Technical Assistance Services *for* Communities

Ringwood Mines/Landfill Superfund Site

Fact Sheet – February 2018

Summary of Ringwood Mines/ Landfill Superfund Site-Related Groundwater Remedial Investigation Report (RIR) Addendum

This fact sheet provides a summary of the October 2017 Site-Related Groundwater Remedial Investigation Report Addendum (RIR Addendum) for the Ringwood Mines/Landfill Superfund site. Technical comments are provided in the last section.

The potentially responsible parties' consultant prepared the RIR Addendum. Next steps in the cleanup process include a Candidate Technologies Memorandum (a summary of potential technologies for groundwater cleanup), followed by a feasibility study for sitewide groundwater (operable unit 3, or OU3), which will list possible cleanup options. EPA will select its preferred cleanup option and publish a Proposed Plan for public comment prior to selecting the final OU3 remedy.

The 500-acre Ringwood Mines/Landfill site is in a historic iron mining district in the Borough of Ringwood in Passaic County, New Jersey. Magnetite mines operated on site as early as the 1700s. In the late 1960s and early 1970s, Ford Motor Company (Ford) disposed of paint sludge and other wastes on site. To manage the cleanup, EPA separated the site into OUs. OU1 was originally intended to comprehensively address the entire site. Later, EPA established OU2 and OU3. OU2 covers the land areas of concern known as the Peters Mine Pit (PMP) Area, the O'Connor Disposal Area (OCDA) and the Cannon Mine Pit (CMP) Area. OU3 is sitewide groundwater and the St. George Pit Area.

This fact sheet is funded by EPA's Technical Assistance Services for Communities (TASC) program. Its contents do not necessarily reflect the policies, actions or positions of EPA.

The RIR Addendum contains five chapters, a limitations section, references, tables and figures. Each chapter is covered in the sections below. The chapters are:

1. Introduction and Background
2. Monitoring Well Installation
3. Water Quality Sampling
4. Delineation and Evaluation of Monitored Natural Attenuation Mechanisms
5. Summary and Conclusions

1. Introduction and Background

1.1 Background. Groundwater sampling results for September 2014 and March 2015 indicated unusually high benzene concentrations in PMP Area wells, which led EPA to request additional sampling. Additional sampling took place in April, June and August 2015.

In April 2015, 1,4-dioxane was found at concentrations above its Interim Specific Groundwater Quality Standard (ISGWQS) of 10 micrograms per liter (µg/L) in the PMP Air Shaft. In November 2015, the New Jersey Department of Environmental Protection (NJDEP) lowered the ISGWQS for 1,4-dioxane from 10 µg/L to 0.4 µg/L. EPA added testing for it to the sitewide monitoring program.

EPA ordered additional monitoring wells to be put in downgradient (downstream) of the PMP Area to further investigate occurrences of benzene and 1,4-dioxane. Surface water was sampled in December 2015 and January and March 2016. Groundwater was

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sampled in May and June 2016. Sitewide sampling took place in August 2016, February 2017 and August 2017. These results are discussed in Section 3. During the August 2017 annual sampling event, free cyanide was sampled for to assist with completion of the human health risk assessment for OU3.

In January 2015, information about groundwater was taken from previous reports and compiled into a Site-Related Groundwater Remedial Investigation Report (2015 Groundwater RIR). Since then, additional monitoring wells have been put in and groundwater sampling has been conducted. The RIR Addendum documents the additional work and discusses how the additional data support the 2015 Groundwater RIR.

1.2 Conceptual Site Model. An iron mine operated on site for more than 200 years. An iron mill was also active on site. Wastes included blast rock, unprocessed ore and mine tailings, which were disposed of near the mine pits and in areas along Peters Mine Road. Ford later disposed of paint sludge and other wastes from its Mahwah facility on site. Also, Ringwood Borough allowed other industrial and municipal wastes to be disposed of on site. Industrial wastes, including Ford's paint waste, were mostly placed in three locations – the PMP Area, the OCDA and the CMP. See Figure 1.

