Health Consultation

Evaluation of Surface Water Data

SIGMON'S SEPTIC TANK SERVICE

STATESVILLE, IREDELL COUNTY, NORTH CAROLINA

EPA FACILITY ID: NCD062555792

AUGUST 8, 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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Prepared by:

U.S. Department of Health and Human Services
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Division of Health Assessment and Consultation
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STATEMENT OF ISSUES AND BACKGROUND

Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this health consultation to evaluate, based on the information currently available, any known or potential adverse human health hazards related to exposures to contaminants in surface water associated with the Sigmon's Septic Tank Site.

Background

The Sigmon's Septic Tank Site is located at 1268 Eufola Road, approximately 5 miles southwest of Statesville, Iredell County, North Carolina. The property comprises approximately 15 acres. Sigmon's Septic Tank Service, a wholly owned subsidiary of AAA Enterprises, purchased the property in 1970. The business installed and repaired septic tanks. In addition, Sigmon's Septic Tank Service pumped septic tank wastes and heavy sludges from residential, commercial, and industrial customers. From 1978 to 1992, the property owners deposited waste in several unlined lagoons which had been dug on the property.

Previously, ATSDR has issued six health consultations for the Sigmon's Septic Tank Site (1,2,3,4,5,6). The health consultations include a review of sampling plans for the site, as well as evaluations of the available groundwater, surface water, and surface soil data. The most recent health consultations, released on April 3, 2006 and April 24, 2006, address recent groundwater and surface soil data, respectively (5,6). This health consultation is intended to address exposures to on-site and off-site surface water. Currently, the U.S. Environmental Protection Agency (EPA) continues to investigate the soil and groundwater conditions at the site. Future health consultations may be prepared if the evaluation of newly collected data changes previous public health conclusions made for the site.

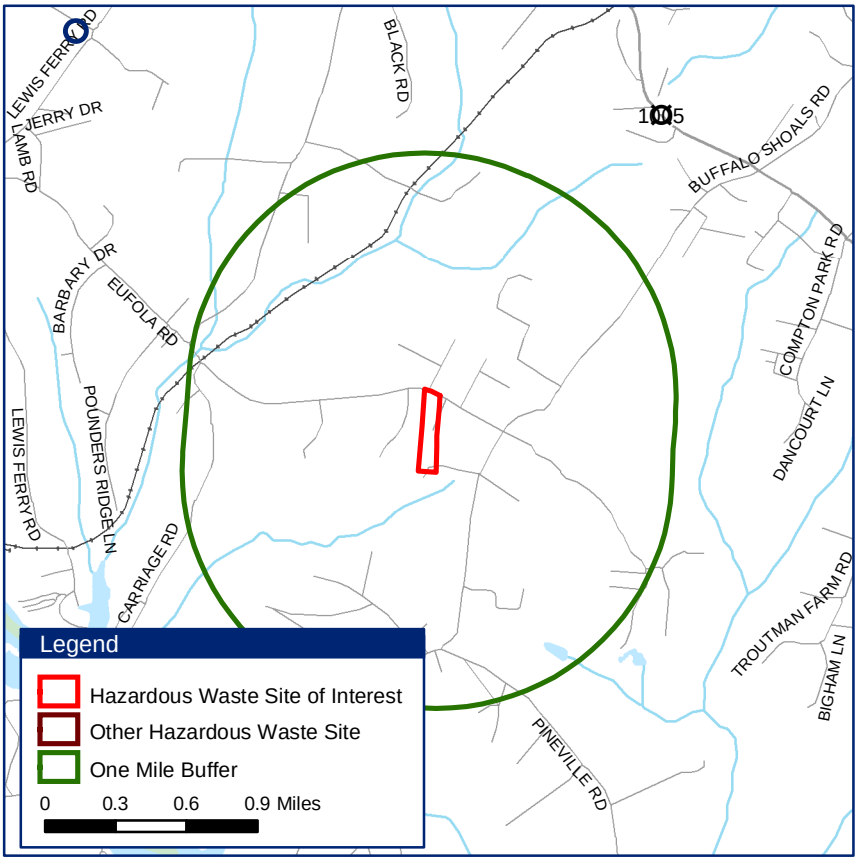
Demographics

According to U.S. 2000 Census data, 802 persons live within a one-mile radius of the site. Approximately 95% of this population, or 760, are white. Also, 81 are children age 6 and under, and 83 are adults over age 65. A total of 323 housing units are in the site area. Additional demographic information for the community in the vicinity of the site is presented in the following figure.

