914, 925, 929, 933, 937, 941]. During an inspection in August 2004, PRDOH observed that the treatment cylinders at Maunabo 1 lacked the necessary filter medium [Ref. 12, pp. 1, 3].

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 [Ref. 13, pp. 3 through 14; 14, pp. 4, 8, 10, 11, 12; 15, pp. 77, 78, 89, 90, 92, 93, 95, 96; 29, p. 9]. These most recent results also indicated the presence of 1,1-DCE in Maunabo 4 and in some distribution samples [Ref. 15, pp. 86, 89, 92, 95, 98, 101; 29, p. 9]. Maunabo 2 and Maunabo 3 showed non-detect background concentrations for PCE, cis-1,2-DCE, and 1,1-DCE [Ref. 15, pp. 80 through 84; 29, p. 9]. EPA validated the organics data for the October 2005 sampling event according to Standard Operating Procedure (SOP) HW-13 (Revision 3) July 2001, USEPA Region II Data Validation SOP for Statement of Work OLC03.2 [Ref. 15, pp. 2, 7 through 34].

The background and observed release samples were not filtered prior to analysis [Ref. 13, pp. 3, 4, 7, 8, 9]. All background and contaminated samples documenting the observed release were collected from the aquifer being evaluated (i.e., MAA aquifer), which is estimated to have a thickness up to 200 feet in the vicinity of the site [Ref. 14, p. 4; 16, pp. 4, 19, 43; 17, p. 101; 18, pp. 2, 3; 19, p. 5; 20, pp. 1 through 4; 21, pp. 2, 4, 5; 22, pp. 1, 2; 30, pp. 1 through 9; 31, p. 5; 35, pp. 1, 2]. Maunabo 2 and Maunabo 3 are evaluated as background due to similar depths, screened intervals, and geologic material (i.e., sand with clay) to those of the wells where observed releases occurred [Ref. 20, pp. 1 through 4; 22, pp. 1, 2; 30, pp. 3, 5, 6, 8, 9; 35, p. 2]. The compounds found in the wells are not naturally occurring, and the non-detect concentrations in the background wells (i.e., Maunabo 2 and Maunabo 3) show that they are not ubiquitous in the area [Ref. 13, pp. 4 through 9; 14, pp. 4, 8, 10, 11, 12; 15, pp. 77 through 86].

Chemical Analysis

Background Concentrations (Public Supply Wells)

Sample ID	Well Location	Screened Interval (ft ∓MSL)*	Date**	Reference(s)
MUW-GW02 (B38N5)	Maunabo 2 (Bordaleza)	-20.32 to -105.32	10/25/05	13, p. 9; 14, pp. 4, 8
MUW-GW03 (B38N6)	Maunabo 3 (Calzada)	13.39 to -46.61	10/25/05	13, p. 8; 14, pp. 4, 8

Sample ID	Hazardous Substance	Conc. (µg/L)	SQL (µg/L)	Reference(s)
MUW-GW02	1,1-DCE	ND	0.50	14, p. 14; 15, pp. 7 through 34, 80, 81; 29, p. 9
	cis-1,2-DCE	ND	0.50	
	PCE	ND	0.50	
MUW-GW03	1,1-DCE	ND	0.50	14, p. 14; 15, pp. 7 through 34, 83, 84; 29, p. 9
	PCE	ND	0.50	

Contaminated Samples (Public Supply Wells)

Sample ID	Well Location	Screened Interval (ft ∓MSL)*	Date**	Reference(s)
MUW-GW01 (B38N4)	Maunabo 1 (Urbano)	-27.27 to -67.27	10/25/05	13, p. 4; 14, pp. 4, 8
MUW-GW04 (B38N7)	Maunabo 4 (San Pedro)	-5.76 to -65.76	10/25/05	13, p. 9; 14, pp. 4, 8

Sample ID	Hazardous Substance	Conc. (µg/L)	SQL (µg/L)	Reference(s)
MUW-GW01	cis-1,2-DCE	1.7	0.50	14, p. 13; 15, pp. 7 through 34, 77, 78; 29, p. 9
	PCE	4.0	0.50	
MUW-GW04	1,1-DCE	0.59	0.50	14, p. 14; 15, pp. 7 through 34, 86; 29, p. 9

