Maryland Department of the Environment

REPORT OF RESULTS FOR LEAD AND HEXAVALENT CHROMIUM GROUNDWATER INVESTIGATION: Report Synopsis

Since 2005, the Maryland Department of the Environment (MDE) has been investigating and overseeing the cleanup of petroleum contamination in the groundwater in the vicinity of the former Green Valley Citgo station (GVC Station) and the Green Valley Plaza at 11791 Fingerboard Road in Monrovia, Maryland. Petroleum contamination in groundwater, including methyl tertiary-butyl ether (MTBE), was found to be impacting six residential supply wells located down-gradient of the GVC Station as well as several commercial supply wells in the immediate vicinity of the GVC Station. Several interim measures were taken by Carroll Independent Fuel Company (Carroll), including installation and continued maintenance of point-of-entry water filtration treatment systems for impacted supply wells in 2007 (for residential wells) and 2008 (for commercial supply wells), and removal of underground storage tanks in 2008. A public informational meeting was held in May 2007 at Green Valley Elementary School.

Dissolved substances in groundwater, including metals, migrate in the direction of, and with the speed of the surrounding groundwater, and their transport is subject to many factors, including changes in groundwater chemistry. The groundwater flow in the area around the GVC Station has been well-documented for years to be predominantly in a south-southwesterly direction. The extent of MTBE contamination in residential wells in the area of interest also has been known since 2006, with all impacted residential wells lying in the direction of groundwater flow, to the south-southwest of the GVC Station. Thus, the MTBE plume originating from the GVC Station is well-defined, with a known source area, and provides information about the groundwater flow direction leaving the source area.

In September 2011, after MDE's approval, Carroll began operation of an *in-situ* chemical oxidation (ISCO) remediation system, which was located in the parking lot of the Green Valley Plaza. The ISCO system consisted of injections of ozone and hydrogen peroxide into the source area of the remaining petroleum contamination, particularly MTBE, in the subsurface at the GVC Station.

In July and August 2012, some residents of the Monrovia area raised concerns to MDE and the Frederick County Health Department (FCHD) through counsel that they thought the ISCO remediation system had contaminated drinking water supply wells throughout the Monrovia area with elevated levels of hexavalent chromium, a metal that is potentially hazardous to human health. In response to the concerns raised, and as a precautionary measure, on July 31, 2012, MDE directed that the ISCO remediation system be shut off, pending further investigation and water sampling. In August and September 2012, residents expressed concern through counsel that they thought that the ISCO remediation system had also caused lead contamination in drinking water supply wells in the Monrovia area.

The *Report of Results for Lead and Hexavalent Chromium Groundwater Investigation* presents and discusses the results of the investigation conducted by MDE that addressed the following concerns:

- Whether concentrations of these metals are above health or regulatory standards used by MDE, such that there may be a public health risk warranting regulatory action. **The investigation found that the concentrations do not represent a public health risk warranting regulatory action.**

- Whether detections of hexavalent chromium and/or lead in residential supply wells were connected to the operation of the ISCO remediation system at the GVC Station. **The investigation found that the detections were not connected to the operation of the ISCO remediation system.**

- Whether these metals are naturally-occurring in groundwater or originate from plumbing materials. **The investigation found that these metals are naturally-occurring in groundwater and originate from plumbing materials.**

- Whether subsurface water quality conditions, such as pH, are contributing factors in the presence of these metals in water. **The investigation found that subsurface water quality conditions, such as pH, are contributing factors in the presence of these metals in water.**

The full report includes background information, site information, sampling information, data collected, and the analyses of those data, including certain risk assessments, and provides MDE's observations, conclusions, and recommendations for both the residents in the area studied and users of residential supply wells throughout Maryland.

This synopsis includes recommendations for limiting potential exposure to lead in drinking water.

Summary of Key Conclusions

MDE, in cooperation with FCHD, sampled 25 homes for lead and hexavalent chromium, from a variety of locations within the plumbing systems inside of homes. All samples collected by MDE and FCHD, as well as those reported by Jenkins Environmental, Inc. and Carroll were evaluated to determine whether or not they pose a human health risk warranting regulatory action.

All hexavalent chromium concentrations measured in residential drinking water systems as part of the investigation were below the conservative lifetime exposure health based concentration of 0.3 micrograms per liter (µg/L), a measure that is far below the 100 µg/L maximum contaminant level (MCL) for total chromium that is established by the United States Environmental Protection Agency (EPA) for public drinking water systems. An explanation of the different concentration levels considered for hexavalent chromium and total chromium is included later in this synopsis. The detections are low enough to not pose a public health risk warranting regulatory action. The hexavalent chromium detections in residential drinking water samples in the area of interest are reasonably attributable to naturally occurring, low levels of hexavalent chromium in groundwater, originating from the surrounding bedrock. They exhibited no specific pattern or plume and had no correlation with the well-defined MTBE plume.

