Health Consultation

Review of 1993 Public Health Assessment Recommendations

DEFENSE SUPPLY CENTER RICHMOND
[a/k/a DEFENSE GENERAL SUPPLY CENTER (DLA)]

RICHMOND, CHESTERFIELD COUNTY, VIRGINIA

EPA FACILITY ID: VA3971520751

JUNE 10, 2002

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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Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Statement of Issue

The Agency for Toxic Substances and Disease Registry (ATSDR) completed a public health assessment (PHA) for the U.S. Defense General Supply Center Richmond, currently known as Defense Supply Center Richmond (DSCR), Chesterfield County, Virginia (CERCLIS No. VA3971520751) on April 21, 1993 (ATSDR, 1993). The PHA concluded the site did not pose a threat to human health. It was placed in the ATSDR category of "no apparent public health hazard." Included in the PHA document were a total of eight recommendations and a public health action plan listing actions undertaken, and actions planned. In May 2001, the Virginia Department of Environmental Quality (VDEQ) requested that ATSDR determine if the 1993 PHA recommendations were adequately addressed.

Background

The Defense Supply Center Richmond (DSCR) is a Defense Logistics Agency (DLA) federal facility that comprises 631 acres in Chesterfield County, Virginia, approximately 12 miles south of the city of Richmond, Virginia. The DSCR has been managing and furnishing military general supplies to the Armed Forces and several federal civilian agencies since 1942. Current operations at the site include the management and storage of military supplies, material handling, and storage of chemicals such as pesticides, herbicides, lubricants and petroleum products (Law, 2001a). As a result of past activities, environmental contamination exists at the site. The responsibility for site environmental cleanup belongs to the DLA, with oversight by the United States Environmental Protection Agency (EPA) and state regulatory agencies, such as VDEQ. The site was proposed for inclusion on the U.S. EPA's National Priorities List (NPL) in 1984 by EPA for contaminated groundwater and source areas. ATSDR is responsible for preparing public health assessments according to the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund) section 104 (i) (6) (42 U.S.C. 9604 (i) (6). As mandated by that law, ATSDR conducts PHAs of hazardous waste sites listed or proposed for listing on the NPL. ATSDR completed it's PHA of DSCR in 1993.

Discussion

This public health consultation (PHC) has been prepared to provide a status and summary of the results of the various investigations or other public health activities undertaken to respond to the eight recommendations made in the 1993 public health assessment (PHA). The recommendations given in that PHA presented issues to be resolved. Those issues and their resolutions are given in the Discussion section of this consultation.

For clarity, this section repeats the ***recommendations*** of the 1993 PHA and then gives the follow-up ***public health action(s)*** taken to resolve that particular issue. In some cases additional discussion will be given to further clarify events, findings, or actions leading to the conclusion or

resolution of a particular recommendation.

Recommendation 1: *Identify and periodically monitor the wells of residences in the Rayon Park, Kingsland Creek, and other areas that are not connected to a public water supply if contaminant plumes are determined to migrate in those directions. Use appropriate quality assurance and quality control procedures to validate sampling data, and set detection limits below MCLs.*

Public Health Action(s) 1:

According to the Virginia Department of Health (VDH)-Chesterfield County, there are three residential wells in Rayon Park currently being used for drinking water. Two of these have been tested and the other resident does not want the well to be tested. One of the residents whose well has been tested was offered the chance to hook up to the county water system prior to discovery of the NPL site, but turned it down at the time. This resident has not yet connected to the public water system. Several additional wells are used for gardening, watering lawns, washing cars, and the like. The Virginia Department of Health-Chesterfield County offers private drinking water well testing to anyone living within a 1/4 mile radius of DSCR.

Historical activities at DSCR have caused contamination of the groundwater from solvents and metals. There are two contamination plumes extending from Area 50 eastward through the National Guard Area. Contamination in the upper aquifer is primarily volatile organic compounds (VOCs), as well as some semi-volatile organic compounds (SVOCs) and metals. In general, these same contaminants are also found in the lower aquifer. Area 50 is a former landfill suspected to be the source of the groundwater contamination (Law, 2001a). DSCR conducts periodic groundwater monitoring, and mapping of the contaminant plumes. By 1993, DSCR had established the movement of the plumes. DSCR has continued to monitor the plumes since then, but DSCR has not monitored off-site private drinking water wells.

