



ARM Group LLC

Engineers and Scientists

April 7, 2020

Ms. Barbara Brown
Project Coordinator
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, MD 21230

Re: Former Coke Oven Area (COA) Interim
Measures Supplemental Investigation
Work Plan
Responses to EPA Comments

Dear Ms. Brown:

On behalf of EnviroAnalytics Group, LLC (EAG), ARM Group LLC (ARM) is pleased to provide the following responses to the US Environmental Protection Agency (USEPA) comment letter dated March 20, 2019 on the Former Coke Oven Area (COA) Interim Measures (IM) Supplemental Investigation Work Plan Revision 1 (dated March 7, 2019). The March 20 letter indicated that no work plan revision was necessary and requested that Tradepoint Atlantic (TPA) proceed with the Supplemental Investigation at Coke Point interim measures (IMs) cells 2, 3, and 5. Following this authorization, this work was immediately implemented.

In coordination with the agencies, TPA conducted extensive investigations in 2019 to better define the nature and extent of groundwater impacts in the IM cell areas. TPA fully implemented the approved supplemental investigation work plan and installed 37 additional wells at the COA IM cells (21 wells in the Cell 2 area, 10 wells at Cell 3, and 6 wells at Cell 5). In 2019, TPA also performed surface water and pore water sampling described in the Offshore Investigation Work Plan (Revision 1), approved on March 5, 2019, and conducted supplemental surface water sampling (six locations at Cell 2 and 11 locations at Cell 5) following review of the initial offshore investigation results.

The March 20, 2019 comment letter also included a number of comments regarding the objectives and effectiveness of the IMs that warrant clarification and updating. The original comments are shown in italics with the responses following in normal text.

The onshore groundwater evaluation is part of the ongoing process to assess the effectiveness of operating Interim Measures and their ability to meet Corrective Action COA objectives. The principal objectives of the IMs at the time of their installation was to protect surface water (Cells 2, 3, and 5) from contaminated groundwater discharges and reduce source hydrocarbon mass (Cells 1, 4 and 6). The COA offshore assessment will provide the data to evaluate the first

objective. Up to the present the sole means of monitoring progress on the second objective was reporting total mass removed on a continuing basis. Based on that metric, IMs operating at Cells 1, 5, and 6 make progress. However, IMs at Cells 2 and 3 are currently less successful and TPA has shut down operation of Cell 3 and the shallow groundwater remedy at Cell 2. Furthermore, based on other metrics, i.e. downgradient well concentrations, groundwater capture, and surface water impacts it is likely the IMs at Cell 5 and Cell 2 intermediate groundwater are not meeting COA groundwater remediation objectives.

EPA commented that this groundwater evaluation is part of the ongoing process to assess the effectiveness of the IMs and their ability to meet corrective action objectives. However, it should be noted that interim measures are implemented on an expedited basis to stabilize conditions and abate potential imminent threats and are not necessarily intended to meet the corrective action objectives that would be established for a final remedy. In fact, as EPA notes in a later comment, the corrective action objectives for the final remedy for the coke oven area have yet to be established.

