Health Consultation

PROVIDENCE HIGH SCHOOL PARCEL B

(a/k/a FORMER GORHAM SITE)

PROVIDENCE, RHODE ISLAND

EPA FACILITY ID: RID001195015

DECEMBER 4, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Agency for Toxic Substances and Disease Registry

Background and Introduction

The Agency for Toxic Substances and Disease Registry (ATSDR) was requested[a] to review and evaluate various environmental data and various exposure scenarios for public health significance for current and future exposures to contaminants at the Gorham Site. One scenario included those associated with a proposed school on a portion of the site. Because the slab is poured and the structure is currently being built, we decided to focus on those community health concerns first. The purpose and only focus of this health consultation is to determine if the remediation plan for the School-Parcel B of the Gorham site is protective of public health. ATSDR evaluated subsurface contamination under the proposed school and the mitigation techniques planned (active sub-slab ventilation system) to protect the students and staff within the school from vapor intrusion. Other site contamination concerns will be addressed by ATSDR in subsequent health consultations.

The School is being constructed on the vacant lot on 333 Adelaide Avenue, Providence, Rhode Island. The property, Figure 1 below, is bounded to the north and west by the Mashapaug Pond, to the south by a residential community and to the east by a shopping center (Parcel A).

Figure 1. Parcel B-High School Footprint, Parcel A-Shopping Center, Gorham Site, Providence, Rhode Island.

[a] ATSDR responds to formal petitions requesting the agency to review chemical exposure data. The purpose of the data reviews are to provide public health advice that prevents people from harmful exposures to chemicals.

Past activities across the Gorham site have resulted in varying levels of soil and groundwater contamination. Much of the subsurface contamination has been removed, but groundwater contamination remains and continues to be monitored. Chlorinated solvents originating from Parcel A have been detected in Parcel B groundwater and soil vapor. However, ATSDR concludes that predicted indoor air concentrations would not be at levels of health concern assuming groundwater conditions do not worsen and the proposed sub-slab ventilation system functions as designed. Only indoor air sampling will confirm or refute these conclusions. As such, ATSDR recommends that sampling indoor air (prior to and subsequent to building occupation) occur in accordance with the approved remedial action plan for Parcel B, along with the continued monitoring of groundwater conditions.

The discussion that follows presents the basis for ATSDR's conclusions, specifically covering:

- Subsurface conditions and groundwater patterns at and near Parcel B
- Summary of contaminants in groundwater, soil, and soil vapor
- A description of vapor intrusion
- Predicted indoor air concentrations
- An evaluation of possible health effects based on predicted indoor air concentrations.

Discussion

To study the possible health impacts of vapor intrusion on Parcel B, ATSDR reviewed groundwater, soil, and soil vapor sampling data collected on and near Parcel B as far back as 1986 and as recently as 2006. ATSDR studied where contamination came from, how conditions have changed over the years, and what current and potential future conditions are on the school parcel. Understanding the conditions beneath the site, including the nature and extent of contamination within groundwater and soil, helped ATSDR evaluate the extent to which vapor intrusion may occur and the expected effectiveness of the active sub-slab ventilation system designed to prevent any such vapor intrusion. Of particular interest are volatile organic compounds (VOCs) which are compounds of greatest concern when evaluating contaminant migration and intrusion into indoor air. ATSDR also reviewed completed and proposed remediation plans for Parcel B. Analytical data were provided by the Rhode Island Department of Environmental Management (RIDEM).

ATSDR's assessment involved several tiers of evaluation. First, as an initial screen, ATSDR compared detected groundwater and soil vapor concentrations to health-based screening values (see text box on the next page for explanation).[b] This initial screen enabled ATSDR to consider

[b] The state of Connecticut's Department of Environmental Protection developed volatilization criteria to identify potential situations where contaminants in groundwater and soil vapor volatilize, travel through overlying soils, and permeate through a building's foundation. In deriving these values, transport models (most current versions of the Johnson and Ettinger model) were used to predict movement of contaminants in the subsurface and provide media concentrations associated with "Target Indoor Air Concentrations" (TACs). Chemical-specific TACs were derived

all detected contaminants, but focus on those contaminants of greatest potential public health concern. ATSDR also reviewed soil data to identify any remaining contaminant "source" areas. We present below a brief overview of our understanding of Parcel B conditions (past and present). These findings serve as basis for subsequent discussions on the possible vapor intrusion.

Comparison values (CVs)—or screening values—are health-based values developed by ATSDR from available scientific literature concerning exposure and health effects. Comparison values are derived for specific environmental media (water, soil, air) and reflect an estimated contaminant concentration that is not expected to cause harmful health effects, assuming a standard daily contact rate. Because they reflect concentrations that are much lower than those that have been observed to cause adverse health effects, comparison values are protective of public health in essentially all exposure situations. As a result, **concentrations detected at or below ATSDR's comparison values are not considered to be a public health hazard**.

ATSDR has not developed screening values that account for vapor migration from groundwater and soil gas into indoor air. Therefore, ATSDR examined screening criteria developed by various states that set target or "safe" indoor air concentrations and establish groundwater and soil gas concentrations associated with those target indoor air concentrations (e.g., California, Connecticut, and Michigan). Connecticut's Remediation Standard Regulations "Volatilization Criteria" (proposed revisions) [CT DEP 2003] were selected to serve as an appropriate health-protective screening guide. The Connecticut target indoor air concentrations (TACs) consider both cancer and non-cancer health effects for the VOCs of interest and appear to be based on the best available science.[b] Further, the Connecticut TACs are the remedial action levels for VOCs specified in the proposed site remediation plan for the Gorham site and RIDEM's Order of Approval. Connecticut standards are being used in Rhode Island in absence of state-specific standards applicable to the soil vapor exposure pathway. The Connecticut criteria are based on generally accepted fate and transport models and standard U.S. EPA risk assessment methodologies.

Next, ATSDR used well-established mathematical models to estimate indoor air concentrations based on reported groundwater contaminants of greatest potential concern and by reviewing detected soil vapor concentrations. ATSDR then evaluated whether predicted levels were of health concern.

Historical Perspective and Current Sampling of Parcel B

Site Geology and Hydrogeology

The hydrogeology of the site area has been fairly well studied. ATSDR reviewed groundwater and other subsurface characteristics to better understand the potential for vapor intrusion. Important considerations include soil type, groundwater depth, and groundwater flow direction and speed—all of which have been evaluated as part of ongoing site investigations.

In 1995, ABB Environmental Services (ABB) conducted an extensive groundwater survey of the site. An unconfined aquifer lies below the site, with the depth to groundwater ranging from approximately 10 feet along the south shore of Mashapaug Cove to 30 feet in the southeastern portion of the site (ABB 1995). Average depth to groundwater in Parcel B is approximately 25 feet (EA 2005). ABB found that most groundwater beneath the site flows either west or north, towards Mashapaug Pond. However, a "groundwater divide" exists beneath the Former Building W on Parcel A, which runs approximately parallel to the eastern property boundary; east of this divide, groundwater flows eastward in the direction of

by the Connecticut Department of Public Health using risk-based calculations recommended by the U.S. EPA with currently available reference concentrations (RfCs) and cancer unit risks (CTDEP 2003).

the railroad tracks. Groundwater below Reservoir Avenue flows west toward the site instead of in an easterly direction, as previously assumed (Harding Lawson 1999).[c]

RIDEM has classified the groundwater beneath the former Gorham Silver site as Class GB: not suitable for public or private drinking water use. Groundwater beneath or near the site is not used as a source of drinking water, and no public or private wells exist within a 4-mile radius of the site (ABB 1995). The nearest public water supply is the Scituate Reservoir, located approximately 9 miles to the west of the Gorham site (MACTEC 2006).

Groundwater Sampling

Several volatile organic compounds (VOCs) were detected in groundwater sampled on Parcel B. VOCs detected historically at concentrations above selected screening values include tetrachloroethylene (PCE), trichloroethylene (TCE), and related breakdown products, such as 1,2-dichloroethene (DCE, cis- and trans-), 1,1,1-trichloroethane (TCA), and vinyl chloride. The most recent Parcel B sampling (2005 and 2006) showed relatively low detections of these VOCs, with TCE and vinyl chloride the only contaminants exceeding groundwater screening values.

Table A-1 (Appendix A) summarizes historical sampling results for groundwater at and near Parcel B (1986-2006). Table A-2 (Appendix A) summarizes groundwater Parcel B groundwater sampling results from 2005 and 2006 only, which are the most recent sampling dates. Sample locations during the 2005 groundwater sampling include MW-1, MW-2, MW-3, MW-4, LRAWP-6, and LRAWP-7 – all located within the boundaries of Parcel B and at or near the footprint of the high school, and all collected from shallow wells (less than 25 feet below ground surface [bgs]). Samples taken during 2006 are from newly installed wells 216-S, 216-D, 217-S, and 217-D. These wells were installed along the boundary of Parcel A and Parcel B in order to monitor possible contaminant/plume migration from Parcel A.

Based on available data, the samples that exhibited the highest levels of contamination in Parcel B were analyzed in the late 1980s to early 1990s. Many of the reported highs presented in Table A-1 were located on the south shore of Mashapaug Cove, adjacent to and downgradient of the parcel. Since the mid-1990s, concentrations of VOCs in groundwater at and near Parcel B have generally decreased. Available data indicate that VOC concentrations will continue to decrease in the groundwater underneath and around Parcel B. This is evidenced by the results of 2005 and 2006 groundwater sampling, which show that almost all suspect VOCs within Parcel B are currently detected at concentrations below both ATSDR comparison values and Connecticut's volatilization criteria (see Table A-1). The two exceptions are the concentration of TCE in shallow groundwater, which was detected at well MW-4 at a maximum concentration of 122 parts per billion (ppb) in 2005, and the one detection (out of the 10 sampled) of vinyl chloride (14.1 ppb) in LRAWP-7 in 2005. The maximum historical TCE concentration within Parcel B bounds was reported in 1994 at 220 ppb - suggesting that TCE concentrations are decreasing with time. It should be noted, however, that 2005 and 2006 groundwater sampling results for

[c] As groundwater flow dynamics are influenced by the sewer line beneath Parcel B, any future work on the sewer line or other nearby utilities would need to consider implications to groundwater flow and contaminant migration.