Sixteen other paint waste disposal areas on site have been cleaned up. Municipal waste was also disposed of in the Borough Landfill and the St. George Pit Area.

The primary constituents of concern at the site are benzene, chloroethane, 1,4-dioxane, arsenic and lead.

Groundwater at the site flows through overburden material (soils and rocks overlaying bedrock) ranging in thickness from 0 to 50 feet, where the thickness is sufficient to support groundwater. Groundwater also occurs within the fractured crystalline bedrock underlying the overburden material. The overburden and bedrock form two separate aquifers, which are connected in some areas. Groundwater flow is influenced by local topography, but generally flows down valley to the south and southeast toward the Wanaque Reservoir in both aquifers. The depth to water ranges from 1 foot to 62 feet below ground

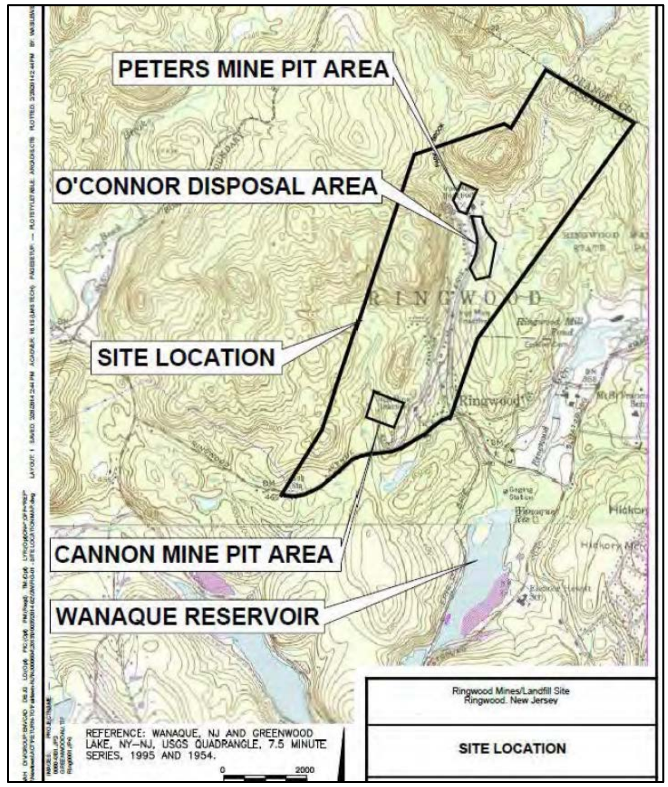

Figure 1. Ringwood Mines/Landfill Site Location (Figure 1, 2014 Record of Decision)

surface. At the site, groundwater generally flows upward from deeper bedrock to shallower bedrock to the overburden. Some groundwater discharges from the overburden into surface water.

2. Monitoring Well Installation

Table 1 lists the new monitoring wells put in since the 2015 Groundwater RIR.

Table 1. New Monitoring Wells

Monitoring Well ID	Total Well Depth (feet)	Open Hole or Screened Interval (feet below ground surface)
Overburden Wells		
OB-31	30	20-30
OB-32	20	10-20
OB-33	75	65-75
Bedrock Wells		
RW14S	153	135-155
RW-14D	185	175-185
RW15S	120	110-120
RW-15D	137	127-137
RW16	62	52-62

Locations of new monitoring wells are shown in Figure 2. See labels highlighted in yellow.

3. Water Quality Sampling

In total, 11 sampling events have been completed since submittal of the 2015 Groundwater RIR. These events have ranged from focused groundwater, mine water and surface water sampling specific to the PMP Area to sitewide annual sampling events in August 2015, 2016 and 2017.

