STATEMENT OF BASIS/REQUEST FOR PUBLIC COMMENTS

REGION 2

Chevron Phillips Chemical Puerto Rico Core, L.L.C.
Guayama, Puerto Rico
EPA ID Number: PRD991291972

Facility/Unit type:	Specialty Chemicals Production
Constituents:	Groundwater and Soil – Benzene, Toluene, Ethylbenzene, Xylenes, and Sulfolane Sediment – Chromium, Copper, Manganese, Nickel, and Zinc
Media:	Groundwater, Soil, and Sediment
Proposed Remedy:	Groundwater – In-Situ Chemical Oxidation using Catalyzed Hydrogen Peroxide for both Shallow and Deep Groundwater Soil – Biological Treatment in Land Farm Treatment Cells Sediment – Excavation and Off-Facility Disposal in Permitted Landfill

FACILITY DESCRIPTION

The Chevron Phillips Chemical Puerto Rico Core, LLC (CPCPRC) facility is approximately 211 acres in size and located in Guayama, the southeast coast of Puerto Rico, refer to Figure 1, Location Map. The CPCPRC facility (hereinafter the Facility) is located approximately 0.25 miles north of the Caribbean Sea at 17°56'45" north latitude and 66°08'30" west longitude in Guayama, Puerto Rico.

CPCPRC operated a specialty chemicals production facility at the Facility from 1966 to 2008 after which operations ceased and facility demolition began. Prior to 1966 the land was used for sugar cane cultivation. The facility was constructed to primarily refine naphtha into hydrocarbon products such as benzene, toluene, xylenes, cyclohexanes, liquid petroleum gas, gasoline and diesel fuels (CPCPRC, 2015a).

A man-made harbor, Las Mareas Harbor, was built approximately one-half mile southwest of the operation area. CPCPRC previously leased a small portion of land at the harbor to receive and ship products for CPCPRC. During facility demolition, CPCPRC's portion of the harbor area underwent Resource Conservation and Recovery Act (RCRA) clean closure in 2010. This RCRA closure included the two ballast water retention basins (ballast water basins) CPCPRC used during operations.

Additionally, on-facility were two hazardous waste management units (HWMUs) and three lime ponds. All residual lime was removed from the lime ponds and disposed offsite at a PREQB landfill as non-hazardous waste. The lime ponds were then graded and backfilled. The two HWMUs (oxidation pond and off-specification pond) were clean closed under RCRA in 2013. All clean closures were approved by EPA and PREQB. Currently, the Facility is completely demolished and no processing structures remain.

In 1995 the U.S. Environmental Protection Agency (EPA) and CPCPRC's predecessor, Phillips Puerto Rico Core Inc., entered into an Administrative Order on Consent (Consent Order). The Consent Order required that CPCPRC initiate a Resource Conservation and Recovery Act Facility Investigation (RFI) to evaluate soil, sediment, air, groundwater, and surface water impacts. Investigations have been ongoing at the Facility since 1995.

The initial RFI was initiated in 1995 and was approved by EPA in 2000. The RFI presented the results of multiple phases of investigation conducted between 1995 and 1999 to determine the nature and extent of contamination (CPCPRC, 2016c) and focused on the ten operable units (OU) defined in the Consent Order. The constituents of concern (COCs) identified at the Facility at that time were benzene, toluene, ethylbenzene, and xylenes (BTEX). Between 1999 and 2006, facility- wide risk characterization work was conducted along with additional investigations to refine the understanding of the nature and extent of contamination and the underlying groundwater system beneath the Facility and in off-facility areas where contamination was identified. The risk characterization was completed in 2004 and approved by EPA in 2005.