Parcel A are showing PCE and TCE concentrations up to 80,000 ppb and 1,000 ppb, respectively, and that the maximum historical TCE value for samples taken just north of Parcel B boundaries was 4,850 ppb.

ATSDR also reviewed the defined areas (or plumes) of groundwater contamination originating on Parcel A to understand the lateral and vertical extent of groundwater contamination, as well as changes observed over time, and ultimately the potential for Parcel A groundwater contamination to contribute to the vapor intrusion concern on Parcel B.

Defined Groundwater Contaminant Plumes

Results of groundwater investigations have revealed the presence of two distinct groundwater plumes, consisting of PCE, TCE, TCA, and related degradation products. Both plumes appear to originate in the general vicinity of the former Buildings T and W, located in the south-central portion of the property (Parcel A). This is also the approximate location of the groundwater divide. In general, VOCs are distributed vertically throughout the upper 45 to 55 feet of the aquifer, with concentrations increasing with depth in this interval (ABB 1995). Each plume is described briefly below.

Northern VOC Plume

The northern VOC plume extends northwest beneath Parcel B, toward Mashapaug Pond. The decreasing PCE concentrations along the plume centerline appear to be biodegrading into daughter products, including TCE, DCE, and vinyl chloride. This is consistent with the 1998 Air Force Center for Environmental Excellence bioremediation screening performed by HLA, which indicated evidence of increased biodegradation with increasing distance from the source area (Harding Lawson 1999). Investigators report that the northern VOC plume is attenuating as it approaches Mashapaug Pond (ABB 1995).

Eastern VOC Plume

This plume extends east, from the former Building W toward the property line, and does not interact with Parcel B. Concentrations of VOCs appear to be significantly lower in the shallow part of the aquifer (less than 25 feet below grade) than in the deeper part (ABB 1995). According to Harding Lawson (1999), the eastward migration of the eastern VOC plume is controlled by a leaking 80-inch diameter sewer, which runs parallel to the eastern property line at about 35 feet bgs. This report concluded that the sewer is acting as a groundwater sink and is intercepting the VOC plume. Therefore, investigators believe that site-related VOCs do not migrate east of the sewer line (Harding Lawson 1999).

Soil Vapor Sampling

In 2005, a total of 15 soil vapor samples were taken from the footprint of the high school. These soil vapor samples were collected from approximately 4 to 5 feet bgs. As such, no vertical profile of conditions was evaluated. The data confirm the presence of VOCs in the subsurface and the potential for vapor intrusion into nearby buildings. Of the 15 samples, four were taken during the summer season. Available results indicate that levels of contamination increase during the warmer months. However, further temporal trends characterizing the profile of the VOC contamination (e.g., possible attenuation over time) or plotting soil vapor data against changing groundwater conditions is not possible, as soil vapor samples were all taken during 2005.

The following VOCs were detected at concentrations above ATSDR's health-based CVs for ambient air and Connecticut target indoor air concentrations (TACs) in at least one sample: benzene, chloroform, methylene chloride, PCE, tetrahydrofuran, TCE, and trichlorofluoromethane (see Appendix A, Table A-3).[d]

Because these concentrations do not represent exposure point concentrations, detected soil vapor concentrations were also compared to Soil Vapor Volatilization Criteria (SVVC) developed by the state of Connecticut.[e] TCE was the only VOC that was detected at concentrations above the SVVC values for soil vapor. The maximum concentration of TCE was 750 parts per billion by volume (ppbv), which exceeds the SVVC of 140 ppbv by more than five times. Vinyl chloride was not detected in any of the collected soil vapor samples.

VOCs detected in soil vapor samples were found throughout Parcel B, although the source is not explicitly discussed in any of the available documentation. According to the plume maps from the 1995 Supplemental Remediation Investigation Report, the soil vapor sampling points are located above or proximally west of the TCE and PCE groundwater plume.

Soil Sampling

Contaminants were also detected in soil at varying depths. Total petroleum hydrocarbons (TPHCs) (4%) were the most significant contaminants found in the subsurface soil (at a depth of between 23 – 24 feet) in one sampling location north of the school building footprint. Remedial actions have been successful in removing TPHC contamination at this location [EA 2006].

[d] This exercise compares detected soil vapor concentrations to ATSDR's CVs for ambient air, though it is understood that no exposure is occurring to the concentrations measured at the point of sampling (4 to 5 feet bgs).
[e] The Connecticut SVVC represents the concentration in soil vapor that would be associated with the health-based TAC assuming attenuation as the vapor passes through space, across the building foundation, and into indoor space. Connecticut developed a residential and industrial/commercial SVVC. For screening potential exposures to high school occupants, the lower residential SVVC values were used.

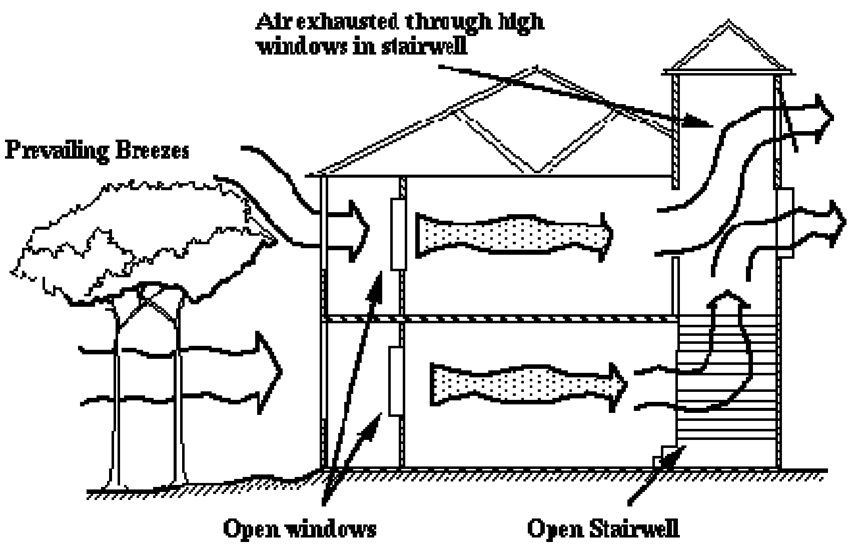
Vapor Intrusion

Building Infiltration

The following information is provided as background to the potential vapor intrusion exposure pathway. This is the exposure pathway of concern specific to this health consultation.

Buildings are natural chimneys. There is a natural tendency for air to move up through buildings because of the following:

1) Wind speed increases with height
2) Objects in the wind experience a lift force at the tail end
3) Solar radiation on the roof
4) When the interior of a building is heated, the air inside moves up and out to the cooler air



Therefore, a sealed building will actually draw air up through the cracks in the floor. If there is a positive pressure of vapors in the soil, the path for those soil vapors is into the building. Buildings with basements or un-vented crawl-spaces tend to have greater infiltration.

This problem is often most severe when a building is sealed and heated and the ground outside is frozen. The soil vapors cannot press through the frozen ground so they find the easiest path into the building. Subsurface ventilation provides the easiest path to prevent exposures. The subsurface system is analogous to a closed fireplace with a chimney: the vapors come from the source through a tube and above the building. As with a closed fireplace, no vapors enter the building as long as the chimney is in tact. Also like a chimney, even if there is a breach in the system, it will still prevent vapors from entering the building as long as the pressure gradient is greater above the building than it is into the building. Additional information on this mitigation technique is provided in the Mitigation Technique section.

Screening Modeling Used to Estimate Levels of VOCs in Indoor Air

ATSDR used well-established mathematical models to estimate indoor air concentrations of those contaminants of greatest potential concern—that is, those contaminants reported above screening values at any time during Parcel B groundwater sampling history. ATSDR evaluated 1) a "worst-case" scenario assuming no sub-slab venting system is installed and 2) a scenario where indoor air concentrations would be expected to be reduced by the installation and maintenance of a sub-slab venting system. For both cases, ATSDR based the calculation on the highest concentrations "ever" reported in Parcel B groundwater and the highest concentrations reported during more recent Parcel B sampling (2005 and 2006).

Conservative estimates of indoor air VOC levels were calculated using the U.S. Environmental Protection Agency's (EPA's) Johnson and Ettinger Model.[f] The soil vapor model (e.g., the Johnson and Ettinger Model) is based on a number of simplifying assumptions regarding contaminant distribution and occurrence, subsurface characteristics, transport mechanisms, and building construction. Therefore, the model can be used only as a screening tool to identify conditions that may warrant additional evaluation [Marley 2002, EPA 1997]. Soil vapor monitoring and modeling results also do not provide actual measurements of concentrations of contaminants that people may inhale. Subsurface vapors migrating indoors are greatly diluted with outdoor air that enters the home, and by diffusive, advective, or other attenuating mechanisms as the vapor migrates through the soil. Therefore, directly measuring indoor air quality in potentially impacted buildings is the best approach to evaluate air contamination at points of exposure.

The maximum groundwater concentrations for those elevated contaminants, the sandy soil type, and the 23 feet depth to groundwater, were used as inputs along with conservative default values to represent a "worst-case" scenario. The results of that modeling are provided in Table 1.

[f] EPA's Johnson and Ettinger screening model calculates indoor air levels for homes with basements.

