San German Groundwater Contamination Superfund Site (OU-2)

San German, Puerto Rico
July 2019

EPA Region 2

EPA ANNOUNCES PROPOSED CLEANUP PLAN

This Proposed Plan describes the remedial alternative developed for the San German Groundwater Contamination Superfund Site (the Site) OU-2 in San German, Puerto Rico, and identifies the preferred remedy for the Site with the rationale for this preference. This document was developed by the U.S. Environmental Protection Agency (EPA), the lead agency for Site activities, in consultation with the Puerto Rico Environmental Quality Board (PREQB), the support agency. EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9617(a) (CERCLA, commonly known as Superfund) and Sections 300.430(f) and 300.435(c) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The nature and extent of the contamination at the Site and the remedial alternatives summarized in this document are described in detail in the OU-2 Remedial Investigation (RI) and Feasibility Study (FS) reports. EPA is addressing the Site in two operable units (OUs). OU-1 addresses soil contamination that acts as a continuing source of groundwater contamination, including soil in the vadose zone (above the water table), and soil and highly contaminated groundwater below the water table in the shallow saprolite zone (soils and highly weathered rock). The OU-1 ROD was signed in December 11, 2015 and called for Soil Vapor Extraction (SVE) and Dual Phase Extraction (DPE)/In Situ Treatments at the properties currently operated by Wallace International de P.R., Inc. (Wallace) and

MARK YOUR CALENDAR

PUBLIC MEETING
July 30, 2019 at 5:00 pm
Santa Marta Basketball Court, San German

PUBLIC COMMENT PERIOD
July 12, 2019 - August 11, 2019

INFORMATION REPOSITORY
The administrative record file, which contains copies of the Proposed Plan and supporting documentation, is available at the following locations:
San German City Hall
Hours: Monday – Friday 9:00 am to 3:00 pm

U.S. Environmental Protection Agency
City View Plaza II- Suite 7000
#48 PR-165 Km. 1.2
Guaynabo, PR 00968-8069
(787) 977-5865
Hours: Monday – Friday 9:00 am to 5:00 pm
By appointment.

Puerto Rico Environmental Quality Board
Emergency Response and Superfund Program
Edificio de Agencias Ambientales Cruz A. Matos
Urbanización San José Industrial Park
1375 Avenida Ponce de León
San Juan, PR 00926-2604
(787) 767-8181 ext 3207
Hours: Monday – Friday 9:00 am to 3:00 pm
By appointment.

U.S. EPA Records Center, Region 2
290 Broadway, 18th Floor
New York, New York 10007-1866
(212) 637-4308
Hours: Monday-Friday – 9:00 am to 5:00 pm
By appointment.
EPA's website for the San German Ground Water Contamination site:
https://www.epa.gov/superfund/san-german-groundwater

formerly occupied by CCL Insertco de PR (CCL Label). OU-2 addresses the site-wide groundwater contaminated plume and is the subject of this action.

Two locations in the Retiro Industrial Park, which is owned by the Puerto Rico Industrial Development Company, were identified as source areas for the groundwater contamination. The two locations consist of a lot currently occupied by Wallace, and a vacant lot formerly occupied by CCL Label. These lots will be referred to as the Wallace and former CCL lots in this document.

EPA's preferred remedy for the Site OU-2 is Alternative 3 – In Situ Treatment and Monitored Natural Attenuation.

This remedy also includes long-term monitoring for vapor intrusion and institutional controls that would restrict the use of the properties and exposure to contaminated groundwater until the contaminant levels are reduced to the Preliminary Remedial Goals (PRGs) or no longer pose any risks to human health and ecological receptors.

COMMUNITY ROLE IN SELECTION PROCESS

EPA relies on public input to ensure that the concerns of the community are considered in selecting an effective remedy for each Superfund site. To this end, this OU-2 Proposed Plan has been made available to the public for a 30-day public comment period, which begins with the issuance of this Proposed Plan and concludes on August 11, 2019.

EPA is providing information regarding the investigation and cleanup of the Site to the public through a public meeting and the public repositories, which contain the administrative record file. EPA encourages the public to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted there.

The public meeting to be held during the comment period is to provide information regarding the Site investigations, the alternatives considered and the preferred remedy, as well as to receive public comments. Comments received at the public meeting, as well as written comments, will be documented in the Responsiveness Summary Section of the OU-2 Record of Decision (ROD), the document that formalizes the selection of the remedy.

Written comments on this Proposed Plan should be addressed to:

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SCOPE AND ROLE OF ACTION

EPA is addressing the cleanup of this Site in two phases, OU-1 and OU-2. This is the second (OU-2) planned remedial action for the Site, addressing the site-wide groundwater contaminated plume not included in the OU-1 remedy. OU-2 is comprised of the core of the plume, which is where concentrations of VOCs are greater than 100 micrograms per liter (µg/L) of either PCE or TCE and the fringe of the plume where concentrations of these contaminants are between 100 and 5 µg/L.

SITE BACKGROUND

Site Description

The Site is located in San German, in southwestern Puerto Rico (Figure 1). Volatile organic compounds (VOCs) were detected above federal drinking water standards, called Maximum Contaminant Levels (MCLs), in three public water supply wells, Retiro, Lola Rodriguez de Tio I (Lola I), and Lola Rodriguez de Tio II (Lola II), located south of the Guanajibo

River, between Routes 139 and 360 (Figure 2). These wells were part of the Puerto Rico Aqueduct and Sewer Authority (PRASA) San German Urbano Water system, which includes a total of seven wells and two surface water intakes.

The Retiro, Lola I, and Lola II wells acted as an independent interconnected supply system with approximately 800 service connections serving approximately 2,280 users in 2005 when VOCs were detected. The Site includes Retiro Industrial Park approximately one-half mile to the southeast of the affected supply wells that has been shown to be the source of the VOCs (Figure 2). Several of the buildings in the industrial park are occupied by active businesses that were investigated during the RI. Only the location of Wallace and the former CCL Label location are considered sources of groundwater contamination.

Site History

From 2001 to 2005, groundwater samples collected by PRASA from the Retiro, Lola I, and Lola II wells regularly exhibited detectable concentrations of tetrachloroethene (PCE) and *cis*-1,2-dichloroethene (cis-1,2-DCE). The maximum concentrations of PCE and cis-1,2-DCE detected in these wells during this period were 6.4 μg/L and 1.2 μg/L, respectively.

On January 17, 2006 the Puerto Rico Department of Health (PRDOH) ordered the closure of the Retiro well due to PCE concentrations exceeding the federal MCL of 5 μg/L. PCE was also detected in tap water samples collected from the water distribution system. The Lola I and Lola II wells were taken out of service at about the same time.

EPA added the San German Groundwater Contamination Site to the National Priorities List (NPL) on March 19, 2008, because chlorinated solvents were found in groundwater that supplies drinking water for local residents.

On December 11, 2015 EPA issued the OU-1 ROD. The OU-1 ROD addresses soil contamination that acts as a continuing source of groundwater contamination, including soil in the vadose zone (above the water table), and soil and highly contaminated groundwater below the water table in the shallow saprolite zone (soils and highly weathered rock). Currently EPA is conducting the remedial design (RD) for OU-1.

Topography and Drainage

The municipality of San German is located in the eastern part of the Guanajibo River floodplain. The three closed public supply wells are located adjacent to the river on the south side, at an approximate elevation of 138 feet above mean sea level. The Guanajibo River flows west through the municipality of San German and is the major surface water body in the area.

Geology

The study area lies within the eastern part of the Guanajibo River floodplain, which is bounded to the north and south by highlands of predominantly igneous rocks and serpentinite. Bedrock is overlain by alluvial deposits in the Guanajibo River valley and is generally encountered at the surface in the highlands, and at depths up to 100 feet below the ground surface (bgs) in the river valley.

Within the well field, the serpentinite is encountered at 30 feet bgs. The geologic units exposed or underlying the study area are described below, from youngest to oldest.

- Alluvium Soils (Quaternary) – Alluvial deposits, also known as the overburden, occur in the Guanajibo River valley and along tributaries, and are made up of sand, clay, and gravel. Deposits are generally less than 100 feet thick.
- Saprolite – This unit is composed of saturated sands, silts, clays, and highly weathered rock with an increasing percentage of rock fragments with depth.
- Unstable Zone – A highly fractured and unstable layer, possibly composed of the underlying serpentinite, is found below the saprolite.

- Serpentinite or Serpentinized Peridotite (late Jurassic and early Cretaceous age or older) - highly fractured and faulted.

Hydrogeology

The aquifer within the study area is part of the Guanajibo River alluvial valley. Groundwater is first encountered in the saprolite (sands, silts, clays and weathered rock) and the depth to water ranges from river level at the Río Guanajibo to about 15 to 25 feet bgs. Groundwater occurs under confined to semi-confined conditions within the saprolite and the unstable bedrock zone.

Flow in the saprolite and bedrock is toward the northwest from the two main source areas in the industrial park. Groundwater flow measured after Hurricane María (in September 2017) exhibited a slightly more northerly trend in upgradient portions of the study area, and water elevations increased by as much as 4.59 feet in MW-14, near the center of the study area. Water level elevations between saprolite and bedrock zone well clusters generally show a slight upward hydraulic gradient.

Land Use

The San German municipality is comprised of 54.51 square miles with a population of 35,527 and a population density of 651.8 people per square mile (United States Census 2010). The primary land use in the vicinity of the San German Site is agricultural with some residential, commercial, and light industrial development. The area directly downgradient of the source areas is densely populated with residential and commercial development. The land use is expected to remain unchanged in the future. There are currently seven water supply wells serving the public connected to the San German Urbano water system.

Ecology

As the Site is comprised of residential, agricultural, commercial, and industrial developments, most undeveloped land parcels are situated along the Guanajibo River, the major surface water body in the area. The river valley is flanked to the north and south by uplands. The Guanajibo River flows from east to west through San German and is joined by smaller unnamed tributaries within the study area. One of these tributaries originates in the highlands southeast of the Site, and flows west, then north, toward the river. Little viable habitat is present within upland portions of the Site due to development. In general, the river banks are heavily vegetated and moderately to steeply sloped, depending on the reach. The majority of both the north and south banks of the river within the area of the Site have been subjected to disturbance activities associated with development. Ecological studies associated with the Site focused primarily on areas adjacent to the River. No known occurrences of listed rare, threatened, and/or endangered species or critical habitats have been identified.