Sigmon's Septic Tank Service

Statesville, NC

EPA Facility ID: NCD062555792



Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Public Health GIS Program, May 2005.
Coordinate System (All Panels): NAD 1983 StatePlane North Carolina FIPS 3200 Feet

Site Location: Iredell County, NC

Demographic Statistics

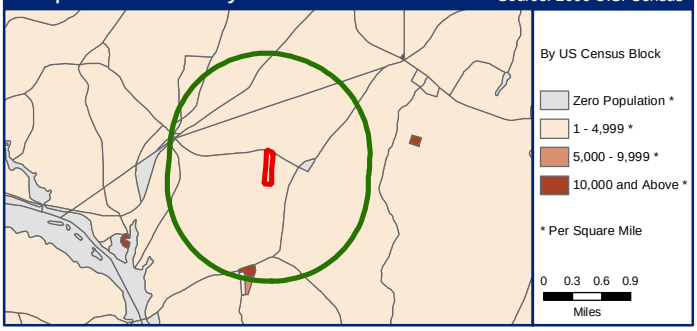
Within One Mile of Site*

Total Population	802
White Alone	760
Black Alone	33
Am. Indian & Alaska Native Alone	0
Asian Alone	0
Native Hawaiian & Other Pacific Islander Alone	0
Some Other Race Alone	5
Two or More Races	4
Hispanic or Latino**	9
Children Aged 6 and Younger	81
Adults Aged 65 and Older	83
Females Aged 15 to 44	176
Total Housing Units	323

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

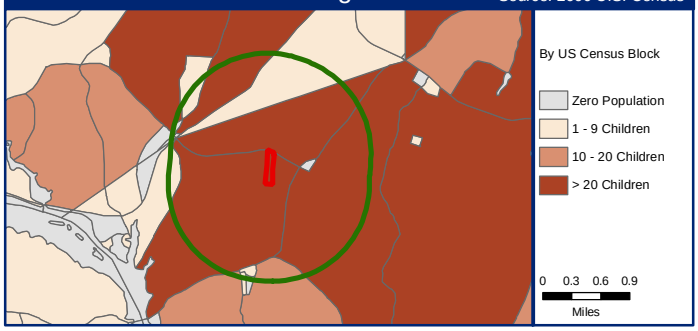
Population Density

Source: 2000 U.S. Census



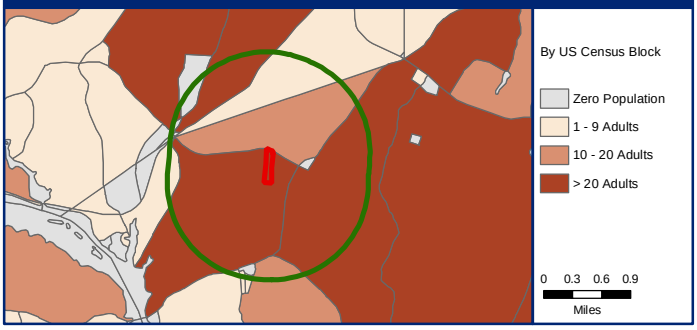
Children 6 Years and Younger

Source: 2000 U.S. Census



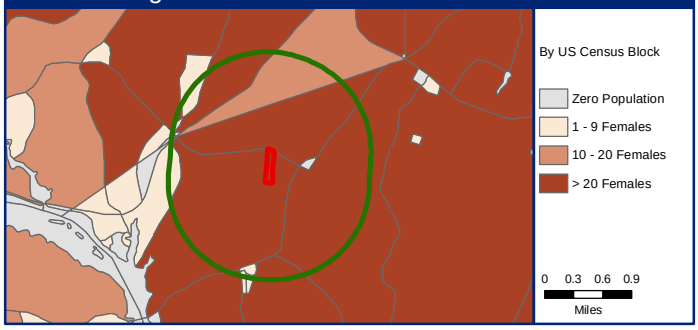
Adults 65 Years and Older

Source: 2000 U.S. Census



Females Aged 15 to 44

Source: 2000 U.S. Census



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ENVIRONMENTAL DATA

As part of this health consultation, ATSDR evaluates surface water samples collected by EPA in October 2002 and May 2004. A total of nine surface water samples were collected by EPA. All surface water samples were analyzed for volatile organic compounds, semi-volatile organic compounds, metals, and pesticides. Seven surface water samples were considered in this evaluation and the other two were used for quality assurance purposes. The available data has undergone EPA's quality assurance/quality control process and has been determined to be useable (1).