Table 1: Modeled Worst Case Uncontrolled (without sub-slab ventilation control) Indoor Air Concentrations,

Former Gorham Silver Manufacturing Site, Parcel B

Analyte	*Historical Maximum* (µg/m³)*	*2005/2006 Maximum* (µg/m³)*
1,1,1-Trichloroethane	42	0.008
cis-1,2 Dichloroethene	0.47	0.47
trans-1,2 Dichloroethene	1.7	Not detected
Tetrachloroethylene	17.9	0.13
Trichloroethylene	34.3	0.86
Vinyl Chloride	0.48	0.42

*Modeled concentrations are based on maximum detected contaminant concentrations in Parcel B groundwater.

Mitigation Technique

The developers are using sub-surface ventilation to mitigate soil gas and plan to ensure the integrity of the system by monitoring for methane and VOCs. Activities are part of an RIDEM-approved comprehensive operations and maintenance (O&M) and air sampling program. The program requires regular and periodic sampling of sub-slab soil vapor and indoor air for VOCs and methane. In addition, a continuous methane monitoring system will be installed throughout the school building as a precautionary measure based on a historical fill area beneath a portion of the site outside of the school building footprint. This monitoring is independent of the VOC monitoring.

Subsurface ventilation was historically used to provide clean air into mines. Engineers adapted ventilation for homes to prevent infiltration of radon gas into homes above radium deposits (EPA 1993; Prill and Frisk 2002). The procedure was so effective that it was later used to reduce infiltration of other gases and vapors. It is currently being used at most sites and appears to be the preferred mitigation technique (Stratford Health Department 2003). Active systems (as used on this parcel of the Gorham site) have a good track record, but do require evaluation and maintenance. A gravel bed beneath the sub-slab has been shown to considerably improve the performance of the system (Bonnefous et al. 1992). A 6-inch layer of gravel is in the approved plan. Sub-slab ventilation was found to be successful in 90% of the (1,000) Virginia and Maryland homes that used it to remove radon (Mose et al. 1997). Removal efficiencies over 80% were typically found in Ohio homes with these systems (Kumar et al. 2006). EPA found that when these systems have strong fans and multiple suction points, they can reduce vapor concentrations in homes by a factor of 1,000. They also found that less than 30% of the original systems (with one suction point) needed some minor corrections to meet the intended targeted reduction (Folkes 2006; Folkes and Kurtz 2002). The depressurization systems such as the one being installed at the school have been found to perform better than the pressurization systems.

Since buildings with basements have the largest problems with infiltration, subsurface ventilation is less effective with these buildings. The school building will have no basement. The mitigation technique is least effective in soils that are permeable, because depressurization (suction) is hardest to obtain in permeable soils. It is essentially like drawing air through a leaky straw. Since Parcel B contains porous soil, it will naturally often provide many pathways for vapors to migrate vertically and depressurization will be less effective. Therefore, contaminants under the building will often (except when the ground is frozen or saturated) find many pathways around the building which will both reduce the average levels in the building and reduce the effectiveness of the mitigation.

Since the mitigation technique is expected to remove more than 80% of possible vapors, a reasonable worst-case estimate can be estimated by using the modeling results. These estimates are provided in Table 2.

Table 2: Estimates of Controlled Indoor Air Concentrations*,

Former Gorham Silver Manufacturing Site, Parcel B

Analyte	*Historical Maximum ($\mu g/m^3$)*	*2005/2006 Maximum ($\mu g/m^3$)*
1,1,1-Trichloroethane	8.4	0.002
cis-1,2 Dichloroethene	0.09	0.09
trans-1,2 Dichloroethene	0.3	Not detected
Tetrachloroethylene	3.6	0.03
Trichloroethylene	6.9	0.17
Vinyl Chloride	0.1	0.08

*Represents an 80% reduction of indoor air concentrations.

Table 3 includes the estimated maximum concentrations for several compounds under current conditions (based on 2005 and 2006 groundwater data) along with their associated comparison values.

Table 3: Predicted Maximum Exposure Levels*,

Former Gorham Silver Manufacturing Site, Parcel B

Analyte	*2005/2006 Maximum* (µg/m³)*	*CV (µg/m³)*	*Source of CV*	*> CV*
1,1,1-Trichloroethane	0.002	500	CT TAC	No
cis-1,2 Dichloroethene	0.09	18	CT TAC	No
Tetrachloroethylene	0.03	300	Chronic MRL (Child)	No
		5	CT TAC	No
Trichloroethylene	0.17	1	CT TAC	No
Vinyl Chloride	0.08	0.1	CREG	No
		0.14	CT TAC	No

*Based on an 80% reduction of indoor air concentrations.
CT TAC - Connecticut Target Indoor Air Concentration
CV - comparison value
MRL - ATSDR minimal risk level
µg/m3 - micrograms per cubic meter
> CV - is the predicted value greater than the comparison value?

Health Effects Evaluation

Estimated exposure point concentrations (i.e., estimated indoor air concentrations with and without vapor controls in place) fall below health guidelines and action levels for residential indoor air exposures (see Table 3 above). As an added layer of analysis, ATSDR considered soil vapor concentrations collected within the footprint of the building where TCE concentrations ranged from 93 to 748 ppb (approximately 500 to 4,000 µg/m^3). Possible indoor air levels of TCE based on attenuation factors (0.00001 to 0.01 [EPA, 1991]) could range from a low of 0.00093 to 7.48 ppb (0.005 to 40 µg/m^3). The high end value of 40 µg/m^3 exceeds the TAC by approximately 10 times.

ATSDR studied the basis for the TCE screening values/action levels used and the underlying scientific studies to fully evaluate whether adverse health effects would be expected at predicted indoor air concentrations. As with all its health evaluations, ATSDR considered impacts to potentially sensitive subpopulations—in this case, high school students. School personnel, who could likely spend several years teaching/working on the premises, were also considered. ATSDR studied possible impacts of short- and longer-term exposures to TCE at predicted concentrations, and evaluated both potential non-cancer and cancer effects.

Scientists have been studying the toxicity of TCE for many years to better understand what levels may be harmful to people and under what exposure situations. Scientists continue to study many aspects of TCE toxicity—for example, comparability of animal and human effects, how TCE exerts its effects, and differences in effects between children and adults. Despite some uncertainties, available study data provide some perspective on predicted Parcel B indoor air concentrations. A brief overview of ATSDR findings follows.

The primary targets of TCE toxicity are the central nervous system, liver, heart, and kidneys (ATSDR 1997; EPA 2001). Endocrine and immune system, developmental effects, among others continue to be explored. The International Agency for Research on Cancer (IARC) has determined that TCE is a "probable human carcinogen" and the National Toxicology Program classifies TCE as "reasonably anticipated to be a human carcinogen." EPA is currently re-evaluating TCE inhalation carcinogenicity.

ATSDR reviewed data from human and animal studies to identify the concentrations and conditions under which adverse health effects have been observed. None of the predicted indoor air concentrations are expected to cause any short-term effects (e.g., irritation, headaches, etc.). Similarly, predicted indoor air concentrations are lower than effect levels reported in longer-term exposures (e.g., less than a year). Predicted indoor air concentrations of TCE are approximately 10,000 times lower than exposure concentrations shown to result in central nervous system, liver, heart, and endocrine system problems (ATSDR 1997; EPA 2001).

Regarding cancer effects, much of the available literature addresses TCE ingestion, not TCE inhalation—making interpretation challenging. Based on available data, EPA has proposed a range of air concentrations that may pose varying levels of increased cancer "risk." Many states have adopted EPA's interim toxicity factors to develop target air concentrations. For example, considering lifetime residential exposures and a range of available study data, the following range of TCE concentrations are associated with theoretical excess cancer risks of 1×10^{-4} (1 in 10,000) and 1×10^{-6} (1 in a million) (EPA 2001; EPA 2005):

1×10^{-6}: 0.021 µg/m^3 – 1.4 µg/m^3
1×10^{-4}: 2.1 µg/m^3 – 140 µg/m^3

These values represent knowledge gained from TCE drinking water studies, occupational studies, and an understanding of how the human body absorbs and metabolizes (breaks down) TCE when ingested and inhaled. These estimates assume lifetime residential exposures (24 hours/day, 350 days/year, and 30 years over a 70 year lifetime). Predicted indoor air concentrations of TCE range from 0.172 µg/m3 (with effective sub-slab venting in place) to 0.86 µg/m3 (worst-case based on modeled data). The predicted high of 40 µg/m3 TCE in indoor air based on soil vapor data falls roughly in the 10^{-4} theoretical cancer risk estimate range. ATSDR classifies this to be the low increased cancer risk estimate based on very conservative exposure and mitigation assumptions and maximum detected concentrations.

Despite uncertainties, the available cancer toxicity data tell us that predicted indoor air concentrations would not be expected to increase cancer risks. As noted above, using toxicity values associated with lifetime residential exposures is a conservative approach. School-related exposures are expected to be less than those assumed for residential exposures (e.g., approximately 8 hours/day, 200 days/year, and generally 4 years over a lifetime), though total number of years in the building may vary and be longer for school personnel. In addition, the predicted TCE indoor concentrations are comparable to concentrations “typically” reported in indoor air since TCE is found in common products, reported in the 0.5 – 1.0 $\mu g/m^3$ range (ATSDR 1997; Sexton et al. 2004; CTDEP 2003).

Predicted maximum TCE levels are not expected to present a public health hazard for cancer or non-cancer outcomes. However, periodic sampling and ongoing operations and maintenance, per remedial action work plan, are necessary to ensure proper operation of venting system and that TCE levels are well below 40 $\mu g/m^3$.