In addition to the investigations, CPCPRC has been implementing Enhanced Fluid Recovery (EFR) in focused areas since 1996. The EFR is a mobile variation of what is known as dual-phased extraction. The system extracts fluids (i.e., vapor, dissolved, adsorbed, and liquid) into a tank for temporary containment for treatment using an air stripper, permitted under EQB Air Permit #PFE-RG-30-0515-0345-I-II-O and EQB Operating Permit #C-AG-12-30-0001. The treated water is discharged to the adjoining Puerto Rico Aqueduct and Sewer Authority (PRASA) wastewater system, under Authorization #AUA-E-11-507-001. The treated water is discharged to the Puerto Rico Aqueduct and Sewer Authority (PRASA). Over the years there has been a significant reduction in the dissolved phase benzene concentrations in several monitoring wells along with the absence of light non-aqueous phase liquid (LNAPL). This interim measure has been effective in providing significant improvement in the groundwater quality at the facility. The performance of the EFR system is reported to EPA and Puerto Rico Environmental Quality Board (PREQB) in quarterly reports and an annual summary report.

In addition to the EFR, CPCPRC implemented a Voluntary Interim Stabilization Measure (VISM) in 1996 to address benzene contamination in shallow groundwater near the southeastern boundary of the Facility. The VISM consists of an air sparging trench, vapor recovery system and vapor treatment units. CPCPRC has been tracking BTEX concentrations in this area for the last 20 years. The BTEX levels observed in the groundwater are well below the target VISM goal of 200 milligrams per Liter (mg/L) for all VISM wells and piezometers. The performance of the VISM is reported to EPA and PREQB in semi-annual progress reports.

In 2009 the CPCPRC facility ceased operations and began dismantling the equipment, tanks, piping and process units. Also during this time, CPCPRC began characterization activities that included sampling of soil in areas exposed by demolition. Sampling efforts completed during this time identified 19 Areas of Concern (AOCs). Although the RFI had been approved in 2000, the results of the post-demolition field sampling indicated more investigation was needed. Because of this, EPA requested that the next phase of corrective action work prescribed in the Order, the Corrective Measures Study (CMS), be put on hold until further post-demolition investigations were completed. In 2013 CPCPRC submitted the Final AOC Investigation Report. However, based on PREQB and EPA comments on this report, it was determined still more investigation was needed. Specifically, a supplemental RFI (SRFI) investigation was required to address data gaps regarding the nature and extent of sulfolane contamination in soil and groundwater. Sulfolane is an organic solvent that was used as part of the petroleum refining process. The SRFI was performed between 2013 and 2014 and identified 15 Areas of Interest (AOIs). The Final SRFI Report was completed and approved by EPA in 2015 and EPA determined that investigations were complete.

Subsequently, EPA requested CPCPRC develop a Work Plan for the CMS which had previously been put on hold. In addition, CPCPRC submitted a Pilot Test Work Plan for soil contaminant degradation treatment. Both documents were approved by EPA in December 2015. The CMS Report was submitted in September 2016 and approved by EPA.

FACILITY GEOLOGY AND HYDROGEOLOGY

The Facility ranges in elevation from 45 feet above Mean Sea Level (MSL) at the northern portion of the facility to less than 5 feet MSL at the southern boundary. The Facility was originally graded to accommodate sugar cane cultivation. In 1966 during CPCPRC's facility construction phase, the Facility was regraded to accommodate containment berms around above ground storage tanks. Within the tank basins, soil platforms were constructed and the tanks were placed on top of the platforms. The soil platforms range in height from 1 foot to approximately 10 feet above grade. Along the southern portion of the Facility, a ditch was constructed to convey the facilities treated wastewater. In site documents this ditch is termed the Effluent Channel.

The Facility is currently demolished and consists of generally flat terrain, except for the raised soil platforms and containment berms that surrounded the tank basins. The Effluent Channel is still present and water flows intermittently depending on rainfall.

The geology at the Facility is characteristic of a transitional alluvial fan depositional environment. The top five feet of the Facility is underlain with fill that includes a mixture of silt sand, gravel and shell fragments. Below the fill, braided stream deposits are present. These stream deposits have been termed the Upper Alluvial Sand.