In 1993, DSCR conducted a residential well survey. Engineering-Science, Inc. reviewed state and county records, conducted a door-to-door survey of residential wells within 1/4 mile of the DSCR property boundary, completed survey forms for all residents contacted, and provided location maps of each residence/well. 108 well surveys were completed. Nine well surveys were left in doorways and were not returned. Of those 108 completed well surveys, 16 residences were using a well as a sole source of potable water. 25 additional residences were using a well for non-potable (other than drinking water) purposes (Engineering-Science, Inc., 1992). These wells were not tested for contamination at that time.

In 1996, the Operable Unit 9 (OU 9) groundwater pump and treat system was initiated. OU 9 consists of the Interim Action System for Operable Unit 6 (OU 6). OU 6 consists of the Area 50/Open Storage Area/National Guard Area Groundwater. OU 9 is a groundwater treatment system that was installed to remove volatile organic compounds from groundwater via air stripping. Residual vapors are treated with activated carbon. The remedial system is in place to

intercept, remove, and treat impacted groundwater from both the upper and lower aquifers on-site, prior to migrating off site and coming into contact with No Name Creek (Law, 2001a). At this time, DSCR also established quarterly groundwater sampling to monitor the performance of OU9. The results of the quarterly sampling are also used in DSCR's continued mapping of the contamination plumes. DSCR has conducted quarterly groundwater sampling consistently since 1996.

In 2001, DSCR conducted an updated residential well survey. Law Engineering and Environmental Services (Law) reviewed state and county records and conducted a door-to-door survey of residential property within 1/4 mile of the DSCR property boundary. The compiled data showed 654 well surveys were completed and 410 letters were returned from the postmaster indicating an invalid address. The compiled survey data indicated that 155 residents have private wells on their property. Of these, 20 residents use their private wells for multiple purposes (drinking, washing, and food preparation); 6 use their well for outside purposes only (washing cars and watering grass); 96 residents never use their private wells; 27 residents have private wells on their property but usage is unknown; and 6 wells showed discrepancies in the records (Law, 2001b).

The Virginia Department of Health-Chesterfield County conducted private drinking water well sampling in Rayon Park and surrounding areas in 2001 and 2002. VDH sampled one private well in Rayon Park on April 27, 2001, one on May 29, 2001, three on September 12, 2001, and two on March 26, 2002. VDH sampled three private wells in surrounding areas on September 12, 2001, three on September 24, 2001, one on October 3, 2001, two on March 14, 2002, three on March 26, 2002, and one on May 30, 2002 (VDH, 2001). Very few compounds were found over the detection limits. Most of the compounds that were detected were metals, which are common and naturally occurring. Of those compounds that were detected, only three were found at levels over the most conservative comparison values. ATSDR uses comparison values to select environmental contaminants for further evaluation. A comparison value is a concentration of a given contaminant in soil, water, or air below which no adverse human health effects are expected to occur.

Manganese was found once in one well at a concentration of 1690 ppb. The chronic Reference Media Evaluation Guide (RMEG) for manganese for children is 500 ppb, and the chronic RMEG for adults is 2000 ppb. Chloroform was found once at 30 ppb. The Cancer Risk Evaluation Guide (CREG) for chloroform is 6 ppb. Lead was found once at 17 ppb. The Action Level for lead is 15 ppb (VDH, 2001).

ATSDR estimated the human exposure doses of manganese and chloroform from ingestion and dermal absorption of private well water. The equations used to derive exposure doses can be found in Appendix B. In order to account for the inhalation route of exposure to chloroform, the ingestion rate was doubled. This is a standard, conservative method for evaluating inhalation exposure doses (Andelman, et.al., 1989 and Wan, et.al., 1990). When the ingestion rate was doubled, the resulting chloroform exposure dose was still below the EPA's reference dose (RfD).

VDH will re-test the well with chloroform to determine if the presence of chloroform was an isolated occurrence. None of the exposure doses of contaminants detected in Rayon Park and surrounding area private wells were greater than health guidelines such as ATSDR's minimal risk levels (MRL) or RfDs.

