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May 12, 2016

Mr. Scott Turner, PE, AICP, LEED AP ND
Nitsch Engineering
2 Center Plaza, Suite 430
Boston, Massachusetts 02108

Subject: Influence of Storm Water Infiltration on Impacted Fill
Nemasket Street Lots - Parker Street Waste Site
New Bedford, Massachusetts
Release Tracking Number 4-15685

Dear Mr. Turner:

As you are aware, TRC Environmental Corporation (TRC) is working with the City of New Bedford, Massachusetts to implement a remedial alternative under the Massachusetts Contingency Plan (MCP) that involves the following Nemasket Street properties: map 69, blocks 86 through 93, and blocks 96 through 100, hereafter referred to as "the Site". The Phase II Comprehensive Site Assessment (Phase II) that was completed in January 2012, indicates that fill material was placed at the Site sometime during the period between the 1940s and the 1970s. The fill consists of sandy soil intermingled with ash, coal fragments, asphalt, rubber, slag, brick, concrete, porcelain, glass, fabric, plastic and metal, and is present across the Site and overlies native peat and glaciofluvial deposits. The chemical quality of the fill has been extensively characterized through laboratory analysis. Samples collected and analyzed as part of the Phase II found that the fill material contains certain metals (i.e., arsenic, barium, cadmium, chromium, lead and nickel), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and dioxins above Massachusetts Department of Environmental Protection (MassDEP) soil cleanup standards which consider the potential mobility of these analytes for protection of groundwater.

The remedy for the Site involves the targeted removal of localized fill that contains greater than 100 milligrams per kilogram (mg/kg) total PCBs and redeveloping the Site as a community athletic complex that principally includes a soccer field and basketball courts. The fill will be covered with three feet of clean soil and three types of exposure barriers will be used to limit the potential for direct contact with residual constituents present in the fill. Since two of the three types of exposure barriers (i.e., artificial turf and clean soil) that will be used over the vast majority of the Site are pervious and will allow for continued infiltration of precipitation through the fill, the New Bedford Conservation Commission has requested information from the Licensed Site Professional (LSP) of Record that infiltration is appropriate at this Site given the nature of the impacted fill. This letter provides the requested documentation.

Infiltration is considered appropriate for the Site since the constituents of interest in the fill exhibit a low potential for mobility. As noted above, the fill contains concentrations of certain PAHs, PCBs, dioxins, and metals that are above Massachusetts soil cleanup standards, which take into consideration the potential migration of these constituents from soil to groundwater. Note that the fill materials at the Site contain significant quantities of ash, decomposing wood and cinders which are an abundant source of organic carbon[1].

TRC estimated the maximum theoretical concentration of the PAHs, PCBs, and dioxins that could potentially partition from the soil into water that percolates through the fill (see Attachment 1) using the following equation (Freeze and Cherry, 1979)[2] and site-specific values of organic carbon:

$$C_w = C_s/(K_{oc} * f_{oc})$$

Where: C_w = the maximum equilibrium concentration of the analyte in water that can partition from soil containing the analyte, mass/volume;
C_s = the concentration of the analyte of interest in soil, mass/mass;
K_{oc} = Organic carbon partitioning coefficient, volume/mass; and
f_{oc} = the fraction of organic carbon in the soil/fill.

To provide a conservative worst-case estimate, the maximum concentrations of PAHs, PCBs, and dioxins detected in the fill were used to estimate the concentration of the analytes in water that contacts the fill. As shown in Attachment 1, the maximum concentrations of PAHs, PCBs and dioxins that could leach from the fill and migrate to groundwater are orders of magnitude lower than the applicable GW-2 or GW-3 groundwater cleanup standards that apply to the Site. These data indicate that the fill material is not capable of contributing dissolved PAHs, PCBs, or dioxins to groundwater at levels that could pose a risk to potential receptors. It should be noted that the calculated concentrations do not account for attenuation processes in the subsurface that would further reduce concentrations of these analytes in groundwater.