EARLY SITE INVESTIGATIONS

2006 to 2008 - EPA Activities

In June 2006 EPA collected groundwater samples from operational wells and analyzed for a wide range of chemicals, including pesticides, metals, VOCs and semivolatile organic compounds. This sampling reflected the presence of PCE (1.6 μg/L), cis-1,2-DCE (1.5 μg/L), and trichloroethene (TCE) (0.54 μg/L). In addition, PCE was detected at an estimated concentration (below the sample quantitation limit) in the Lola II well. EPA was unable to collect a sample from the Retiro well because the pump was removed in February 2006 as part of the response to PRDOH's closure order.

In July 2006, EPA conducted reconnaissance activities at 44 industrial sites in the San German area as part of a Site Discovery Initiative to identify hazardous waste sites that could be potential sources of contamination. This led to the identification of several locations in San German that were investigated further as part of EPA's Site studies.

NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination in Site media was assessed during the OU-1 and OU-2 RI by collecting and analyzing samples and then comparing analytical results to federal, commonwealth, and site-specific screening criteria. Groundwater PCE and TCE plumes were identified during OU-1 evaluations in the saprolite zone originating in two source areas in Retiro Industrial Park; the contamination extended to the former supply wells approximately 3,300 feet to the northwest. Limited contamination was identified in the bedrock zone.

Separate plumes of PCE and TCE originated at the Wallace and former CCL Label source areas, respectively, and then co-mingled as the contaminated groundwater moved downgradient toward the northwest (Figure 3, Figure 4). The plumes and groundwater movement may have been influenced by pumping at the former supply wells when they were in operation (prior to 2006). Although the PCE and TCE plumes were co-mingled, TCE was more dominant on the northern side of the plumes. The TCE observed at and downgradient of the Wallace source area may be a result of biodegradation of the PCE, or TCE may have also been used in the Wallace buildings as part of the industrial processes.

Contaminants selected to represent Site contamination in OU-2 are consistent with those from OU-1: PCE, TCE, cis-1,2-DCE, 1,1-dichloroethene (1,1-DCE), and vinyl chloride. These five VOCs were detected the most frequently, and at the highest levels, in source area soil samples and other affected media including groundwater. These chemicals include chlorinated solvents and degradation products of those solvents. The RI also investigated the Site for the presence of Site contaminants in the form of nonaqueous phase liquids. Site contaminants are chlorinated VOCs that are denser than water, so are also referred to as dense nonaqueous phase liquids (DNAPLs) at certain concentrations. DNAPL has not been observed at the Site.

The major OU-2 field activities included a hydrological investigation, groundwater sampling and surface water sampling. As part of the OU-2 RI, two rounds of groundwater and surface water sampling events were completed. In addition, after the passage of Hurricane Maria a sampling was conducted to observe whether the contaminant plumes had changed. Selected monitoring wells and irrigation wells were sampled in March 2018 to determine if the September 2017 hurricane resulted in changes to groundwater contamination.

The purpose of the OU-2 Remedial Investigation (RI) report was to refine the hydrogeologic framework, evaluate the nature and extent of site-wide groundwater contamination, update surface water conditions in the Río Guanajibo, and refine the conceptual site model (CSM) developed during the investigation of OU-1.

The results of the sampling events are discussed below.

Summary of Groundwater Contamination

As part of the OU-2 groundwater investigation, five monitoring wells in the saprolite zone and four monitoring wells in the unstable bedrock zone were installed to assesses groundwater contamination. The OU-2 Round 1 and Round 2 sampling events included all wells and ports: 14 shallow wells screened in the saprolite zone; 4 wells screened in the unstable bedrock zone; 1 single-screen bedrock well, 7 multiport bedrock wells, each with 2 to 5 ports (total of 25 ports) and irrigation well MW-C, which is only used for monitoring purposes and not for potable water (Figure 5). Wells completed in the saprolite zone contained the highest PCE and TCE levels, as well as the majority of the screening criteria exceedances.

- PCE and TCE were detected in 13 saprolite monitoring wells and the results exceeded the screening criteria in 11 and 6 wells, respectively.
- The highest PCE concentrations in the saprolite zone were located at, and just downgradient of, the Wallace source

area, at 16,000 µg/L (MW-2S), 2,400 µg/L (MW-4S), and 1,300 µg/L (MW-6S).

- PCE was detected in three of the four monitoring wells completed in the unstable bedrock zone, but the results exceeded the screening criterion in only MW-4UR (2,400 µg/L), located near the Wallace source area.
- In the bedrock aquifer, PCE was detected only in the top four ports in MPW-10, the furthest downgradient bedrock well; all concentrations were below the screening criterion, ranging from 0.65 µg/L to 2.8 µg/L.
- The highest TCE concentrations in the saprolite zone were at, and just downgradient of, the former CCL Label source area, at 680 µg/L (MW-3S) and 580 µg/L (MW-12).
- TCE was detected in all unstable bedrock wells and the results exceeded the screening criterion in three wells. The highest TCE concentration of 21 µg/L was in MW-14UR, located downgradient of the source areas but on the northern side where TCE is the more dominant contaminant. The remaining TCE exceedances were in MW-3UR (6.2 µg/L) and MW-4UR (13 µg/L). MW-3UR is located close to the former CCL Label source area and MW-4UR is close to the Wallace source area.
- TCE was detected at levels well below the screening criterion in five bedrock wells: MPW-3 (ports 2 and 3); MPW-5 (port 2); MPW-6 (ports 1, 2, and 3); MPW-7 (ports 3, 4, and 5); and MPW-10 (ports 3, 4, and 5). TCE concentrations ranged from 0.12J[1] µg/L to 0.42J µg/L.
- Cis-1,2-DCE was detected in 13 saprolite wells, and the results exceeded the screening criterion in 4 wells. The highest cis-1,2-DCE concentration was detected in MW-12 (310 µg/L), located downgradient of the former CCL Label and Wallace source areas.
- Cis-1,2-DCE was detected in three unstable bedrock wells; concentrations in two of these wells exceeded the screening criterion (80 µg/L in MW-3UR and 96 µg/L in MW-14UR).
- Remaining cis-1,2-DCE exceedances were detected in MW-3S (100 µg/L) at the former CCL Label source area and in MW-4S (120 µg/L) and MW-5S (94 µg/L), downgradient of the two source areas.
- Cis-1,2-DCE was detected at levels well below the screening criterion in five bedrock wells: MPW-3 (all 5 ports), MPW-4 (1 of 3 ports), MPW-6 (2 of 3 ports), MPW-7 (all 5 ports), and MPW-10 (all 5 ports). cis-1,2-DCE concentrations ranged from 0.14J µg/L to 2.8 µg/L.
- Vinyl chloride was detected in seven saprolite wells and the results exceeded the screening criterion in four wells. The maximum vinyl chloride concentration of 12 µg/L was detected in MW-3S at the former CCL Label source area.
- Vinyl chloride was detected in two unstable bedrock wells and the results exceeded the screening criterion in one unstable bedrock well (2 µg/L in MW-3UR).
- Vinyl chloride was the only site-related contaminant to exceed its screening criterion in the bedrock aquifer; exceedances were detected only in MPW-3 (all ports, ranging from 1.2 µg/L to 26 µg/L).
- 1,1-DCE was detected in seven saprolite wells and the results exceeded the screening criterion in four wells; the highest concentration was in MW-4S, near the Wallace source area, at 41 µg/L.

[1] J is a laboratory qualifier to indicate that the concentration of a chemical is estimated.

- 1,1-DCE was detected in two unstable bedrock wells below the screening criterion.
- Similar to Round 1, the highest levels and the majority of exceedances of PCE and TCE in Round 2 were found in wells completed in the saprolite zone. Round 2 results were generally slightly higher than Round 1 results in the majority of wells.
- The irrigation well MW-C contained PCE (0.58 µg/L), TCE (1 µg/L), cis-1,2-DCE (5.3 µg/L), and vinyl chloride (0.024J µg/L); all detections were well below the screening criteria.

The majority of PCE and TCE contamination in groundwater occurs in the saprolite zone and in the upper portion of the unstable bedrock zone. The highest contaminant levels occur near the two source areas, and the levels decrease as the plumes move downgradient and become more diluted. However, the two plumes differ in distribution and extent. The PCE plume, which is more extensive and at higher concentrations, is oriented toward the northwest, whereas the TCE plume is oriented toward the north/northwest. (Figure 7).

Several private residential wells were installed illegally in the residential area northwest of the Retiro Industrial Park. None of these wells are currently used for drinking water purposes since all the homes in the area have been connected to the PRASA public water supply system. Currently, some of these wells are used for irrigation purposes. Public awareness sessions to educate the community on the risks of using contaminated groundwater have been conducted and are ongoing.

Selected monitoring wells and newly discovered irrigation wells were sampled in March 2018 to determine if the September 2017 Hurricane Maria resulted in changes to groundwater contamination (Figure 6). Post-Hurricane María samples results generally indicated that this unusually strong storm had little impact on the overall contaminant plumes. Concentrations of PCE and TCE generally were similar to all other rounds of sampling, except at the Wallace source area where results for MW-2S showed an increase in PCE. Overall, concentrations of site-related contaminants are gradually decreasing although the areas of the plumes immediately downgradient of the two source areas remain well above screening criteria.

Monitored Natural Attenuation

Natural attenuation is the process by which contaminant concentrations are reduced by various naturally occurring physical, chemical, and biological processes. The main processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. These processes occur naturally, in-situ, and act to decrease the mass or concentration of contaminants in the subsurface. The groundwater geochemistry and the contaminant distribution in the PCE plume in the saprolite indicate that very limited naturally occurring reductive dechlorination is occurring. However, there is clear evidence of naturally occurring reductive dechlorination in the TCE plume and the portion of the commingled PCE and TCE plumes. Analytical data from MW-3S, MW-3UR, MPW-3, MW-12, MW-14, and MW-14UR demonstrate that the occurrence of anaerobic biodegradation of TCE is ongoing at the source areas, in the PCE and TCE commingled plumes, and in the bedrock portion of the aquifer. These wells show elevated concentrations of degradation products cis-1,2-DCE and vinyl chloride and detections of the degradation product ethene. The dissolved oxygen, nitrate, and ORP indicate favorable geochemical conditions for degradation at these wells. MW-3S in the source area has relatively high levels of ferrous iron and manganese and MW-14 has high ferrous iron, also indicating reducing conditions. Additionally, several years (2013 – 2018) of groundwater monitoring data indicate that the plume fringe is stable. Natural processes of reductive dechlorination, along with dilution and dispersion, are on-going and expected to continue to reduce concentrations in the future.