Surface water runoff from the site flows primarily across the Lambreth property to the Lamberth pond. The Lamberth pond discharges to an intermittent stream west of the site on the Williams property. Surface water runoff from the southeastern corner of the site collects in a Lauren Drive grassy swale east of the site and discharges from a culvert underneath the road to a grassed area in between Lauren Drive and Davidson pond. The Davidson pond discharges through an outlet pipe to an intermittent stream which eventually meets other intermittent streams from the other surface water pathways which flow into the Catawba River (1).

One surface water sample was collected on-site from the pond located on the Sigmon's Septic Tank Site. One sample was also collected from each of the ponds located on private, residential property in the vicinity of the site, including the Williams, Davidson, and Lambreth ponds. In addition, three surface water samples were also collected from a nearby intermittent stream (1). Sediment samples were also collected at these locations and evaluated in the surface soil health consultation completed in April 2006 (6).

PATHWAY ANALYSIS

ATSDR's pathways analysis determines whether people have come into contact with chemicals from a site and whether those contacts were substantial enough to cause harm. To make this determination, ATSDR identifies exposure pathways or ways in which a chemical could enter a person's body.

As outlined in ATSDR's Public Health Assessment Guidance Manual, an exposure pathway contains five major elements:

1. a source of contamination,
2. transport through an environmental medium,
3. a point of exposure,
4. a route of exposure, and
5. an exposed population.

If an exposure pathway contains all five elements and exists now or did exist in the past, the pathway is considered complete. Completed exposure pathways are evaluated to determine whether health effects could occur. If one or more of the five elements is not clearly defined but could be present, the exposure pathway is classified as potential (8). ATSDR has identified the surface water pathway as a completed exposure pathway in this health consultation. Based on information from EPA, there is no evidence of individuals eating fish from the Sigmon pond at the current time or in the past. In addition, fish that people would consume are not likely to be present in the Sigmon pond. Therefore, the fish consumption pathway is incomplete and poses no public health hazard.

Other completed or potential pathways may exist for the Sigmon's Septic Tank Site and have been evaluated in separate health consultations. More detailed information on the surface water exposure pathway is presented in Table 1.

Table 1. Surface Water Exposure Pathway Elements

Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	Timeframe
Past disposal activities	Surface water	On-site Off-site	Ingestion Inhalation Direct Contact	Adults and children using the water for recreational purposes	Past Present Future

DISCUSSION

The first step in ATSDR's evaluation process is to select the chemicals of concern, also described as the chemicals that require further evaluation. ATSDR selects chemicals of concern on the basis of whether the maximum detected concentrations of the chemical are found to exceed applicable, health-based comparison values. A chemical found to exceed a comparison value indicates that a more detailed analysis is necessary for that chemical. Levels of chemicals greater than comparison values do not necessarily mean that adverse health effects will occur. The amount of the chemical, the duration of exposure, the route of exposure (i.e., ingestion, inhalation, and direct skin contact), and the health status of exposed individuals are also important factors in determining the potential for adverse health effects. ATSDR has not developed comparison values specifically for surface water. Therefore, drinking water comparison values were used in this evaluation. This is a very protective approach because no one uses the surface water bodies evaluated in this health consultation for drinking water purposes. In addition, individuals are not expected to swallow large quantities of water during swimming and wading. A complete discussion of ATSDR's evaluation process is presented in the appendix of this health consultation.

Concentrations of calcium, iron, magnesium, potassium, and sodium were detected in the surface water samples collected from the ponds and intermittent stream. These elements occur naturally in the environment and are unlikely to be related to the site. They are also essential nutrients and are not expected to cause any health-related problems at the levels at which they were detected. Therefore, calcium, iron, magnesium, potassium, and sodium have not been considered further in this health consultation.