The RIR Addendum data continue to demonstrate a limited list of site-related constituents of concern reported at varying concentrations above applicable New Jersey groundwater or surface water quality standards or criteria. The RIR Addendum analytical results reported above the New Jersey Groundwater Quality Standard (NJGWQS), the Interim Specific Groundwater Quality Standard (ISGWQS), the Interim Generic Groundwater Quality Criteria (IGGWQC), and Surface Water Quality Standards (SWQS) are summarized in Tables 2 through 7 of the RIR Addendum. Site constituents of concern frequently detected above these standards and criteria include benzene, chloroethane, 1,4-dioxane, arsenic and lead.

Water sampling data from March 2015 through August 2017 in the RIR Addendum provide the following information:

- *Benzene*. September 2014 and March 2015 benzene "spikes" reported in three groundwater monitoring wells have not been repeated. Water quality data since March 2015 consistently have low-level benzene concentrations. In sampling events after March 2015, benzene was found in concentrations above its NJGWQS of 1 µg/L in seven PMP Area monitoring wells, one CMP Area monitoring well and the PMP Air Shaft. It was found in concentrations above its SWQS of 0.15 µg/L in four surface water locations.
- *Chloroethane*. Concentrations of chloroethane were found above its IGGWQC of 5 µg/L in eight PMP Area monitoring wells and the PMP Air Shaft.
- *1,4-dioxane*. The highest concentration of 1,4-dioxane was found in the PMP Air Shaft at a depth of 230 feet below ground surface. It was found in seventeen PMP Area monitoring wells, two CMP Area wells and one OCDA well above its ISGWQS. The highest concentrations in monitoring wells occurred in the RW-3 well cluster and RW-11D in the PMP Area. It was also found above its ISGWQS in the CMP Shaft. The RIR Addendum says that 1,4-dioxane does not appear to be biodegrading. There is no SWQS for 1,4-dioxane.

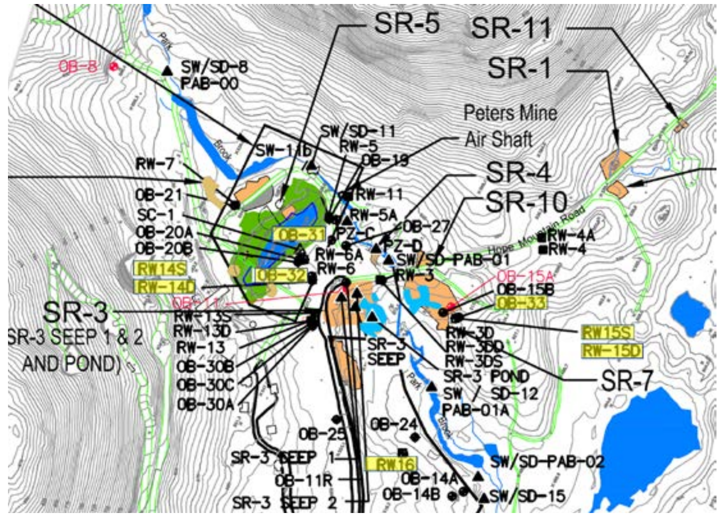

Figure 2. Locations of New Monitoring Wells (Adapted from Figure 1 of the RIR Addendum)

- *Arsenic and lead*. These are naturally occurring metals as well as constituents of paint waste. Results for total metals more frequently exceed their respective NJGWQSs than results for dissolved metals, indicating that the results are often due to particulates in the groundwater. Particulates are not as mobile in the environment as dissolved metals.

  Arsenic was found at concentrations above its NJGWQS of 3 µg/L in monitoring wells in the PMP Area, the CMP Area, the OCDA, Sally's Pond, the PMP Air Shaft and the CMP Shaft. Sally's Pond is downstream of the site and upstream of Wanaque Reservoir. Arsenic was also found in concentrations above its SWQS of 0.017 µg/L in 13 locations.