Summary of Surface Water/Sediment Contamination

- No site-related contaminants were detected in any surface water samples collected from the Río Guanajibo during OU-1 and OU-2 RI investigations.
- During OU-1 piezometer pore water sampling, PCE (at 0.77 µg/L) was detected in one sample at a concentration well below the screening criterion. This very low concentration of PCE detected during OU-1 sampling indicates that groundwater discharges to the Río Guanajibo.
- PCE was not detected in piezometer pore water samples collected during the OU-2 RI investigation.
- Site-related contaminants were detected in surface water samples collected in a small drainage ditch on the northeastern side of the former CCL Label building in the industrial park.
- PCE levels in these samples ranged from nondetect to 25 µg/L, with two exceedances, and TCE levels ranged from 4.6 to 58 µg/L, with three exceedances.
- Vinyl chloride levels, which ranged from 1.1 to 2.9 µg/L, exceeded the screening criterion in all samples.
- The maximum detections of cis-1,2-DCE and 1,1-DCE were 57 µg/L and 0.64 µg/L, respectively. These results are similar to those detected during OU-1.

EPA has a statutory preference to use treatment to address any principal threats posed by a site. Principal threat wastes are those source materials considered to be highly toxic or mobile that generally cannot be reliably contained or would present a significant risk to human health Contaminated groundwater generally is not considered to be a source material. The contamination in the core and fringes of the plume is not considered principal threat waste.

SUMMARY OF SITE RISKS

The purpose of the risk assessment is to identify potential cancer risks and noncancer health hazards at the Site assuming that no further remedial action is taken. A risk assessment was performed to evaluate current and future cancer risks and noncancer health hazards based on the results of the RI. A screening-level ecological risk assessment was also conducted to assess the risk posed to ecological receptors due to Site-related contamination

Human Health Risk Assessment

As part of the RI/FS, a baseline human health risk assessment was conducted to estimate the risks and hazards associated with the current and future effects of contaminants on human health and the environment. A baseline human health risk assessment is an analysis of the potential adverse human health effects caused by hazardous-substance exposure in the absence of any actions to control or mitigate these under current and future land uses.

A four-step human health risk assessment process was used for assessing site-related cancer risks and noncancer health hazards. The four-step process is comprised of: Hazard Identification of Chemicals of Potential Concern (COPCs), Exposure Assessment, Toxicity Assessment, and Risk Characterization (see adjoining box "What is Risk and How is it Calculated").

The baseline human health risk assessment began with selecting COPCs in the various media (i.e., groundwater, and surface water) that could potentially cause adverse health effects in exposed populations. The current and future land use scenarios included the following exposure pathways and populations:

- Residents (child/adult): future ingestion, dermal contact and inhalation of groundwater.

- Recreational (adolescent 12-18): current/future ingestion and dermal contact for surface water from the Rio Guanajibo.

Only future exposure to groundwater was considered since all residents are currently connected to public water. In this assessment, exposure point concentrations were estimated using either the maximum detected concentration of a contaminant or the 95% upper-confidence limit (UCL) of the average concentration. Chronic daily intakes were calculated based on the reasonable maximum exposure (RME), which is the highest exposure reasonably anticipated to occur at the Site. The RME is intended to estimate a conservative exposure scenario that is still within the range of possible exposures. A complete summary of all exposure scenarios can be found in the baseline human health risk assessment.

Groundwater

Risks and hazards were evaluated for the potential future exposure to groundwater. The populations of interest included adult workers and residential adults and children. The cancer risks were above the EPA acceptable ranges. The noncancer hazards were above the EPA threshold of 1. The COCs identified in the groundwater were TCE, PCE, vinyl chloride and cis – 1,2-DCE.

Table 1. Summary of hazards and risks associated with exposure to groundwater via ingestion, dermal contact and inhalation while bathing.

Receptor	Hazard Index	Cancer Risk
Worker – future	34	$3x10^{-4}$
Resident adult – future	317	$4.0x10^{-3}$
Resident child - future	289	
The COCs identified in the groundwater were PCE, TCE, vinyl chloride and cis-1,2-DCE.		

WHAT IS RISK AND HOW IS IT CALCULATED?

<u>Human Health Risk Assessment:</u>
A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current- and future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (*i.e.*, soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants in air, water, soil, etc. identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk;" or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk. For non-cancer health effects, a "hazard index" (HI) is calculated. The key concept for a non-cancer HI is that a threshold (measured as an HI of less than or equal to 1) exists below which non-cancer health hazards are not expected to occur. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a non-cancer health hazard. Chemicals that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at the site and are referred to as Chemicals of Concern or COCs in the final remedial decision or Record of Decision.

Surface Water & Sediment

Risks and hazards were evaluated for the potential future exposure to surface water in the Rio Guanajibo. The population of interest included adolescent recreators. The cancer risks were below or within the EPA acceptable ranges. The noncancer hazards were below or slightly above the value of 1. Although the sum of the hazard quotients slightly exceeds 1 for the sediment pathway, no individual chemical or chemicals that act on the same target organ were above a value of 1. Therefore, there were no COCs identified in the surface water or sediment.

Vapor Intrusion

The potential for vapors to volatilize from contaminated groundwater into buildings that are over the groundwater plume was evaluated as a removal action during the OU1 investigation. Elevated soil gas concentrations of TCE and PCE were detected under several buildings (three commercial buildings and two residential properties). One of the residential properties also had a slight exceedance of the indoor air screening value for TCE. Vapor intrusion in the source area was addressed in the OU-1 ROD. The vapor intrusion pathway in the residential area is considered part of OU-2 and will continue to be monitored.

Ecological Risk Assessment

A screening-level ecological risk assessment (SLERA) was conducted to evaluate the potential for ecological risks from the presence contaminants in contaminated media. The SLERA focused on evaluating the potential for impacts to sensitive ecological receptors from site-related constituents of concern through exposure to surface soil on the properties and surface water, sediment, and pore water from Rio Guanajibo. Surface water, sediment and pore water concentrations were compared to ecological screening values as an indicator of the potential for adverse effects to ecological receptors. A complete summary of all exposure scenarios can be found in the SLERA.

Surface Water: There is a potential for adverse effects to ecological receptors (invertebrates, reptiles, amphibians, birds, and mammals) from exposure to surface water in the Rio Guanajibo. The surface water screening criteria were exceeded for metals (aluminum, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, silver, vanadium and zinc) and three volatile organic compounds (chloroform, toluene and TCE), which resulted in HIs greater than the acceptable value of 1. Based on a review of the historic chemical usage at the Site (i.e., VOCs), the metals were not considered to be site-related and therefore metals were not selected as COCs. The elevated concentration of TCE in surface water was located near a drainage area adjacent to Retiro Industrial Park, in an area with limited viable habitat. Therefore, no adverse effects on survival, growth and/or reproduction of aquatic organisms are expected to occur and no COCs were identified for surface water.

Sediment: There is a potential for adverse effects to ecological receptors (invertebrates, reptiles, amphibians, birds, and mammals) from exposure to sediment in the Rio Guanajibo. The surface soil screening criteria were exceeded for metals (antimony, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, nickel, silver and zinc), which resulted in HIs greater than the acceptable value of 1. However, based on a review of the historical chemical usage at the Site (i.e., VOCs), the metals were not considered to be site-related and therefore there were no COCs selected for sediment from the Rio Guanajibo.

Pore Water: There is a potential for adverse effects to ecological receptors (invertebrates, reptiles, amphibians, birds, and mammals) from exposure to pore water in the Rio Guanajibo. The surface soil screening criteria were exceeded for metals (aluminum, barium, chromium, cobalt, copper, iron, lead, manganese, nickel and vanadium), which resulted in HIs greater than the acceptable value of 1. Based on a review of the historic chemical usage at the Site (i.e., VOCs), the metals were not considered to be site-related and therefore metals were not selected as COCs, therefore there were no COCs selected for pore water from the Rio Guanajibo.

Based on the results of the ecological risk assessment no remedial action is necessary to protect the environment from actual or threatened releases of hazardous substances.

Risk Assessment Summary

Based on the results of the human health risk assessment, it is the lead agency's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as applicable or relevant and appropriate requirements (ARARs), to-be-considered (TBC) guidance and site-specific risk-based levels. The site-related contaminants are chlorinated ethenes and their degradation products, including PCE, TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride. These five VOCs were detected the most frequently and at the highest concentrations in groundwater during the OU-1 and OU-2 RIs.

The contaminated media identified at this site include soil, groundwater and soil vapor. The soil contamination at the Wallace and former CCL Label source areas and the highly contaminated soil and shallow saprolite zone groundwater in the source areas are addressed under the ROD for OU-1 issued in December 2015.

This OU-2 action addresses the sitewide groundwater contaminant plume, including contaminated groundwater below the saprolite zone within the source area footprint.

Site-related contaminants were also detected in surface water samples collected in a small drainage channel on the northeastern side of the former CCL Label and former Baytex buildings. This surface water contamination is expected to be addressed through the remediation of soil and shallow saprolite zone groundwater as part of OU-1. No site-related contaminants were detected in any surface or pore water samples located in Río Guanajibo during OU-2. Therefore, surface water will not be targeted for active remediation.

Based on the currently available data, vapor intrusion into downgradient structures has not been observed. However, vapor accumulation underneath buildings is occuring. Vapor mitigation systems in the source area were part of the OU-1 remedy. Periodic sampling of any downgradient structures will continue and concentrations beneath the slab and in the indoor air will be compared to the appropriate vapor intrusion screening levels (VISLs). The suitable sub-slab contaminant-screening criteria and indoor air concentration requiring mitigation will be based on EPA VISL guidance for residential properties and will be used to monitor sub-slab and indoor air quality over time.

To protect human health and the environment, the following OU-2 RAOs have been identified.