With the exception of the essential nutrients previously discussed, no other chemicals were detected in surface water at concentrations exceeding comparison values in the Williams, Lamberth, and Davidson ponds. Only one chemical (Aroclor-1260) was indicated in surface water above comparison values in the pond located on the Sigmon's Septic Tank Site property. Aroclor-1260 is part of a group of chemicals known as polychlorinated biphenyls (or PCBs). Arsenic and manganese were detected above comparison values in the surface water collected from the intermittent stream. Additional information about the chemicals detected above comparison values is presented in Table 2 and 3.

Table 2. Surface Water from Sigmon Pond (On-site) – Detected chemical(s) that exceed comparison values

CONTAMINANT	Milligrams/kilogram (mg/kg) or parts per million (ppm)			SOURCE	FREQUENCY DETECTED
	Minimum	Maximum	Comparison Value		
Aroclor-1260	0.00071	0.00071	0.2	Chronic Child EMEG	1/1

Notes:

Chronic Child EMEG= Environmental Media Evaluation Guide developed for long-term exposure to the chemical by children

Frequency of Detection = Number of samples in which chemical was detected / Total number of samples collected

Table 3. Surface Water from Intermittent Stream (Off-site) – Detected chemicals that exceed comparison values

CONTAMINANT	Milligrams/kilogram (mg/kg) or parts per million (ppm)			SOURCE	FREQUENCY DETECTED
	Minimum	Maximum	Comparison Value		
Arsenic	0.00094	0.00094	0.00002	CREG	1/3
Manganese	0.180	1.2	0.5	Child RMEG	3/3

Notes:

CREG=Cancer Risk Evaluation Guide

RMEG = Reference Media Evaluation Guide developed for exposure to the chemical by children

Frequency of Detection = Number of samples in which chemical was detected / Total number of samples collected

PUBLIC HEALTH IMPLICATIONS

For chemical concentrations found to exceed comparison values, ATSDR performed calculations referred to as exposure doses and cancer risk estimates. These calculations estimate the amount of the chemicals of concern that individuals may have been exposed to and the likelihood of cancer and non-cancer health impacts. They are based on the types of site-specific activities that individuals may be involved with that result in contact with chemicals in the surface water. In the event that calculated exposure doses exceed established health guidelines (e.g., ATSDR Minimal Risk Levels or EPA Reference Doses), an in-depth toxicological evaluation is the next step necessary to determine the likelihood of health effects.

ATSDR has evaluated adults and children who may wade or swim in the Sigmon pond (on-site) or the intermittent stream (off-site). Unintentional ingestion and direct skin contact with surface water has been considered. This is considered a conservative approach because the water may not even be deep enough to swim in at certain times of the year. Additional information on the exposure scenarios, assumptions and calculations used to estimate exposures are discussed in the appendix of this health consultation.

No additional evaluation of the Williams, Lamberth, and Davidson ponds has been completed. Further evaluation is not warranted because none of the chemicals found in surface water samples collected from these ponds exceeded comparison values. Therefore, wading and swimming in the Williams, Lamberth, and Davidson ponds poses no public heath risk.

Non-Cancer Health Effects Evaluation

Only one chemical, Aroclor-1260, was detected in the Sigmon pond (on-site) at a concentration that exceeds a comparison value. Therefore, site-specific exposure doses were calculated. The calculated doses for the Sigmon pond were lower than the established health guidelines.

Arsenic and manganese were the only chemicals found in the intermittent stream (off-site) at concentrations that exceed a comparison value. The dose calculations were determined to be much lower than the established health guidelines.

Therefore, ATSDR concludes that swimming and wading in the Sigmon pond and the intermittent stream is not expected to result in adverse non-cancer health effects. A list of the calculated doses and available health guidelines is presented in the appendix of this health consultation (Table A).

Cancer Evaluation

The only cancer-causing chemical detected in surface water above comparison values is arsenic. Arsenic was found in low levels in one of the three samples collected from the intermittent stream. Studies have indicated that exposure to arsenic causes cancer in humans. The risk of individuals developing cancer from exposure to arsenic in surface water was considered in this health consultation. Cancer risk was calculated for residents and includes exposures occurring during childhood and adulthood.

On the basis of the risk calculations, ATSDR has determined that there is no increased risk of cancer to residents who swim or wade in the intermittent stream. A complete list of the calculated cancer risks for surface water is presented in the appendix of this health consultation (Table B).