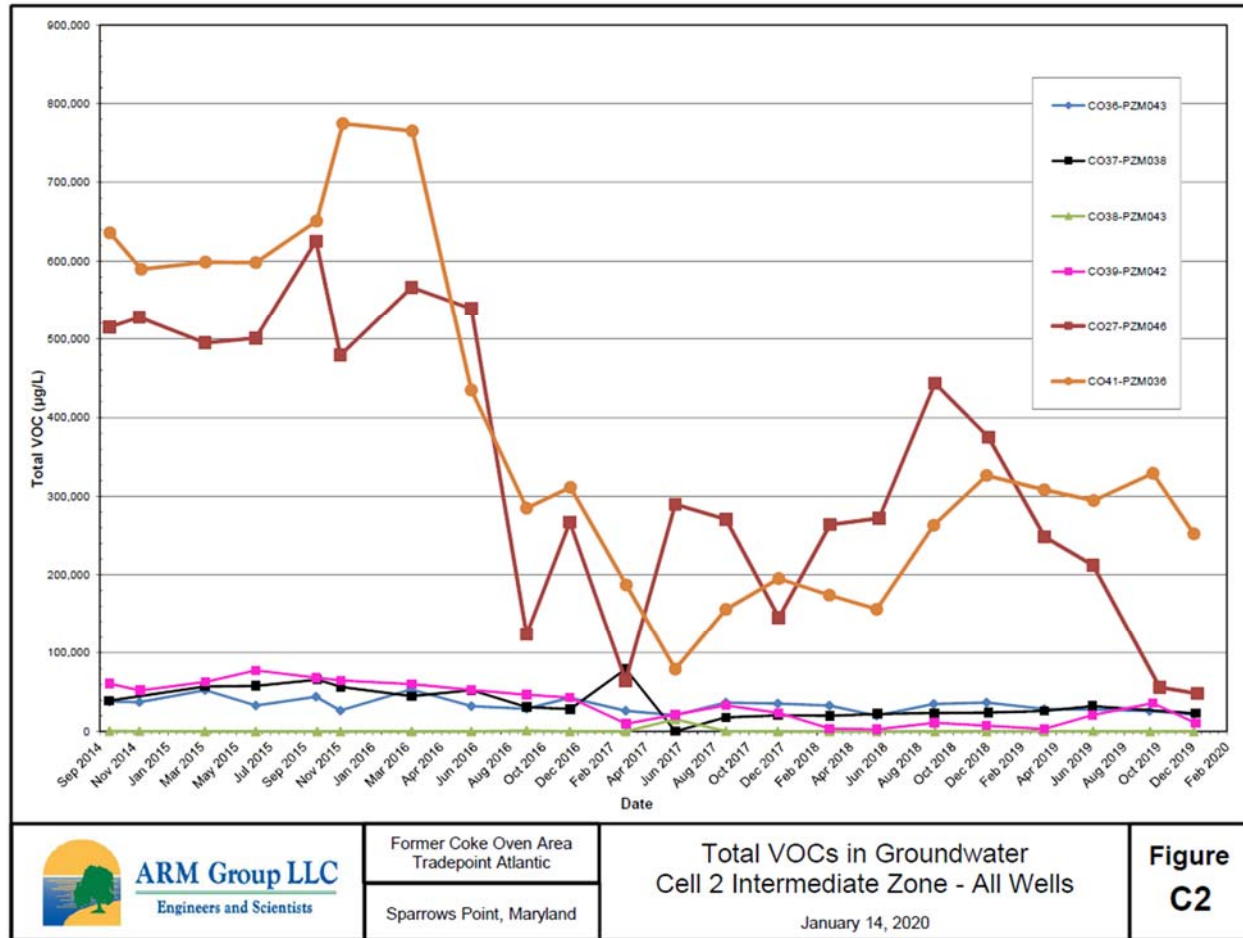
EPA notes that the principal objective for the IMs at Cells 1, 4 and 6 is to reduce source hydrocarbon mass. Therefore, reporting of mass removed is an appropriate means of monitoring performance. As EPA notes in the comment, based on this metric Cells 1, 5, and 6 are making progress. Similarly, DNAPL recovery at Cell 4 continues to show effective mass removal.

The EPA comment indicates that the principal objective for the Cell 2, 3 and 5 IMs was to protect surface water from contaminated groundwater discharges and that the COA offshore assessment will provide the data to evaluate this objective. Indeed the results of the surface water sampling performed during the offshore investigation confirm that there were no exceedances of the current Maryland Numerical Criteria for Toxic Substances in Surface Waters at any of the sample locations at Cell 2 and Cell 5, and at Cell 3 there was only one exceedance for benzene in one near-shore sample out of a total of 31 samples. EPA has commented that the National Recommended Water Quality Level (NRWQL) for benzene was lowered in 2015. The surface water samples indicate that even this more stringent criterion is being met at all locations at Cell 2. At Cell 5, the sampling confirmed the absence of significant naphthalene in surface water in this area. Thus, surface water is not being adversely impacted by contaminated groundwater discharges and the principal objective identified by EPA for the IMs is being achieved at Cell 2 and Cell 5.