  Lead was found above its NJGWQS of 5 µg/L in one monitoring well in the PMP Area, the PMP Air Shaft and the CMP Shaft. Lead was found in two surface water seeps in concentrations above its SWQS of 5 µg/L.

4. Delineation and Evaluation of Monitored Natural Attenuation Mechanisms

Data continue to support key conclusions made in the 2015 Groundwater RIR regarding benzene, arsenic and lead. These conclusions are:

- The flow of groundwater, mine water and surface water at the site are well understood.
- The occurrence and distribution of constituents of concern in groundwater are sporadic and limited to localized landfill areas and have been delineated.
- Natural processes are lowering concentrations of benzene and controlling concentrations of lead and arsenic. Benzene is biodegrading. Particulates in groundwater samples and groundwater geochemistry near land areas of concern result in the sporadic and temporal occurrence and distribution of lead and arsenic.

Additional remedial investigation (RI) activities have furthered the understanding of the fate and transport of 1,4-dioxane at the site.

4.1 Use and History of 1,4-Dioxane. Produced commercially since the late 1920s, 1,4-dioxane has been used as a stabilizer for chlorinated solvents and in many personal care products such as detergents and shampoos. The U.S. Food and Drug Administration currently recommends a maximum concentration of 10 µg/L in commercial products. The highest 1,4-dioxane concentrations in groundwater are reported deep within the PMP Air Shaft as opposed to in shallow groundwater or soils associated with known paint waste disposal areas. The concentrations in groundwater cannot be linked to a specific source or to past disposal practices.

4.2 Transport and Fate of 1,4-Dioxane in Groundwater. Software called BIOCHLOR modeled reduction of 1,4-dioxane in groundwater due to advection (movement with the bulk flow of groundwater) and dispersion (mixing and dilution). The modeling supports the collected site data, which indicate that the bedrock is of low hydraulic conductivity and that 1,4-dioxane concentrations in groundwater will be below the ISGWQS of 0.4 µg/L within site boundaries.

4.3 Transport and Fate of 1,4-Dioxane in Surface Water. 1,4-Dioxane has been detected in surface water at concentrations ranging from non-detect to 4.78 µg/L in a seep. The highest concentration measured in a stream was 2.32 µg/L in Park Brook adjacent to the OCDA. Park Brook is upstream of Sally's Pond, which flows into Ringwood Creek. Ringwood Creek discharges into the Wanaque Reservoir. 1,4-Dioxane has not been detected downstream of Sally's Pond during any of the three sampling events. These surface water data indicate that 1,4-dioxane is not being transported downstream in surface water and is not expected to be transported off site in surface water in the future. An analysis of the potential contribution of 1,4-dioxane in water from Ringwood Creek using the highest concentration measured in any surface water indicated that 1,4-dioxane would not be detectible in the Wanaque Reservoir because of dilution.

5. Summary and Conclusions

The RIR Addendum concludes that data collected since March 2015 continue to support the conclusions presented in the 2015 Groundwater RIR. It recommends proceeding with the Candidate Technologies Memorandum and the feasibility study for site-related groundwater (OU3).

Conclusions include:

- Benzene concentration spikes in the PMP Area were not representative of groundwater quality. Benzene concentrations are low and limited to the immediate vicinity of the PMP Area. Benzene is reported in PMP Area seeps and sporadically at one location in surface water at estimated values nominally above its SWQS.
- Although chloroethane exceeds its IGGWQC in some groundwater samples, concentrations are well below the EPA's Regional Screening Level for tap water (21,000 µg/L).
- 1,4-Dioxane in groundwater in the PMP Area has been sufficiently characterized for completing a feasibility study. Concentrations are highest at 230 feet below ground surface in

the PMP Air Shaft and decrease with shallower depths within the air shaft and in the aquifers with distance from the air shaft. BIOCHLOR modeling indicates that 1,4-dioxane will decrease to less than its ISGWQS of 0.4 µg/L downgradient of the PMP Area and within site boundaries. 1,4-Dioxane is reported in surface water samples in the PMP Area with lower concentrations near the OCDA but not downstream of Sally's Pond.

