GOVERNMENT OF THE DISTRICT OF COLUMBIA

DISTRICT DEPARTMENT OF THE ENVIRONMENT
DEPARTMENT OF HEALTH

REMEDY SELECTION

FOR

RIGGS PARK COMMUNITY, WASHINGTON, D.C.

District of Columbia
Remedy Selection
Riggs Park Community
Washington, DC

TABLE OF CONTENTS

GLOSSARY AND ABBREVIATIONS

ACE	U.S. Army Corps of Engineer
ATSDR	The Agency for Toxic Substances and Disease Registry
BSEA	Building Sciences and Engineering Associates
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CDD	Chronic Daily Dose
Chevron	Chevron U.S.A. Inc
COC	Contaminants of Concern
District	District of Columbia
DDOE	District Department of the Environment
DOH	District of Columbia Department of Health
EPA Region 3	The Regional Branch of the U.S. Environmental Protection Agency which includes the District of Columbia, Delaware, Maryland, Pennsylvania, Virginia, and West Virginia
Facility	5801 Riggs Road in Chillum, Prince George's County, Maryland
FDRTC	Final Decision Document and Response to Comments
HHRA	Human Health Risk Assessment
HI	Hazard Index. A summation of the hazard quotients for all chemicals to which an individual is exposed.
HQ	Hazard Quotient. A comparison of an estimated chemical intake (dose) with a reference dose level below which adverse health effects are unlikely. The hazard quotient is expressed as the ratio of the estimated intake to the reference dose. The value is used to evaluate the potential for non-carcinogenic health effects, such as organ damage, from chemical exposures.
ILCR	Incremental Lifetime Cancer Risk
MCL	Maximum Contaminant Levels
MDE	Maryland Department of Environment
MTBE	Methyl tertiarybutyl ether
Non-carcinogenic risk	The term used to describe risks associated with non-carcinogenic or non-cancer causing materials. These materials can cause damage to the respiratory system, central nervous system, reproductive system and other internal organs.
OSHA	Occupational Safety and Health Administration
OSHI	Organ Specific Hazard Index
PCE	Perchloroethene, also known as Perchlorethylene or Tetrachloroethylene. An alternate abbreviation for Perchloroethene is PERC.
PERC	Perchloroethene, also known as Perchlorethylene or Tetrachloroethylene. An alternate abbreviation Perchloroethene for is PCE. "Perc" is also occasionally used as an abbreviation for Perchlorate, so it is not used in this document to avoid confusion.
ppb	Parts per Billion
ppbv	Parts per Billion by Volume
ppm	Parts per Million

RAGS	Risk Assessment Guidance for Superfund
RBC	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RME	Reasonable Maximum Exposed
SB	Statement of Basis
Site Specific Subslab COCs	For this site only: PCE, its degradation products, 1,4-dichlorobenzene, chloroform, naphthalene, carbon tetrachloride, and methylene chloride. This is not intended to be an exhaustive list.
Soil vapor	Vapor in soil. This can either be subslab soil vapor or subsurface soil vapor.
SSP&A	S. S. Papadopolous and Associates.
Subslab soil vapor	Soil vapor collected from immediately below the basement slab of a building, usually 0 to 5 feet below the slab
Subsurface soil vapor	Soil vapor collected from below the soil surface.
TMB	Trimethyl benzene
UAO	Unilateral Administrative Order
ug/l	Micrograms per liter
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VI	Vapor Intrusion
VOC	Volatile organic compounds
VMS	Vapor Mitigation System

I. INTRODUCTION

This document sets forth the District of Columbia's ("District's") selected remedy for the Riggs Park community, which addresses both the non-carcinogenic (or non-cancer) and carcinogenic (or cancer) risks posed by the release of hazardous materials, including the release of gasoline from underground storage tanks located at the gas station formerly owned by Chevron U.S.A., Inc. ("Chevron"), at 5801 Riggs Road in Chillum, Prince George's County, MD. The District, by the Department of the Environment ("DDOE") and Department of Health ("DOH"), is proposing this remedy pursuant to its authority to protect human health and the environment, by requiring corrective action under the District of Columbia Hazardous Waste Management Act of 1997 (D.C. Code §§ 8-1301, 8-1305(a)(9)), the Underground Storage Tank Management Act of 1990 (D.C. Code §§ 8-113, 8-113.08(d)), and under the Brownfield Revitalization Amendment Act of 2000 (D.C. Code §§ 8-632.01(b), 8-634.02(a)(b)).

After reviewing the data collected by S.S. Papadopulos & Associates ("SSP&A) in 2008[1], as well as additional documents contained in the administrative record compiled in support of this Remedy, and conducting an extensive risk assessment to evaluate the cancer risk and non-cancer health hazard[2], the District has selected the following Remedy:

Installation and operation of vapor mitigation systems in up to 45 residences with elevated subslab soil vapor levels attributable to contaminated groundwater.