Child Health Considerations

ATSDR considers children in the evaluation of all exposures, and the agency uses health guidelines that are protective of children. ATSDR also considers unique exposure situations on a site-specific basis. For the Gorham site, the agency understands that young adolescents (age approximately 13-19 years) represent a large population of potential concern. In general, ATSDR assumes that children are more susceptible to chemical exposures. Children weigh less than adults, which may result in higher doses of chemical exposures relative to body weight; children have higher rates of respiration; metabolism and detoxification mechanisms may differ, and if toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. While these characteristics apply largely to younger children, scientists continue to explore vulnerabilities at all growth stages, including puberty and early adolescence. Consideration is also given to the effects of possible exposures on the fetus, or unborn child.

ATSDR has considered these factors in the development of conclusions and recommendations for this site. Comparison values and site-specific action levels used for this health consultation are intended to represent exposures that could be continued for a lifetime for the general population — including potentially susceptible subgroups such as children — without appreciable health risks. Assuming continuous lifetime exposure and residential exposure scenarios in setting the action levels for the school, provides an added layer of protection. As noted previously, students would be expected to spend considerably less time in the school setting (i.e., generally 4 years and approximately 200 days of the year). This is important, especially for TCE (the primary constituent of concern), because scientists continue to evaluate the levels and exposure conditions under which TCE is most harmful. Uncertainties about special sensitivities remain.

Limitations

The following observations limit full evaluation of the soil vapor pathway:

- Subsurface soil contamination was at approximately 23 to 24 feet; however, soil gas samples were collected at 4-5 feet. Therefore, there are limitations to the confirmation that the soil gas data can provide.

- Soil vapor data only represent a snapshot in time and were collected in relatively shallow soils. The data confirm the presence of VOCs in the subsurface and the potential for vapor intrusion into nearby buildings. However, temporal trends characterizing the profile of the VOC contamination (e.g., possible attenuation over time) or plotting soil vapor data against changing groundwater conditions is not possible. Further, no vertical profile of conditions is available because most samples were collected from depths of approximately 4 to 5 feet.

- Worst-case soil vapor infiltration estimates were provided by a model that is designed for homes with basements. No model is available for large buildings with basements. It is expected that the school will have a slab that is much less permeable than a home (i.e., much less likely to allow vapors to move up through the floor).

Conclusions

On the basis of the available environmental data, ATSDR concludes that the proposed mitigation technique should prevent harmful exposures to school occupants from the vapor intrusion exposure pathway. The proposed periodic sampling should determine if the sub-slab ventilation system is operating according to design.

Recommendations

Although the groundwater modeling data and soil vapor data, coupled with the successful operation and maintenance of the proposed sub-slab venting system do not suggest adverse health effects, prudent public health practice calls for the collection of indoor air samples prior to the opening of the school (and routinely thereafter) to verify the absence of VOCs at concentrations above the action levels specified in the site Remedial Action Work Plan and RIDEM's Order of Approval (Appendix B), and discussed in this health consultation. More specifically,

- Maintain the sampling regimen and modify it over time to ensure that the mitigation system continues to work as designed and verify that VOC levels are well below limits established in the Remedial Action Work Plan. Some venting systems have been shown to loose efficiency and need adjustments to ensure proper operation

- Develop a management program to insure long-term operations and maintenance (O&M) of the sub-slab ventilation control system for the school (e.g., in-house training of critical personnel on the O&M of the system).
- The City of Providence should continue to take the necessary actions to ensure that groundwater contaminant sources, concentrations, and migration patterns at and near Parcel A continue to be monitored. Measures should be taken to carefully evaluate and document any potential changes in groundwater flow dynamics, especially those that might result from underground utility work (e.g., relining the sewer), as such actions could influence Parcel B groundwater conditions.

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Appendix A

Tables

Table A-1. Groundwater Sampling, Former Gorham Silver Manufacturing Site, Parcel B and Immediate Vicinity, 1986-2006

Analyte	*# of detect*	*Minimum (ppb)*	*Maximum (ppb)*	*Maximum Sample Name*	*Location of Maximum*	*Well Depth*	*Date of Maximum*	*CV (ppb)*	*Source of CV**	*# > CV*
Volatile Organic Compounds										
1,1,1-Trichlorethane	13/28	0.4 J	3,450	GZA-5	S shore of Cove	Shallow	09/27/95	200,000	Intermediate EMEG (Child)	0/28
								6,500	CT GWVC	0/28
1,1-Dichloroethane	8/28	1.1	130	MW-106D	E edge	Deep	12/29/94	896	RBC Tap Water	0/26
								3,000	CT GWVC	0/26
1,1-Dichloroethene	3/28	1	4	GZA-3	S shore of Cove	Shallow	12/08/98	90	Chronic EMEG (Child)	0/28
								190	CT GWVC	0/28
1,2-Dichlorobenzene	1/17	0.2 J	0.2 J	LRAWP-7	NE corner	Deep	12/02/05	4,000	Chronic EMEG (Child)	0/17
								5,100	CT GWVC	0/17
trans 1,2-Dichloroethene	2/28	33	270	GZA-2	N edge	Deep	03/19/86	200	RMEG (Child)	1/28
								1,000	CT GWVC	0/28
cis 1,2-Dichloroethene	14/25	1.4	170	MW-216S	Border of Parcel A	Shallow	05/10/06	10,000	Intermediate EMEG (Child)	0/28
								830	CT GWVC	0/28
1,2,4-Trimethylbenzene	1/17	12	12	MW-216S	Border of Parcel A	Shallow	05/10/06	360	CT GWVC	0/17
1,3,5-Trimethylbenzene	1/17	9.5	9.5	MW-216S	Border of Parcel A	Shallow	05/10/06	280	CT GWVC	0/17
2-Butanone	1/17	12	12	MW-217S	Border of Parcel A	Shallow	05/10/06	6,000	RMEG (Child)	0/17
								50,000	CT GWVC	0/17
Acetone	1/25	10	10	MW-216S	Border of Parcel A	Shallow	05/10/06	9,000	RMEG (Child)	0/25
								50,000	CT GWVC	0/25
Benzene	2/28	1	1.8	LRAWP-7	NE corner	Deep	12/02/05	0.6	CREG	2/28
								130	CT GWVC	0/28
sec-Butylbenzene	1/17	0.3 J	0.3 J	LRAWP-7	NE corner	Deep	12/02/05	1,500	CT GWVC	0/17
Chloroform	3/28	2	37 J	GZA-5	S shore of Cove	Shallow	09/21/94	100	Chronic EMEG (Child)	0/28
								26	CT GWVC	1/28
Ethylbenzene	2/28	0.3 J	1	GZA-2	N edge	Deep	03/19/86	1,340	RBC Tap Water	0/28
								2,700	CT GWVC	0/28
Isopropylbenzene	2/17	0.4 J	1	GZA-3	S shore of Cove	Shallow	12/08/98	2,800	CT GWVC	0/17
Methylene Chloride	1/28	10 J	10 J	GZA-3	S shore of Cove	Shallow	09/21/94	600	Chronic EMEG (Child)	0/28
								160	CT GWVC	0/28
Methyl-tert Butyl Ether	2/25	1	2.6	LRAWP-7	NE corner	Deep	12/02/05	3,000	Intermediate EMEG (Child)	0/25
								21,000	CT GWVC	0/25

Analyte	# of detect	Minimum (ppb)	Maximum (ppb)	Maximum Sample Name	Location of Maximum	Well Depth	Date of Maximum	CV (ppb)	Source of CV*	# > CV
Naphthalene	2/17	17	21	MW-216S	Border of Parcel A	Shallow	05/10/06	200	RMEG	0/17
n-Propylene	1/17	1	1	GZA-3	S shore of Cove	Shallow	12/08/98	None		
Tetrachloroethylene	22/28	0.8 J	1,640	MW-106D	E edge	Deep	12/29/94	100	RMEG (Child)	5/28
								340	CT GWVC	2/28
Toluene	1/28	2.9	2.9	MW-216S	Border of Parcel A	Shallow	05/10/06	200	Intermediate EMEG (Child)	0/28
								7,100	CT GWVC	0/28
Trichloroethylene	24/28	0.4 J	4,850	GZA-5	S shore of Cove	Shallow	09/27/95	0.026	RBC Tap Water	24/28
								27	CT GWVC	14/28
Trichlorofluoromethane	6/28	0.2 J	15.4	MW-4	E central	Deep	01/31/01	3,000	RMEG (Child)	0/28
								1,300	CT GWVC	0/28
Vinyl chloride	3/28	7	16	MW-G	S shore of Cove	Shallow	12/08/98	0.03	CREG	3/28
								30	Chronic EMEG (Child)	0/28
								1.6	CT GWVC	3/28
Xylenes (m/p)	1/10	3.7	3.7	MW-216S	Border of Parcel A	Shallow	05/10/06	6,000	Intermediate EMEG (Child)	0/10
								8,700	CT GWVC (Xylenes, total)	0/10
Xylenes (o)	2/10	0.2 J	6.2	MW-216S	Border of Parcel A	Shallow	05/10/06	6,000	Intermediate EMEG (Child; M Xylenes)	0/10
								8,700	CT GWVC (Xylenes, total)	0/10
Inorganics										
Arsenic	2/7	30	70	MW-106D	E edge	Deep	12/29/94	0.02	CREG	2/7
								3	Chronic EMEG (Child)	2/7
Cyanide (total)	3/7	10	10	GZA-2	N edge	Deep	09/21/94	200	RMEG (Child)	0/7
Calcium	7/7	6,400	41,400	GZA-2	N edge	Deep	09/21/94	None		
Iron	5/7	50	24,200	MW-106D	E edge	Deep	12/29/94	10,950	RBC Tap Water	2/7
Lead	4/9	6	8	GZA-5	S shore of Cove	Shallow	09/21/94	15	EPA Action Level	0/9
Magnesium	7/7	800	3,200	GZA-2	N edge	Deep	09/21/94	None		
Manganese	7/7	940	4,220	MW-106D	E edge	Deep	12/29/94	500	RMEG (Child)	7/7
Potassium	7/7	1,500	5,300	MW-106D	E edge	Deep	12/29/94	None		
Silver	2/7	10	10	GZA-2	N edge	Deep	09/21/94	50	RMEG (Child)	0/7
Sodium	7/7	7,000	23,800	MW-108	Central	Deep	12/29/94	None		
Zinc	6/7	20	1,800	MW-108	Central	Deep	12/29/94	3,000	Chronic EMEG (Child)	0/7

*ATSDR drinking water CVs were used as conservative screening values, though it is acknowledged that the groundwater at Parcel B is not used as a drinking water source. In the absence of ATSDR derived CVs, U.S. EPA risk-based concentrations (RBCs) for tap water were used. The inclusion of the Connecticut GWVC provides additional perspective and a more realistic screen for the exposure pathway of interest.