- Arsenic and lead are naturally occurring metals and are also associated with paint waste. Results are affected by particulates in the groundwater samples as well as by fluctuations in groundwater geochemistry, specifically oxidation-reduction and pH.

TASC Comments

TASC staff reviewed the RIR Addendum and portions of other site-related documents. The following technical comments are based on TASC's independent review and are provided for the use of the Community Advisory Group (CAG) and community members. TASC does not submit comments to EPA on behalf of the CAG or community. The comments reflect the opinions of the reviewers and may not reflect the policies, actions or positions of EPA.

- *Permeable soil cover for the OCDA.* The plan for the OCDA cleanup is to put a permeable soil cap over the consolidated fill materials and 6 inches of clean soil in excavated areas beyond the engineered soil cap to prepare the site for use as a recycling center, as indicated in the RIR Addendum. This plan eliminates the potential for people to come in direct contact with contaminated soils. However, there is still the potential for infiltration of rainwater. Members of the public have expressed concern about this plan.

  It is understandable that members of the public are concerned to find out that waste in the OCDA is being left in place after being told it would be removed. However, excavation or even design of an impermeable cap for the OCDA could be considered unnecessary based on groundwater sampling results. The 2015 Groundwater RIR indicates that some debris and fill is left in place, that some of the material is in contact with groundwater, and that there are no significant groundwater impacts from it.[1] During the RI, no volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, or polychlorinated biphenyls (PCBs) were reported in groundwater within and downgradient of the OCDA at concentrations above regulatory standards. Dumping took place over 40 years ago. No evidence of a mass of contaminated material leaching into groundwater has been found during soil or groundwater investigations. Adding a building and pavement in the OCDA will limit rainwater infiltration, decreasing the potential for leaching even if there is an undiscovered source (such as a paint can that finally degrades and releases leachable material).

  The RI found various total metals, including aluminum, arsenic, iron, lead, and manganese, in unfiltered samples at concentrations above their respective groundwater standards. However, only manganese, iron and arsenic were above regulatory standards in dissolved form, which is the form that is most mobile in groundwater. The 2015 Groundwater RIR states that iron and manganese are a result of reducing conditions, and that arsenic detections were isolated. The 2015 Groundwater RIR also states that some fill soil samples exceeded aluminum, beryllium, cadmium, lead, manganese, mercury and/or nickel soil screening levels for impacts to groundwater. Yet, only aluminum, arsenic, iron, lead and manganese were found above regulatory standards for groundwater. <u>If the public is concerned about future leaching of these constituents in the soil, the CAG could ask EPA to conduct leachability tests.</u>

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[1] Arcadis. Site-Related Groundwater Remedial Investigation Report. Volume 1 of 3. January 2015.

The work already done at the OCDA (including removal of 2,200 tons of paint sludge) probably removed most of any source material that could endanger the groundwater. Based on reported sampling results, remaining material does not seem to be causing any significant groundwater impacts. A soil cap to prevent direct exposure and continued groundwater monitoring downgradient seem appropriate. The CAG could consider asking EPA if any soil/debris encountered during construction could be dug up and disposed of off site to help alleviate some community concerns.

- *Potential for vapor intrusion.* EPA includes 1,4-dioxane in its Vapor Intrusion Screening Level (VISL) calculator because it is considered to be volatile and sufficiently toxic through the soil gas intrusion pathway. The CAG could ask EPA whether further evaluation of 1,4-dioxane via the vapor intrusion pathway is warranted in light of new site data.