Based on its review of the SSP&A sampling data[1] and the risk assessment[2], the District finds the following:

- No residences have gasoline-related contaminants such as benzene in the SSP&A study in subslab soil vapor at concentrations that exceed the $1x10^{-5}$ cancer risk level after the application of an attenuation factor of 10%;
- No residences have contaminants analyzed by EPA Method TO-15 in the SSP&A study in subslab soil vapor at concentrations that pose an unacceptable non-cancer risk (that is, that exceed the hazard index of "1") after the application of an attenuation factor of 10%; and
- That out of the 106 residences where subslab soil vapor samples were analyzed, the residences that require VMS are those where the site specific subslab Chemicals of Concern (Perchloroethene, its degradation products, 1,4-dichlorobenzene, chloroform, naphthalene, carbon tetrachloride, and methylene chloride) have the potential to pose a cumulative health risk from subslab soil vapor to exceed the $1x10^{-5}$ cancer risk level after the application of an attenuation factor of 10%.
- That out of the 106 homes, additional residences require VMS where gasoline-related contaminants are still present in subslab soil vapor.

In selecting this Remedy, the District has evaluated the risk for healthy adults. The District has based the decision on subslab soil vapor samples. Subslab soil vapor results are indicative of contaminants potentially emanating from groundwater and represent a source of potential indoor vapor intrusion. Indoor air sampling results are often confounded by in-home sources of vapor (such as recently dry-cleaned clothing, paint, solvents, and chemicals), as well as ambient sources. Using subslab soil vapor results to make determinations protects against possible current and future exposures.

DDOE has not evaluated the indoor air results at any building in this study; therefore, residents' actual cumulative risk levels at the buildings addressed in this Remedy are not known.

In addition to selecting installation and operation of Vapor Mitigation Systems (VMS) in up to 45 residences, the District's selected remedy includes:

- Hazardous Substance Easements, also called Environmental Covenants, at residences or inhabited buildings receiving VMS, to allow continuous access to DDOE and/or its agents to monitor the VMS operation in each home.
- Evaluations to determine the most appropriate VMS systems to install.

- Evaluations during the design phase to confirm that contaminants observed in subslab vapor samples are attributable to groundwater contamination.
- Development of a program to monitor each VMS installed pursuant to the District's Remedy, while the VMS is in operation.
- Development of a program to determine when there is no further need to operate the VMS installed at the direction of the District.
- Development and administration by DOH of a health survey of Riggs Park residents who reside in the plume footprint caused by the leakage of gasoline from the Chevron gas station. This survey will pose specific questions on health conditions of current residents and will seek information on the causes of death of former residents from the time of the gas spill in 1989. Once gathered, these empirical data will be cross referenced with disease registry data.
- The District will determine in conjunction with EPA Region 3 when shutting down the VMS whose installation was required by the EPA Region 3 is appropriate.

The purpose of this document is to inform the public of the District's selected Remedy. In addition to the above-referenced administrative record, the findings presented in this Remedy are based primarily on data gathered by SSP&A, and a risk assessment performed by the District's expert toxicologist. To gain a more comprehensive understanding of these data and other information upon which the District's Remedy decision is based, the District encourages the public to review the Administrative Record compiled to date. The Remedy Administrative Record and index are available for public review on-line at DDOE's website: http://ddoe.dc.gov/ddoe/cwp/view,a,1210,q,498921.asp. Copies will also be added to the document repository established for this site at the Lamond Riggs Branch Library located on 5401 South Dakota Avenue, N.E., Washington, D.C.

II. BACKGROUND

A. Site History

The Riggs Park community is presently being impacted primarily by perchloroethene ("PCE") and its degradation products, and, to a lesser degree, by additional compounds, including naphthalene, 1,4-dichlorobenzene, chloroform, carbon tetrachloride, and methylene chloride (all these contaminants will hereinafter be collectively referred to as the site specific subslab COCs), as well as gasoline-related contaminants. Initial site investigations focused on the source and location of petroleum products in groundwater, and their impacts. For a full history of the petroleum investigation, please see DDOE's Riggs Park website at http://ddoe.dc.gov/ddoe/cwp/view,a,1210,q,498921.asp .

A gas station formerly owned by Chevron is located at 5801 Riggs Road, in Chillum, Prince George's County, Maryland, and abuts the District. In October 1989,

Chevron conducted an UST tightness test on its underground storage tanks. This and subsequent investigations confirmed the release of gasoline from the gas station and the presence of gasoline product in groundwater. Since 1990, Chevron has been recovering gasoline product from the groundwater by operating a groundwater remediation system at the facility.

In 2001, Chevron discovered that gasoline-contaminated groundwater had migrated into the District, into and underneath a residential neighborhood known as Riggs Park, in Northeast D.C., Ward 4. Because the gasoline plume impacted two separate political jurisdictions (the State of Maryland and the District), at the request of then-Councilmember Fenty, EPA Region 3 assumed the lead investigatory role for the Facility. In December, 2002, EPA Region 3 ordered Chevron to perform interim measures to mitigate threats to human health and the environment; to perform a Site Investigation to determine the nature and extent of petroleum-related contaminants in the groundwater; and to perform a Corrective Measure Study to evaluate alternatives for corrective action necessary to protect human health and the environment. Under the interim measures provision of EPA Region 3's 2002 Unilateral Order, Chevron was required to upgrade the groundwater remediation system to recover additional gasoline product in the parking lot[3, 4]. Chevron completed the system upgrade in early 2005. In 2007, EPA Region 3 informed Chevron that an additional expansion of the existing pump and treat system was required[5]. In January 2009, EPA Region 3 informed Chevron that the Final Order was executed and plans for the expansion of the system were to be provided within 90 days[6]. Therefore, this expansion has not been installed to date.