The Upper Alluvial Sand consists of silt, sand and gravel and is the primary unit impacted by hydrocarbon contamination. It includes sand deposits with varying thicknesses and in some locations are truncated by clay deposits. It is a fairly complex unit that includes sand channels and isolated bodies of sand. At the southern end of the facility, the Upper Alluvial Sand transitions into clay and silt deposits. These deposits have been termed the Lagoon Silt and Clay and refer to the shallow deposits south of the effluent channel. This layer consists of low permeability silt and clay and is up to 30 feet thick south of the Facility.

The Upper Alluvial Sand is separated from the Lower Alluvial Sand by the Tank Basin Shallow Aquitard and the Process Area Shallow Aquitard depending on the location within the Facility. These aquitards are composed of low permeability silt and clay that vary in thickness from 2-15 feet. With the exception of a narrow area in the north-central portion of the Facility the aquitard is continuous throughout the Facility.

The Lower Alluvial Sand is composed of silt, sand, and gravel that tends to be more homogenous and coarser-grained than the Upper Alluvial Sand. The Lower Alluvial Sand is present beneath the entire Facility and is found between 10 to 30 feet below ground surface (bgs) and extends to bedrock. Bedrock underlies the entire facility at about 60-80 feet bgs and consists of andesite. The andesite bedrock is not considered to act as an aquifer (USGS 1992). Groundwater flow direction in the Upper Alluvial Sand also referred to as the shallow aquifer is to the south with components of flow to the southeast and southwest. Groundwater flow generally is aligned with the orientation of sand channels. The hydraulic gradient is approximately 0.0045 ft. / ft. from north to south. During the dry season the saturated thickness of the shallow aquifer is approximately 14 feet and during the rainy season approximately 17 feet. The Lower Alluvial Sand also referred to as the deep aquifer has a saturated thickness averaging 30 feet. Flow in the deep aquifer is to the south-southwest following the regional flow direction. The hydraulic gradient in the deep aquifer is approximately 0.0035 ft. / ft. from north to south.

Interaction between the two aquifers consists of a downward vertical hydraulic gradient in the northern half of the Facility (the former Process Area). In the southern portion of the Facility, vertical gradients tend to be upward. In the north-central portion of the Facility the water levels tend to be in equilibrium. The downward vertical gradients occur in areas where the shallow aquifer is topographically higher and isolated from the deep aquifer. In the southern portion of Facility, the deep aquifer is confined by the Tank Basin Aquitard creating an upward vertical gradient. In the north-central portion of the Facility the aquitard is absent so the aquifers are in direct connection or equilibrium.

The hydraulic conductivity for the shallow and deep aquifers were calculated and presented in the CMS. The hydraulic conductivity of the shallow aquifer is approximately 20 feet/day. The deep aquifer hydraulic conductivity is 270 feet/day.

The hydraulic conductivity for the shallow aquifer was recalculated in the CMS using a revised approach based on the percentage of sand along the plume centerlines rather than the cross-sections at the Facility boundary. The revised hydraulic conductivity of the shallow aquifer is approximately 20 feet/day. The deep aquifer hydraulic conductivity is 270 feet/day.

EXPOSURE PATHWAYS

The nature and extent of Facility-related contamination has been determined through multiple phases of RFI including the original RFI performed prior to demolition and the AOC Investigation and the SRFI, both performed after demolition of the Facility.

In the shallow aquifer, one benzene groundwater plume extends from beneath the former Process Area south for about 2,800 feet terminating near former AOC Tank 360 (See Figure 2). The second groundwater plume is located along the western edge of the Facility and its alignment is consistent with the alignment of a sand channel mapped in this area. This plume is approximately 1,300 feet in length and extends about 200 feet off-site.

In the deep aquifer, benzene was below detectable levels in the majority of the deep aquifer monitoring wells. Where benzene is detected in deep groundwater, it is found in isolated areas at levels generally below its Federal Maximum Contaminant Level (MCL) of 5 µg/L. Two wells, MW-30D and MW-159D, did have benzene concentrations above the MCL at levels of 15 and 21 µg/L, respectively, in May/June 2012.