CREG - cancer risk evaluation guide
CV - comparison value
EMEG - environmental media evaluation guide
N - North
RBC - risk-based concentration
S - South
CT GWVC - Connecticut groundwater volatilization criteria
E - East
J - estimated value between the detection limit and the quantitative value
ppb - part per billion
RMEG - reference media evaluation guide
W - West

SOURCES:

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[Shaw] Shaw Environmental, Inc. 2006. Status Report, May 2006 Sampling event and April-May additional investigation activities.

Table A-2. Groundwater Sampling, Former Gorham Silver Manufacturing Site, Parcel B (2005 and 2006)

Analyte	# of detects	Min (ppb)	Max (ppb)	Max Sample Name	Location of Max	Well Depth	Date of Max	Geo. Mean (ppb)[1]	CV (ppb)	Source of CV*	# > CV
1,1-Dichloroethane	1/10	1.1	1.1	LRAWP-7	NE corner	Deep	12/02/05	0.54	896	RBC Tap Water	0/10
									3,000	CT GWVC	0/10
1,1,1-Trichloroethane	2/10	0.4 J	0.7 J	MW-1	E edge	Shallow	01/31/05	0.67	700,000	Intermediate EMEG (Child)	0/10
									6,500	CT GWVC	0/10
1,2- Dichlorobenzene	1/10	0.2 J	0.2 J	LRAWP-7	NE corner	Deep	12/02/05	0.60	4,000	Chronic EMEG (Child)	0/10
									5,100	CT GWVC	0/10
cis-1,2 Dichloroethene	4/10	1.4	170	MW-216S	Border of Parcel A	Shallow	05/10/06	2.64	3,000	Intermediate EMEG (Child)	0/10
1,2,4-Trimethylbenzene	1/10	12	12	MW-216S	Border of Parcel A	Shallow	05/10/06	0.85	360	CT GWVC	0/10
1,3,5-Trimethylbenzene	1/10	9.5	9.5	MW-216S	Border of Parcel A	Shallow	05/10/06	0.83	280	CT GWVC	0/10
2-Butanone	1/10	12	12	MW-217S	Border of Parcel A	Shallow	05/10/06	8.65	6,000	RMEG (Child)	0/10
									50,000	CT GWVC	0/10
Acetone	1/10	10	10	MW-216S	Border of Parcel A	Shallow	05/10/06	8.49	9,000	RMEG (Child)	0/10
									50,000	CT GWVC	0/10
Benzene[2]	1/10	1.8	1.8	LRAWP-7	NE Corner	Deep	12/02/05	0.57	0.60	CREG	1/10[2]
									130	CT GWVC	0/10
									830	CT GWVC	0/10
Ethylbenzene	1/10	0.3 J	0.3 J	LRAWP-7	NE corner	Deep	12/02/05	0.63	1,340	RBC Tap Water	0/10
									2,700	CT GWVC	0/10
Isopropylbenzene	1/10	0.4 J	0.4 J	LRAWP-7	NE corner	Deep	12/02/05	0.65	2,800	CT GWVC	0/10
Methyl-tert Butyl Ether	2/10	1	2.6	LRAWP-7	NE corner	Deep	12/02/05	0.83	3,000	Intermediate EMEG (Child)	0/10
									21,000	CT GWVC	0/10
Naphthalene	2/10	17	21	MW-216S	Border of Parcel A	Shallow	05/10/06	1.43	200	RMEG (Child)	0/10
Sec-Butylbenzene	1/10	0.3 J	0.3 J	LRAWP-7	NE corner	Deep	12/02/05	0.63	1,500	CT GWVC	0/10
Tetrachloroethylene	6/10	0.8 J	11.7	LRAWP-6	NE corner	Deep	12/002/05	2.04	100	RMEG (Child)	0/10
									340	CT GWVC	0/10
Toluene	1/10	2.9	2.9	MW-216S	Border of Parcel A	Shallow	05/10/06	0.73	200	Intermediate EMEG (Child)	0/10
									7,100	CT GWVC	0/10
Trichloroethylene	7/10	4.2	122	MW-4	E central	Shallow	01/31/05	3.55	0.026	RBC Tap Water	7/10
									27	CT GWVC	1/10
Trichlorofluoromethane	6/10	0.2 J	15.4	MW-4	E central	Shallow	01/31/05	1.73	3,000	RMEG (Child)	0/10
									1,300	CT GWVC	0/10

Analyte	*# of detects*	*Min (ppb)*	*Max (ppb)*	*Max Sample Name*	*Location of Max*	*Well Depth*	*Date of Max*	*Geo. Mean (ppb)*[1]	*CV (ppb)*	*Source of CV**	*# > CV*
Vinyl Chloride[3]	1/10	<0.5	14.1	LRAWP-7	NE corner	Deep	12/02/05	0.92	0.03	CREG	1/10[3]
									1.6	CT GWVC	1/10
Xylenes (m/p)	1/10	3.7	3.7	MW-216S	Border of Parcel A	Shallow	05/10/06	1.14	6,000	Intermediate EMEG (Child)	0/10
									8,700	CT GWVC (Xylenes, total)	0/10
Xylenes (o)	2/10	0.2 J	6.2	MW-216S	Border of Parcel A	Shallow	05/10/06	0.72	6,000	Intermediate EMEG (Child; M Xylenes)	0/10
									8,700	CT GWVC (Xylenes, total)	0/10

Note: All analytes that were not detected, or not analyzed, in 2005 have been omitted from this table. Please consult raw data tables for further details.

*ATSDR drinking water CVs were used as conservative screening values, though it is acknowledged that the groundwater at Parcel B is not used as a drinking water source. In the absence of ATSDR derived CVs, U.S. EPA risk-based concentrations (RBCs) for tap water were used. The inclusion of the Connecticut GWVC provides additional perspective and a more realistic screen for the exposure pathway of interest.

[1]The geometric mean was calculated by taking the nth root of n numbers, where n is the number of samples for which an analyte was measured. In the case that a sample was not detected, one half of the detection limit was used to complete these calculations.
[2]The laboratory detection limit for benzene was 1 ppb, which is higher than the CREG value of 0.6 ppb.
[3] The laboratory detection limit for vinyl chloride was 1 ppb, which is higher than the CREG value of 0.03 ppb.

CREG - cancer risk evaluation guide
CV - comparison value
EMEG - environmental media evaluation guide
N - North
ND - not detected above detection limit (<1 ppb)
RBC - risk-based concentration
S - South
CT GWVC - Connecticut groundwater volatilization criteria
E - East
J - estimated value between the detection limit and the quantitative value
NA - not analyzed
ppb - part per billion
RMEG - reference media evaluation guide

SOURCES:

[EA] EA Engineering, Science, and Technology, Inc. 2005. Limited remedial action work plan and supplemental site investigation summary report.

[EA] 2005. Site Investigation Report Addendum.

[Shaw] Shaw Environmental, Inc. 2006. Status Report, May 2006 Sampling Event and April-May Additional Investigation Activities.

Table A-3. Soil Vapor Sampling, Former Gorham Silver Manufacturing Site, Parcel B (2005)

Analyte	*# of detects*	*Minimum (ppbv)*	*Maximum (ppbv)*	*Maximum Sample Name*	*Date of Maximum*	*Geo. Mean (ppb)[1]*	*CV (ppbv)*	*Source of CV**	*# > CV*
Volatile Organic Compounds									
1,1,1-Trichloroethane	4/15	2.2	12.6	SV-C	06/01/05	4.58	700	Intermediate EMEG	0/15
							70,000	CT SVVC	0/15
							92	CT TAC	0/15
1,2,4-Trimethylbenzene	1/15	0.9	0.9	SV-11	10/05/05	2.28	1,400	CT SVVC	0/15
							1.89	CT TAC	0/15
1,4-Dichlorobenzene	5/15	0.5	1.1	SV-07	10/05/05	2.76	20	Chronic EMEG	0/15
							3,000	CT SVVC	0/15
							3.99	CT TAC	0/15
2-Butanone	8/15	1.5	123	SV-B	06/01/05	52.78	1,732	RBC	0/15
							130,000	CT SVVC	0/15
							169.53	CT TAC	0/15
2-Hexanone	1/15	0.8	0.8	SV-09	10/05/05	6.12	None		
Acetone	8/15	4.2	69.6	SV-B	06/01/05	63.31	13,000	Chronic EMEG	0/15
							57,000	CT SVVC	0/15
							75.77	CT TAC	0/15
Benzene[2]	1/15	0.5	0.5	SV-B	06/01/05	2.61[2]	0.003	CREG	1/15
							3	Chronic EMEG	0/15
							780	CT SVVC	0/15
							1.03	CT TAC	0/15
Carbon disulfide	1/9	2.7	2.7	SV-08	10/05/05	0.33	300	Chronic EMEG	0/9