In April of 2008, EPA Region 3 issued its Final Order to Chevron requiring installation of an additional ground water treatment system within the District, installation of an oxygen curtain, installation of Vapor Mitigation Systems at 3 homes, and additional testing to be conducted at up to 5 additional homes. As 1 home-owner has elected not to be tested, Chevron tested only 4 additional homes. As of February 12, 2009, Chevron has completed installing the Vapor Mitigation Systems (VMS) in 1 home and is in the process of completing the installation of the remaining 2 VMS. EPA Region 3 is evaluating the data from the most recent round of testing in the 4 homes. The EPA Region 3 Administrative Order on Consent states that EPA Region 3 will review and consider the results from the SSP&A testing conducted on behalf of the District[7, 8].

As of September 30, 2008, Chevron has removed over 5,000 gallons of gasoline product from the source area.

During the summer of 2002, as a result of the Site Investigation, instances of Perchloroethene (PCE) contamination were detected within part of the groundwater contaminant plume. EPA Region 3 conducted an investigation focused on the source and current groundwater contamination of PCE. In its August 2008 Fact Sheet, EPA Region 3 announced that it had completed its PCE investigation, and concluded that no further action was required related to PCE at that time. For a history of EPA Region 3's PCE investigation, please see EPA's website at http://www.epaosc.org/site_profile.asp?site_id=A3Q3%20 .

The SSP&A study has revealed soil vapor contaminated with PCE, its degradation products, 1,4-dichlorobenzene, chloroform, naphthalene, carbon tetrachloride, and methylene chloride. The SSP&A report is available for review at the Lamond Riggs Branch Library and on the web at DDOE's Riggs Park website http://ddoe.dc.gov/ddoe/cwp/view,a,1210,q,498921.asp .

B. Summary of Investigatory Activities

Pursuant to EPA Region 3's Orders, Chevron collected soil, soil vapor, indoor air and groundwater samples, and conducted pilot tests to upgrade the existing groundwater remediation system. Between 2001 and 2007, Chevron installed 232 temporary Geo-probe wells, 80 groundwater monitoring wells, 7 product recovery wells, and 4 soil vapor monitoring wells. During the same period, Chevron collected over 3000 groundwater samples, 300 soil samples, and 250 soil vapor samples, 50 indoor and ambient air samples from 20 properties, and 14 basement sump samples from 90 properties.

Between 2002 and 2005, U.S. EPA's Superfund Removal program collected indoor air samples from 32 properties and installed 24 soil vapor wells for its PCE investigation. The U.S. Army Corps of Engineers (ACE), on behalf of EPA Region 3, generated split/quality control data from over half the properties sampled by Chevron.

In the summer of 2006 the residents of Riggs Park retained a contractor to obtain independent samples.

In 2006, the District's Department of Health ("DOH") initiated an independent indoor air sampling effort based on voluntary participation by the Riggs Park residents. Sampling was conducted by the District's contractor, Building Sciences and Engineering Associates (BSEA). BSEA collected indoor air data from 97 homes in Riggs Park, bounded geographically by four streets: Kennedy Street, Madison Street, Eastern Avenue, and Riggs Road.

Based on its review of 151 indoor air samples collected by EPA Region 3, Chevron, DDOE and DOH, EPA Region 3 identified up to 5 homes above the gasoline plume and potentially requiring remediation in its August 30, 2007 Statement of Basis[9].

In response to concerns expressed by residents, the District retained a second contractor, SSP&A, to conduct additional sampling intended to verify the BSEA results. Over the course of three quarters, in 2008, SSP&A collected samples from a total of 118 homes. Indoor air samples were collected from a total of 115 homes; subslab vapor samples were taken at 106 homes. Outdoor subsurface soil vapor samples were taken at 66 homes. Ambient air samples were taken concurrently with indoor, subslab, and subsurface samples. Subslab vapor samples were taken from below the concrete slab of the residence, outdoor subsurface vapor samples were taken from the soil in the vicinity of the home. Ambient air or background samples were taken outside the home.

Chevron continues to perform routine testing and monitoring as required by EPA Region 3's order.

III. REGULATORY FRAMEWORK

Pursuant to the District Department of the Environment Establishment Act (D.C. Code §§ 8-151.01, 8-151.07(11)), the Mayor has charged the Director of DDOE with the task of executing and enforcing the provisions of this chapter and the rules and regulations adopted pursuant to this chapter. As such, the Director is hereby selecting corrective action for this site pursuant to three different District of Columbia statutes: (i) the Brownfield Revitalization Amendment Act of 2000 (D.C. Code §§ 8-634.02(a),(b); 8-635.01); (ii) the District of Columbia Hazardous Waste Management Act of 1997 (D.C. Code §§ 8-1301, 8-1311(a)(1); and (iii) the Underground Storage Tank Management Act of 1990 (D.C. Code §§ 8-113, 8-113.09(a)).