One sulfolane plume in the shallow aquifer is observed beneath the former Process Area. This plume extends south and east for about 2,800 feet and extends about 600 feet beyond the eastern Facility boundary and south and west about 4,200 feet and extends off-facility to the west about 1,200 feet. The second plume is observed near the northwestern Facility boundary and is approximately 2,000 feet in length and extends about 600 feet off-site to the west. The third plume, found in the southeast corner of the Facility, is approximately 2,600 feet in length and extends off-site south about 1,200 feet to monitoring well MW-166. In the deep aquifer sulfolane is above the remediation goal of 16 µg/L in 11 of the 15 deep wells onsite, and in two of the 8 deep wells located offsite based on the May/June 2012 monitoring event.

Both the shape of the benzene and sulfolane plumes and the migration of COCs in shallow groundwater is primarily governed by the orientation of sand channels.

In surface soil, BTEX and sulfolane were below the remediation goals at 255 of the 322 surface soil sample locations (79% of the samples had no exceedance). There are 30 locations where at least one BTEX constituent was found above remediation goals, but sulfolane was not found above its remediation goal. Sulfolane was found as the only COC above the remediation goals at 22 of the 322 locations. Twelve of these exceedances were in one area, AOC 540. At 15 locations, sulfolane and at least one BTEX constituent were found above the remediation goals.

In subsurface soil (soil below 2 ft deep) BTEX and sulfolane were below the remediation goals at 229 of the 322 subsurface soil sample locations (71% of the samples had no exceedance). There are 59 locations where at least one BTEX constituent was found above the remediation goals but sulfolane was not found above its remediation goal. Sulfolane was found as the only COC above the remediation goal at 24 of the 322 locations. Twelve of these exceedances were in one area, AOC 540. At 11 locations, sulfolane and at least one BTEX constituent were found above the remediation goals.

The Final AOC Investigation Report and the Final SRFI Report present the identification of COCs, exposure pathways, and risk characterization.

Exposure to groundwater at the Facility was evaluated relative to the hypothetical resident and the construction worker. For the hypothetical resident, exposure to both the shallow and deep groundwater present an unacceptable risk. The construction worker would be at potential risk while working in contact with the shallow groundwater. Benzene is the risk driver in groundwater. Sulfolane, ethylbenzene, and xylenes also contribute risk to the hypothetical resident. Exposure to surface soil at the Facility was evaluated relative to the construction worker, industrial worker, and trespasser. Subsurface soil was evaluated relative to the construction worker. The construction worker would be at potential risk while working in contact with the soil. The majority of the risk would result from contact with benzene. The cumulative risks for the industrial worker and the trespasser were within the acceptable risk ranges and contact with facility soil does not pose a risk to these potential receptors. Two onsite receptors (a hypothetical resident and an industrial worker) and two off-facility receptors (a worker in the AES Corporation administration building and a worker in the AES Corporation shed near CPCPRC's southwest property boundary) were evaluated. The onsite receptors were evaluated for vapor inhalation risks from soil as well as groundwater. The off-site receptors were evaluated for groundwater vapor inhalation risks only since the soil contamination is only onsite and is limited to the AOCs identified at the Facility. Potential unacceptable risks were indicated for the hypothetical onsite resident and industrial worker. Benzene and ethylbenzene were the primary risk contributors. For the AES Corporation worker, the conservative calculations indicated there was no risk due to groundwater contamination attributed to CPCPRC.

Effluent Channel surface water and sediment do not pose a risk to humans. The screening level ecological risk assessment (SLERA) concluded that surface water posed no unacceptable risk to ecological receptors. However, the potential risks to benthic invertebrates in the Effluent Channel due to chromium, copper, manganese, nickel, and zinc in sediment were marginal but could not be excluded.