* - The screened interval listed for each well is equal to the elevation of the well with respect to mean sea level (MSL) minus the top and bottom depths of the screened intervals of the well, based on well records from PRASA and USGS [Ref. 20, pp. 1 through 4; 22, p. 1; 30, pp. 5, 6, 8, 9; 35, p. 2].
** - date sampled

µg/L - micrograms per liter
SQL - Sample Quantitation Limit
ND - contaminant not detected

Attribution:

No surface source of the ground water contaminants has yet been identified [Ref. 28, pp. 1 through 6]. In December 2005, EPA conducted an investigation of possible sources of the ground water contamination in Maunabo [Ref. 13, pp. 16 through 49; 38, pp. 2 through 18; 39, pp. 2 through 6; 40, pp. 1 through 37]. Facilities that were investigated include the former Maunabo landfill, PRASA's wastewater treatment plant that is located very close to Maunabo Well 1, two nearby service stations, and five light industrial facilities owned by Puerto Rico Industrial Development Corporation (PRIDCO) [Ref. 40, pp. 2 through 12, 15 through 18]. Surface soil, subsurface soil, and ground water samples were collected from soil borings advanced using direct-push methodology. Monitoring wells located at the two nearby service stations and the former Maunabo landfill were sampled using EPA Region 2's Low-Flow Groundwater Sampling Procedures [Ref. 38, pp. 2 through 18; 39, pp. 2 through 6; 40, pp. 2, 3]. Soil borings were screened for VOCs using a TVA-1000™ combination photoionization detector (PID) and flame ionization detector (FID) and a Multi-RAE Plus PID. Field screening using the PID indicated no elevated levels of organic vapors in any of the soil borings [Ref. 13, pp. 18, 21, 25, 28, 33, 37, 42, 46]. Confirmatory laboratory analysis for several samples from each investigated possible source indicated non-detect values for the chlorinated solvents present in the Maunabo Urbano water supply system (i.e., PCE, 1,1-DCE, and 1,2-DCE); metabolites such as vinyl chloride were also not detected [Ref. 40, pp. 5 through 18; 41, pp. 11 through 49, 61 through 99, 139 through 195, 243 through 257, 272 through 287, 306 through 308, 314 through 325, 341 through 343]. During an inspection in August 2004, PRDOH observed that the treatment cylinders at Maunabo 1 lacked the necessary filter medium (Ref. 12, pp. 1, 3). This suggests that the carbon used in the treatment cylinders is not the present source or a continuing source of the contamination in the water supply.

Hazardous Substances Released:

1,1-Dichloroethylene (1,1-DCE)	CAS No. 000075-35-4
cis-1,2-Dichloroethylene (cis-1,2-DCE)	CAS No. 000156-59-2
Tetrachloroethylene (PCE)	CAS No. 000127-18-4

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Ground Water Observed Release Factor Value: 550

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

Hazardous Substance	Source Numbers	Toxicity Factor Value	Mobility Factor Value	Toxicity/ Mobility	Reference(s)
1,1-Dichloroethylene	1, OR	100	1.0	100	2, p. BI-5
cis 1,2-Dichloroethylene	1, OR	100	1.0	100	2, p. BI-5
Tetrachloroethylene	1, OR	100	1.0	100	2, p. BI-10

OR = Observed Release

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Toxicity/Mobility Factor Value: 100

3.2.2 Hazardous Waste Quantity

Source Number	Source Hazardous Waste Quantity (HWQ) Value (Section 2.4.2.1.5)	Is source hazardous constituent quantity data complete? (yes/no)
1	>0	No

Sum of Values: >0 (rounded to nearest integer as specified in HRS Section 2.4.2.2)

The sum corresponds to a hazardous waste quantity factor value of 1 in Table 2-6 of the HRS [Ref. 1, p. 51591]. However, based on the fact that targets are subject to Level I concentrations (see Section 3.3.2.3 of this document), a hazardous waste quantity factor value of 100 can be assigned if it is greater than the hazardous waste quantity value from Table 2-6 (i.e., 1) [Ref. 1, p. 51592]. Therefore, a hazardous waste quantity factor value of 100 is assigned for the ground water pathway.

3.2.3 Waste Characteristics Factor Category Value

PCE corresponds to the toxicity/mobility factor value of 100, as shown previously (see Section 3.2.1).