At Cell 3, the NRWQL for benzene was exceeded in 7 of the 31 surface water sample locations but the impact was limited to the shallow end of a cove constructed of slag fill, and this in-stream criterion was met in all of the samples in the transect closest to the river, just 100 feet from the maximum concentration measured, certainly within a reasonable mixing zone for an in-stream criterion. Nevertheless, based on the vertical delineation results, TPA has committed to evaluating improvements to the Cell 3 system to increase its effectiveness. Options for system upgrade, expansion, replacement, or implementation of an alternate technology will be evaluated in the proposed Corrective Measures Study (CMS).

In terms of mass removal, the Cell 2 intermediate zone IM has been highly effective, having achieved greater than 50% reduction in well concentrations (as indicated in the figure below).





As indicated in this time-series chart, the benzene concentration in CO41-PZM036 has decreased by more than 50% from over 600 mg/L to less than 300 mg/L. The benzene concentration in CO27-PZM026 has been reduced about 90% from over 500 mg/L to a current level of less than 50 mg/L. Accelerated mass removal and reductions of benzene concentrations were noted over the past year due to improvements in operations of the Cell 2 system. The Cell 2 pump and treat system was down during the last half of 2018 but repairs to the system allowed nearly continuous operation in 2019, resulting in the removal of 5,800 pounds of hydrocarbons in 2019 compared to 2,700 pounds in the previous year.

Therefore, it is apparent that the existing IMs have been effective at achieving or are making progress toward the principal objectives of mass removal and protecting surface water quality.

EPA notes that TPA shut down the Cell 2 shallow groundwater air sparge system due to the decline in the mass removal rate. However, as discussed above, the surface water sampling conducted since the system was shut down confirms that the shallow groundwater system is no longer needed to meet the objective of protecting surface water quality, especially since the seawall extends through the shallow zone and restricts flow to the river.



The EPA comment also states that TPA has shut down Cell 3. The system operated for 6,500 hours in 2017, removing 79 pounds of hydrocarbons. In 2018, the system operated 4,900 hours, removing 151 pounds of hydrocarbons until the system was turned off temporarily in September 2018 due to extremely low recovery yields. During that period, sparge wells were pressure tested and repaired to restore sparge pressure. Upon completion of this work, the system was restarted and operated 4,800 hours in 2019, removing an estimated 30 pounds of hydrocarbons. With the exception of the short period when the system was shut down for testing and repair, this system has been operating, and is currently in operation.

The stated primary objective of the COA Workplan is the delineation of dissolved phase hydrocarbons at Cells 2, 3 and 5. Additionally, the implication, based on a proposal to collect geochemical parameters at Cell 2 area, is that TPA is pursuing the implementation of other remedies for intermediate groundwater, possibly Monitored Natural Attenuation. It is the Agencies' desire to optimize and improve IMs to meet COA groundwater objectives and not expend resources delineating plumes that have been characterized multiple times since 2000 up to the 2015 report submitted by Key Environmental. This is not to suggest that further delineation is unnecessary, just that delineation should not be the primary focus of the COA Workplan.

We concur with the Agencies' desire to optimize and improve IMs to meet COA groundwater objectives and not expend resources delineating plumes that have been characterized multiple times. In addition to lateral delineation of dissolved phase plumes, the supplemental investigation included vertical profiling to evaluate the design of the IM at Cell 3, as well as supplemental surface water sampling west of Cell 2 and east of Cell 5 to confirm that these IMs are, indeed, meeting the principal objective of protecting surface water quality. The supplemental onshore investigation completed the characterization of the onshore groundwater in the IM cell areas to support a CMS to evaluate potential final remedies and, with the exception of a few data gaps as noted in the CMS work plan, the groundwater is sufficiently characterized to complete a CMS. As EPA requested, TPA has proceeded to install additional wells to fill the remaining data gaps in the COA and provide data on the remaining areas of the coke point peninsula so that the CMS can address the entire peninsula as a whole rather than just the COA.