SELECTED/PROPOSED REMEDY

The remedial alternative selected to address groundwater is In-situ Chemical Oxidation (ISCO) using Catalyzed Hydrogen Peroxide (CHP) in the shallow and deep aquifers. The ISCO processes destroy contaminants by chemical reaction. The CHP, a chemical oxidant, will be introduced to the groundwater aquifer through 2-inch diameter injection points. At each of the injection points, 6,000 pounds (~640 gallons) of 35% CHP would be placed. During the oxidation process, chemical bonds are broken and the COCs are transformed into carbon dioxide, water, and salts. Based on the groundwater ISCO pilot test, the life-cycle for this alternative is assumed to be five years with one round of treatment at approximately 427 shallow and 10 deep treatment points in the first year. In the second year, a second round of ISCO treatment would be implemented at 142 (approximately one-third) of the shallow treatment locations. Groundwater monitoring would be implemented through year 5 when it is assumed COC levels in the shallow and deep groundwater would meet remediation goals. Six rounds of groundwater monitoring will be conducted during the first year at approximately 100 monitoring wells with semi-annual monitoring conducted at approximately 75 wells for the remaining four years. The estimated cost for this alternative is $16.9 million.

The remedial alternative selected to address soil with COCs above remediation goals is biological treatment in land farm treatment cells (See Figure 3). Landfarming uses conventional soil management practices to stimulate biodegradation in contaminated soil by increasing aeration, maintaining moist conditions, providing nutrients and adding microorganisms. An estimated volume of 44,323 cubic yards (CY) of soil will be excavated, loaded into dump trucks or roll-off containers, and placed in onsite landfarm treatment cells constructed inside portions of former tank basins. The base of the treatment cells will be lined and the existing gunite-lined berms will control stormwater run-on and run-off. Soil will be placed in lifts up to 2 feet high, inoculated with microbes and fertilizer, then tilled and watered on a regular basis using water obtained on facility. Soil will be sampled monthly to monitor treatment progress. Any excess water from a storm event will be placed in the existing hippo storage tank and will either be reused on the treatment cells to keep moisture at the proper levels or will be treated through the existing permitted water treatment unit and discharged to the PRASA. Based on soil biodegradation pilot test, soil treated by landfarming is expected to meet cleanup levels in one year. The estimate of potential cost for this alternative is $6 million.

The remedial alternative selected to address Effluent Channel sediment with metals above remediation goals is excavation and off-facility disposal. The estimated volume of sediment to be removed is 3,520 CY based on removing one (1) foot of sediment from the 1,900-foot long channel within the Facility boundary. Sediment is expected to be non-hazardous based on previously collected samples and will be disposed of in a PREQB permitted landfill. Clean soil obtained on the facility will be used to backfill the excavation area. The estimated cost for this alternative is $988,000.

INNOVATIVE TECHNOLOGIES CONSIDERED

Applicable innovative and traditional remedial technologies were evaluated in the Corrective Measures Study (CMS) prepared by CPCPRC for this Facility. The technologies considered for soil included traditional excavation and off-facility disposal and innovative biological treatment in landfarm treatment cells (selected remedy) and innovative biological treatment in-situ using soil mixing. For groundwater, traditional pump and treat was considered as well as innovative ISCO (selected remedy) and slurry walls. Innovative in-situ stabilization was considered for sediment along with traditional excavation and off-facility disposal (selected remedy). A combination of innovative and traditional remedial technologies was chosen for the Facility based on overall better technical (performance, reliability, and implementability), environmental, human health, institutional, and cost criteria.