These statutes all contain provisions which allow the District to require and secure corrective action at this site. In addition, the District's Brownfield Revitalization Act provides the District with the authority to impose the necessary institutional controls at this site, as discussed below in Section IX.A.1 of this Remedy (D.C. Code § 8-635.01).

Pursuant to its authority to secure corrective action, the District is using the National Oil & Hazardous Substances Contingency Plan ("NCP") promulgated by U.S. EPA pursuant to the Comprehensive Environmental Response, Compensation and Liability of 1980, 42 U.S.C. §§ 9601, *et seq*., and used by U.S. EPA in formulating cleanups under CERCLA, as well as corrective actions under the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901, *et seq.* U.S. EPA intended to publish an implementation framework for the RCRA(C) corrective action provision, which was titled RCRA(S), but prior to finalizing it, withdrew the new provision (FR Vol. 64, No. 194 / Thursday, October 7, 1999 / Proposed Rules). Instead, U.S. EPA urged coordination between the RCRA and CERCLA corrective action programs, by implementing guidance and policy which both should follow (RAGS and NCP) (U.S. EPA memorandum from Elliott P. Laws and Steven A. Herman to RCRA/CERCLA Senior Policy Managers, *Use of the Corrective Action Advance Notice of Proposed Rulemaking as Guidance*, January 17, 1997, *see also* FR Vol. 64, No. 194). In addition, RAGS, Part D, encourages the use of RAGS for RCRA corrective action sites (RAGS, Part D, Frequently Asked Questions, Fact Sheet).

Under these authorities, the District is selecting installation of VMS at homes where gasoline-related contaminants are still being detected in subslab soil-vapor. The District is also selecting installation of VMS at homes where Site Specific Subslab COCs have been detected in subslab soil-vapor at concentrations that pose unacceptable cancer and non-cancer risk.

The NCP specifies that "*for systematic toxicants, the acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime,*

incorporating an adequate margin of safety." 40 C.F.R. § 300.430(e)(2)(i)(A)(1). A U.S. EPA Memorandum, dated April 21, 1991, from Don R. Clay (Assistant Administrator), which provides guidance on the above-cited Section, at page 1 of the Memorandum, quantifies the acceptable non-carcinogenic Hazard Quotient as no greater than 1.

In addition, the NCP specifies that "*for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound life-time cancer risk to an individual of between $1x10^{-4}$ and $1x10^{-6}$…*" 40 C.F.R. § 300.430(e)(2)(i)(A)(2), The Don Clay Memo provides that U.S. EPA remedial action is generally not warranted where cancer risk is found to be below $1x10^{-4}$ unless there are adverse environmental impacts (Page 2). The District has selected a $1x10^{-5}$ cancer risk level, which is within the range permitted by the NCP, and is consistent with the level selected by EPA Region 3 for the Riggs Park site.

Consistent with the Federal CERCLA (or Superfund) statute, the NCP (40 CFR §300.430), and the D.C. UST regulations at 20 DCMR § 6206.4, the District determined risk based on a cumulative evaluation of chemicals.

IV. SELECTED RISK LEVELS

The District selects a cumulative hazard index of 1.0 for non-cancer risk, and a cummulative$1x10^{-5}$ level for cancer risk to be protective for the current and future residents of Riggs Park.

The District has used subslab vapor samples in making this determination. Therefore the Remedy is predicated on potential vapor intrusion, not confirmed vapor intrusion. Actual cumulative health risks based on indoor air data have not been calculated.

The attenuation factor is a conservative estimate of the amount of the subslab soil vapors which may be currently entering the home or which might enter the home in the future. An attenuation factor of 0.1 (or 10%) was selected for this site. Actual cumulative health risks based on indoor air data have not been calculated.

Non-Cancer Risk

Using conventional risk assessment equations[10] and an attenuation factor of 10%[11], the District calculated the Hazard Quotient (HQ) posed by each chemical individually to generate its list of Chemicals of Concern (COCs). The District then calculated the Hazard Index by summing the HQ. The District ran these equations using toxicity values for both healthy adults, and children.

Based upon this study, the District has concluded that none of the homes which were tested in the SSP&A study in the Riggs Park area have contaminants present in

subslab vapors at levels that exceed a Hazard Index of 1 after the application of an attenuation factor of 10%.

Cancer Risk

The District has selected a $1x10^{-5}$ cancer risk level, which is within the range permitted by the NCP ($1x10^{-4}$ to $1x10^{-6}$), and is consistent with the level selected by EPA Region 3.

The District has evaluated the cumulative risk posed to healthy adults by 66 detected contaminants using U.S. EPA's IRIS toxicity values and updated EPA Region 3 toxicity values (September, 2008), after application of an attenuation factor of 10%.

The District will evaluate contaminant levels detected in subslab soil vapor in comparison to contaminant levels attributable to groundwater to confirm that the levels detected in soil vapors, that the District will require be remediated, result from contaminated groundwater.

V. RISK ASSESSMENT METHODOLOGY

A comprehensive human health risk assessment (HHRA) was conducted for 106 Riggs Park homes based on a total of 357 vapor port samples. More than 1,700 separate risk assessments were conducted to determine if the vapor could produce noncancer health effects (like liver damage or brain damage) or cancer risks.