EPA inferred from the proposed geochemistry analysis that TPA was seeking monitored natural attenuation as an alternative to the existing Cell 2 pump and treat system. However, the proposed geochemical analyses for the Cell 2 intermediate groundwater was intended to provide data to evaluate the feasibility of enhanced bioremediation as a potentially applicable technology to supplement the existing IM to accelerate the cleanup of the intermediate zone groundwater at Cell 2.

EPA believes one of the issues underlying the apparent cross-purpose of TPA and the Agency is that no numerical cleanup endpoint has been agreed upon and therefore each has proceeded with different objectives. Without specific cleanup endpoints TPA has ceased operation of IMs, proposed others for shutdown (Cell 5) and is pursuing alternate remedies, i.e. MNA. You may recall that in 2018 EPA drafted a memorandum stating that groundwater under the Sparrow's Point Peninsula cannot be used as drinking water and therefore does not have to be restored to drinking water standards. However, while the groundwater does not have to be restored to drinking water standards, contaminated groundwater continues to discharge to surface water and



volatilize to the atmosphere. Numerical cleanup goals for groundwater will need to be developed for both exposure pathways. For example, based on risk to future occupants of the site, given the development of the entire property, the Agencies note the following risk-based groundwater concentrations as preliminary groundwater cleanup values at COA based on EPA's Vapor Intrusion Screening Levels (VISL):

Commercial Groundwater VISLs (ug/L) set to cumulative 1×10^{-5} and cumulative HQ = 1 (both noncancer chemicals are neurotoxins)

<i>Benzene</i>	<i>23</i>
<i>Ethylbenzene</i>	<i>50</i>
<i>Naphthalene</i>	<i>67</i>
<i>Toluene</i>	<i>40,000</i>
<i>Xylenes</i>	<i>810</i>

Based on the above it is readily apparent that none of the IMs operating are near meeting a specific groundwater cleanup endpoint and while IMs at some Cells are inefficient, shutdown is not an option; optimization and expansion are required.

The EPA comment expresses the concern that “without specific cleanup endpoints TPA has ceased operation of IMs, proposed others for shutdown (Cell 5) and is pursuing alternate remedies, i.e. MNA”. This is not the case. The lack of final cleanup objectives has not been a factor in a decision to shut down any of the COA IMs. As discussed above, other than temporary shutdowns to facilitate testing and repairs, the only IM that has been shut down is the air sparge system in the shallow groundwater zone in Cell 2. This system was shut down because it was no longer effectively removing mass or reducing concentrations in the shallow groundwater. Based on the surface water sampling, it was determined not to be necessary to meet the design objective of the IM to protect surface water quality.

Development of remedial action objectives and media cleanup levels is identified as an initial task in the proposed CMS work plan. The ability of the IMs to achieve these final remedial action objectives (as opposed to the IM design objectives), and the need to optimize and expand these IM systems, will be evaluated as one of the alternatives in the proposed CMS.

Detailed Comments:

- 1. It has been pointed out previously that the effect of the Graving Dock Pump overwhelms any remedy at Cell 2, based on both the 750 gallons per minute (gpm) pump rate and effluent benzene concentrations requiring treatment. If there were no surface water between Cell 2 and the Graving Dock Pump there would be no issue, however there is, and it is likely groundwater is impacting surface water based on surface water detections. If TPA continues to operate the Graving Dock Pump then a more protective remedy is necessary, i.e. a slurry wall as recommended in the 2015 Key report. Short of an impermeable wall the current extraction well configuration is insufficient. The reported rate of 2.3 gpm from the Intermediate zone in 2018 will not intercept groundwater drawn from COA to the Graving Dock Pump. Extracting groundwater at that rate will not affect*