The RAOs for OU-2 groundwater are:

- Prevent or minimize unacceptable risk from exposure (via direct contact, ingestion, or inhalation) to contaminated groundwater attributable to the site
- Restore groundwater to drinking water quality
- Reduce or eliminate the potential for migration of contamination above drinking water standards

PRELIMINARY REMEDIATION GOALS

To meet the RAOs, Preliminary Remediation Goals (PRGs) were developed to aid in defining the extent of contaminated groundwater that would require remedial action under OU-2. PRGs are chemical-specific remediation goals for each media and/or exposure route that are expected to be protective of human health and the environment. They have been derived based on comparison to ARARs and risk-based levels (human health and ecological), with consideration also given to other requirements such as analytical detection limits, guidance values and other pertinent information.

Groundwater at the Site is classified as SG (which includes all groundwater as defined in Puerto Rico's Water Quality Standards Regulation [May 2016]), suitable for drinking water use, and is used as a potable water supply source in areas outside of the contaminated plume. Therefore, federal drinking water standards are relevant and appropriate requirements. Puerto Rico Water Quality Standards are promulgated and applicable standards for this Site. Table 3 at the end of this Proposed Plan presents the PRGs for groundwater at this Site.

EPA expects the remedial alternatives considered in this Proposed Plan to comprehensively address groundwater contamination and achieve the remediation goals. EPA also expects the implementation of this action will overlap with the already selected OU-1 remedy.

SUMMARY OF REMEDIAL ALTERNATIVES

CERCLA § 121(b)(1), 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, be cost-effective, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions, which employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants and contaminants at a site. CERCLA § 121(d), 42 U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA § 121(d)(4), 42 U.S.C. § 9621(d)(4).

The time frames presented below for each alternative reflect only the time required to construct or implement the remedy and do not include the time required to design the remedy, negotiate the performance of the remedy with any potentially responsible parties, or procure contracts for design and construction. The precise timeframe to achieve RAOs in the groundwater is dependent on remediation of the source areas and plume core. Therefore, long-term groundwater monitoring would ensure that RAOs are achieved at the Site

The cost estimates, which are based on available information, are order-of-magnitude engineering cost estimates that are expected to be within +50 to -30 percent of the actual cost of the project.

<u>Common Elements</u>

There are several common elements that are included in all active remedial alternatives. The common elements listed below do not apply to the No Action alternatives.

Pre-Design Work

A pre-design investigation (PDI) would be conducted as part of the remedial design. A PDI would be conducted to delineate the vertical extents of the treatment zone in the saprolite and unstable bedrock zone. Additional monitoring wells would be drilled at the Wallace source area, the former CCL Label source area, and selected downgradient areas where the treatment system would be installed.

Institutional Controls

Institutional controls would be needed to restrict the use and exposure to contaminated groundwater until the contaminant levels are reduced to the PRGs or no longer pose any risks to human health. The types of institutional controls employed to prevent exposure to contaminated groundwater could include restrictions on installation of drinking water wells and restrictions on groundwater use at locations within the contaminated areas. The effectiveness of selected institutional controls would depend on their continued implementation. The reliability of institutional controls depends on the ability to enforce them, availability of resources for inspections, and compliance with the restrictions.

More information about Institutional Controls can be found at: http://www.epa.gov/fedfac/pdf/ic_ctzns_guide.pdf

Long-term Groundwater and Vapor Monitoring of the Plume Fringe

Long-term monitoring would be conducted in the plume fringe, which includes monitoring contamination in the fractured bedrock aquifer and the deep unstable bedrock zone below the active treatment area. The monitoring program would involve periodic collection of groundwater samples for the evaluation of contaminant migration, MNA and continued protection of human health and the environment.

Once the active treatment in the plume core (where concentrations of either PCE or TCE exceed 100 µg/L) is terminated, any remaining low contamination in the plume fringe (where concentrations of these contaminants are between 5 µg/L and 100 µg/L) and in the overall plume would also be included under the long-term monitoring and MNA program. Based on multiple lines of evidence, monitored natural attenuation is expected to continue to reduce concentrations over time. The contaminant plume is located in a densely populated residential/commercial area and available locations for implementing treatment areas outside the plume core are limited. Additionally, targeting higher concentrations (i.e., 100 µg/L and higher) will address the highest contaminant mass.

Groundwater monitoring data would also be used for the evaluation of possible areas of vapor accumulation underneath structures. Sub-slab and indoor air samples would be collected periodically for vapor VOC analysis. Vapor mitigation systems would be installed as necessary.

Five-Year Reviews

Alternatives resulting in contaminants remaining above levels that allow for unrestricted use and unlimited exposure, require that the Site be reviewed at least once every five years. If justified by the review, additional remedial actions may be considered to remove, treat, or contain the contamination. For remedial actions where, unrestricted use and unlimited exposure is the remedial objective, it may require many years to reach that objective. It is EPA policy to conduct five-year reviews until remediation goals are achieved.

EPA expects that this Site will require more than five-years to remediate; however, because the OU-1 and OU-2 remedies are expected to be closely aligned, the need for a five-year review will be comprehensively addressed. EPA would conduct five-year reviews for OU-1 until RAOs are achieved within the source area and for OU-2 until RAOs are achieved in groundwater.

EPA Region 2 Clean and Green Policy

The environmental benefits of the preferred remedy may be enhanced by giving consideration, during the design, to technologies and practices that are sustainable in accordance with EPA Region 2's Clean and Green Energy Policy.[2] This will include consideration of green remediation technologies and practices. Some examples of practices that would be applicable are those that reduce emissions of air pollutants, minimize fresh water consumption, incorporate

[2]See https://www.epa.gov/greenercleanups/epa-region-2-clean-and-green-policy.

native vegetation into revegetation plans, and consider beneficial reuse and/or recycling of materials, among others.

Remedial Alternatives

The alternatives developed for the plume are described below. The selected alternative would be coordinated with the OU-1 source zone remedy to provide remediation of the overall site.

<u>Remedial Alternatives</u>

Alternative 1 – No Action

Capital Cost	$0
Present Worth O&M Cost	$0
Total Present Worth Cost	$0
Timeframe to meet RAOs	Will not meet RAOs

The No Action alternative is required by the NCP to be carried through the screening process. The No Action alternative would include no action being taken and serves as a baseline for comparison of remedial alternatives.

Alternative 2 – Groundwater Extraction, Ex Situ Treatment and MNA

Capital Cost	$ 7,800,000
Present Worth O&M Cost	$13,900,000
Total Present Worth Cost	$21,700,000
Construction Time Frame	2.5 -3 years
Timeframe to meet RAOs	Greater than 30 years

Under this alternative, groundwater extraction wells would be installed at the Retiro Industrial Park and downgradient portion of the plume core to intercept the contaminant plume and minimize further plume migration. The major components of this alternative are:

- PDI
- Remedial design (RD)
- Installation of groundwater extraction wells at the plume core
- Construction of pipeline and groundwater treatment system.
- O&M of the groundwater extraction and ex situ treatment system (air stripping, vapor-phase GAC and liquid-phase GAC)
- Monitoring of the plume fringe to evaluate migration and natural attenuation
- Institutional controls
- Five-year review
- For cost estimating purposes, it is assumed the treatment zone is from ground surface to 20 feet bgs.

Under this alternative, groundwater extraction wells would be installed in the plume core to remove contaminated groundwater to minimize contaminant downgradient migration and facilitate the cleanup of the contaminant plume over the long-term. The groundwater model developed during the RD would be updated as necessary and used to simulate groundwater extraction and determine the locations and numbers of extraction wells, the extraction well screen intervals, and the groundwater extraction rates. For the FS, an analytical groundwater flow calculation was conducted to estimate the number of extraction wells and the extraction rates.

It is assumed that vertical extraction wells would be installed in two areas of the plume core. It is expected that an extraction well fence would be installed at the north of Wallace, immediately downgradient of the Wallace source areas, and at the former CCL Label source area (Line #1). Another extraction well fence would be installed along Calle 2 and Calle B (Line #2).

Wells at Line #1 would consist of well clusters screened in the saprolite and unstable bedrock zone. Wells at Line #2 would be screened across the lower saprolite and the upper unstable bedrock zone. For cost-estimating purpose, 29 extraction wells are assumed for this alternative. It is also assumed that these wells would be 6-inch and installed using mud rotary drilling method. All the wells would be completed flush mount, with a traffic-rated vault.

The plume core would be actively remediated under this alternative, whereas the plume fringe would be monitored for continued protection of human health and the environment.

Alternative 3 – In Situ Treatment and MNA

Under this alternative, in situ treatment would be conducted at the Wallace and former CCL Label properties and in the downgradient portion of the plume core. The conceptual approach for this alternative involves recirculating bioremediation amendment at Wallace and former CCL Label facilitates and installing two biobarriers in the plume core. Other approaches may be developed during the RD. The major components of this alternative include:

- PDI
- RD
- In situ treatment at the plume core
- Monitoring of the plume fringe to evaluate migration and natural attenuation
- Institutional controls
- Five-year review

For cost estimating purposes, it was assumed that two treatment barriers would be installed using either horizontal or vertical injection wells to intercept the contaminant plume and minimize contaminant migration (see figures 8 and 9). Both horizontal and vertical injection wells were considered for cost estimating in this area. While installation of horizontal wells would require a large staging area and enough distance for the lead pipe to be drilled to the target depth, vertical injection wells would need to be spaced approximately 30 feet apart; thus, a large number of vertical wells would be required. It is estimated that 60 vertical injection wells would be necessary to cover the same area as two horizontal wells in the plume core. The installation of 60 vertical injection wells would likely cause disruption to the local community for an extended period of time. Figure 8 presents the conceptual approach using two horizontal injection wells; Figure 9 presents the conceptual approach using vertical injection wells. The orientation of the injection wells will be evaluated in the PDI.

A wide range of amendments are commercially available, such as EVO, whey, LactOil™, or Plume Stop™, that would last 2 years or longer. A pilot study would be conducted at a location feasible for the installation of a full-scale treatment barrier to collect site-specific design parameters such as injection rate, radius of influence, longevity of the amendment and the number of expected injections.

Capital Cost	$13,300,000
Present Worth O&M Cost	$4,000,000
Total Present Worth Cost	$17,300,000
Construction Time Frame	4 years
Timeframe to meet RAOs	30 years or longer

The plume core would be actively remediated under this alternative, whereas the plume fringe would be monitored for continued protection of human health and the environment.