Health risks were calculated according to U.S. EPA's *Risk Assessment Guidance for Superfund, Volume I, Part A* (RAGS; EPA 1989). According to RAGS, an HHRA must include 2 calculated risk estimates—namely, the cancer risk and the noncancer health hazards. The cumulative cancer risk is represented by the Incremental Lifetime Cancer Risk (ILCR), and the noncancer health hazard is represented by the (cumulative) Hazard Index (HI). Both of these health risks must be calculated for the Reasonable Maximum Exposed (RME) individual.

The HHRA was conducted strictly according to RAGS. There are 4 steps in the risk assessment process, and RAGS provides specific and detailed guidance for conducting each of the 4 steps, which are as follows: Data Assessment; Exposure Assessment; Toxicity Assessment; and Risk Characterization.

All risk calculations were based on sub-slab soil vapor samples. For homes with multiple subslab soil vapor sample results, the basis of the cancer risk was the sample posing the maximum calculated cancer risk. This conceptual site model is consistent with the model presented in U.S. EPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (VI Guidance; EPA 2002), which supplements RAGS. The VI guidance states: "Sampling of foundation air (e.g., sub-slab and/or crawlspace air) provides a direct measure of the potential for exposures from vapor intrusion."

Indoor air samples were not evaluated. While other types of samples, such as indoor air samples, can augment the analysis, they are confounded by the numerous contributions of non-groundwater sources termed "background" sources.

All subslab soil vapor samples were analyzed for a total of 66 chemicals. 36 of those were identified as chemicals of interest because they were detected (the rest of the chemicals were not considered because they were not detected in any home). For each home it was assumed that a resident would stay home and breathe the vapors 24 hours a day, 7 days a week, 350 days a year, for 30 years even though most residents will not be in their homes for such extended periods[12].

According to U.S. EPA VI guidance (EPA 2002), the recommended attenuation factor for sub-slab soil gas samples is 0.1. This assumes that ten percent (0.1) of the vapors detected under the basement concrete slab could migrate through cracks in the floor; this is an attenuation factor of 0.1. It is important to note that while an attenuation factor of 0.1 may not represent current conditions, U.S. EPA requires that all remedial decisions consider both current and future risks.

Carcinogenic risk was calculated using toxicity values adopted by EPA Region 3 in September 2008.

Noncarcinogenic Health Hazard Index (HI) were calculated using both U.S. EPA's Integrated Risk Information System (IRIS) and toxicity values adopted by EPA Region 3 in September 2008. Dosimetric adjustments for exposure to children and noncarcinogenic toxicity values for carcinogens were also calculated and utilized. The highest calculated risk was used for decision making.

The exposure point concentration for each chemical (which is the concentration used to calculate the chemical-specific dose and risk) was derived by multiplying the attenuation factor of 0.1 by the concentration detected in the subslab soil vapor sample. This forms the basis of the cumulative risk to the RME individual. To calculate the chemical dose, the frequency, and duration of exposure are combined with the exposure point concentration, which is then averaged over the total time of exposure to represent the chronic daily dose (CDD). Exhibit 1 presents the exposure assumptions used to calculate the CDD.

EXHIBIT 1
Exposure Parameters[12]

Chronic Daily Dose (CDD) = $\frac{C \times ET \times EF \times ED}{AT \times CF}$			
		Parameter	**RME**
C	=	Chemical Concentration (µg/m3)	VMP Conc. x 0.1
ET	=	Exposure time (hours/day)	24

EF	=	Exposure frequency (days/year)	350
ED	=	Exposure duration (years)	30
BW	=	Body weight (kg)	70
CF	=	Conversion Factor	1000 μg/mg
AT	=	Averaging time (days) Noncarcinogenic Carcinogenic	 10,950 25,550

Excess Lifetime Cancer Risk (ELCR) = CDD x IUR

Where:

ELCR = A unitless probability of an individual developing cancer over a 70-year lifetime associated with inhaling a cancer-causing chemical for 30 years

CDD =Chronic daily dose of the chemical averaged over 30 years (mg/kg-day)

IUR = Inhalation unit risk $(ug/m^3)^{-1}$

For each SSV sample, the ELCR is calculated for each chemical detected in the sample. The cumulative ELCR for the sample is the sum of each calculated chemical-specific ELCR.

A confidential compilation of the cumulative ELCR based on the subslab vapor results for each home with risk at or above $1x10^{-5}$ was provided to DDOE.

Observed Chemicals:

A total of sixty-six (66) chemicals were reported on the SSP&A TO15 test results. Thirty-six (36) of those were identified as chemicals of interest because they were detected in homes in Riggs Park (the rest of the chemicals were not considered because they were not detected in any home). These 36 chemicals are listed in Table 1.

Seventeen (17) chemicals were identified as potential carcinogens. These 17 chemicals are identified in Table 1.

Ten chemicals were not evaluated in this study because they did not have EPA Region 3 derived toxicity values. These 10 chemicals are identified in Table 2.

Table 1.
Chemicals of Interest which were detected in Riggs Park subslab soil vapor samples.