PUBLIC PARTICIPATION

EPA reviewed the CMS prepared by CPCPRC and is inviting the public to comment on this document and the proposed remedial alternatives to address impacts to soil, sediment and groundwater at the Facility. On June 15, 2017, a notice inviting the public to comment on the proposed remedy for the Facility was published by EPA on the *Primera Hora and El Regional* newspapers. A 45-day public comment period on the proposed remedy will be opened from June 15, 2017 July 30, 2017. If deemed necessary and requested by the public, a hearing will be coordinated by EPA and CPCPRC at such effects. Interested persons or parties can submit written comments to:

Carmen Guerrero Pérez, Director
U.S. Environmental Protection Agency
Caribbean Environmental Protection Division
City View Plaza II 7000
Road PR-165, KM 1.2
Guaynabo, PR 00968-8069

The documents related to the investigations and CMS will be located at the following repository:

Guayama Public Library
#1 Ashford Street
Guayama, P.R., 00784
Tel: (787)- 864-0600

Additional information can be obtained from Zolymar Luna Díaz, EPA Project Manager for the Facility, and/or from Eng. Josephine Acevedo Esquilín, Project Manager from the Puerto Rico Environmental Quality Board.

The compliance history of former activities at the Facility is also available at Region 2 Corrective Action Website at https://www3.epa.gov/region02/waste/fsphilli.htm and in EPA's Region 2 office located in Guaynabo, Puerto Rico. Please, be advised, that copies of CPCPRC's Administrative Record may be requested through a Freedom of Information Act request, fees may apply.

NEXT STEPS

EPA will evaluate all comments received from the public and will determine whether or not the CMS needs to be revised or finally approved. If approved, CPCPRC will begin with Corrective Measures Implementation (CMI) within two (2) or three (3) months after receiving the EPA notification.

IMPACTS DETECTED AND CLEANUP GOALS

Media	Estimated Volume	Constituents	Lowest Human Health Goal (µg/L)	Maximum Detected Concentration (µg/L)	Federal MCL (µg/L)	PRWQS (µg/L)	Remediation Goal (µg/L)
Groundwater	135,000,000 gallons	Sulfolane	16	14,000	--	-	16
		Benzene	0.45	190,000	5	5	5
		Ethylbenzene	1.49	14,000	700	530	530
		Toluene	856	4,500	1,000	1,000	1,000
		Xylene	189	68,000	10,000	10,000	10,000

Source: BTEX values obtained from Table 2.2 2007 Final Risk Characterization Sulfolane values obtained from Table 5.1 of the 2015 Final SRF

Media	Estimated Volume	Constituents	Lowest Human Health Goal (µg/Kg)	Maximum Detected Concentration (µg/Kg)	EPA Soil Screening Value for Protection of Groundwater (µg/Kg)	Remediation Goal (µg/Kg)
Soil	44,323 cy	Sulfolane	193,000	17,000,000	65	65
		Benzene	4,230	570,000	168	168
		Ethylbenzene	25,560	710,000	49,700	25,560
		Toluene	6,220,000	260,000	51,284	51,284
		Xylene	253,454	6,490,000	809,787	253,454

Source: BTEX values obtained from Table 2.5 2007 Final Risk Characterization, Sulfolane values obtained from Table 5.1 of the 2015 Final SRFI.

Media	Estimated Volume	Constituents	Maximum Detected Concentration (µg/Kg)	EPA Regional Ecological Screening Level (µg/Kg)	Remediation Goal (µg/Kg)
Sediment	3,520 cy	Chromium Copper Manganese Nickel Zinc	1,870,000 65,200,000 2,050,000 55,000 1,010,000	37,300 18,700 460,000 15,900 121,900	37,300 18,700 460,000 15,900 121,900

Source: Table 4.1 2007 Final Risk Characterization

KEY WORDS:

Groundwater, soil, sediment, sulfolane, benzene, toluene, ethylbenzene, xylene, dual-phased extraction, air sparging, ISCO, land farm, aquifer, exposure pathway, risk characterization.