EVALUATION OF REMEDIAL ALTERNATIVES

The NCP lists nine criteria for evaluation and comparison of remedial alternatives. This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, and how each of the alternatives compares to the other options under consideration. Seven of the nine evaluation criteria are discussed below. The final two criteria, "State Acceptance" and "Community Acceptance" are discussed at the end of the document. A more detailed analysis of each of the alternatives is presented in the FS report.

Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

Alternative 1, No Action, would not meet the RAOs and would not be protective of human health and the environment because no action would be taken. Without the implementation of institutional controls, human exposure to site contamination would not be prevented. Even though the soil and highly contaminated groundwater at the source areas serving as sources for groundwater contamination would be treated under OU-1, contaminants concentrations downgradient of the source areas are still significantly elevated and would go untreated. Under Alternative 1, no mechanisms would be implemented to reduce the toxicity, mobility and volume of the contamination except through natural processes that would not be monitored to assess the effectiveness or predict the duration of this alternative.

Alternatives 2 and 3 would be effective in protecting human health and environment. Institutional controls would prevent future human exposure to groundwater contamination. Alternative 2 would remove contaminants through groundwater extraction and ex situ treatment; Alternative 3 would destroy contaminants in the subsurface. Over time, the entire contaminant plume would be remediated. Both alternatives would achieve the groundwater RAOs. However, the rate of contaminant removal by the groundwater extraction and ex situ treatment system would likely reach an asymptotic level in the long-term because the rate of contaminant removal by groundwater extraction would be limited by the complex geology at the site. Alternative 3 is expected to achieve the PRGs faster than Alternative 2.

Compliance with ARARs

Alternative 1 would not achieve chemical-specific ARARs or PRGs. Location- and action-specific ARARs would not apply with Alternative 1 because no remedial action would be conducted. Alternatives 2 and 3 are anticipated to satisfy the chemical-specific ARARs by achieving the PRGs in the future and would be designed and implemented to comply with location- and action-specific ARARs. Location-specific-ARARs will be met by using floodplain management during the design and implementation of the selected alternative, as both alternatives propose subsurface disturbance within the 0.2% and 1% annual chance flood hazard zones. Wetlands and archeological zones in the area will not be impacted with the proposed subsurface disturbance.

Long-Term Effectiveness and Permanence

Alternative 1, No Action, would not provide long-term effectiveness and permanence because no action would be implemented to reduce the level of contamination or the potential for exposure to contaminated groundwater to site receptors.

Alternatives 2 and 3 would provide long-term effectiveness because they combine treatment, long-term monitoring, MNA and institutional controls to protect human health and the environment. For Alternative 2, contaminants would be extracted and treated ex situ. The rate of contaminant removal is expected to be slower than Alternative 3 because groundwater extraction and treatment could not be as focused in the source areas where the original releases of contaminants occurred due to space and logistical constraints. The technology proposed in Alternative 3 would be easier to target areas with the highest contamination and is expected to result in lower residual concentrations of contaminants than Alternative 2.

Even though the sources of groundwater contamination in the vadose zone and shallow saprolite would be treated under OU-1, there are most likely residual high levels of contamination in the unstable bedrock zone, especially at Wallace, which would require a long time to be flushed out by natural groundwater flow.

Alternative 3 is expected to provide additional long-term effectiveness because it would target the area where original contaminant releases occurred—the saprolite and unstable bedrock zone below the OU-1 source areas—and would destroy the contaminants in situ. The residual contaminant concentrations are expected to be lower under Alternative 3 than Alternative 2.

Alternative 2 uses proven technology to remove contaminated groundwater from the subsurface and is reliable. However, the residual contaminant concentrations could be higher than the PRGs for a long time because this technology tends to have reduced efficacy on contaminant removal in the long-term. Alternative 3 uses innovative technologies that have been tested in full-scale field application (i.e. implemented at other remediation sites). In situ bioremediation technology has been demonstrated at many sites to be effective and reliable in reducing contaminant mass in the source areas and in the contaminant plume.

Using vertical injection wells has been implemented at many sites; using horizontal wells for amendment injection has also been tested at sites with effective results. The reliability of institutional controls under Alternatives 2 and 3 would rely on the enforcement of local government and the understanding and willingness of residents to comply with intuitional controls. The effectiveness of these alternatives would be assessed through routine groundwater monitoring and five-year reviews.

Reduction of Toxicity, Mobility, or Volume (T/M/V) Through Treatment

Alternative 1, No Action, would not reduce contaminant T/M/V because no remedial action would be conducted. Contaminant concentrations are expected to decrease over time due to remediation under OU-1 and natural attenuation, however.

Both Alternatives 2 and 3 would reduce T/M/V through treatment. Alternative 2 would remove contaminated groundwater and treat it ex situ, whereas Alternative 3 would biologically or chemically treat and destroy contamination in situ. The extent and effectiveness of T/M/V reduction would need to be verified with monitoring results. It is expected that Alternative 3 would have higher T/M/V reduction than Alternative 2 because Alterative 3 would target the area and vertical zones directly below the contamination sources under OU-1.

Short-Term Effectiveness

Under Alternative 1, the No Action alternative, there would be no short-term impact to the community, environment, and site workers as no remedial action would occur. There would be short-term impacts to the local community and site workers for Alternatives 2 and 3 due to the active remedial actions undertaken and associated construction, operation, and maintenance activities. Alternative 2 would require the installation of a large number of vertical groundwater extraction wells and a pipeline through a densely populated residential community, which would impact residents' daily life.

Alternative 3 is assumed to use horizontal wells for amendment injection, which would have much less impact to the local community. However, if vertical injection wells are used under Alternative 3, it would involve the installation of a larger number of wells than Alternative 2, which could have a greater impact on the local community. Alternative 3 also involves the presence of an amendment injection crew and equipment, potentially in the residential community. Under Alternatives 2 and 3, careful planning and public communication would be required for implementation to minimize negative impacts to the local community.

Impact from collecting groundwater samples from sitewide monitoring wells for the long-term monitoring and MNA program would be minimal. For Alternatives 2 and 3, air monitoring, engineering controls, and appropriate personal protective equipment would be used to protect the community and workers from any exposure to contamination.

The construction period for Alternative 2 is estimated to be 2.5 to 3 years, including an initial 1 year for system startup, testing, and optimization operation. O&M of the groundwater extraction wells and the groundwater treatment system is expected to be much longer than the 30-year-period usually evaluated for an FS.

The construction period for Alternative 3 is estimated to be 4 years, assuming the in-situ treatment at the Retiro Industrial Park would be conducted first, then at the downgradient plume area. It is also assumed that one round of replenishment of amendment for the treatment zones would be required after the initial amendment injection after which the entire contaminant plume would be under a long-term monitoring program, which may be required for 30 years or longer.

Implementability

Alternative 1, the No Action alternative, would be easiest to implement both technically and administratively as no additional work would be performed at the Site.

Alternatives 2 and 3 would be constructible and operable because services, materials, and experienced vendors would be available. Alternative 2 would require installation of a large number of wells and interconnecting piping through a residential neighborhood, which would require acceptance and coordination with the community. Drilling and installation of a large number of extraction wells in the unstable bedrock zone would be challenging due to potential borehole collapse; however, mud rotary or sonic drilling methods may mitigate this concern. Alternative 2 also requires space for a treatment plant, which could use existing vacant buildings and should not be an implementability issue.

Construction of Alternative 2 would require a thorough survey of utilities and the implementation needs to be designed to avoid interruption or damage to utilities. Ex situ treatment equipment, such as the air stripper, might need to be manufactured and shipped from off the island. Currently, the local publicly owned treatment works (POTW) is operating under the designed capacity. With the appropriate permits and approvals, the treated water may be discharged to the local POTW.

For implementing Alternative 3, horizontal injection wells are assumed in this FS for cost estimating purposes. Experienced vendors are available for the installation of horizontal wells for chemical injection. However, the equipment and crews for horizontal well installation and amendment injection would need to be transported from off the island. Under Alternative 3, potential disruption to existing utilities by horizontal well drilling and installation is minimal because the horizontal wells would be installed at a deep depth at which utilities would be unlikely to be present. Horizontal well installation would require one or two large staging areas. Currently, there are large open spaces available to serve as the staging areas; permission to use those areas would likely be obtainable. During the remedial design, the use of vertical injection wells and horizontal injection wells would be evaluated to determine a cost-effective approach. If vertical injection wells are used, a larger number of vertical wells would be required for Alternative 3 than for Alternative 2, and careful well installation would be required so as to not impact utilities.

For both Alternatives 2 and 3, health and safety measures would be implemented to protect the local community and the construction workers. Equipment and working hours that would minimize impact of noise would be utilized. The time for construction would also be scheduled to minimize impact to local community to the extent practical.

Cost

The cost estimates for all alternatives are provided using a seven percent discount rate.

Alternative	Capital Cost	Present Worth O&M Cost	Total Present Worth Cost
1	$ 0	$0	$0
2	$7,800,000	$ 13,900,000	$21,700,000
3	$13,300,000	$4,000,000	$17,300,000

Commonwealth/Support Agency Acceptance

The PREQB concurs with the preferred remedy in this Proposed Plan.

Community Acceptance

Community acceptance of the preferred remedy will be evaluated after the public comment period ends and will be described in the Responsiveness Summary section of the ROD for this Site. The ROD is the document that formalizes the selection of the remedy for a site.

PREFERRED REMEDY

Alternative 3 (In Situ Treatment and MNA) is the preferred alternative for the OU-2. Under this alternative, in situ treatment would be conducted at the Wallace and former CCL Label properties and in the downgradient portion of the plume core. The conceptual approach for this alternative involved recirculating bioremediation amendment at Wallace and former CCL Label facilitates and installing two biobarriers at the plume core. The approach may be refined during the RD.

The plume core would be actively remediated under this alternative, whereas the plume fringe would be monitored for the continued protection of human health and the environment.

BASIS FOR REMEDY PREFERENCE

The Preferred Alternative is believed to provide the best balance of tradeoffs among the alternatives based on the information available to EPA at this time. EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element. The preferred alternative can change in response to public comment or new information.

The environmental benefits of the preferred remedy may be enhanced by consideration, during the design, of technologies and practices that are sustainable in accordance with EPA Region 2's Clean and Green Energy Policy. This would include consideration of green remediation technologies and practices.