Chemicals of Interest which were detected in Subslab	**Potential Carcinogen**

Vapor Port Samples	
1,1,1-Trichloroethane	
1,1-Dichloroethene	Known carcinogen
1,2,4-Trichlorobenzene	
1,2,4-Trimethylbenzene	
1,2-Dichlorobenzene	
1,3,5-Trimethylbenzene	
1,3-Dichlorobenzene	
2-Butanone (MEK)	
Acetone	
Chlorobenzene	
Chloromethane	
cis-1,2-Dichloroethene	
Cyclohexane	
Ethyl acetate	
Ethylbenzene	Known carcinogen
Hexane	
Naphthalene	Known carcinogen
Styrene	
Toluene	
trans-1,2-Dichloroethene	
Xylenes	
1,2-Dichloroethane	
1,3-Butadiene	Known carcinogen
1,4-Dichlorobenzene	Known carcinogen
1,4-Dioxane	Known carcinogen
Benzene	Known carcinogen
Carbon tetrachloride	Known carcinogen
Chloroethane	Known carcinogen
Chloroform	Known carcinogen
Hexachlorobutadiene	Known carcinogen
Methyl tert-butyl ether	Known carcinogen
Methylene chloride	Known carcinogen
Tetrachloroethene	Known carcinogen
Tetrahydrofuran	Known carcinogen
trans-1,3-Dichloropropene	Known carcinogen
Trichloroethene	Known carcinogen

Table 2
Chemicals with no established toxicity values which were detected in Riggs Park subslab soil vapor samples

Chemical
2-Hexanone (MBK)
4-Ethyltoluene

4-Isopropyltoluene
4-Methyl-2-pentanone (MIBK)
n-Butylbenzene
n-Heptane
Propene
Dichloroethylene
1,2-cis Cyclohexane
Ethyl acetate

VI. SCOPE OF REMEDIATION

The scope of remediation in this document is limited to addressing potential vapor intrusion. Actual cumulative health risks based on indoor air data have not been calculated. Groundwater has not been evaluated.

Buildings located above contaminated groundwater are vulnerable to subsurface vapor intrusion coming from the contaminated groundwater and entering basements through cracks, joints and utility openings. This effect is referred to as subsurface vapor intrusion.

The District's Remedy is to install a subslab vapor mitigation system, similar to a radon system, in all residences or inhabited buildings in Riggs Park which meet the criteria below.

To be considered, the levels of the contaminants of concern in the subslab soil vapor samples must either:

1) exceed a Hazard Index of 1 for cumulative non-cancer risk posed by gasoline, PCE and/or other contaminants detected in the subslab vapor samples after the application of an attenuation factor of 10% (0.1), or

2) exceed a $1x10^{-5}$ cumulative cancer risk posed by gasoline, PCE and/or other contaminants detected in the subslab vapor contaminants, after the application of an attenuation factor of 10% (0.1).

To receive VMS:

3) The chemicals of concern in subslab soil vapor must also be attributable to groundwater contamination.

Explanation of criteria:

1) A Hazard Index of 1 is specified in Title 20 of the District of Columbia Municipal Regulations, Section 6206.4(c), (20 DCMR § 6206.4(c)), and U.S. EPA Memorandum, dated April 21, 1991, from Don R. Clay (Assistant Administrator) The Hazard Index is the sum (or cumulation) of the Hazard Quotients for all the

chemicals of concern. The Hazard Quotient is a comparison of an estimated chemical intake (dose) with a reference dose level below which adverse health effects are unlikely.

The attenuation factor is a conservative estimate of the amount of the subslab soil vapors which might enter the home. An attenuation factor of 10% is specified in OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) November 2002 EPA530-D-02-004 [11].

2) The District has selected a $1x10^{-5}$ cancer risk level, which is mid-way within the range permitted by the NCP[13], and is consistent with the level selected by EPA Region 3.

The attenuation factor is a conservative estimate of the amount of the subslab soil vapors which might enter the home. An attenuation factor of 10% is specified in OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) November 2002 EPA530-D-02-004.

3) The chemicals of concern in subslab soil vapor must also be attributable to groundwater contamination to demonstrate that the source of the chemical is the groundwater. Homes where soil vapor contamination cannot be attributed to contaminated groundwater will not be remediated.

Based primarily on the SSP&A data and the risk assessment based on those data, as well as other documents referenced in the Administrative Record, the District finds that 45 residences have measured subslab soil vapor concentrations at levels that pose an unacceptable cancer risk.

VII. REMEDY

The District will periodically review its selected Remedy, and will change the specifics of any programs to reflect advances in technology, medicine, and regulation as needed.

A. Installation of Vapor Mitigation System

The District's Remedy is to install a subslab vapor mitigation system, similar to a radon system, in all residences or inhabited buildings which meet the criteria described in Section VI. All installation and testing will be subject to owners' consent. The installation of the VMS will be contingent upon acquisition of all necessary permits from the District and/or EPA Region 3 to install and operate the VMS.

B. Additional tasks required to support this Remedy

1) Determine the most appropriate VMS system to install. In particular, the overall impact on background air results due to the operation of 45 VMS within a limited area must be determined. If the impact will be significant, systems which capture and/or treat the emitted vapors will be required. The final design of the VMS will be determined in the design phase.

2) Determine if the contaminants observed in subslab vapor samples can be attributed to groundwater contamination.