Community Health Concerns

ATSDR held a public availability session on Monday, December 5, 2005 to gather health concerns from the community surrounding the Sigmon's Septic Tank Site. The public availability session was held at the Celeste Henkel Elementary School from 6:00 PM to 8:00 PM. A media availability session was held at the same location from 5:30 PM to 6:00 PM. Representatives from ATSDR and EPA attended the sessions. Flyers were sent out to residences in the vicinity of the Sigmon's Septic Tank Site to announce the meeting. Five community members attended the session. Most of the individuals had questions about EPA's environmental investigation and cleanup planned for the site. No questions or concerns were raised about surface water on or around the site.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposures to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. On the basis of the evaluation conducted in this health consultation, ATSDR has determined that children are not at risk for health-related problems from swimming or wading in surface water in and around the site, including Sigmon pond, Williams pond, Lamberth pond, Davidson pond, and the intermittent stream.

CONCLUSIONS

1. ATSDR has evaluated exposure to chemicals in on-site surface water on the Sigmon's Septic Tank Site. On the basis of the available data, ATSDR has determined that exposure to chemicals by adults and children during wading and swimming in Sigmon pond poses **no apparent public health hazard**.

2. ATSDR has also evaluated children and adult exposure to chemicals in off-site surface water, including nearby residential properties. The water bodies include the Williams, Lamberth, and Davidson ponds, as well as a nearby intermittent stream. ATSDR has determined that swimming and wading in these surface water bodies is not expected to result in harmful health effects and poses **no apparent public health hazard**.

3. There is no evidence of individuals eating fish from the Sigmon pond at the current time or in the past. In addition, fish that people would consume are not likely to be present in the Sigmon pond. Therefore, the fish consumption pathway is incomplete and poses **no public health hazard**.

RECOMMENDATIONS

1. The findings of this health consultation are not intended to encourage swimming or wading in the Sigmon pond located on-site. The site is located on private property and is currently under investigation by EPA. It is recommended that residents avoid accessing the property, for any reason, without the owner's consent.

2. If information becomes available about individuals routinely consuming fish from the Sigmon's pond, it is recommended that EPA collect additional surface water samples or fish tissue samples. The basis for this recommendation is the detection of Aroclor-1260 in the one surface water sample collected from the Sigmon pond. Although this chemical has been found at levels that are not expected to be harmful to people swimming and wading, studies have found that Aroclor-1260 can accumulate in fish tissue. Therefore, additional samples would be needed to determine the potential exposure to people eating fish from Sigmon pond.

PUBLIC HEALTH ACTION PLAN

A Public Health Action Plan describes the actions designed to mitigate or prevent adverse human health effects that might result from exposure to hazardous substances associated with site contamination. A summary of the public health actions that have been taken and those completed for the Sigmon's Septic Tank Site are provided below.

Public Health Actions Taken

Previously, ATSDR has issued six health consultations for the Sigmon's Septic Tank Site (1,2,3,4,5,6). The health consultations include a review of sampling plans for the site, as well as evaluations of the available groundwater, surface water, and surface soil data. The most recent health consultations, released on April 3, 2006 and April 24, 2006 address recent groundwater and surface soil data, respectively (5,6).

ATSDR participated in a site tour conducted by EPA and its contractor on Monday, December 5, 2005. ATSDR examined the conditions of the site and toured the surrounding community at this time.

ATSDR conducted a public availability session on Monday, December 5, 2005 to gather health concerns from the community. The public availability session was held at the Celeste Henkel Elementary School from 6:00 PM to 8:00 PM. Representatives informed residents about ATSDR's work at the site and gathered community health concerns.

ATSDR also prepared a fact sheet that was mailed to the community in the vicinity of the site in summer 2006. The fact sheet provides information on ATSDR's work at the site, the findings of the recent soil and groundwater health consultations, and contacts for additional information.

Public Health Actions to be Completed

ATSDR will continue to collaborate with the appropriate federal, state, and local agencies. ATSDR may review new environmental data associated with the Sigmon's Septic Tank Site. If the data evaluation impacts previous public health conclusions made for the site, ATSDR will produce additional health consultations.