Table 3
Preliminary Remediation Goals for Groundwater
San German Groundwater Contamination Site OU-2
San German, Puerto Rico

Site Contaminants	Puerto Rico Water Quality Standards (PRWQS)[1] (µg/L)	National Primary Drinking Water Standards (EPA MCLs)[2] (µg/L)	PRGs[3] (µg/L)	Maximum Detected Concentrations[4] (µg/L)	Well ID with Maximum Concentration[5]
Volatile Organic Compounds					
Tetrachloroethene	5	5	5	11,000	MW-2S
Trichloroethene	5	5	5	890	MW-3S
cis-1,2-Dichloroethene	NL	70	70	310	MW-12
Vinyl Chloride	0.25	2	0.25	29	MPW-3-P1
1,1-Dichloroethene	7	7	7	73	MW-4UR

Notes:

1. Puerto Rico Water Quality Standards (PRWQS) Regulation, Environmental Quality Board, Commonwealth of Puerto Rico, May 2016.
2. EPA National Primary Drinking Water Standards (web page), EPA 816-F-09-004, May 2009.
3. Based on the lower value between PRWQS and EPA MCLs.
4. The maximum concentrations detected at the Site during OU-2 remedial investigation.
5. Well ID associated with the maximum concentration detected at the Site during OU-2 remedial investigation.

Acronyms:

EPA - United States Environmental Protection Agency
MCLs - Maximum Contaminant Levels
NL - not listed
PRGs - Preliminary Remediation Goals
µg/L - microgram per liter

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Page 1 of 1

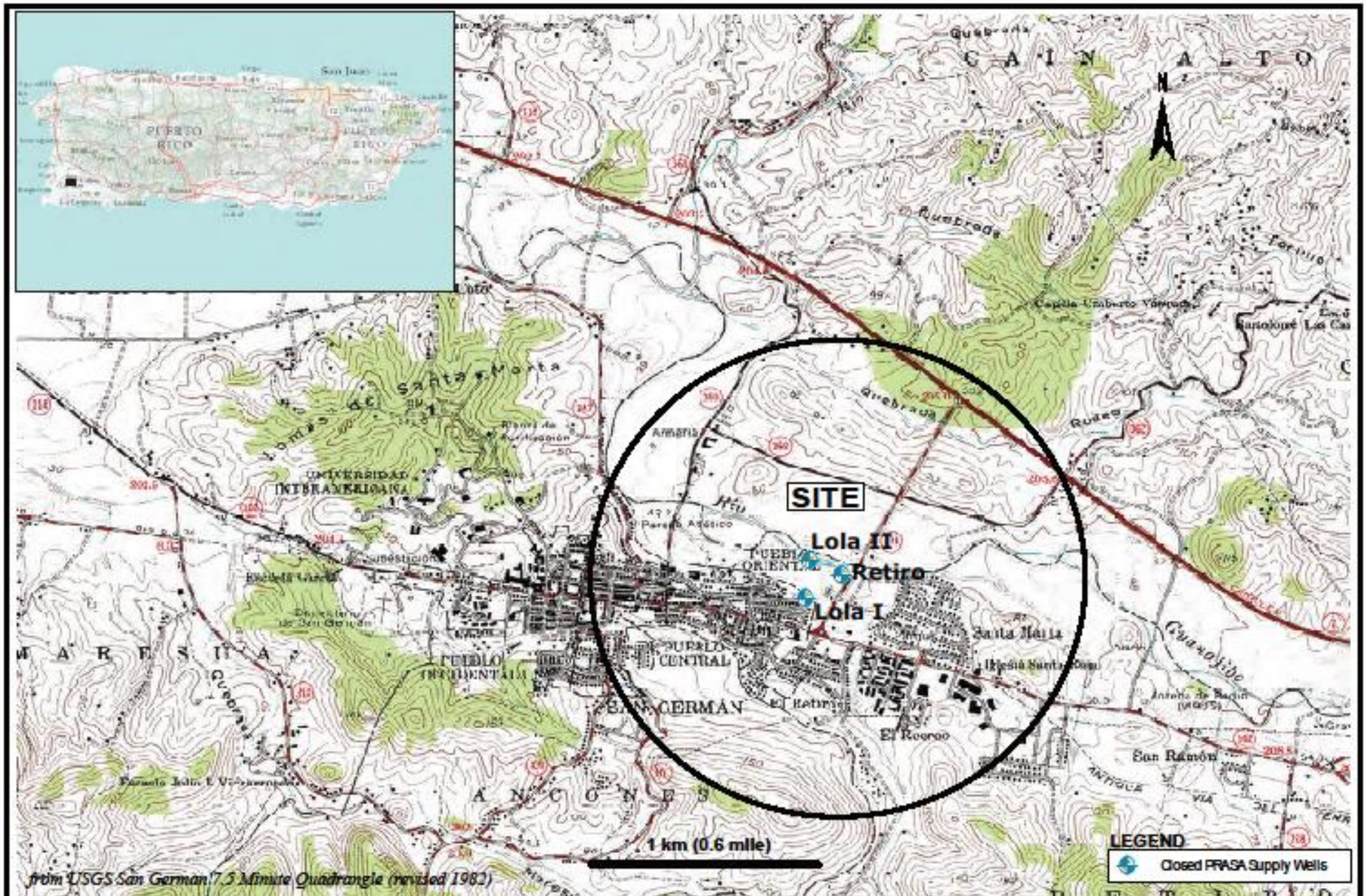

Figure 1
Site Location Map
San German Groundwater Contamination Site
San German, Puerto Rico

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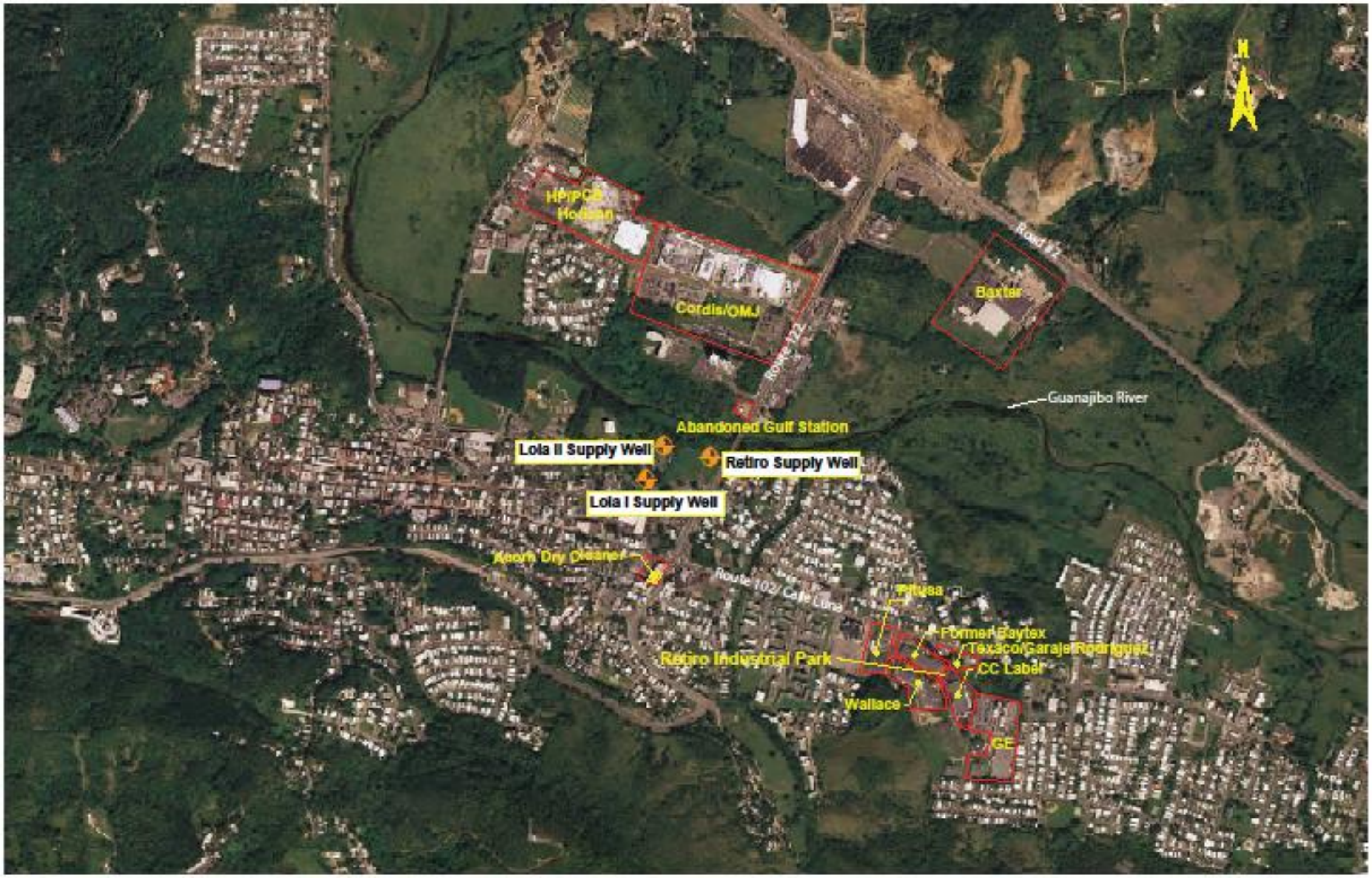


Figure 2
Site Map
San German Groundwater Contamination Site
San German, Puerto Rico