- *Benzene in groundwater.* In Section 1.2 of the RIR Addendum, Conceptual Site Model, the second paragraph on page 4 incorrectly states that benzene in groundwater is limited to the PMP Area. According to Table 8, benzene is also periodically detected at or above the 1 µg/L NJGWQS in CMP Area well RW-8 (204-214). In August 2016, benzene was detected at 3.8 µg/L in this well; in August 2017, it was detected at 1 µg/L. There were no benzene detections above its 1 µg/L NJGWQS in shallower wells in this area. The CAG may want to ask for the RIR Addendum to be corrected.

- *Groundwater flow pathways.* The RIR Addendum states several times that the groundwater flow pathway is generally from deeper bedrock to shallower bedrock to the overburden (e.g., Section 1.2). This seems to overgeneralize the data found during the RI. Page 86 of the 2015 Groundwater RIR notes downward vertical gradients at bedrock wells RW-3 and RW-4, downgradient of the PMP Area. Some wells in the CMP Area also reported downward vertical gradients. The downward gradient at RW-3 is particularly interesting since this well cluster (RW-3, RW-3DS and RW-3DD) reports some of the highest 1,4-dioxane concentrations detected at the site (only RW-11D and the PMP Air Shaft reported higher concentrations). If a downward gradient is observed at the RW-3 cluster, contaminant transport pathways do not appear as certain as presented in the Conceptual Site Model. It is not clear if this contamination eventually migrates to shallower depths further downgradient and discharges to surface water, as the Conceptual Site Model states, or if it migrates along a deeper flow path, possibly extending past site boundaries. TASC staff suggest that the CAG should ask EPA for further clarification of groundwater flow paths in the deep bedrock, in consideration of observed downward vertical gradients at RW-3 and other wells on site.

  Several new well clusters were put in during 2015. The CAG may want to ask EPA whether flow characteristics were identified in these new wells. What types of vertical gradients were observed in these wells? Are the findings consistent with the RI findings?

- *Concentration of 1,4-dioxane in groundwater and need for sentinel wells.* Based on the relatively low concentrations of constituents of concern at the site, lack of detections in the downgradient surface water bodies, low hydraulic conductivity, and distance to the Wanaque Reservoir, it appears that there is little risk that site contaminants will affect drinking water from the reservoir. However, 1,4-dioxane contamination is not properly defined in the deep bedrock and it is not clear whether it extends off site. Well RW-15D is the furthest on-site downgradient well from the PMP Area and there are no other wells between RW-15D and the eastern site boundary. It is not clear that RW-15D is deep enough to determine if 1,4-dioxane is in the deep

> Hydraulic conductivity – a measure of how easily water can pass through soil or rock. Low values indicate that it is less easy for water to flow.

bedrock groundwater. 1,4-Dioxane was not detected in RW-12, a deep bedrock monitoring well near Sally's Pond. However, RW-12 is more than a quarter mile outside of the property boundary and more than a half mile from PMP Area wells. It is unclear to TASC that RW-12 is downgradient of the PMP Area. The RIR Addendum does not include potentiometric surface contours showing this off-site area. TASC did not find any information in the 2015 Groundwater RIR indicating that RW-12 is in connection with deep bedrock groundwater from the site.

Section 1.2 of the RIR Addendum states that "1,4-dioxane concentrations in groundwater migrate to greater distances but are attenuated in the downgradient direction in both the overburden and bedrock through advection and dispersion such that they dissipate before reaching the boundaries of the Site and do not migrate beyond the Site boundaries." It would be helpful if figures were provided to document the extent of 1,4-dioxane contamination in overburden and bedrock (similar to the figures in the 2015 Groundwater RIR). There are also higher concentrations of 1,4-dioxane at depth (200 feet or greater). It is not clear that the existing well network, including the new wells installed in 2015, has defined the groundwater contamination to the site boundaries. The CAG may want to ask EPA to consider further defining concentrations of 1,4-dioxane in deeper groundwater and to include figures showing the extent of 1,4-dioxane contamination in groundwater.

TASC staff suggest that the CAG should ask EPA to consider installing sentinel wells at the site boundary to better detect 1,4-dioxane and any other constituents of concern flowing past the site boundaries and posing a risk to reservoir water quality.