shallow groundwater at Cell 2. It's questionable whether intermediate groundwater extraction at Cell 2 has ever affected shallow groundwater; previous studies conclude otherwise. However, nested wells proposed downgradient of the interception trench and to the immediate west will provide data on an ongoing basis as to the effectiveness of the interception trench and those proposed wells are approved. The Agencies request the remainder of the proposal be implemented as a secondary phase and request that the extraction rate of the pumping configuration be immediately maximized approaching the design parameter versus the minimal rate reported from 2018. TPA may pursue other remedial options but with current data from the Graving Dock and surface water detections it is unlikely a passive remedy, i.e. MNA will meet objectives. Finally, the remedy as currently implemented does not address the dissolved phase plume between the Benzol Process Area and Cell 2. In addition to maximizing the extraction rate of the current configuration TPA should investigate expansion of groundwater remediation to the south.

The EPA comment states that pumping at the Graving Dock overwhelms any remedy at Cell 2 and that because of the presence of surface water between Cell 2 and the Graving Dock it is likely that groundwater is impacting surface water. While the Graving Dock pumps at a high rate (750 gpm), it is pumping from an underdrain system that draws from both the shallow and intermediate zones and is spread over an area of approximately 200 ft x 1400 ft (6.4 acres) surrounded by surface water that serves as a source of recharge. Therefore, it is not clear that pumping from the Graving Dock would overwhelm pumping occurring at Cell 2. In fact, a localized capture area has been documented in the intermediate zone, indicated by water levels in the intermediate zone measured 2 to 3 feet lower in the vicinity of the Cell 2 IM pumping system than in nearby intermediate zone wells. This provides evidence that the Cell 2 pump and treat system is not being "overwhelmed" by the Graving Dock pumping, and is providing hydraulic control within the plume area. The 2018 average pumping rate indicated in the comment is misleading, as it was affected by system downtime. The system has a design capacity of 30 to 40 gpm; however, with optimization of the system by maximizing influent concentrations it has been determined that pumping 1 or 2 recovery wells exhibiting high concentrations is the most effective approach to removing mass contamination. As such, the normal pumping rate has been approximately 10 gpm.

As noted, in 2019 the Cell 2 system operated continuously and removed 5,800 pounds of hydrocarbons from the intermediate zone. By comparison, the average influent benzene concentration at the Graving Dock from January through September 2019 is 733.4 parts per billion. Using that and a withdrawal rate of 1,080,000 gallons per day (750 gpm) results in about 2,412 pounds of benzene removed per year. So the Cell 2 system is also not being overwhelmed by the Graving Dock in terms of removal rate.

The results of surface water sampling confirmed that there are no exceedances of water quality criteria in surface water between Cell 2 and the Graving Dock. In addition, as discussed above, the Cell 2 IM removed 5,800 pounds of hydrocarbons from the intermediate zone groundwater in 2019 and has reduced concentrations in the well at the shoreline by 90%. Therefore, the Cell 2 intermediate zone IM appears to be meeting the objectives of removing mass and protecting surface water.



The comment also notes that the current extraction from the intermediate zone will not affect shallow groundwater at Cell 2. It should be clarified that it was never the intent that the intermediate zone pumping system would affect the shallow groundwater. A separate IM system was installed to ensure that the shallow system does not impact surface water quality. However, as noted, sampling indicates that surface water meets water quality criteria, so it does not appear that restarting operation of the shallow zone IM is necessary to meet the IM objective of protecting surface water quality.

The ability of the existing IMs to achieve final remedial objectives will be evaluated along with enhancements to and alternatives to the existing system in the CMS.