Analyte	*# of detects*	*Minimum (ppbv)*	*Maximum (ppbv)*	*Maximum Sample Name*	*Date of Maximum*	*Geo. Mean (ppb)*[1]	*CV (ppbv)*	*Source of CV**	*# > CV*
Chloroform	2/15	1	1.1	SV-C	06/01/05	2.54	0.008	CREG	2/15
							20	Chronic EMEG	0/15
							78	CT SVVC	0/15
							0.1	CT TAC	2/15
cis-1,2 Dichloroethene	2/15	0.7	1.1	SV-C	06/01/05	2.70	3,400	CT SVVC	0/15
							4.5	CT TAC	0/15
Dichlorodifluoromethane	4/15	0.5	0.8	SV-A	06/01/05	2.63	1.712	RBC	0/15
							14,000	CT SVVC	0/15
							18	CT TAC	0/15
Ethanol	7/9	3.9	30	SV-11	10/05/05	4.58	None		
Ethylbenzene	1/15	1.7	1.7	SV-07	10/05/05	2.50	1,000	Intermediate EMEG	0/15
							9,300	CT SVVC	0/15
							12	CT TAC	0/15
Hexane	2/9	0.5	0.6	SV-11	10/05/05	0.30	600	Chronic EMEG	0/9
Isopropanol	2/9	1.2	1.5	SV-08	10/05/05	0.36	None		
Methylene chloride	6/15	0.6	2.5	SV-B	06/01/05	4.34	0.9	CREG	3/15
							300	Chronic EMEG	0/15
							650	CT SVVC	0/15
							0.9	CT TAC	3/15
Methyl tert-butyl ether	4/15	0.5	0.9	SV-11	10/05/05	3.26	700	Chronic EMEG	0/15
							3,400	CT SVVC	0/15
							44	CT TAC	0/15
Propene	4/9	0.9	1.7	SV-B	06/01/05	0.63	None		
Tetrachloroethylene	4/15	2.7	91.8	SV-C	06/01/05	0.81	40	Chronic EMEG	2/15
							5,600	CT SVVC	0/15
							0.7	CT TAC	4/15
Tetrahydrofuran	4/9	360	844	SV-B	06/01/05	7.46	0.352	RBC	4/9

Analyte	# of detects	Minimum (ppbv)	Maximum (ppbv)	Maximum Sample Name	Date of Maximum	Geo. Mean (ppb)[1]	CV (ppbv)	Source of CV*	# > CV
Toluene	8/15	0.9	3	SV-C	06/01/05	5.50	80	Chronic EMEG	0/15
							42,000	CT SVVC	0/15
							56	CT TAC	0/15
Trichloroethylene	7/15	93.04	748	SV-D	06/01/05	14.34	100	Intermediate EMEG	4/15
							140	CT SVVC	4/15
							0.2	CT TAC	7/15
Trichlorofluoromethane[3]	6/15	0.6	2,380	SV-A	06/01/05	118.19	5	RBC	10/15[3]
							50,000	CT SVVC	0/15
							49	CT TAC	10/15[3]
Vinyl Chloride[4]	0/15	<0.5	<195.6	SVE 1 – SVE 6	02/05	NA	0.04	CREG	0/15[4]
							41	CT SVVC	0/15[4]
							0.06	CT TAC	0/15[4]
Xylene (m/p)	3/15	0.4	6.8	SV-07	10/05/05	3.85	50	Chronic EMEG (Xylenes, total)	0/15
							38,000	CT SVVC (Xylenes, total)	0/15
							51	CT TAC (Xylenes, total)	0/15

*When available, ATSDR CVs for ambient air were used as a conservative screening value. The Connecticut SVVC represents the concentration in soil vapor that would be associated with the health-based TAC assuming attenuation as the vapor passes through space, across the building foundation, and into indoor space. Connecticut developed a residential and industrial/commercial SVVC. For screening potential exposures to high school occupants, the lower residential SVVC values were used. Connecticut's TAC

[1]The geometric mean was calculated by taking the nth root of n numbers, where n is the number of samples for which an analyte was measured. In the case that a sample was not detected, one half of the detection limit was used to complete these calculations.
[2]The detection limit for benzene was either 0.5 ppbv or 156.51 ppbv for soil vapor samples, which is well above the CREG of 0.003 ppbv. The high detection limit accounts for the relatively high geometric mean.
[3]The detection limit for trichlorofluoromethane was 93.04 ppbv for samples SVE 1 through SVE 6. To be conservative, these six samples have been considered as samples over the RBC value of 5 ppbv.
[4]Vinyl chloride was not detected in any of the soil vapor samples. However, laboratory detection limits (0.5 ppbv or 195.6 ppbv,) for vinyl chloride are well above the CREG of 0.04 ppbv.

CREG - cancer risk evaluation guide
CT TAC – Connecticut Target Indoor Air Concentrations
EMEG - environmental media evaluation guide
RBC - risk-based concentration
CT SVVC - Connecticut soil vapor volatilization criteria (residential)
CV - comparison value
ppbv - part per billion by volume
RMEG - reference media evaluation guide

SOURCES:
[EA] EA Engineering, Science, and Technology. 2005. Response to RIDEM Site Investigation Report Comments, May 19, 2005.

[EA] 2005. Site Investigation Report Addendum.

[EA] 2006. Remedial Action Work Plan.

Appendix B
RIDEM's Order of Approval for the Proposed Remediation Plan for the Providence Public School Site- Parcel B (Formerly a portion of the Gorham/Textron Dump Site)

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
235 Promenade Street, Providence, RI 02908-5767 TDD 401-222-4462

June 9, 2006

RECEIVED

JUN 12 2006

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.
BY

CERTIFIED MAIL

Alan Sepe, Acting Director
Department of Public Properties
City of Providence
25 Dorrance Street
Providence, RI 02903

RE: Order of Approval, Proposed Providence Public School Site – Parcel B
Formerly a portion of the Gorham/Textron Dump site, 333 Adelaide Avenue, Providence
City of Providence Tax Assessor's Office Plat 51, Lot 323, Parcel B
Case No. 2005-029 (Formerly part of Case No. 97-030)

Dear Mr. Sepe:

Enclosed please find the Order of Approval (Order) for the proposed remediation plan for the above referenced facility. Please review the stipulations of this Order thoroughly to ensure your compliance with the requirements. This Order places primary responsibility for the construction, operation, maintenance and monitoring of the approved Remedial Action Work Plan (RAWP) on the City of Providence (City). In order to enable the Department to monitor the City's compliance with the RAWP, the Order requires the City to notify the Department of any condition that is non-compliant with the Order or that constitutes an interruption of the RAWP. In order to maintain compliance with the Order and the RAWP, the City's responsibilities under the Order necessarily include the responsibility to respond to and correct non-compliant conditions in a timely, proactive and professional manner that minimizes non-compliance with the Order and RAWP, and protects human health and the environment.

Please notify this office 48 hours prior to the beginning of any work related to the remediation of the property. If you have any questions regarding this matter, please contact me at (401) 222-2797 x7109.

This Order shall be recorded in the land evidence records of the City of Providence as required by law, and a recorded copy must be returned to the Department within 7 days of recording.

Sincerely,

Joseph T. Martella II
Senior Engineer, Office of Waste Management

cc: Terrence D. Gray, P.E., Assistant Director, RIDEM/AW&C
Leo Hellested, P.E., Chief, RIDEM/OWM
Kelly J. Owens, RIDEM/OWM
Brian Wagner, Esq., RIDEM/OLS
Christopher Walusiak, RIDEM/OWM
Douglas McVay, RIDEM/OAR
Barbara Morin, RIDEM/OAR
Dr. Robert Vanderslice, PHD, RIDOH
Hon. David N. Cicilline, Mayor, City of Providence
Senator Juan M. Pichardo, District 2
Representative Thomas Slater
Providence City Councilman Ronald Allen
John J. Lombardi, City of Providence
Thomas Deller, City of Providence
Mary McClure, President – Providence School Bd.
Sara Rapport, Esq., City of Providence
James Ryan, Esq, PS&H
Peter M. Grivers, EA
Gregory L. Simpson, Textron
Gerald Petros, Esq., Hinkley Allen
Steven Fischbach, Esq., RILS
Knight Memorial Library – Project Repository

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

In the matter of Remedial Action Approval at: **Case No. 2005-029**
Proposed Providence Public School Site – Parcel B
(Formerly a portion of the Gorham/Textron Dump site)
333 Adelaide Avenue, Providence, RI, Plat 51, Lot 323 (the Site)

ORDER OF APPROVAL

In the above entitled matter wherein the following documents have been filed by or on behalf of the **City of Providence (City), in its capacity as owner and Responsible Party for the remediation of property located at 333 Adelaide Avenue, Providence**, or are otherwise on record with the Rhode Island Department of Environmental Management (the Department):

1. Remedial Action Work Plan, Former Gorham Manufacturing Facility, Parcel B, Adelaide Avenue, Providence, Rhode Island (RAWP), prepared by EA Engineering, Science, and Technology, Inc. (EA), dated April 2006, received April 26, 2006;

2. Electronic mail from EA to the Department, Re: Gorham ... Proposed Indoor Air Sampling, dated April 28, 2006;

3. Department Comment Letter, Re: Remedial Action Work Plan Comments - Proposed Providence Public School Site, (Former) Gorham Textron Dump Property, 333 Adelaide Avenue, Parcel B, Providence, City of Providence Tax Assessor's Office Plat 51, Lot 323, Parcel B, Case No. 2005-029 (Formerly part of Case No. 97-030), dated May 23, 2006;

4. Response to RAWP Comments, Former Gorham Manufacturing Facility, Parcel B, 333 Adelaide Avenue, Providence, Rhode Island, Case No. 2005-029, prepared by EA, dated May 25, 2006;

5. Letter from EA to the Department, Re: Draft ELUR for Parcel B Former Gorham Manufacturing Facility, Parcel B, 333 Adelaide Avenue, Providence, Rhode Island, Case No. 97-030 (Including Case No. 2005-029 and Case No. 2005-059), including a draft copy of the proposed Environmental Land Usage Restriction, delivered in PDF format via e-mail, dated June 7, 2006; and

6. Letter from Mark V. Dunham, Chief Financial Officer, Providence School Department, Re: Response to RAWP Comment No. 6, Former Gorham Manufacturing Facility, Parcel B, 333 Adelaide Avenue, Providence, Rhode Island, Case No. 2005-029, dated June 6, 2006, received via facsimile machine on June 8, 2006.