Lead concentrations for all point-of-use samples (*i.e.* faucets) were low enough to not pose a public health risk warranting regulatory action. The elevated lead concentrations found in some residential water samples were primarily attributed to lead-bearing sediments collected in pressure tanks and the degradation of residential plumbing systems. The lead detections are also likely due in part to naturally occurring lead in groundwater, which is a result of groundwater contact with lead-containing bedrock. The lead detections in water samples from residences in the area of interest exhibited no specific pattern or plume and had no correlation with the well-defined MTBE plume.

The elevated lead concentrations referenced above, which could present health risks if consumed, were found in water samples taken from within residential plumbing systems at pressure tanks. Further investigation confirmed that plumbing system pressure tanks collect sediments and suspended solids, including metals. These sediments lead to elevated concentrations of metals in water samples obtained from those locations. The presence of metals in samples of that origin would present a public health risk only if the high lead levels were delivered to point-of-use locations or otherwise consumed.

Certain areas in plumbing systems, such as pressure tanks, hot water heaters, and filters, can accumulate deposits of sediments over time. These sediments may include degraded plumbing and natural materials, which may contain lead and other metals. Accumulated sediments that contain lead can act as a continued source of lead in the water supply. These sediments, when exposed to acidic water like the groundwater in the Monrovia area, could cause lead levels to exceed action levels at specific locations within a plumbing system. To try to prevent this from occurring, wells and plumbing components should be properly maintained by the owners and/or users of the systems.

The detections of lead and hexavalent chromium in residential drinking water samples in the Monrovia area are not related to the operation of the ISCO remediation system, which had a highly-localized impact, as intended and as evidenced by data collected from wells in close proximity to the injection locations. The past operation of the ISCO remediation system is not expected to have any future impact on residential drinking water supplies.

Conclusions from the data analysis include:

1. Hexavalent chromium and lead concentrations at all residential properties were below conservative public health based concentrations at point-of-use faucets;

2. There is no pattern in the residential well detections of hexavalent chromium that would correspond to a definable hexavalent chromium plume from a single place of origin;

3. There is no pattern in the residential well detections of lead that would correspond to a definable lead plume from a single place of origin;

4. There is no correlation between the presence of hexavalent chromium and lead in samples from residential drinking water systems;

5. There is no correlation between the presence of MTBE and hexavalent chromium or lead in samples from residential drinking water systems; and

6. Statistical analysis of the monitoring well and residential supply well data sets reveal an inverse correlation between the mean metals concentrations, indicating that a single source (*e.g.* ISCO) is unlikely to be the cause of both.

Geology and Groundwater Resources in the Area of Interest in Monrovia

Properties with Monrovia addresses are located in a broad, unincorporated area of Frederick County, defined by the Monrovia zip code of 21770. The land use in the area of interest near the GVC Station consists of the adjoining commercial shopping centers where the station is located and the surrounding residential neighborhoods. The shopping centers and the homes in the immediate area use groundwater as their primary source of water.

Public and private water supply wells in the Monrovia area and other areas of Frederick County typically are completed in an unconfined, fractured-rock formation or combination of formations. Water withdrawn from different wells in the Monrovia area may have different characteristics due to the variability in the underlying bedrock formations that are known to exist across the area.

Lead and chromium are among the numerous naturally occurring metals in soils, sediment, and rock throughout Maryland. Metals, including chromium in its various valence states and lead, may be present in groundwater in solid and/or dissolved form dependent upon the characteristics of underlying bedrock formations and groundwater conditions.

Groundwater across Central Maryland, including the Monrovia area, is known to be acidic (i.e. pH below 7) based on historic monitoring data. Several independent studies conducted in this area and more broadly across the same geologic formation that underlies portions of Monrovia have demonstrated pH readings in the 5 to 5.5 range.[1] Groundwater with a pH reading in this range would be considered corrosive to metallic plumbing components without treatment.

Hexavalent Chromium

Hexavalent chromium, like numerous other substances, is potentially hazardous to human health and is characterized as a human carcinogen through inhalation. The most commonly occurring valence states of chromium are trivalent chromium (Cr III) and hexavalent chromium (Cr VI). Hexavalent chromium occurs naturally in soil, water, and air from the erosion of natural chromium deposits and also may be

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[1] *Network Description and Initial Water-Quality Data from a Statewide Ground-Water-Quality Network in Maryland*. Report of Investigations No. 60, Maryland Department of Natural Resources, 1996; *Keystone Landfill Maryland Monitoring System Investigation and Report*, State of Maryland, Department of Health and Mental Hygiene, Office of Environmental Programs, Waste Management Administration, June 1986

produced by manmade processes, such as ISCO. Depending on subsurface conditions, hexavalent chromium can be mobilized in groundwater, either naturally or due to manmade conditions.