Deriving exposure doses requires evaluating the concentrations of the contaminants to which people may have been exposed, and how often and how long exposures to those contaminants occurred. Together, these factors help influence the individual's physiological response to chemical contaminant exposure and the potential for non-cancer or cancer outcomes. In the absence of exposure specific information, ATSDR applied several conservative assumptions to define site-specific exposures as accurately as possible for people contacting contaminated media.

The estimated exposure doses were used to evaluate potential non-cancer effects associated with contaminants detected in site media. When evaluating non-cancer effects, ATSDR first compared the estimated exposure dose to standard toxicity values, including MRLs and RfDs, to evaluate whether adverse effects may occur. The chronic MRLs and RfDs are estimates of daily human exposure to a substance that is likely to be without appreciable risk of adverse non-cancer effects over a specified duration. The chronic MRLs and RfDs are conservative values, based on the levels of exposure reported in the literature that represent no-observed-adverse-effects-levels (NOAEL) or lowest-observed-adverse-effects-levels (LOAEL) for the most sensitive outcome for a given route of exposure (e.g., dermal contact, ingestion). In addition, uncertainty (safety) factors are applied to NOAELs or LOAELs to account for variation in the human population and uncertainty involved in extrapolating human health effects from animal studies. When comparing dermal absorption exposure doses to oral health guidelines, a gastrointestinal (GI) factor is applied to the Oral RfD or Oral MRL. This accounts for the difference in absorption through skin as compared to the absorption through the gastrointestinal wall. If estimated exposure doses are greater than the MRL or RfD, ATSDR reviews the toxicological literature to determine the likelihood of adverse effects.

ATSDR health guidelines are not available for lead, but toxicological and epidemiological information is available. The maximum lead concentration in private well water in Rayon Park was 17 ppb. This level was detected once in one private well. VDH informed the owner of the well of the elevated lead level. The well is not used for drinking water, and therefore does not pose a health hazard. ATSDR determined that chronic drinking water exposure at the highest detected concentration of lead in water (17 ppb) would not pose a public health hazard to children or adults. ATSDR estimated blood lead levels using the Integrated Exposure Uptake Biokinetic Model (IEUBK) for Lead (EPA, 1996). The Centers for Disease Control and Prevention (CDC) have determined that health effects are more likely to be observed if actual blood lead levels are at or above 10 micrograms per deciliter (µg/dl). Using the IEUBK model, estimated blood lead levels were found to be below 10 µg/dl for all populations. Health effects are not expected from exposure to the levels of lead in private well water in Rayon Park and surrounding areas.

In summary, ATSDR does not find that the drinking water from private wells in Rayon Park or surrounding areas poses a health threat. Most residents of Rayon Park and the surrounding areas are connected to the public water supply. Contaminants were not found at levels that could cause health effects. VDH will continue to test private drinking water wells in Rayon Park and surrounding areas at the request of residents.

Recommendation 2: *Restrict site access to non-essential personnel at the National Guard Area and Fire Training Area, as well as the Fuel Oil Storage Area and Buildings 202, 112, and 68. For personnel who must be at those areas, provide personal protective equipment in accordance with OSHA and NIOSH standards.*

Public Health Action(s) 2:

Access to DSCR is restricted to employees. The general public must have specific permission to enter DSCR. Access to the National Guard Area, Fire Training Area, Fuel Storage Area, and Buildings 202, 112, and 68 is restricted to DSCR Engineers and Protective Services utilizing protective equipment in most cases. All activities that involve the operable units (OUs) are reviewed by the DSCR environmental office to determine whether the OUs will be impacted. If the environmental office determines that contact with contaminated soil or groundwater is likely, then projects may be modified to eliminate contact, or engineering controls may be added to protect workers. In addition, Records of Decision (ROD) for the National Guard Area and the Open Storage Area may require pre-construction sampling. In 1999, a No Further Action ROD was completed for the Fire Training Pit Soil, also known as OU4. Access to this site is no longer restricted, but the groundwater beneath the site, also known as OU7, is still contaminated. Exposure to contaminated groundwater at these areas is unlikely, and exposure to soils would be through intermittent dermal contact. Although not directly related to the issue of site access, indoor air quality is also a concern for workers in buildings at the National Guard Area and Fire Training Area. DSCR will address inhalation exposure to VOCs through indoor air in their RODs for OU6 and OU7.