CDM Smith

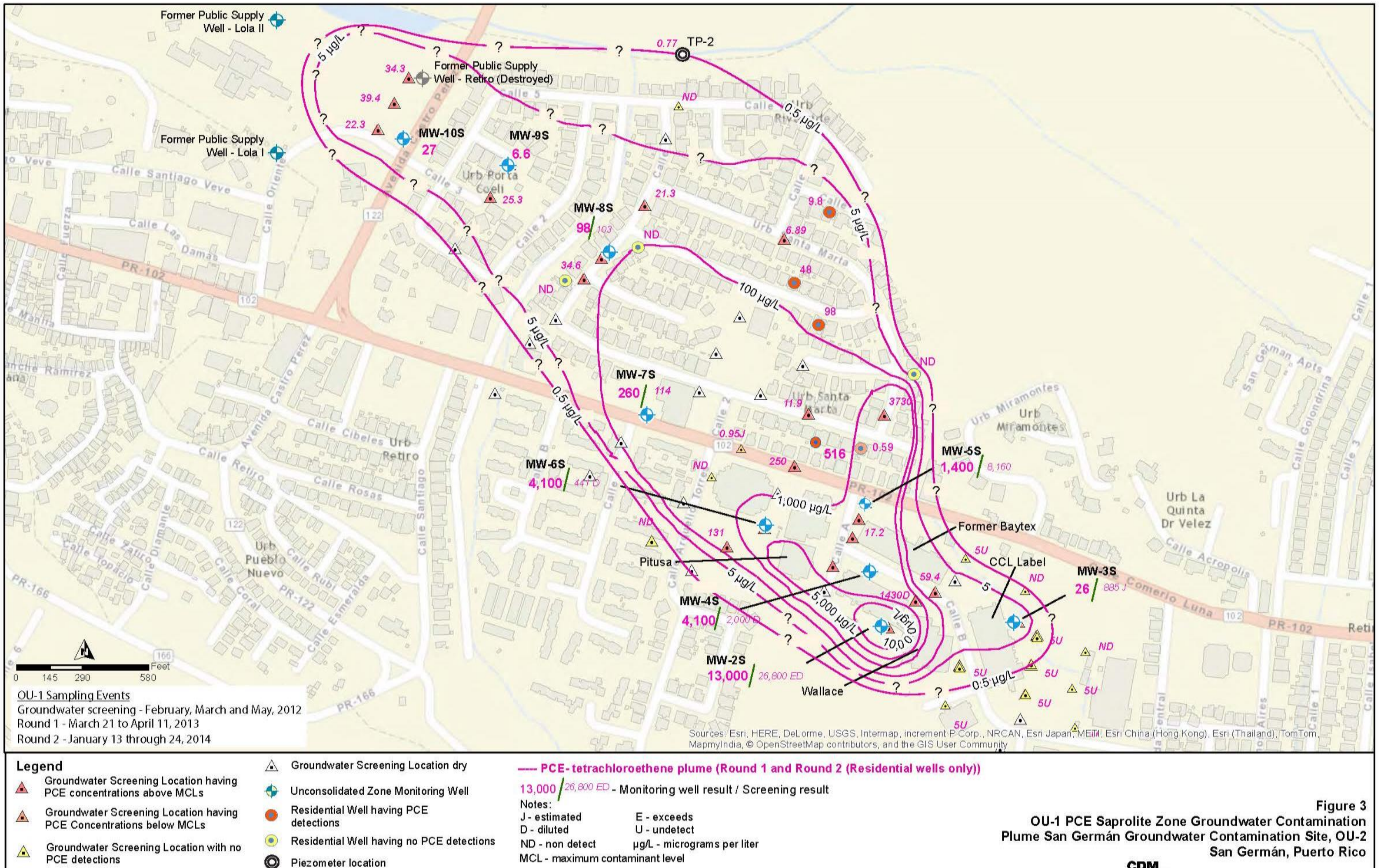


Figure 3
OU-1 PCE Saprolite Zone Groundwater Contamination
Plume San Germán Groundwater Contamination Site, OU-2
San Germán, Puerto Rico

Figure 4
OU-1 TCE Saprolite Zone Groundwater Contamination Plume
San Germán Groundwater Contamination Site, OU-2
San Germán, Puerto Rico

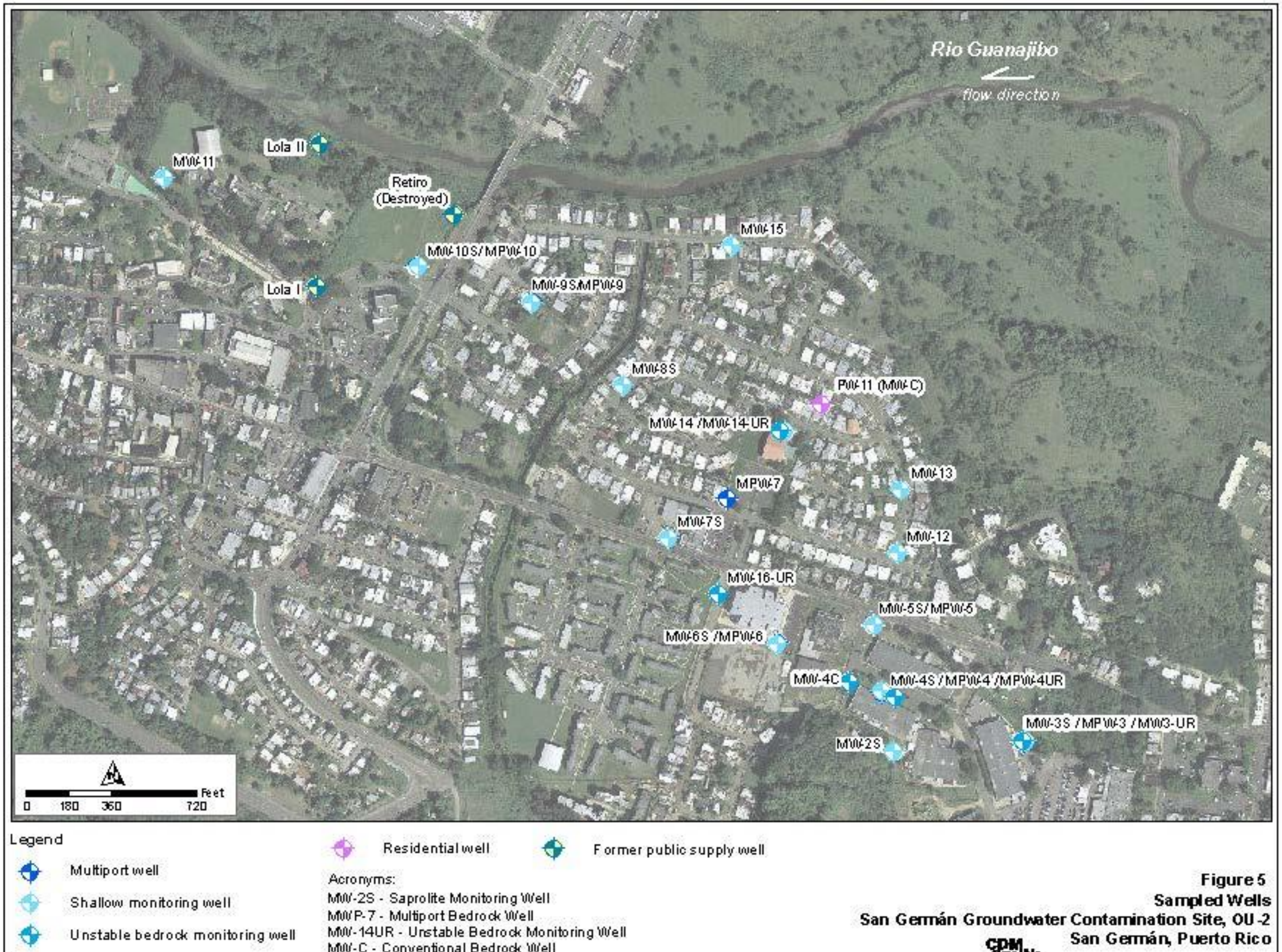
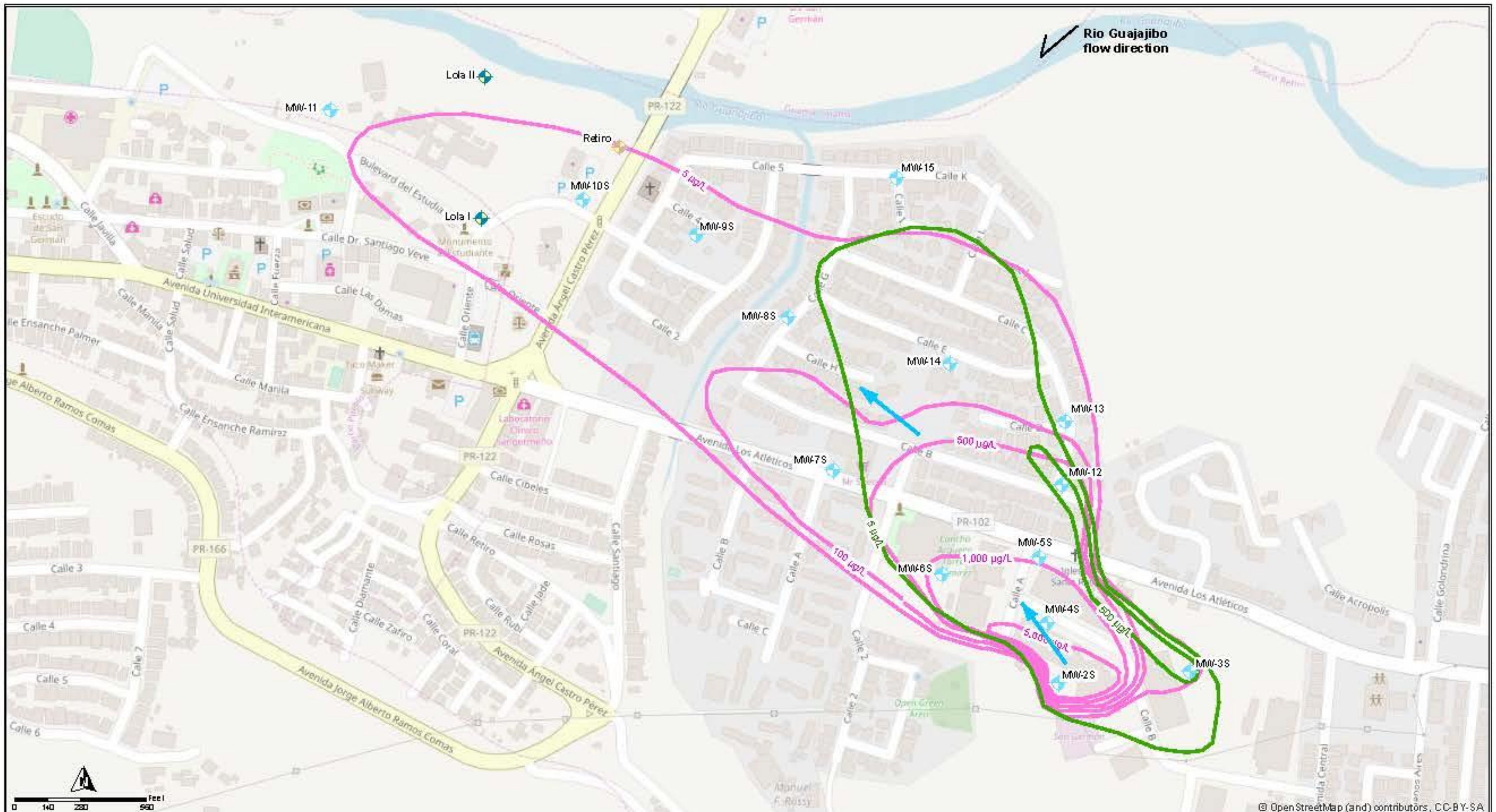