EPA has established an enforceable MCL of 100 µg/L for total chromium (all valence states) in public drinking water systems. There currently is no federal or State MCL for hexavalent chromium alone, but EPA is in the process of evaluating the need for a separate MCL. Currently, EPA's MCL for total chromium allows drinking water to contain up to 100 µg/L of hexavalent chromium without violating the MCL.

In this groundwater investigation, due to the nature of hexavalent chromium as potentially hazardous to human health, MDE evaluated the potable well sampling results for hexavalent chromium using a far more conservative concentration than the MCL of 100 µg/L. MDE used a risk calculation formula that resulted in a conservative lifetime exposure health based concentration of 0.3 µg/L of hexavalent chromium. None of the point-of-use samples analyzed as part of this investigation exceeded the MDE recommended lifetime health based risk criteria for hexavalent chromium (0.3 µg/L).

Lead

Lead, like numerous other substances, is potentially hazardous to human health, and is characterized as a probable human carcinogen. Scientists have linked the effects of lead with lowered IQ in children. The greatest risk of lead exposure is to infants, young children, and pregnant women. The main sources of lead exposure are lead-based paint and lead-contaminated dust or soil, and some plumbing materials. A common source of lead in drinking water is the corrosion of lead-containing plumbing components. Lead in the natural environment may also contribute to groundwater contamination and impact drinking water under certain water quality conditions. Low water pH levels may contribute to the corrosivity of water.

Based on possible health risks, the EPA has set a non-enforceable maximum contaminant level goal (MCLG) of zero for lead. Because lead contamination of drinking water is often due to corrosion of plumbing materials, EPA has not established a MCL for lead, and instead, established an action level and requires public drinking water systems to comply with a treatment technique to control the corrosivity of the water as part of a regulation known as the Lead and Copper Rule. This rule recognizes that lead and copper enter drinking water mainly from the corrosion of plumbing materials that contain these metals. It establishes a 15 µg/L action level for lead in public drinking water systems as the concentration at which additional investigation is warranted under specified circumstances.

In this groundwater investigation, MDE used 15 µg/L as guidance for residential point-of-use samples. Lead levels greater than this guidance were measured at various points in the plumbing systems of individual homes as part of this study. Based upon a detailed analysis of site-specific factors, the elevated lead levels were determined not to be a result of the operation of the ISCO system at the GVC Station. This investigation concluded that the concentrations of lead in point-of-use samples do not represent a public health risk warranting regulatory action.

Summary of Recommendations for All Users of Drinking Water Wells

As a precaution and to limit potential exposures to lead in drinking water, users of groundwater throughout the State are encouraged to maintain their plumbing systems, periodically test water for the presence of contaminants, and follow other recommendations provided in the EPA publication "Drinking Water from Household Wells."[2] Day-to-day steps to reduce exposure to lead in drinking water[3] include:

1. **Let the water run from the faucet before using it for drinking or cooking.** The longer water stands in the plumbing, the more lead it may contain. Flushing the faucet means running the cold water faucet for 15 to 30 seconds. Although toilet flushing or showering flushes water through a portion of the plumbing system, you still need to flush the water in each faucet before using it for drinking or cooking. Flushing faucet water is a simple and inexpensive measure you can take to protect your health. It usually uses less than one gallon of water. To conserve water, fill a couple of bottles for drinking water after flushing the faucet, and whenever possible use the first flush water to wash dishes or water plants.

2. **Never cook with or drink water from the hot water faucet.** Hot water can dissolve lead more quickly than cold water. If you need hot water for drinking or cooking, draw water from the cold faucet and then heat it.

The steps described above will reduce the concentration of lead in drinking water. However, if residents are still concerned, bottled water may be used for drinking and cooking.

The groundwater in the area of interest typically has a low pH, and may be corrosive: Users may want to periodically test their drinking water for lead, flush sediments from water lines and pressure tanks, and consider the addition of water treatment system components to remove metals from the water and adjust pH to recommended levels to make the water less corrosive to metallic plumbing materials. Implementing some or all of these recommendations reduces the likelihood of lead and other metals within the residential water supply systems.

While MDE did not find any public health risks warranting regulatory action based on this investigation, MDE's finding does not affect and is not intended to influence people's rights to investigate, evaluate and respond independently to any issues or concerns they may have about their drinking water.

The full text of the *Report of Results for Lead and Hexavalent Chromium Groundwater Investigation* of the groundwater investigation can be found in the "Reports and Publications" section of the "Research Center" on MDE's website: http://bit.ly/1mHcLJr

A copy of the report also is available in the Urbana Regional Library through December 2014.

[2] The EPA publication "Drinking Water from Household Wells" is available as Appendix O of the full report, which is available on MDE's website, and on EPA's website.
[3] See EPA's publication "Is There Lead in My Drinking Water?" which is available as Appendix Q of the full report, and on EPA's website.