- 2. Based on design documents the interception trench at Cell 3 is installed to a depth of from 20 to 22 feet. The system was placed in operation in August of 2010 and historically was more productive. The result from a single upgradient sample obtained from boring location CO130 to the northeast of the Cell 3 area indicates an absence of a connection between Cell 3 and the Benzol Process Area; this conclusion based on a single sample may or may not be true. TPA contends that the trench is likely not deep enough and proposed 10 piezometers to delineate the dissolved plume surrounding the trench.*

A review of boring and monitoring well details for existing wells indicate that the 100 series of wells surrounding Cell 3 trench are installed to depths from around 17 to 20 feet and that the nested CO30 wells are installed to 27.5 and 73 feet and downgradient of the trench. Based on the trend graph presented in the last progress report, CO30PZM15 is the only well never reporting declining concentrations. It appears the data from CO30PZM15 already confirms TPA's hypothesis that the trench is not deep enough. Since the stated objective is to identify the depth of contamination then EPA requests a single boring utilizing vertical profiling be installed at the proposed location to the west of CO102 PZM collecting groundwater samples at the top of the water table down to the intermediate zone, or until contaminants are not detected. As TPA proposed 9 additional piezometers, they should install these borings in a second phase subsequent to reporting the results from the initial boring. Elevated benzene concentrations were reported in surface water samples from the Cove Area. It is apparent the interception trench at Cell 2 (sic) does not protect surface water from groundwater discharge but will be confirmed or refuted with pore water results. The current remedy does not address the dissolved phase mass upgradient of the trench. It is believed that once the data from pore water and the initial requested boring are available TPA can investigate expansion of a remedy in the Cell 3 area.

TPA has committed to making improvements to the Cell 3 system to increase its effectiveness and has completed all of the proposed wells to provide data to further evaluate the system design. The EPA general comments point out that the principal objective of this IM system was to protect surface water quality. This specific comment refers to pore water results to confirm or refute the effectiveness of this IM. However, the potential to impact sediment pore water is a separate, new consideration that was only identified by EPA well after the design and installation of the existing IMs. This new objective will be evaluated in determining corrective measures as part of the proposed CMS. As noted, elevated benzene concentrations were reported in surface water samples in the Cove Area, but the elevated benzene in the surface water is limited to a very small area and



the surface water meets all potentially applicable criteria within a reasonable mixing zone distance. The long-term effectiveness of the Cell 3 system and potential system upgrade, expansion, replacement, or implementation of an alternate technology will be evaluated in the CMS.

3. *Cell 5 (Turning Basin side of former Coke Oven Area): Dual Phase Extraction (DPE) system and Dense Non-Aqueous Phase Liquid (DNAPL) recovery system for the shallow zone. These systems were operated for the majority of the year 2018, resulting in the removal of approximately 3,762 pounds of hydrocarbons from the Cell 5 area, 3,551 lbs. from DNAPL and 211 lbs. via the DPE system. PDI activities completed in 2015 focused on the horizontal and vertical delineation of DNAPL in an area located west of Cell 5, but no additional soil borings and/or monitoring wells were installed within the vicinity of Cell 5 to better delineate naphthalene impacts in the shallow groundwater zone. Groundwater from CO25-PZM008 sampled during the PDI investigation provided a naphthalene concentration of 3.71 parts per million (ppm) (or 9.370 ppm?). Investigation activities proposed, focus on the horizontal delineation of naphthalene in groundwater around well CO25-PZM008, the northern area around CO60-PZP001, and along the shoreline to determine if modifications to the existing system are warranted to modify the remediation process and/or mitigate impacts to surface water and sediment pore water.*

Historical analytical data from this area characterizes naphthalene (and benzene) impacts to shallow groundwater upgradient, sidegradient, and downgradient of the DPE interception trench. The data demonstrate the system is either improperly installed, or poorly operated. Both the upgradient free product recovery wells and the DPE system remove hydrocarbon mass and admittedly the DPE system is inefficient, but overall they have had little effect on dissolved phase concentrations. Review of additional metrics, i.e. the pending offshore pore water sampling event, area well concentrations, and downgradient well concentrations suggest the interception trench does not meet remediation goals. Minimally the trench must prevent contaminant flow downgradient. Based on concentrations reported from CO 58, the system fails. Additionally, two monitoring wells to the north, CO 26 and CO 60 report naphthalene concentrations that are unchanging over time. The concentrations reported from these wells suggest the trench is not installed far enough to the north.