Subject to the conditions herein, these documents fulfill the requirements of Section 9.00 (Remedial Action Work Plan) of the Department's Rules and Regulations for the Investigation and Remediation of Hazardous Materials Releases (Remediation Regulations), as amended February 24, 2004, and describe a plan to remediate existing contamination pursuant to 23-19.14-1 et seq. and Department's Remediation Regulations, amended February 24, 2004 in accordance therewith.

This Order of Approval (Order) places primary responsibility for the construction, operation, maintenance and monitoring of the approved Remedial Action Work Plan (RAWP) on the City. In order to enable the Department to monitor the City's compliance with the RAWP, the Order requires the City to notify the Department of any condition that is non-compliant with the Order or that constitutes an interruption of the RAWP and to take immediate action to correct the non-compliant condition. In order to maintain compliance with the Order and the RAWP, the City's responsibilities under the Order necessarily include the responsibility to independently and proactively respond to and correct non-compliant conditions in a timely manner.

As the responsible party and performing party, the City is expected to implement the RAWP semi-autonomously; i.e. with Department oversight but without the need for constant Department direction or approval of the City's activities. The City is also responsible for promptly addressing non-compliant site conditions (e.g. equipment malfunctions or exceedances of established contaminant limits). Upon identifying any non-compliant condition, the City is expected to act accordingly to develop and implement an appropriate response to re-establish compliance. The City's response(s) to non-compliant conditions must be implemented in an expeditious and professional manner that minimizes non-compliance with the Order and RAWP, and protects human health and the environment.

It is the Department's intent that this Order implement clear and specific timelines for deliverables that must be met by the City with respect to the on-site monitoring, reporting and operation & maintenance requirements necessary to maintain the Remedy in a state of compliance. Upon consideration thereof, and in accordance with Rule 10.1 (Remedial Action Approvals) of the Remediation Regulations, the Department conditionally approves said RAWP through this Order, provided that:

1) All work, operations, activities and schedules shall be performed in accordance with the terms and conditions of this Order, the Department approved RAWP, and all other applicable federal, state and local laws and regulations.

2) The City shall prepare and distribute a community notice to the residents in the reservoir triangle neighborhood and to other interested parties (e.g. community groups and local elected officials). The notice shall be printed in English and Spanish and shall include an estimated schedule for remedial activities and construction, a brief description of the work to be performed and the precautions to be taken to protect the community, and relevant contact information for the City and its on-site contractors (name, phone, e-mail ... etc.) for questions and complaints.

3) Work shall be initiated at the Site within thirty (30) days of receipt of this Order.

4) No hazardous waste shall be accepted from any off-site sources for treatment or disposal at the Site.

5) Sampling and analysis of all media involved in the Remedial Action shall be conducted in accordance with the requirements of the RAWP and this Order.

6) The Site remedy as described in the RAWP shall incorporate the following:

   a) All work, operations, and activities shall be performed to ensure the applicable remedial objectives for the site are achieved for all hazardous substances at the site, so as to manage actual or potential risks to human health and the environment.

   b) Encapsulation of all regulated site soils through the installation of Department approved engineered controls (including the building foot print, side walks, asphalt parking areas, landscaped areas, or other engineered caps). A Department approved engineered control shall cover every portion of Parcel B up to the "barrier to prevent access to the Park Parcel" described in the March 29, 2006 Superior Court Consent Order (Parcels B & C). All engineered controls shall provide a level of protection equivalent to a minimum of two feet of clean soil. Any additional proposed engineered control design, not previously described in the RAWP and approved through this Order, must be submitted to the Department for approval prior to installation. Engineered control caps consisting of concrete pavement or walkways shall be completed with a minimum six (6) inch base of appropriate clean material covered with a minimum of four (4) inches of concrete. All engineered controls over areas known or suspected to be subject to the Solid Waste Regulations, and under the jurisdiction of the Solid Waste Program, shall consist of a minimum of two feet of clean soil. All regulated site soils and engineered controls shall be subject to an Environmental Land Usage Restriction (ELUR).

   c) Construction, installation, maintenance and continuous operation of an active sub-slab ventilation (SSV) system designed to extract soil vapor from under the building, and to prevent the accumulation and/or buildup of methane gas or volatile organic compounds (VOCs), and to ensure levels of methane and or VOCs are maintained below applicable "Action Levels." The SSV system shall also be equipped with an alarm system, and system operation and maintenance will include periodic monitoring of methane and VOC levels below the building, within the building, and in the extracted soil vapor.

   d) Following the installation of the sub-slab ventilation system, its proper operation shall be tested to demonstrate compliance with the Department approved performance criteria in the final RAWP, and to verify actual emission values, in order to determine if treatment, a permit, or registration for the SSV system is required under the Department's Office of Air Resources (OAR) Air Pollution Control (APC) Regulation No. 9.

e) Implementation of a long term vapor and air-monitoring program sufficient to ensure site conditions are maintained in compliance with the applicable remedial objectives. Said monitoring program shall include at a minimum:

   i) Incorporation of remedial "Action Levels" as follows:
      (1) Within buildings, the remedial Action Level shall be 1 percent of the methane lower explosive limit (LEL).
      (2) Under buildings, the remedial Action Level shall be 10 percent of the methane LEL.
      (3) The remedial Action Level for VOCs shall be the Connecticut Residential Proposed Target Indoor Air Concentrations (TACs). An appropriate analytical method shall be selected with a detection limit sufficiently sensitive to allow proper comparison of detected VOC concentrations to each applicable TAC (e.g. speciated VOCs using EPA method TO-15).
   ii) The proposed location of each interior methane monitor/alarm (i.e. continuous within the buildings), as well each proposed interior and sub slab sample collection location shall be provided to the Department prior to installation.
   iii) Performance of baseline ambient air monitoring within the subsurface slab area and the building interior shall be conducted, prior to system start up and any occupancy, to evaluate concentrations of methane and VOCs at the site.
   iv) The schedule for periodic compliance monitoring shall be weekly from system start-up through the first quarter of system operation, followed by monthly provided that there are no exceedances of the applicable remedial Action Levels. After successfully demonstrating one year of continuously compliant system operation, the City may petition the Department to decrease the required monitoring frequency.
   v) A minimum of three (3) representative sub slab monitoring locations shall be sampled and analyzed for both methane and VOCs. In the event that concentrations of VOCs in the sub slab air are detected at a level which exceeds an Action Level, VOC samples shall immediately be collected and analyzed from correspondingly representative interior monitoring locations.
   vi) In the event that a remedial Action Level is exceeded in a location that is already being addressed by the active sub-slab ventilation system (i.e. indoor air or under a building), the City shall immediately notify the Department by telephone and respond to and correct non-compliant conditions in a timely manner. Written notification to the Department shall follow within seven (7) days with any plans to upgrade or adjust the system to remedy the problem, including steps taken to address the non-compliance. It shall be the City's responsibility to assess immediate threat or emergency situations and to address non-compliant conditions in an expeditious and professional manner that minimizes non-compliance with the Order and RAWP, and protects human health and the environment.
   vii) Each of the interior methane monitors shall be operated continuously and be connected to the remote alarm system in such a manner as to trigger the alarm should the concentration of methane in any building exceed the remedial Action Level of 1 percent of the methane LEL. Each interior methane monitor shall be powered in a manner such that operation will not be interrupted during a power failure. In the event that the

concentration of methane in any building exceeds the remedial Action Level of 1 percent of the methane LEL, the City shall act accordingly to develop and implement an appropriate response to re-establish compliance, and protect human health and the environment. Response protocols may include, but not necessarily be limited too, building evacuation, notification of the Providence Fire Department via "911", notification of the Department, and other steps, as appropriate, designed to identify and correct any alarm system or SSV system-related problems that may have contributed to site conditions, which caused the methane sensor alarm.

viii) All equipment shutdowns (intentional and unintentional) or operational problems shall be reported to the Department immediately. Intentional equipment shutdowns for regular maintenance shall not require immediate notification to the Department provided that the shutdown is for less than twenty-four (24) hours and the maintenance activity is discussed in the next quarterly report.

ix) Monitoring of methane and VOCs shall continue at the specified rate as long as a source of contamination exists.

f) Preparation and submission of quarterly air monitoring reports in accordance with this Order, and including the recording of the following parameters:

i) The concentrations of methane and VOCs detected in each sample collected and analyzed during monitoring activities for the current reporting period.
ii) A summary table of the concentrations of methane and VOCs detected in each sample collected and analyzed during prior reporting periods.
iii) The occurrences of any alarm activations during the quarter and the resulting activities performed in response to the alarm activation.
iv) The occurrences of any remedial Action Level exceedances during the quarter and resulting activities performed in response to the exceedance.
v) The system operational status during the quarter, particularly noting the length of any system shutdown due to power failure, system malfunction, repairs, scheduled maintenance, etc.
vi) The anticipated delivery date of the next scheduled monitoring report submittal.

g) Management of all Site soil in accordance with the requirements of the RAWP and this Order.

h) Implementation of appropriate procedures to manage, control and monitor regulated soil, asbestos containing material (ACM) and dust in a manner consistent with the asbestos and fugitive dust management precautions employed during the Department-approved Limited Remedial Action Work Plan (LRAWP) for Parcel B, except as amended by the RAWP, including but not limited too:

i) Real-time dust monitoring shall be conducted at the perimeter of the site to ensure that site activities do not create unacceptable impacts to off-site air quality and risks to nearby populations. Dust monitoring results must be submitted to the Department on a weekly basis, at a minimum, and be made part of the Operating Log for the RAWP. The Department must be immediately notified of any exceedances of any approved action levels (see above referenced LRAWP), any corrective action that was performed, and the results and effectiveness of corrective action measures.