Unlike organic substances (e.g., PAHs, PCBs, and dioxins), the mobility of the metals of interest (i.e., arsenic, barium, cadmium, chromium, lead, and nickel) is influenced primarily by adsorption of these metals onto minerals that exist within soil or fill, the stability of these minerals, and redox reactions that occur in response to precipitation and storm water infiltration through the fill. These processes, and thus metals mobility, are controlled largely by the pH of the precipitation and storm water. As previously noted, the fill will be covered with precharacterized clean soil that would be below applicable Massachusetts soil cleanup standards and synthetic turf and pavement which are inert. These materials will not significantly alter the pH or chemical characteristics of precipitation or storm water, which has been percolating through the fill for over 30 years. Based on the most current groundwater data which was presented in the Phase II, metals concentrations in wells located at and immediately downgradient of the Site meet the GW-3 groundwater criteria that apply to the Site as well as the more stringent GW-1 criteria[3]. Since the pH and chemical characteristics of the storm water and precipitation is anticipated to be similar to existing conditions, the geochemical reactions and stability of

[1] The average fraction of organic carbon in the soil/fill measured during the Phase II ranged from 0.094 and ranged from 0.0735 to 0.1149.
[2] Freeze, R.A. and J.A. Cherry, 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.
[3] GW-2 standards apply to compounds that could potentially volatile from groundwater to soil gas and cause a vapor intrusion concern to indoor air. Since metals do not volatize, GW-2 criteria do not apply to metals.

minerals that currently limit the mobility of metals are not expected to change. Therefore, there is no basis to conclude that concentrations of metals in groundwater will increase to a level that would pose a risk to potential receptors as a result of infiltration.

If you have any questions or comments, please do not hesitate to contact me at 978-656-3565.

Sincerely,

TRC

David M. Sullivan, LSP
Senior Project Manager

Attachment

Attachment 1
Estimated Maximum Theoretical Concentrations of Organic Constituents of Interest
That Could Leach from Fill
Nemasket Street Properties
New Bedford, Massachusetts

Statement of Problem:

Estimate the theoretical maximum concentration of organic constituents in water infiltrating the fill as the Nemasket Street properties for those constituents exceeding Massachusetts Contigency Plan (MC) generic Method 1 Soil Standards that consider protection of groundwater.

Approach:

The theoretical equlibrium concentration of a constuent that can partition from soil into water contained in the soil pore space is a linear process that is characterized by the Freundlich Isotherm and can be mathmatically expressed by the following equation:

$$C_w = C_s/K_d$$

Where: C_w = Theoretical concentration of constituent in sporewater infiltration through the soil/fill, mass/volume;
C_s = Concentration of constituent in the soil/fill, mass/volume;
K_d = Soil distribution coefficient = Koc * foc, volume/mass;
K_{oc} = organic carbon partitioning coefficient; and
f_{oc} = fraction of organic carbon in the soil/fill, unitless.

Organic carbon partitioning coefficents for organic constituents are established in the scientific literature and were presented in the Phase II Investigation Report (TRC, 2012). The average fraction organic carbon content of thesoil/ fill based on samples analyzed as part of the Phase II Investigation of the Nemasket Street Properties to be 0.094. The organic carbon content is consistent with the presence ash, cinders, wood debris and other sources of organic carbon within the fill. Based on these data and the maximum concentrations of constituents detected in the soil, the maximum theoretical concentrations the the constituents that could be expected to partition from the fill to stormwater or precipitation infiltrating the fill was conservatively estimated in the following table.

Compound	Maximum Concentration in Fill (mg/Kg)	Organic Carbon Partitioning Coefficient, K_{oc} (L/Kg)	Fraction of Organic Carbon, f_{oc} (unitless)	Distribution Coefficient, K_d (L/Kg)	Theoretical Maximum Pore Water Concentration, C_w (mg/L)	Theoretical Maximum Pore Water Concentration, C_w (µg/L)	Appicable MCP Groundwater Criteria GW-2 (µg/L)	Appicable MCP Groundwater Criteria GW-3 (µg/L)
Organic Analytes								
Acenaphthylene	13	4,786	0.094	451	0.029	29	10000	40
Benzo(a)anthracene	120	358,000	0.094	33,759	0.004	4	NA	1,000
Benzo(a)pyrene	93	969,000	0.094	91,377	0.001	1	NA	500
Benzo(b)fluoranthene	130	1,230,000	0.094	115,989	0.001	1	NA	400
Chrysene	130	398,000	0.094	37,531	0.003	3	NA	70
Dibenz(a,h)anthracene	15	1,790,000	0.094	168,797	8.89E-05	0.1	NA	40
ideno(1.2.3-cd)pyrene	53	3,470,000	0.094	327,221	1.62E-04	0.2	NA	100
PCBs	95.295	309,000	0.094	29,139	0.003270393	3	5	10
Dioxins (TEQ)	0.41	1,584,893	0.094	148979.942	2.75E-06	2.75E-03	NA	0.04

As shown in the table above, the maximum concentration of organic constituents of interest would not exceed the groundwater standards that apply to the Site.

Notes:

1. mg/Kg = milligrams per kilogram
2. L/Kg = Liters per kilogram.
3. mg/L = Milligrams per liter.
4. µg/liter.