Development of Site-specific Media Protection Standards (MPS) for Volatile Organic Compounds (VOCs) and Site Metals in Groundwater

This document presents the development of site-specific MPS for VOCs and site metals to be used as target concentrations for monitored natural attenuation (MNA) as a final remedy at the site. MPS for groundwater reflect the following considerations:

- Human health considerations for groundwater at the site
- Ecological considerations through groundwater migration to surface water
- Source reduction considerations

This document addresses the approach and initial assumptions relied upon in the calculations of site-specific MPS for human and ecological exposures to groundwater. Site-specific MPS for groundwater are developed consistent with the Massachusetts Contingency Plan (MCP; 310 CMR 40) process for establishing risk-based levels for groundwater.

The MCP sets forth three methods for the development of MPS. These standards represent concentrations of hazardous substances at which no further remedial response actions are required based upon the risk posed by these chemicals. The standards are protective of public health, public welfare, and the environment (*i.e.*, represent a condition of "no significant risk"), given the exposures assumed, and are measurable. Method 1 standards are, by nature, generic, and are derived in a manner to be protective at a wide range of disposal sites across the state. Flexibility also exists under the MCP to use more site-specific risk characterization approaches under Method 2: default Method 1 equations with site-specific inputs, and Method 3: comprehensive site-specific risk evaluations.

Under the MCP, three approaches are available for development of media protection standards for groundwater based on potential exposures to groundwater.

- **Category GW-1 –** Concentrations based on the use of groundwater as drinking water, either currently or in the foreseeable future.
- **Category GW-2 –** Concentrations based on the potential for volatile material to migrate into indoor air.
- **Category GW-3 –** Concentrations based on the potential environmental effects resulting from impacted groundwater discharging into the surface water of the Little River.

Groundwater in the area where the site is located is not currently used, nor is it reasonably anticipated to be used, as a drinking water source, and the residential area north of the site is on city water. Category GW-2 standards apply to groundwater that is considered shallow and where there is currently (or may in the future be) a residential or industrial structure built at the land surface. The GW-2 standards are intended to address the potential for migration of volatile vapors into indoor air from hazardous substances in groundwater. Groundwater concentrations that are below site-specific GW-2 standards for protection of indoor air exposures would not be expected to pose a risk to resident or industrial worker populations through the vapor migration pathway. GW-3 standards are appropriate for non-volatile constituents and volatile constituents in groundwater that does not flow toward or beneath occupied buildings but will eventually discharge to the surface water of the Little River.

VOCs

For the VOCs at the site, a Method 2 approach was used to the development of site-specific GW-2 standards. Site-specific GW-2 standards (MPS) for North End Groundwater reflect the potential for residential exposures to volatile vapor in indoor air and for South End Groundwater reflect the potential for industrial

exposures to volatile vapor in indoor air. Specifically, the default Method 1 equations for volatilization of groundwater constituents into indoor air were modified with site-specific inputs. *Table 1 (Input Parameters for Method 2 GW-2 MPS for Residential Exposures)* and *Table 2 (Input Parameters for Method 2 GW-2 MPS for Industrial Exposures)* provide a summary of the default residential (Table 1) and industrial (Table 2) inputs along with site-specific input parameters used in the calculation of the GW-2 standards. Rationale for the site-specific input parameter is also provided in Tables 1 and 2. A limited number of the parameters were modified with site-specific inputs as follows:

- Groundwater temperature
- Soil type
- Indoor air exchange rate
- Depth to groundwater
- Enclosed space floor length, width, and height
- Target hazard quotient (HQ) – noncarcinogens

The following table presents the site-specific GW-2 standards reflective of residential and industrial indoor air exposures and provides a comparison of site-specific values to the MCP Method 1 GW-2 standards.

PARAMETER	MA DEP RESIDENTIAL EXPOSURE MIGRATION TO INDOOR AIR (mg/L)	SITE-SPECIFIC RESIDENTIAL EXPOSURE MIGRATION TO INDOOR AIR (mg/L)	SITE-SPECIFIC INDUSTRIAL EXPOSURE MIGRATION TO INDOOR AIR (mg/L)
Benzene	2.0	50	50
Bromomethane	0.007	1.0	2.4
Chloroform	0.05	1.4	3.4
1,1-Dichloroethane (1,1-DCA)	1.0	50	50
1,2-Dichloroethane (1,2-DCE)	0.005	0.13	0.52
1,1-DCE	0.08	11.5	26
cis-1,2-DCE	0.1	14	33
trans-1,2-DCE	0.09	12	29
Naphthalene	1.0	26	31
1,1,2,2-Trichloroethane	0.009	0.21	0.87
Tetrachloroethene (PCE)	0.05	1.2	2.8
Trichloroethene (TCE)	0.03	0.8	1.9
Vinyl chloride	0.002	0.013	0.052

Site Metals

For groundwater in the southern portion of the site that does not or will not flow beneath an occupied building, including groundwater beneath the neighboring agricultural properties, Method 1 GW-3 standards are used. The following table presents default GW-3 standards that are protective of potential environmental effects resulting from impacted groundwater discharging to the surface water of the Little River.

PARAMETER	MA DEP PROTECTIVE OF POTENTIAL ENVIRONMENTAL EFFECTS (mg/L)
Benzene	10
1,2-DCA	20
1,1-DCE	30
cis-1,2-DCE	50
Naphthalene	20
PCE	30
TCE	5.0
Vinyl chloride	50
Cadmium	0.004
Chromium	0.3
Copper	No published value
Nickel	0.2
Zinc	0.9

Site metals include cadmium, chromium, copper, nickel, and zinc. Cadmium is above the Method 1 GW-3 standard in background monitoring well MW-25S. Therefore, in accordance with 310 CMR 40.0983(1), the background concentration of cadmium will be used as an alternative MPS for cadmium. The background concentration is calculated as the 95 percent upper confidence limit (95% UCL) of the mean concentration in background monitoring well MW-25S.

Method 1 does not provide an MPS for copper. Copper has been identified as a site-specific COC. However, a default GW-3 MPS for copper is not provided in the MCP. Per 310 CMR 40.0983(4), the GW-3 MPS is 10 times the appropriate ecologically based water quality criterion. Massachusetts surface water quality standards in 314 CMR 4.05(5)(e) cite the National Recommended Water Quality Criteria established by USEPA. The appropriate water quality criterion for copper is the fresh water chronic water quality standard is 0.009 mg/L. Thus, the GW-3 MPS for copper is 0.09 mg/L. The following table presents the two alternative GW-3 MPS values being applied to the Site.

PARAMETER	SITE-SPECIFIC MPS (mg/L)	BASIS
Cadmium	0.009	95% UCL of mean background concentration
Copper	0.09	10 times chronic fresh water, Water Quality Criterion