Figure 5
Sampled Wells
San Germán Groundwater Contamination Site, OU-2
San Germán, Puerto Rico


Rio Guanajibo
flow direction
MW-10S
PW-6
PW-9
MW-8S
PW-4
PW-1
PW-5
PW-11 (MW-C)
PW-7
MW-13
PW-3
MW-7S
PW-10
PW-2
PW-8
MW-5S
MW-6S
MW-4S
MW-4UR
MW-3UR
MW-3S
MW-2S
Legend
Monitoring well location
Residential well location
Rio Guanajibo
Miles
0 0.015 0.03 0.06 0.09 0.12
Figure 6
Post-Hurricane María Sampled Monitoring and Residential Well Location Map
San Germán Groundwater Contamination Site, OU-2
San Germán, Puerto Rico
CDM Smith



Legend

- Former public supply well
- Saprolite monitoring well
- TCE isocontour in µg/L
- PCE isocontour in µg/L
- Destroyed former public supply well
- Groundwater flow direction

Acronyms:
PCE - tretrachloroethylene
TCE - trichloroethylene
OU - Operable Unit

Notes:
1 - Given the elevated PCE detection and elevated TCE detection limit,TCE is expected to be present at MW-2S at concentrations above 5 micrograms per liter (µg/L) and therefore is included in the contour line.

2 - Monitoring well PCE and TCE detections are included on Figures 4-5 and 4-7.

Figure 7
PCE and TCE Saprolite Zone Round 1 Plumes Map
San Germán Groundwater Contamination Site, OU-2
San Germán, Puerto Rico

CDM Smith

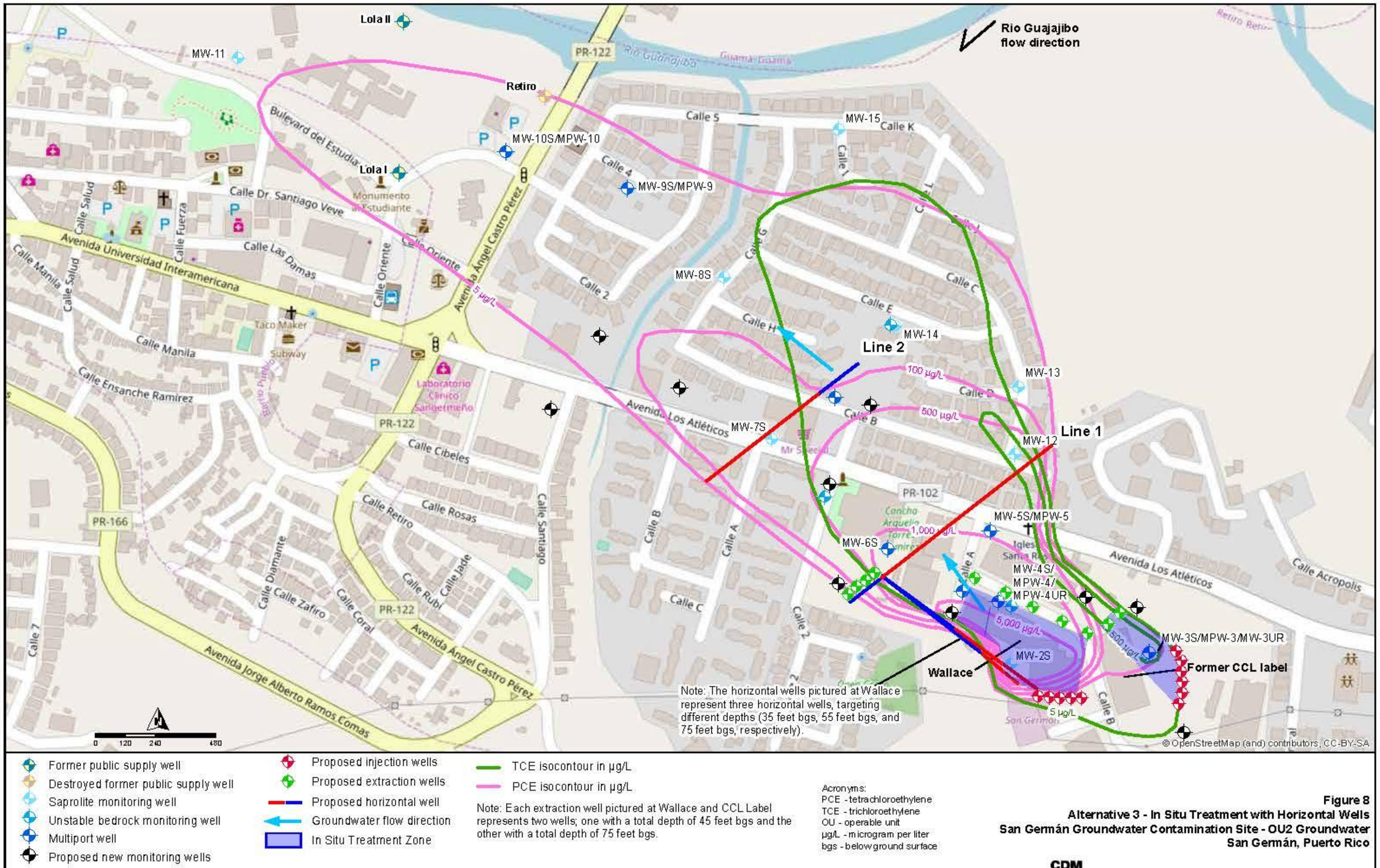


Figure 8
Alternative 3 - In Situ Treatment with Horizontal Wells
San Germán Groundwater Contamination Site - OU2 Groundwater
San Germán, Puerto Rico

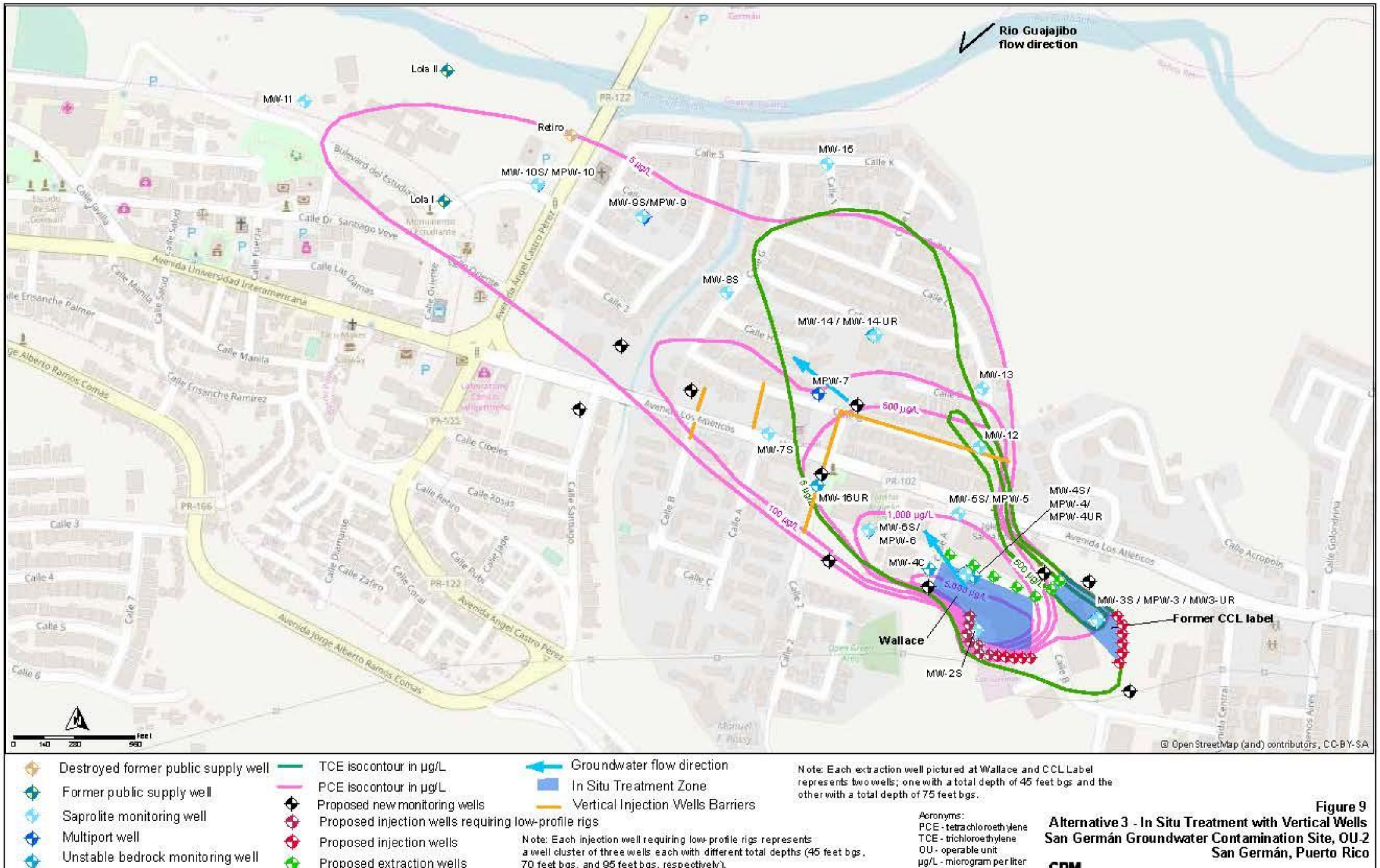


Figure 9
Alternative 3 - In Situ Treatment with Vertical Wells
San Germán Groundwater Contamination Site, OU-2
San Germán, Puerto Rico