Toxicity/Mobility Factor Value (100) x Hazardous Waste Quantity Factor Value (100): 1×10^4

The product (1×10^4) corresponds to a Waste Characteristics Factor Category Value of 10 in Table 2-7 of the HRS [Ref. 1, p. 51592].

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Hazardous Waste Quantity Factor Value: 100
Waste Characteristics Factor Category Value: 10

3.3 TARGETS

The Maunabo Urbano Water System (ID No. PR0004815), one of 130 water systems operated by PRASA, consists of four active public supply wells which function as a unit (i.e., a blended system) to serve 13,988 people [Ref. 1, p. 51603; 6, pp. 1, 53; 7, p. 1; 24, p. 1; 32, p. 1; 33, p. I-16; 34, p. 1]. The capacities of the four active wells in the Maunabo Urbano system are listed in PRASA records as follows:

Well Name	Capacity (gpm)*	Reference
Maunabo 1	600	20, p. 4
Maunabo 2 (Bordaleza)	725	20, p. 1
Maunabo 3 (Calzada)	700	30, pp. 4, 5, 6
Maunabo 4 (San Pedro)	325	30, p. 8

* gpm = gallons per minute
PRASA records from 1986 present the capacities for Maunabo 1 and Maunabo 2 (Bordaleza), which were installed in 1961 and 1974, respectively, as "Original production" [Ref. 20, pp. 1, 4]. Newer PRASA records present the capacities for Maunabo 3 (Calzada) and Maunabo 4 (San Pedro), which were replaced in 1992 and 2002, respectively, as "Maximum capacity" [Ref. 30, pp. 4, 5, 6, 8].

Based on the well capacities provided by PRASA, the total system capacity is 2,350 gallons per minute, and the maximum contribution of any single component to the system is 31 percent (725gpm / 2,350 gpm x 100% = 31%) for Maunabo 2 [Ref. 6, p. 53; 20, pp. 1, 4; 22, p. 2; 30, pp. 4, 5, 6, 8]. Since no single component provides more than 40 percent of the total blended system water supply based on capacity, the population of 13,988 is apportioned equally among the four active wells [Ref. 1, p. 51603; 6, p. 53; 22, p. 2; 24, p. 1]. The apportioned populations and levels of contamination are presented below:

Well	Distance from Source (mi.)*	Population	Level I Contam. (Y/N)	Level II Contam. (Y/N)	Potential Contam. (Y/N)	Reference(s)
Maunabo 1	0.06 mile	3,497	Y	N	N	Figure 2; 6, p. 53; 7, p. 1; 15, pp. 2, 78; 22, p. 2; 24, p. 1
Maunabo 4	0.06 mile	3,497	N	Y	N	Figure 2; 6, p. 53; 7, p. 1; 15, pp. 2, 86; 22, p. 2; 24, p. 1
Maunabo 2	0.13 mile	3,497	N	N	Y	Figure 2; 6, p. 53; 7, p. 1; 15, pp. 2, 80, 81; 22, p. 2; 24, p. 1
Maunabo 3	0.25 mile	3,497	N	N	Y	Figure 2; 6, p. 53; 7, p. 1; 15, pp. 2, 83, 84; 22, p. 2; 24, p. 1

* Distance is measured from the center of the area of observed ground water contamination [Figure 2].

The four active Maunabo public supply wells listed above are finished in alluvial deposits (i.e., the MAA aquifer) to depths ranging from 80 to 125 feet below ground surface [Ref. 16, pp. 4, 19, 43; 17, p. 101; 18, pp. 2, 3; 19, p. 5; 20, pp. 2, 3, 4; 21, pp. 2, 4, 5; 22, pp. 1, 2; 30, pp. 1 through 9; 31, p. 5; 35, pp. 1, 2].

Level I Samples

Sample	Substance	Concentration	Benchmark	References
MUW-GW01	PCE	4.0 µg/L	1.6 µg/L (CRSC)*	2, p. BII-11; 15, pp. 2, 78; 29, p. 9

Level II Samples

Sample	Substance	Concentration	Benchmark	References
MUW-GW04	1,1-DCE	0.59 µg/L	7.0 µg/L (MCL)**	2, p. BII-5; 15, pp. 2, 86; 29, p. 9

* CRSC - Cancer Risk Screening Concentration
** MCL - Maximum Contaminant Level

3.3.1 Nearest Well

Maunabo 1 is subject to Level I concentrations (page 24 of this HRS documentation record); therefore, a nearest well factor value of 50 is assigned [Ref. 1, pp. 51602, 51603].