Recommendation 3: *Periodically monitor Kingsland Creek and the No-Name Creek adjoining the installation if future groundwater monitoring results indicate that concentrations could be higher than previously detected. Use appropriate quality assurance and quality control procedures to validate the sampling data.*

Public Health Action(s) 3:

DSCR has been monitoring Kingsland and No Name Creeks periodically since 1993. Historical activities at DSCR have caused contamination of the groundwater from solvents and metals. The

OU6 upper aquifer groundwater flow, during periods of elevated water-table conditions, is believed to discharge into No Name Creek. By contrast, OU6 lower aquifer groundwater flows toward and beneath No Name Creek. Due to the presence of a stratigraphic confining unit, there is no apparent hydraulic connection between OU6 lower aquifer groundwater flow and No Name Creek. The primary source of flow for No Name Creek is surface water runoff from DSCR and the area west of DSCR (Law, 2001a). The primary source of flow for Kingsland Creek is surface water runoff from the area west of DSCR.

The administrative record and information repositories contain several reports that concern creek monitoring, including the Creek Monitoring Plan for Kingsland, No Name, and Falling Creek Tributary, August 2001. Law Engineering and Environmental Services, Inc. (Law) sampled Kingsland Creek on May 16, 2001. Law also sampled No Name Creek on May 14, May 16, and July 20, 2001. Additionally, the Virginia Department of Environmental Quality (VDEQ) sampled No Name Creek on May 14, May 21, and May 30, 2001. Appropriate quality assurance and quality control procedures were used to validate the sampling data. The results of these sampling efforts have been reviewed by ATSDR, and were not found to pose a human health hazard. These results were discussed in ATSDR's Defense Supply Center Richmond Health Consultation, dated April 4, 2002 (ATSDR, 2002).

VDEQ sampled stormwater channels in Rayon Park on March 18, 2002 following the first stormwater runoff event since summer 2001. The only three channels that contained flowing stormwater were sampled. No stations contained trichloroethylene (TCE) above the detection limit of 0.5 ppb. VDEQ will try to sample a larger storm event if one occurs.

Recommendation 4: *Appropriately store and shelter drums and containers of chemicals in the Open Storage Area.*

Public Health Action(s) 4:

According to DSCR's Environmental Program Manager, all drums with liquid contents were removed from the OU 1 storage area in 1995. Drums are now stored at another location inside new covered storage facilities. These facilities utilize concrete berms, and the drums are neatly and compatibly organized in discrete locations according to the National Stock Numbers. The OU 1 area stores gas cylinders ready for refurbishment.

Recommendation 5: *Stock Parker Pond with fish from non-contaminated supplies.*

Public Health Action(s) 5:

This recommendation was made because during August 1987, DSCR experienced a fish kill in Parker Pond. This occurred during a time of dry, hot weather, and low dissolved oxygen levels. One of the fish had a total DDT concentration of 0.26 ppm. Parker Pond was restocked with fish from a state fish hatchery in 1988 (DGSC, 1994).

Because DDT was found in the fish in 1987, DSCR was required to perform an expanded site investigation at Parker Pond. Approximately 20 fish were caught in September 1993. Several fish were analyzed to determine if compounds would bioaccumulate in the fish. Three samples were prepared; one edible fillet composited from two fish, and two samples which were mixed whole pond fish. DDT was not detected above the lower detection limit of 0.005 ppm. No chlorinated pesticides were found above the detection limits in Parker Pond that were part of the expanded site investigation. Since DDT was not found in either the sediment or the water at or above the detection level of approximately 1 ppb, it was concluded that the fish that was found to have DDT in its system in 1987 was exposed to the DDT prior to being placed in Parker Pond (DGSC, 1994). Parker Pond is not currently stocked with fish.

Recommendation 6: *If a multiple-contaminant exposure registry is initiated, DGSC, because of past exposure, should be re-evaluated to determine if persons who were exposed to VOCs in their private drinking water wells should be included in that registry.*

Public Health Action(s) 6:

ATSDR has not established a multiple-contaminant exposure registry. The National Exposure Registry (NER) is a critical, long-term effort that meets the need for collecting information concerning the potential impact of hazardous substances on human health. It is a listing of persons exposed to hazardous substances at various sites around the country. It contains sub-registries for specific substances. Currently, there are four active sub-registries- trichloroethylene (TCE), trichloroethane (TCA), benzene, and dioxin. Each sub-registry is a substance-specific part of the NER. It is made up of self-reported health information, from people throughout the United States who have been exposed to one of the four listed substances from the environment. The purpose of the sub-registries is to assess the long-term health consequences to a general population from long-term, low-level exposures to specific contaminants in the environment. ATSDR has not yet established a substance-specific sub-registry that combines more than one contaminant. If ATSDR establishes a multiple-contaminant exposure sub-registry, community members from sites in the country that have had exposure to the multiple contaminants in the

sub-registry will be considered for inclusion, according to established criteria for that sub-registry.