- *Protective level for 1,4-dioxane in surface water*. Page 14 of the RIR Addendum states that because there is no New Jersey surface water quality standard for 1,4-dioxane, the report therefore compares detected concentrations to the ecological screening level (22,000 µg/L). The CAG may want to ask EPA to clarify how this use of the ecological screening level is protective of human receptors and the drinking water reservoir downstream.

- *BIOCHLOR model*. Based on the complicated groundwater flow patterns at the site resulting from fractured bedrock and underground mine workings, use of the BIOCHLOR model to approximate attenuation of 1,4-dioxane in groundwater may not be an appropriate tool at the site. According to the BIOCHLOR user's manual (https://nepis.epa.gov/Adobe/PDF/P1000YUW.pdf), the model assumes simple groundwater flow conditions and should generally not be applied where vertical flow gradients affect contaminant transport. At the site, it appears that horizontal and vertical movement of groundwater and contaminants is occurring. While the predominant flow direction is to the south and southeast, there is also a component of vertical flow. Vertical flow gradients vary at the site. Some well clusters report upward flow gradients and other well clusters (such as the RW-3 and RW-4 clusters) report downward vertical flow gradients.[2]

  It also appears that the data selected to calibrate the model (from the PMP Air Shaft, RW-11D, RW-3DD, RW-15D and RW-16) oversimplify a flow path and assume flow is primarily in one direction. The depths of the data from these sampling locations appear to vary greatly (from 230 feet at the PMP Air Shaft to 52-62 feet at downgradient well RW-16). The RIR Addendum has not presented groundwater elevation data for these locations or a deep bedrock potentiometric surface map to show that the selected locations represent a likely flow path for groundwater. Improper characterization may result in a model "calibrated" to a set of conditions that is not representative of actual field conditions. Further discussion

[2] Arcadis. Site-Related Groundwater Remedial Investigation Report. Volume 1 of 3. January 2015.

of the assumptions and limitations of the BIOCHLOR model is needed in consideration of: 1) the complicated groundwater flow at the site; and 2) the varied depths of 1,4-dioxane contamination. The CAG may want to ask EPA to review the appropriateness of using results from the BIOCHLOR model for site decision-making.

- *1,4-Dioxane levels in soil*. Although soils were tested for VOCs, OU2 remedial investigations for the CMP Area and the OCDA do not list 1,4-dioxane as an analyte. The RI Report for the PMP Area was not available on EPA's website and was not reviewed. Page 4 of the RIR Addendum states that a focused investigation in the OCDA did not find a discrete source of 1,4-dioxane in the fill/waste. Likewise, a discrete source of 1,4-dioxane in PMP Area soil was not discovered in soil borings from 15 locations in the PMP Area, as summarized in Appendix C of the October 2017 OU2 Final Remedial Design Report. PMP Area soil boring samples were taken at depths of 2.5 to 12.5 feet and detection limits ranged from 4.9 to 16 micrograms of 1,4-dioxane per kilogram of soil (µg/kg). The CAG may want to ask EPA if any additional focused investigation for 1,4-dioxane in soils is needed to be sure that source material is not overlooked.

- *Routine testing of drinking water*. The North Jersey District Water Supply Commission 2017 Consumer Confidence Report indicates that testing is done at different times for different constituents. Chlorine residuals, turbidity, pH, temperature and color are tested for daily. Bacteria are tested for monthly. Trihalomethanes, haloacteic acids, inorganics, VOCs and nitrates are tested for yearly. Lead and copper are tested for twice a year. Radioactivity is tested for every nine years. The drinking water report does not list specific VOCs such as the site constituents of concern – benzene, chloroethane and 1,4-dioxane. The CAG may want to ask the North Jersey District Water Supply Commission whether drinking water is or could be routinely sampled for these constituents.

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