There are other unknowns, marginally related to plume definition, that could be answered. If 18000 gallons of water is extracted per day what is the capture zone? Additionally, if 18000 gallons per day is injected into the aquifer what are the effects? There is not enough groundwater data to answer either question. Water levels are somewhat elevated in monitoring well CO 24 – is this the result of the reinjection? There are three monitoring wells to the southeast and upgradient of the trench, CO 55, CO 57, and CO 59 that are relatively unimpacted. Do these define the southern extent of the dissolved phase plume or do they represent dilution effects from injecting 18000 gpd? All three regularly report higher groundwater levels than the wells to the north.

Based on the limited mass removed by the DPE trench versus the large volume of water generated, the barely changing dissolved plume, and downgradient and side gradient well



concentrations demonstrating the trench is ineffective, more groundwater data including analytical data are necessary in the Cell 5 area. Piezometer installation should consider the above data gaps but moreover collect the data necessary to pursue other remedial options. As an example, DPE systems can be installed as a grid versus a trench and shallow groundwater in this area, approximately 20 feet, is beneficial to remediation. It is beyond the scope of this review to diagnose why the trench is ineffective but monitoring well results demonstrate it is. Any remedy in this area should decrease source mass, shrink the dissolved phase plume, and prevent groundwater discharge to the Turning Basin. The onshore investigation in Cell 5 should focus on data gaps and pursuing a final remedy for this area.

As noted, the sampling results indicate that surface water is not significantly impacted by naphthalene discharges. The ability of the existing IM system to achieve final remedial objectives will be evaluated in the CMS, along with enhancements and alternatives to the existing IM system as discussed in the comment.

EPA requests that you proceed with the Supplemental Investigation at Coke Point remediation cells 2, 3, and 5. The request is based on the qualifiers as stated above. Plumes can be further defined as necessary, but the focus must be on remedy optimization and expansion. IMs have been operating at the various cells for various times but all greater than five years. IMs at Cells 2, 3, and 5 were installed to prevent groundwater discharge to surface water; it has never been demonstrated that objective was met. Results from pore water sampling will address that question. The IMs were never designed to address the great majority of the dissolved phase plumes in the three cells. Groundwater data demonstrate the three IMs do not wholly intercept contaminated groundwater. EPA's goal at the COA has always been to address historical groundwater contamination and proceed to Final Remedy. None of the three IMs are Final Remedies. Since no changes are proposed other than a phasing of the drilling effort, no workplan revision is necessary. Please begin the implementation of the workplan.

TPA has completed all of the onshore investigations proposed in the work plan, as well as completing supplemental surface water sampling at Cell 2 and Cell 5. The EPA comment acknowledges that the IMs at Cell 1, Cell 4/5 and Cell 6 are making progress toward the IM principal objective of mass removal. TPA has made improvements to the Cell 2 intermediate zone IM that have significantly increased operating hours and mass removal in 2019 and concentrations in the shoreline well have now been reduced by over 90%. These IM systems continue to remove mass. In addition, the surface water results from this investigation confirm that the IMs at Cell 2 and Cell 5 are meeting the principal objective of protecting surface water quality. Elevated benzene was detected in the Cove Area at Cell 3, but the surface water samples confirmed that surface water impacts at Cell 3 are limited to a small area. The long-term effectiveness of the Cell 3 system and potential system upgrade, expansion, replacement, or implementation of an alternate technology will be evaluated in the CMS.

The comment letter refers to the potential to impact sediment pore water. However, this is a new consideration that was only identified by EPA well after the design and installation of the existing IMs. As a part of the supplemental investigations conducted in 2019, TPA has collected new



information on pore water and this new objective will be evaluated as part of the proposed CMS and considered in evaluating and recommending a final remedy.

With the exception of a few data gaps, as noted in the CMS work plan, the groundwater is sufficiently characterized to complete a CMS for the COA. TPA is currently completing the additional investigation requested by the agencies to allow the CMS to address the entire coke point peninsula.

If you have questions regarding any information covered in this document, please feel free to contact ARM Group at (410) 290-7775.

Respectfully Submitted,
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