Recommendation 7: *Health Guidelines, such as Minimal Risk Levels, should be developed for contaminants for all exposure routes (ingestion, inhalation, and dermal contact). Guidelines lacking for specific contaminants in this public health assessment are discussed in the Toxicologic Evaluation section. Validated studies should also be either conducted or funded by EPA, ATSDR, or other appropriate agencies and organizations to determine possible health effects that may be associated with simultaneous exposure to multiple VOCs.*

Public Health Action(s) 7:

Several new health guidelines have been established by ATSDR for the contaminants of concern that were outlined in the Toxicologic Evaluation section of the 1993 public health assessment (PHA). In 1993, benzene, 1, 2-dichloroethane, and 1, 1, 1-trichloroethane did not have health guidelines for any exposure routes. 1, 1-Dichloroethylene and tetrachloroethylene had health guidelines for ingestion and inhalation routes, and trichloroethylene had a health guideline for the ingestion route. Currently, 1, 2-dichloroethane, 1, 1-dichloroethylene, tetrachloroethylene, and trichloroethylene have health guidelines for ingestion and inhalation routes. Benzene and 1, 1, 1-trichloroethane have health guidelines for the inhalation route of exposure. Dermal health guidelines have not been established by ATSDR, but they can be extrapolated from the oral health guidelines by applying a gastrointestinal factor to account for the difference in absorption through skin, versus the gastrointestinal wall. The 1993 PHA determined that because of infrequent exposure to low levels of VOCs in those private wells in Rayon Park, adverse health effects were not expected (ATSDR, 1993). Current private well data (2001) is available for Rayon Park and is discussed in Public Health Action 1 of this document.

ATSDR considered interactive effects (cumulative, additive, synergistic, and antagonistic) of chemicals following exposure to multiple chemicals to the extent of the scientific knowledge in this area. ATSDR has reviewed the scientific literature surrounding chemical interactions and noted that if the estimated exposure doses for individual contaminants detected at the site are below doses shown to cause adverse effects, No Observed Adverse Effect Level (NOAEL), then the combined effect of multiple chemicals is not expected to result in adverse health effects. Studies have shown that exposure to a mixture of chemicals is unlikely to produce adverse health effects as long as components of that mixture are detected at levels below the NOAEL for individual compounds (Seed et al. 1995; Feron et al. 1995).

Recommendation 8: *The data and information in the Public Health Assessment for the Defense General Supply Center have been evaluated for follow-up health activities by the ATSDR Health Activities Recommendation Panel (HARP). The citizens living in communities near DGSC need information about their potential for exposure, the extent of contamination at DGSC, and additional environmental sampling and remediation that is planned at DGSC. DGSC has held public meetings with the communities and disseminated environmental fact sheets to discuss those issues. DGSC has communicated sampling results to private well owners. Currently, there are no indications that adverse health conditions are occurring or have occurred from past exposures to DGSC contaminants. However, if contaminants are measured in groundwater from off-site private wells, community health education concerning exposure is indicated. Moreover, if other environmental or health outcome data become available that indicate human exposure to hazardous substances is occurring at levels that may cause illness or injury, ATSDR will re-evaluate the need for additional follow-up health actions.*

Public Health Action(s) 8:

DSCR has worked with the community for several years. In 1992, DSCR prepared a Community Relations Plan. Currently, DSCR is working on another Community Relations Plan. DSCR distributes a quarterly newsletter to residents of the area detailing the site's environmental program. Public meetings were held in the community on July 27, 2001 and November 1, 2001. The meetings were jointly sponsored by DSCR and Chesterfield County. Representatives from VDEQ, VDH, EPA Region III, and ATSDR were also in attendance. As a result of a Congressional Briefing held in August 2001, an EPA Community Involvement Coordinator was assigned to the site. The Community Involvement Coordinator will oversee DSCR's community involvement program and help to ensure that information is distributed to the community. DSCR set up a Restoration Advisory Board (RAB) comprised of a center representative, community members, regulators, and representatives of other organizations that are affected by restoration activities. The RAB meets periodically. The purpose of the RAB is to provide a forum whereby community members can review the on-going restoration activities being taken by DSCR.