REFERENCES

1. Agency for Toxic Substances and Disease Registry. Health Consultation for Sigmon's Septic Tank Service. 2001 August 24.
2. Agency for Toxic Substances and Disease Registry. Health Consultation for Sigmon's Septic Tank Service – Review of Groundwater Data. 2002 March 29.
3. Agency for Toxic Substances and Disease Registry. Health Consultation for Sigmon's Septic Tank Service – Review of Surface Water Data. 2002 July 09.
4. Agency for Toxic Substances and Disease Registry. Health Consultation for Sigmon's Septic Tank Service – Review of Sampling Plan. 2005 July 05.
5. Agency for Toxic Substances and Disease Registry. Health Consultation for Sigmon's Septic Tank Service. 2006 April 03. (Groundwater)
6. Agency for Toxic Substances and Disease Registry. Health Consultation for Sigmon's Septic Tank Service. 2006 April 24. (Surface soil)
7. US Environmental Protection Agency. Remedial Investigation Report, Operable Unit 1 for Sigmon's Septic Tank Service. 2005 August.
8. Agency for Toxic Substances and Disease Registry. Public health assessment guidance manual. Atlanta: US Department of Health and Human Services; 2005.

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Appendix - ATSDR's Evaluation Process

Step 1 – Comparison Values and the Screening Process

To evaluate the available data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the chemical concentrations found in a specific media (for example: air, soil, or water) and are used to select chemicals for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may take into their body each day. CVs are generated to be conservative and non-site specific. These values are used only to screen out chemicals that do not need further evaluation; CVs are not intended as environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based comparison values are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor (CSF) or inhalation risk unit. CVs based on cancerous effects account for a lifetime exposure (70 years) with a theoretical excess lifetime cancer risk of 1 new case per 1 million exposed people. Non-cancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), EPA's Reference Doses (RfDs), or EPA's Reference Concentrations (RfCs). When a cancer and non-cancer CV exists for the same chemical, the lower of these values is used in the comparison for conservatism. The chemical and media-specific CVs utilized during the preparation of this HC are listed below:

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for which exposure is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

A **Reference Dose Media Evaluation Guide (RMEG)** is an estimated comparison concentration that represents concentrations of chemicals (in water, soil, and air) to which humans may be exposed to without experiencing adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is a comparison concentration that is based on an excess cancer rate of one in a million persons and is calculated using EPA's cancer slope factor (CSF).

Step 2 – Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Therefore, calculations are performed to estimate the possibility of cancer and non-cancer health problems. The calculations consider the activities of people living in the community. The assumptions used in the calculations are discussed in the following sections.

Adult Residents

Adult residents were assumed to be exposed to chemicals while swimming or wading in on- and off-site surface water. They were estimated to engage in these activities twice a week during the four summer months of the year (or 32 days per year). Unintentional ingestion and direct skin contact with surface water has been evaluated.

It was assumed that these individuals ingest one-tenth the amount of water ingested for drinking purposes during swimming, which is equal to 0.10 liters per day (L/day) and weighed 70 kilograms (kg) (or 153 pounds). The surface area available for direct skin contact was conservatively considered to be the entire body (or 18,150 cubic centimeters [cm^3]). Chemical-specific permeability constants were used when available. When unavailable, the EPA recommended default permeability constant of 0.0010 centimeters per hour (cm/hour) was used. Adult residents were assumed to be exposed for 30 years.

Children Residents

Children residents were assumed to be exposed to chemicals while swimming or wading in on- and off-site surface water. They were estimated to engage in these activities twice a week during the four summer months of the year (or 32 days per year). Unintentional ingestion and direct skin contact with surface water has been evaluated.

It was assumed that these individuals ingest one-tenth the amount of water ingested for drinking purposes during swimming, which is equal to 0.10 liters per day (L/day) and weighed 23 kilograms (kg) (or 50 pounds). The surface area available for direct skin contact was conservatively considered to be the entire body (or 8,545 cm^3). Chemical-specific permeability constants were used when available. When unavailable, the EPA recommended default permeability constant of 0.0010 centimeters per hour (cm/hour) was used. Children residents were assumed to be exposed for 6 years.

The Calculations

In order to evaluate the potential for human exposure to chemicals present at the site and potential health effects from site-specific activities, ATSDR estimates human exposure to the site chemicals from different environmental media by calculating exposure doses and cancer risk estimates. A brief discussion of the calculations is presented below. Separate calculations have been performed for exposures to adults and children to account for the different types of exposures each has as described above. The same equations have been used for the non-cancer and cancer calculations with the indicated modifications. The equations and the assumptions are based on the EPA Risk Assessment Guidance for Superfund, Part A[1], EPA Risk Assessment Guidance for Superfund, Part E[2] and the EPA

[1] U.S. Environmental Protection Agency. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Part A. December 1989.