3) The Department of Health will develop and administer a health survey of Riggs Park residents who reside in the plume footprint caused by the leakage of gasoline from the Chevron gas station. This survey will pose specific questions on health conditions of current residents and will seek information on the causes of death of former residents from the time of the gas spill in 1989. Once gathered, these empirical data will be cross referenced with disease registry data.

4) Develop a program to monitor each VMS installed pursuant to the District's Remedy, while the system is in operation. Monitoring protocols will be determined during the design phase.

5) Development of a program to determine when there is no further need to operate the VMS at the direction of the District.

6) The District will determine in conjunction with EPA Region 3 when shutting down the VMS whose installation was required by the EPA Region 3 is appropriate.

C. Institutional Controls

Pursuant to D.C. Code § 8-635.01(b)(3), require the recording of Hazardous Substance Easements, also known as Environmental Covenants, with the D.C. Recorder of Deeds for each home with a VMS, to allow continuous access to DDOE and/or its agent to monitor and ensure the continuity of VMS operation in each home.

VIII. EVALUATED REMEDIATION ALTERNATIVES

1) Basement sealant – Sealant products are available on the open market which can be applied to walls and floors which are in contact with soil. The products are intended to seal small cracks and prevent vapor intrusion. The products must be applied to the structural walls and floor and are therefore not suitable for use in a basement which is already finished. Some of the products are clear, therefore the integrity of the seal cannot be easily monitored in the future. The effectiveness of these products is unknown at this time, therefore the District does not consider this to be protective.

2) Pressurization of basement – A system can be installed to increase the overall air pressure in the basement which is intended to decrease vapor intrusion. In order to maintain the pressure, the basement cannot be accessed after the system is installed,

rendering the basement non usable by the homeowner. The results of installations of these systems are inconsistent, therefore the District does not consider this to be protective.

3) Natural ventilation – The basement area can be vented using windows and fans. This renders the basement inaccessible to the homeowner except when the weather is pleasing to their taste. The heating and cooling costs for the home will increase significantly unless the basement is insulated from the house. The results are from this method are inconsistent, therefore the District does not consider this to be protective.

IX. EVALUATION OF REMEDY

This section provides a description of the criteria which DDOE has used to evaluate the Remedy in accordance with DDOE's guidance documents.

The scope of remediation in this document is limited to addressing potential vapor intrusion. This Remedy does not address actual cumulative health risk levels, only the potential cumulative health risk levels. This Remedy is limited to the participants of the SSP&A study.

The criteria are applied in two phases. In the first phase, DDOE evaluates Remedy threshold criteria as general goals. In the second phase, for those remedies which meet the threshold criteria, DDOE then evaluates balancing criteria to determine which Remedy alternative provides the best relative combination of attributes.

A. Threshold Criteria

The District's evaluation of the threshold criteria is as follows:

1. Protect human health and the environment

The primary health concern under current conditions is vapor intrusion into basements.

The Remedy requires the installation of a vapor mitigation system in each residence where the criteria specified in section VI are met. Based on extensive sampling and toxicological evaluation for cancer and non-cancer risk, up to 45 residences meet these criteria because subslab vapor sampling results demonstrate the potential for intrusion into basements.

In the course of implementing this Remedy, the following additional evaluations, determinations, and developments will be made:

1) Evaluations must be performed to determine the most appropriate VMS systems to install.

2) Evaluations must be performed to determine if the contaminants observed in subslab vapor samples can be attributed to groundwater contamination.

3) Development of a program to monitor each VMS installed pursuant to the District's Remedy, while the VMS is in operation.

4) Development of a program to determine when there is no further need to operate the VMS installed at the direction of the District because both non-carcinogenic and carcinogenic risk levels associated with vapor intrusion have been met.

5) The District will determine in conjunction with EPA Region 3 when shutting down the VMS whose installation was required by the EPA Region 3 is appropriate.

In addition, the Department of Health will develop and administer a health survey of Riggs Park residents who reside in the plume footprint caused by the leakage of gasoline from the Chevron gas station. This survey will pose specific questions on health conditions of current residents and will seek information on the causes of death of former residents from the time of the gas spill in 1989. Once gathered, these empirical data will be cross referenced with disease registry data.

DDOE's remedy requires the following institutional controls be implemented to ensure the protection of human health in the future.

- The recording of Hazardous Substance Easements, also known as Environmental Covenants, pursuant to D.C. Code § 8-635.01(b)(3), with the D.C. Recorder of Deeds for each home with a VMS, to allow continuous access to DDOE and Chevron to monitor VMS operation in each home.

The District of Columbia's Brownfield Revitalization Amendment Act of 2000 allows the District to place these institutional controls, and to register the documents with the D.C. Recorder of Deeds (D.C. Code § 8-635.01). Other jurisdictions also routinely use these types of institutional controls in hazardous waste sites.

2. Achieve media cleanup objectives

The vapor mitigation systems will achieve the media (indoor air) cleanup objective by preventing subsurface vapor intrusion into homes affected by the groundwater contaminants. This will ensure that contaminants in the contaminated groundwater do not contribute to indoor air levels which pose an unacceptable cancer or non-cancer risk.

3. Control the source(s)

The District's Remedy does not control the source of the groundwater contaminants.