Conclusions

ATSDR was asked to review the recommendations from the 1993 PHA. After a review of the recommendations and environmental activities carried out by DSCR, EPA, VDEQ and VDH since 1993, ATSDR concludes that the recommendations were substantially met with the appropriate public health actions. Activities addressing each recommendation have been carried out with the possible exception of Recommendation 6. ATSDR has not established a multiple-contaminant exposure registry. Resources have been focused on obtaining detailed information to determine potential health outcomes from the sub-registries that are currently in place, such as TCE, TCA, benzene, and dioxin. If ATSDR establishes a multiple-contaminant exposure sub-registry, community members from sites in the country that have had exposure to the multiple contaminants in the sub-registry will be considered for inclusion, according to established criteria for that sub-registry. As a supplement to Recommendation 2, DSCR will address inhalation exposure to VOCs through indoor air in buildings at the National Guard Area and the Fire Training Area in their RODs for OU6 and OU7.

Recommendations

1. Because of concerns for DSCR employees and the potential for VOCs in underground plumes to reach the surface, DSCR should address the indoor air inhalation pathway in buildings in the National Guard Area and Fire Training Area. This will be presented in the RODs for OU6 and OU7.

Preparer of Report

Agency for Toxic Substances and Disease Registry
Department of Health Assessment and Consultation
Federal Facilities Assessment Branch
Defense Section A

Katherine E. Hanks, Environmental Health Scientist

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Appendix A: Comparison Values and Health Guidelines

Comparison Values

RMEG: **R**eference **M**edia **E**valuation **G**uide is a concentration in air, soil, or water below which non-cancer health effects are not expected to occur. RMEGs are derived from the US Environmental Protection Agency's (EPA) Reference Dose or Reference Concentration, and are for chronic exposure.

Action Level: Action Levels are the estimated contaminant concentrations in water which indicate that additional evaluation is needed to determine whether action is required to eliminate or reduce exposure.

CREG: **C**ancer **R**isk **E**valuation **G**uides are derived by ATSDR from the EPA Cancer Slope Factor. They represent an estimated concentration in water, soil, or air that would be expected to cause no more than one excess cancer in a million persons exposed over a lifetime.

Health Guidelines

MRL: **M**inimal **R**isk **L**evel is an estimate, developed by ATSDR, of the daily human exposure to a substance below which no adverse non-cancer health effects are expected to occur.

RfD: **R**eference **D**ose is an estimate of the daily exposure to the general public that is likely to have no measurable risk of harmful health effects during a lifetime exposure or exposure during a limited time interval.

Appendix B: Exposure Dose Equations

Exhibit 1. Water Ingestion Exposure Dose Equation

Exposure doses from incidental ingestion of water can be calculated as follows:

$$ED = (C * IR * EF) / BW$$

where,

ED	=	exposure dose (mg/kg/day)
C	=	contaminant concentration (mg/L)
IR	=	intake rate of contaminated water (L/day)
EF	=	exposure factor (unitless)
BW	=	body weight (kg)

Default Ingestion Water Intake Rates[3]

2 L/day - adult
1 L/day - child

Note:
L/day - liters per day

Exhibit 2. Water Dermal Contact Exposure Dose Equation

Exposure doses from dermal contact with water can be calculated as follows:

$$ED = (C * P * SA * ET * CF) / BW$$

where,

ED	=	exposure dose (mg/kg/day)
C	=	contaminant concentration (mg/L)
P	=	permeability coefficient (cm/hr)
SA	=	exposed body surface area (cm^2)
ET	=	exposure time (hours/day)
CF	=	conversion factor (1 L/1,000 cm^3)
BW	=	body weight (kg)

Default Dermal Exposure Values
50th Percentile Total Body Surface Area for Males
(square centimeters [cm^2])

Age (years)	Male
6<9	9310
18-70	19400

Source: EPA 1997