[2] U.S. Environmental Protection Agency. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Part E, Supplemental Guidance for Dermal Exposure. July 2004.

Exposure Factors Handbook[3], unless otherwise specified. A discussion of the cancer and non-cancer evaluation of exposure is presented following the equations for each pathway.

Incidental Ingestion of Surface Water While Swimming and Wading

Adult and children residents may be exposed to chemicals as a result of unintentionally swallowing water during swimming and wading. The exposure dose for incidental ingestion of surface water is

$$Dose\,(mg/kg/day) = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where

C = maximum detected concentration of a chemical; milligrams per liter (mg/L)

IR = ingestion rate; 0.10 L/day for adults and children

EF = exposure frequency; 32 days/year

ED = exposure duration; 30 years for adults and 6 years for children

BW = body weight; 70 kg (or 153 pounds) for adults and 23 kg (or 50 pounds) for children

AT = averaging time; 10,950 days for adults and 2,190 days for children

Direct Skin (Dermal) Contact with Chemicals Present in Surface Water

Dermal absorption depends on numerous factors, including the area of exposed skin, anatomical location of the exposed skin, length of contact, concentration of the chemical in contact with the skin, and other factors. Because chemicals differ greatly in their potential to be absorbed through the skin, each chemical needs to be evaluated separately. The exposure dose for direct contact with chemicals in surface water is

$$Dose\,(mg/kg/day) = \frac{C \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

where

C = maximum detected concentration of a chemical; mg/L

SA = surface area exposed; 18,150 square centimeters/day (cm^2/day) for adults and 8,545 cm^2/day for children

PC = permeability constant; 0.43 cm/hour for Aroclor-1260; 0.0010 cm/hour for arsenic and manganese

ET = exposure time; 2 hours per event for adults and children

[3] U.S. Environmental Protection Agency. Exposure Factors Handbook. August 1997.

EF = exposure frequency; 32 days/year for adults and children

ED = exposure duration; 30 years for adults and 6 years for children

CF = conversion factor; 0.0010 liter per cubic centimeters (L/cm^3)

BW = body weight; 70 kg (or 153 pounds) for adults and 23 kg (or 50 pounds) for children

AT = averaging time; 10,950 days for adults and 2,190 days for children

Non-Cancer Health Effects

The doses calculated for exposure to each individual chemical are then compared to an established health guideline, such as a MRL or RfD, in order to assess whether adverse non-cancer health impacts from exposure are expected. These health guidelines, developed by ATSDR and EPA, are chemical-specific values that are based on the available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice for deriving health guidelines is to identify, usually from animal toxicology experiments, a No Observed Adverse Effect Level (or NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The NOAEL is then modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (for example; children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of available data. Thus, exposure doses at or below the established health guideline are not expected to result in adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies. For non-cancer health effects, the following health guidelines are described below in more detail. It is important to consider that the methodology used to develop these health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer evaluation is necessary for potentially cancer-causing chemicals detected in samples at this site. A more detailed discussion of the evaluation of cancer risks is presented in the following section.

Minimal Risk Levels (MRLs) – developed by ATSDR

ATSDR has developed MRLs for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. MRLs are developed for different routes of exposure, such as inhalation and ingestion, and for lengths of exposure, such as acute (less than 14 days), intermediate (15-364 days), and chronic (365 days or greater). At this time, ATSDR has not developed MRLs for dermal exposure. A complete list of the available MRLs can be found at http://www.atsdr.cdc.gov/mrls.html.

References Doses (RfDs) – developed by EPA

An estimate of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause non-cancerous health effects. RfDs consider exposures to sensitive sub-populations, such as the elderly, children, and the developing fetus. EPA RfDs have been developed using information from the available scientific literature and have been calculated for oral and inhalation exposures. A complete list of the available RfDs can be found at http://www.epa.gov/iris.

If the estimated exposure dose for a chemical is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. Non-cancer health effects from dermal exposure were evaluated slightly differently than ingestion and inhalation exposure. Since health guidelines are not available for dermal exposure, the calculated dermal dose was compared with the oral health guideline value (RfD or MRL).