The Remedy (VMS) is intended to limit the hazardous effects at residences or inhabited buildings impacted by the contaminated groundwater, until such time as the groundwater is remediated.

B. Balancing Criteria

After satisfying the threshold criteria, DDOE evaluates the following balancing criteria to demonstrate the suitability of the Remedy:

1. Long-term Reliability and Effectiveness

The vapor mitigation systems to be installed in those occupied buildings affected by vapor intrusion, evidenced by results where the criteria specified in Section VI are met, are a proven technology which has been adopted from the radon mitigation industry. Similar systems have been installed in millions of homes throughout the nation to mitigate radon intrusion. The systems are expected to be equally reliable and effective because the mechanism to prevent vapor and radon intrusion is identical.

During the design phase of the Remedy, the District will require the development of a monitoring protocol to evaluate individual home vapor mitigation systems.

2. Reduction of Waste Toxicity, Mobility or Volume

The Remedy does not reduce toxicity, mobility, or volume of the contaminants, but limits residents' exposure to vapors emanating from the contaminated groundwater.

3. Short Term Effectiveness

The short term effectiveness criterion is intended to address hazards posed during construction of the Remedy. Short term effectiveness is designed to take into consideration the impact on site workers and nearby residents such as potential for volatilization of contaminants, the spread of contamination through dust generation, and disposal and/or transportation of the wastes.

Workers are required to comply with the Occupational, Safety and Health Administration rules and to follow the Health and Safety Plans submitted to DDOE.

No short term hazards to the residents have been identified for the Remedy.

4. Implementability

The implementability criterion addresses various constraints, such as regulatory constraints, ability to obtain access agreements, technological and practicability limitations, and intrusiveness to residents due to noise, traffic and aesthetic disruptions.

The vapor mitigation system is a proven technology with no implementation constraints except for obtaining access agreements from homeowners to install, maintain and test the systems. The District will require that all District and EPA Region 3 required permits be acquired before installation.

Installation of the systems in private properties is contingent upon consent from homeowners. At this time, it is unknown if any homeowners will refuse to allow installation of VMS.

5. Cost

The Remedy is cost effective in meeting the remediation objectives. According to published information, the estimated cost to install each vapor mitigation system ranges from $800 to $8000[14],[15].

Maintenance is minimal, but may include replacing the fan, which can be performed from outside the home.

The fan draws approximately the same amount of electricity as a 75 watt light bulb. Alternative energy sources (solar panels or wind turbines) may be available.

References

[1] SSP&A Riggs Park Indoor Air, Sub-Slab Vapor, Soil and Groundwater Sampling and Analysis Report. February 2009.

[2] Final Toxicology Report re: Risk Assessments based on SS&PA testing results, February 13, 2009.

[3] EPA Unilateral Order. USEPA Docket Number: RCRA-03-2003-0006TH . November 26, 2002. Page 8 http://www.epa.gov/reg3wcmd/pdf/chevfinal.pdf .

[4] EPA letter to Chevron. September 30, 2002. Page 1. http://www.epa.gov/reg3wcmd/pdf/chev9.pdf .

[5] EPA Statement of Basis Chevron Gasoline Release at Chillum Maryland. August 30, 2007. Page 10 http://www.epaosc.net/sites/abc/files/chillumsb.pdf .

[6] EPA Response to Chevron Comments on Administrative Order on Consent – Transmittal, response to comments and fact sheet for the Chillum/Riggs Park Community. January 16, 2009. Page 1 http://www.epaosc.net/sites/abc/files/finalorderresponsetocomments.pdf .

[7] EPA Administrative Order on Consent. July 10, 2008. USEPA Docket Number: RCRA-03-2008-0355TH. Page 13. http://www.epaosc.net/sites/abc/files/iporder.pdf .

[8] EPA Response to Chevron Comments on Administrative Order on Consent – Transmittal, response to comments and fact sheet for the Chillum/Riggs Park Community. January 16, 2009. Page 9. http://www.epaosc.net/sites/abc/files/finalorderresponsetocomments.pdf .

[9] EPA Statement of Basis Chevron Gasoline Release at Chillum Maryland. August 30, 2007. Page 6. http://www.epaosc.net/sites/abc/files/chillumsb.pdf .

[10] Hazard Quotient (HQ) = CDD/RfCi

where:
HQ = The likelihood that a chemical will produce a noncancer toxic effect.
CDD = Chronic daily dose of the chemical averaged over 30 years (mg/kg-day)
RfCi = Reference concentration

[11] OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) November 2002 EPA530-D-02-004 pages 16, 17, and 28.

[12] EPA Region 3-Risk Based Concentration Table. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/equations.htm .

[13] National Oil & Hazardous Substances Contingency Plan ("NCP") promulgated by EPA pursuant to the Comprehensive Environmental Response, Compensation and Liability of 1980, 42 U.S.C. §§ 9601, *et seq*., 40 CFR Part 300 (2008).

[14] Estimates for VMS installation were obtained via web search, document search, and personal communication.

[15] Detailed Field Investigation of Vapor Intrusion Processes ESTCP Project ER-0423. September 2008. Page 32. http://www.estcp.org/viewfile.cfm?Doc=ER%2D0423%2DFR%2Epdf