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Figure 1 - Location Map

Figure 1

Facility Location Map
Chevron Phillips Chemical
Puerto Rico Core, LLC

Figure 2- Depiction of Shallow Groundwater Plume and Alternative 2 Remedy for Groundwater

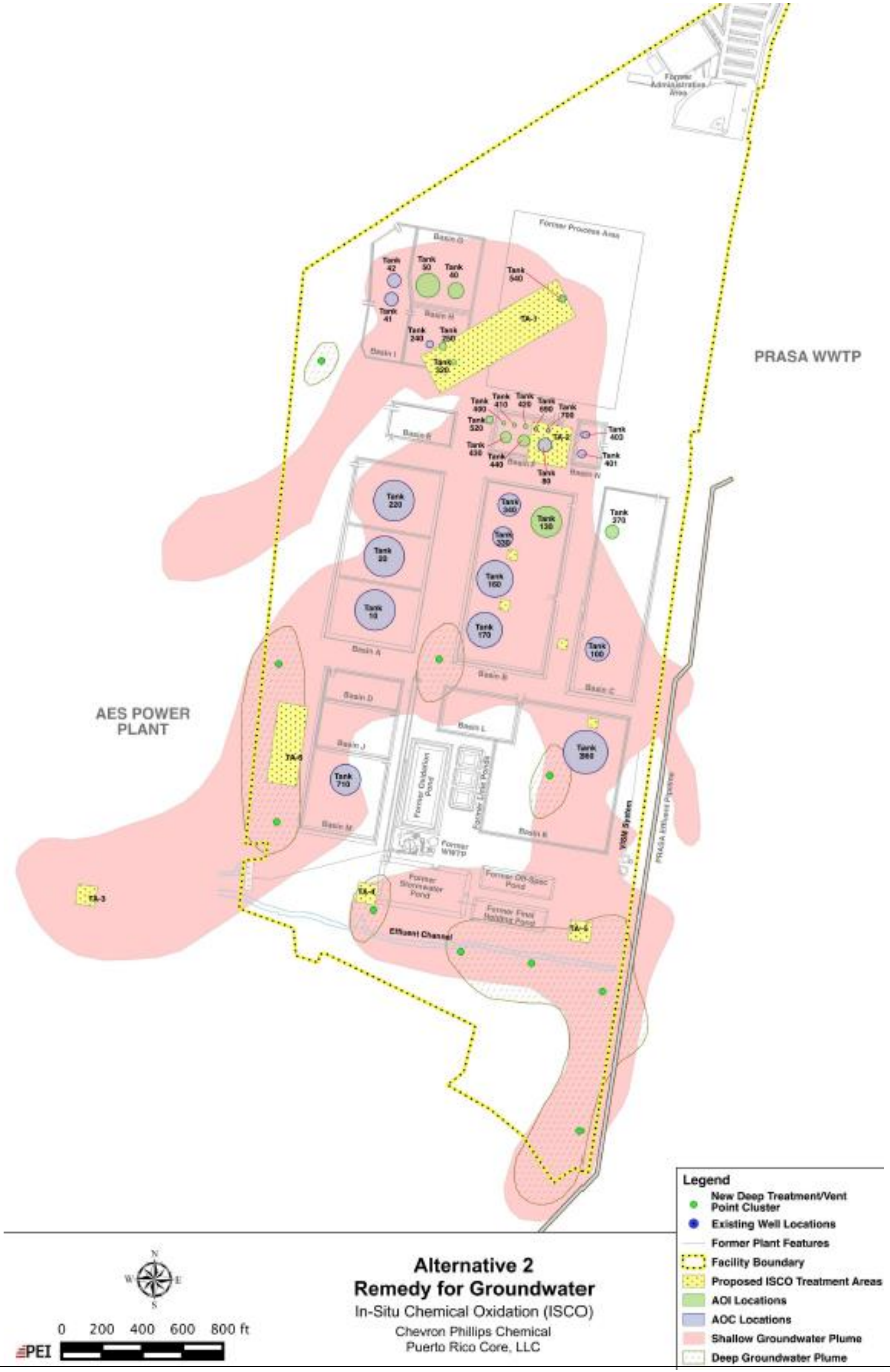

Figure 3 - Alternative 2 Soil Landfarming