ii) Regular application of water to the work area or any area of soil disturbance to control dust through the use of either a water truck equipped with multiple spray nozzles and a manual hose attachment, or multiple oscillating water sprinklers.

i) Preparation and submission of a Remedial Action Closure Report documenting the work performed and including at a minimum the following items:

i) A post remediation survey of the entire site with as-built plans demarcating the exact location (e.g. vertical and horizontal extent and type) of the installed engineered controls, including: geotextile fabric, clean fill, utilities, structures, basins, swales, the storm water detention pond, the SSV system, and all monitoring locations.

ii) Analytical results and summary of all post remediation/post construction methane, VOC and air monitoring performed to date, demonstrating compliance with the requirements of this Order.

iii) All original laboratory analytical data results from the remedial activities, compliance and confirmation sampling, and clean fill sampling as applicable.

iv) A statement from the facility or environmental consultant attesting to the origin of the clean fill and/or loam, and suitability consistent with the RAWP and this Order. Any organic topsoil utilized shall conform to the general vegetated top cover criteria outlined in Rule 2.2.12 of the Solid Waste Regulations.

j) The final Department approved ELUR, referenced as document 5 above, shall be recorded in the City of Providence land evidence records of the subject property.

k) Long-term maintenance of the engineered controls and portions of the property subject to the ELUR, including annual inspection and certification by an environmental professional.

7) The SSV system (including the alarm system) shall be operated and maintained to prevent methane and/or VOC concentrations from reaching or exceeding the remedial Action Levels within any and all occupied structures at the site.

8) Any temporarily stockpiled regulated soils shall be placed upon and covered with polyethylene of thickness at least 6mm or greater to prevent tearing, and segregated from clean fill material to prevent cross contamination.

9) All excess fill material generated on site, shall have all solid waste and debris removed prior to reuse as closure cap subgrade beneath the filter fabric layer.

10) Any material discovered during excavation activities that qualifies as "Solid Waste," as defined by the Department's Solid Waste Regulations, must be disposed of at a licensed Solid Waste Facility. This includes, but is not limited to, any solid waste material removed under the proposed building footprint.

11) All RAWP activities shall be performed in compliance with all appropriate Office of Air Resources (OAR) Rules and Regulations, including but not limited to the monitoring and control of any air emissions and the timely acquisition of any required Air Pollution Control Permits (Air Permits).

12) Any portion of the RAWP or development project conducted on the Site which falls under the jurisdiction of the Department's Freshwater Wetlands Program must be done in accordance with the Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act (the Wetlands Regulations), including but not limited to the timely acquisition of a Wetlands Permit.

13) Any portion of the RAWP or development project conducted on the Site which falls under the jurisdiction of the Department's Office of Water Resources (OWR), Rhode Island Pollution Discharge Elimination System (RIPDES) Program, must be performed in compliance with all appropriate OWR/RIPDES Rules and Regulations, including but not limited to the timely acquisition of a RIPDES Permit or a General Permit for Storm Water Discharge Associated with Construction Activity as appropriate and/or applicable.

14) All waste derived from implementation of the RAWP, the repair and maintenance of the Remedy, or the engineered systems shall be managed in accordance with the Department's Remediation Regulations, Rules and Regulations for Hazardous Waste Management, and Solid Waste Regulations, as appropriate. In accordance with Rule 11.07 (Initiator) of the Remediation Regulations, the City must comply with the requirements of the Solid Waste Regulations, as amended, for all solid waste shipments that they initiate, and documentation of disposal shall be provided to the Office of Waste Management (OWM).

15) All fill material brought onto the Site and all soil utilized for the engineered control cap must be compliant with the Department's Method 1 Residential Direct Exposure Criteria pursuant to the Remediation Regulations. All clean fill, including sub-grade material and loam, imported to the site must be sampled in accordance with the RAWP and this Order, prior to delivery and placement. Laboratory analytical results must be submitted to the OWM via fax (401) 222-3812. Written approval (via e-mail, fax or letter) to use the fill must be received from the Department prior to use.

16) Within sixty (60) days of completion of the Remedial Action described in the RAWP, a Remedial Action Closure Report, detailing the Remedial Action and current site status, shall be submitted to the OWM for review and approval. The Remedial Action Closure Report shall include a draft Site specific post remediation Soil Management Plan (SMP) and a post

remediation survey and as-built plan, to be recorded with the Department approved ELUR referenced as document 5 above.

17) Within thirty (30) days of receiving Department approval of the Remedial Action Closure Report, the City will have the Department approved ELUR recorded in the Providence land evidence records, and submit a recorded (stamped) copy to the OWM within fifteen (15) days of the date that it is recorded.

18) Within ten (10) days of submittal of the recorded (stamped) copy of the Department approved ELUR to the OWM, the City shall notify all abutting property owners, tenants, and interested parties that the ELUR has been recorded.

19) The City, its representatives, employees, agents and contractors shall adhere to the following timelines in its management, operation and maintenance of the Site.

a) The City shall immediately notify the OWM of any Site or operating condition that results in non-compliance with this Order, or that indicates that the Remedy is not meeting its intended goal of preventing human exposure to hazardous materials contained in the former manufacturing facility site.

b) The OWM shall be notified in writing immediately if the City suspects or has reason to believe that any of the remedial objectives will not be met.

c) The OWM will be notified a minimum of five (5) working days in advance of any changes in contractors and/or consultants for the remedial activities in this RAWP, and will be promptly supplied with complete contact information for each new contractor or consultant (including but not limited to company name and address, contact name and address, contact telephone number and e-mail address).

d) Any RAWP interruptions shall be reported to the OWM by telephone within one (1) working day and in writing within seven (7) days.

e) All exceedances of the "Action Levels" established in the Order that are detected during any site monitoring activity (including but not limited to monitoring of sub-slab ventilation systems, or interior methane monitors/alarms) shall be reported to the OWM immediately and responded to immediately by the City.

f) All equipment shutdowns (intentional and unintentional) or operational problems shall be reported to the OWM immediately. Intentional equipment shutdowns for regular maintenance shall not require immediate notification to the OWM provided that the shutdown is for less than twenty-four (24) hours and the maintenance activity is discussed in the next quarterly report.

g) All repairs or replacements of equipment or other actions taken in response to any non-compliance with the RAWP shall be completed within fourteen (14) days of discovery of the non-compliant condition. Additional time may be requested from the OWM in writing, provided that the request is supported with a justifiable explanation as to why the work cannot be completed within 14 days and includes a binding timetable for the completion of all work. All requests for additional time shall be submitted to the OWM as soon as the City becomes aware that additional time is necessary, but not later than 14 days from the discovery of the non-compliant condition. Documentation describing the repairs and certifying that the malfunction was corrected and that the equipment is operational must be received by the OWM within 5 (five) days of completion of the repairs.

h) All deficiencies in the approved engineered cap (including but not limited to sinking, cracking or excavation of soil, asphalt, cement or foundations) shall be reported to the OWM immediately upon discovery and shall be repaired within fourteen (14) days. Until repairs are made, the City shall prevent access to the deficient areas by staff, students, visitors or the general public. Documentation describing the deficiency, the repairs and certifying that the repairs meet the requirements of the Remedy must be received by the OWM within 5 days of completion of the repairs.

i) Any report or notice required to be submitted to the OWM "immediately," shall require verbal notification to the OWM within twenty-four (24) hours and written notification to the OWM within seventy-two (72) hours. The report or notice shall include a description of: the point of non-compliance (e.g. Action Level exceedance, equipment problems); the known or suspected cause for the non-compliance; any response actions taken as of the time of the report or notice; preliminary concepts for response actions to address, correct and/or prevent recurrence of the non-compliance; and a preliminary timetable for the completion of any further response actions. Final plans and timetables for response actions shall be reported to the OWM as soon as they are developed.

20) All notifications or reports required to be made or submitted to the Department under this Order, any other information pertinent to the RAWP, and/or any other notification regarding the subject site shall be reported to:

Joseph T. Martella II, Senior Engineer
RIDEM – Office of Waste Management
235 Promenade St., 3rd Floor
Providence, RI 02908-5767

Tel: (401) 222-2797 x7109
Fax: (401) 222-3812
E-mail: joseph.martella@dem.ri.gov

21) This Order does not remove the obligation of the City to obtain any other permits, licenses or approvals from any state, local, or federal agencies (including the Department) that may be necessary to comply with this Order.

22) It is the City's sole obligation to obtain all necessary approvals and permits required to implement the RAWP in a timely manner consistent with the RAWP schedule and deadlines in this Order.

23) The City shall have this Order recorded in the City of Providence, land evidence records of the subject property within thirty (30) days of execution of this Order.

24) There shall be no occupation or use of any building, facility or grounds on the Site until all the requirements described in the RAWP and this Order have been met to ensure that the applicable remedial objectives for the site are achieved for all hazardous substances, so as to manage actual or potential risks to human health and the environment for workers, clients, visitors and trespassers at the Site.

Subject to future revisions or amendments by the Department, this Order shall remain in full force and effect for as long as said RAWP shall be operated and maintained in a condition satisfactory to the Department. Failure to comply with all points outlined in the Department approved RAWP and stipulated in this Order shall result in the issuance of a Notice of Violation and Order against the City.

This Order shall be subject to modification or revocation in accordance with law.

Entered as an approval by the Department this 9TH day of June, 2006.

By: [signature]

Leo Hellested, P.E.
Chief, Office of Waste Management
Department of Environmental Management