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Nearest Well Factor Value: 50

3.3.2 Population

3.3.2.2 Level I Concentrations

Level I Well	Population	Reference(s)
Maunabo 1	3,497	6, p. 53; 7, p. 1; 15, p. 78; 22, p. 2; 24, p. 1

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Population Served by Level I Wells: 3,497

Level I Concentrations Factor Value: 34,970

3.3.2.3 Level II Concentrations

Level II Well	Population	Reference(s)
Maunabo 4 (San Pedro)	3,497	6, p. 53; 7, p. 1; 15, p. 86; 22, p. 2; 24, p. 1

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Population Served by Level II Wells: 3,497

Level II Concentrations Factor Value: 3,497

3.3.2.4 Potential Contamination

The aquifer being evaluated (i.e., the MAA aquifer) is limited in lateral extent to a portion of the Maunabo basin, where PRASA accounts for all ground-water withdrawals [Ref. 16, pp. 19, 43; 17, pp. 98 through 103; 18, p. 2; 25, p. 21]. Therefore, the two public wells that are not subject to Level I or Level II contamination, Maunabo 2 (Bordaleza) and Maunabo 3 (Calzada), are the only wells subject to potential contamination that withdraw drinking water from the aquifer being evaluated [Ref. 6, p. 53; 7, p. 1; 15, pp. 80 through 84; 20, pp. 1, 2; 22, pp. 1, 2]. For the purposes of HRS scoring, each well has been apportioned 3,497 people as population targets, as shown in Section 3.3 of this HRS documentation record [Ref. 1, pp. 51603, 51604; 6, p. 53; 13, pp. 4, 8, 9; 20, pp. 1, 4; 22, p. 2; 24, p. 1; 30, pp. 4, 5, 6, 8]. Figure 2 of this HRS documentation record shows that Maunabo 2 is located less than ¼ mile from the center of the area of observed ground water contamination (i.e., the site reference point) and Maunabo 3 is located exactly ¼ mile from the site reference point [Figure 2; Ref. 1, p. 51595].

The populations apportioned to wells located within 4 miles of the site that draw from the aquifer being evaluated are:

Distance Category	Potential Population	Distance-Weighted Population Value
0 to ¼ mile	6,994	5,214
>¼ to ½ mile	0	0
>½ to 1 mile	0	0
>1 to 2 mile	0	0
>2 to 3 mile	0	0
>3 to 4 mile	0	0

Sum of Distance-Weighted Population Values: 5,214

[Ref. 1, pp. 51603, 51604; 6, p. 53; 20, pp. 1, 4; 24, p. 1; 30, pp. 4, 5, 6, 8]

Based on the above information, the potential contamination factor value is 521. This value is obtained by multiplying the distance-weighted population sum value by 0.1 (5,214 x 0.1 = 521.4), and rounding off to the nearest integer since the result is greater than 1 [Ref. 1, p. 51604].

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Potential Contamination Factor Value: 521

3.3.3 Resources

Resource use of the MAA aquifer within the target distance limit is unknown. Therefore, a resources factor value of 0 is assigned [Ref. 1, p. 51604; Ref. 25, pp. 25, 28].

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Resources Factor Value: 0

3.3.4 Wellhead Protection Area

The Wellhead Protection Program for Puerto Rico was developed in accordance with Section 1428 of the Safe Drinking Water Act and approved by EPA in 1991 [Ref. 26, pp. 3, 4; Ref. 27, p. 1]. Wellhead protection areas are defined by a fixed radius of 1,500 feet around each public supply well that does not withdraw water from the North Coast artesian limestone aquifer [Ref. 26, pp. 29 through 45]. The Maunabo Urbano Public Wells site is located in the east region of Puerto Rico, outside of the North Coast artesian limestone aquifer, so the 1,500-foot fixed radius is applicable for the active public supply wells within the target distance limit of the site [Ref. 26, p. 34]. Based on this information, observed ground water contamination associated with the site lies within a designated wellhead protection area (i.e., at the contaminated public supply wells), and a wellhead protection area factor value of 20 is assigned [Ref. 1, p. 51604].

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Wellhead Protection Area Factor Value: 20