If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the health consultation. The known toxicological values are doses derived from human and animal studies that are presented in the ATSDR Toxicological Profiles and EPA's Integrated Information System (IRIS). A direct comparison of site-specific exposure doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. This in-depth evaluation is performed by comparing calculated exposure doses with known toxicological values, such as the no-observed adverse-effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL) from studies used to derive the MRL or RfD for a chemical.

Cancer Risks

Exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated excess risk of developing cancer from exposure to chemicals associated with the site was calculated by multiplying the site-specific adult exposure doses, with a slight modification, by EPA's chemical-specific Cancer Slope Factors (CSFs or cancer potency estimates), which are available at http://www.epa.gov/iris. Calculated dermal doses were compared with the oral CSFs.

An increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular chemical. Therefore, the cancer risk calculation incorporates the equations and parameters (including the exposure duration and frequency) used to calculate the dose estimates, but the estimated value is divided by 25,550 days (or the averaging time), which is equal to a lifetime of exposure (70 years) for 365 days/year.

There are varying suggestions among the scientific community regarding an acceptable excess lifetime cancer risk, due to the uncertainties regarding the mechanism of cancer. The recommendations of many scientists and EPA have been in the risk range of 1 in 1

million to 1 in 10,000 (as referred to as 1×10^{-6} to 1×10^{-4}) excess cancer cases. An increased lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk. Cancer risk less than 1 in 10,000 (or 1×10^{-4}) is not typically considered a health concern. An important consideration when determining cancer risk estimates is that the risk calculations incorporate several very conservative assumptions that are expected to overestimate actual exposure scenarios. For example, the method used to calculate EPA's CSFs assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. As previously stated, the method also assumes that there is no safe level for exposure. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude.

Because of the uncertainties involved with estimating carcinogenic risk, ATSDR also employs a qualitative approach in evaluating all relevant data. The numerical risk estimate must be considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions. The actual parameters of environmental exposures have been given careful and thorough consideration in evaluating the assumptions and variables relating to both toxicity and exposure. A complete review of the toxicological data regarding the doses associated with the production of cancer and the site-specific doses is an important element in determining the likelihood of exposed individuals being at a greater risk for cancer.

Appendix, Table A - Summary of Calculated Exposure Doses for Surface Water (Non-cancer Effects)
Sigmon's Septic Tank Site

	Ingestion & Direct Contact Dose (mg/kg/day)	Oral Health Guideline (mg/kg/day)	Exceeds Health Guideline?	Health Guideline Source	Conclusion
Adult Resident - Sigmon Pond					
Aroclor-1260	1.40E-05	2.50E-05	No	(a)	Non-cancer health effects are not expected.
Child Resident - Sigmon Pond					
Aroclor-1260	2.02E-05	2.50E-05	No	(a)	Non-cancer health effects are not expected.
Adult Resident - Intermittent Stream					
Arsenic	1.61E-07	3.00E-04	No	(a)	Non-cancer health effects are not expected.
Manganese	2.05E-04	5.00E-02	No	(b)	Non-cancer health effects are not expected.
Child Resident - Intermittent Stream					
Arsenic	4.19E-07	3.00E-04	No	(a)	Non-cancer health effects are not expected.
Manganese	5.35E-04	5.00E-02	No	(b)	Non-cancer health effects are not expected.

NOTES:
(a) ATSDR's Chronic Oral Minimal Risk Level and EPA's Oral Reference Dose
(b) EPA's Oral Reference Dose

Appendix, Table B - Summary of Theoretical Cancer Risk for Surface Water
Sigmon's Septic Tank Site

Calculated Theoretical Lifetime Cancer Risk				
	Ingestion	**Direct Contact**	**Total Cancer Risk**	**Cancer Risk Conclusion**
Intermittent Stream				
Residents[1]				
Arsenic	1.22E-07	3.54E-08	1.57E-07	**No Increased Cancer Risk**
Total Risk for Contaminants[2]			**1.57E-07**	

NOTES:

[1] The information presented above for residents accounts for exposures to chemicals in surface water occurring during childhood and adulthood. It is considered a conservative approach that may overestimate risk.

(2) Arsenic is the only chemical detected in surface water above comparison values that has been associated with cancer in human and animal studies.