Exponent®

1, 2, 3-Trichloropropane (TCP): Assessment of Risks from Drinking Water

1, 2, 3-Trichloropropane (TCP): Assessment of Risks from Drinking Water

Prepared for

Alaimo Group
(Engineers and Architects)
200 High Street
Mount Holly, NJ 08060

Prepared by

Exponent
1800 Diagonal Road
Suite 500
Alexandria, VA 22314

July 17, 2015

QMS QA ID no. 1501740.000 - 7658

Contents

List of Tables

Acronyms and Abbreviations

ADAF	age-dependent adjustment factor
CSF	cancer slope factor
CTE	central tendency exposure
DWEL	drinking water equivalent level
EPA	U.S. Environmental Protection Agency
NJ DEP	NJ Department of Environmental Protection
NTP	National Toxicology Program
PQL	practical quantitation level
RfD	reference dose
RME	reasonable maximum exposed
TCP	1, 2, 3-trichloropropane

Limitations

The purpose of this report was to analyze the potential risks from drinking water containing 1, 2, 3-trichloropropane (TCP). The risk assessment methodology forming the basis of the results presented in this report is based on a standard regulatory approach using conservative default assumptions. Certain standard and accepted assumptions for the reasonable maximum exposed (RME) individual may be worst case assumptions (e.g., drinking this particular well water for 365 days per year) and may overestimate the potential risks from drinking water. However, other such assumptions, such as future water concentrations may underestimate the potential risks. Given the nature of these evaluations, which is inherent in any risk assessment, significant uncertainties are associated with the estimation of potential exposure and potential risks. These uncertainties are inherent in the methodology and subsequently in the estimates of risks. These results are not facts or predictions of the risk that may occur. Furthermore, the assumptions adopted in determining these risk estimates do not constitute the exclusive set of reasonable assumptions and use of a different set of assumptions or methodology could produce materially different results.

Exponent has relied on information provided by the Alaimo Group to perform this assessment: the sampling data for TCP and the estimated timeframe for the future installation of a treatment system to remove TCP from the water. We have used this information for the assessment, but its accuracy is the Alaimo Group's responsibility.

Executive Summary

1, 2, 3,-Trichloropropane (TCP) was detected in several water samples at the North Church Water Treatment Plant in the Township of Moorestown, NJ between March 2013 and September 2014. Two wells were closed in October of 2014 as the result of possible health concerns. EPA traditionally develops drinking water standards called maximum contaminant levels (MCLs), but no such value has been developed for TCP. No other enforceable drinking water standards exist for TCP, although the NJ Department of Environmental Protection (NJ DEP) has a recommended ground water criteria based on the ability to analytically detect TCP in water. The Township of Moorestown has requested that Exponent conduct a risk assessment in order to better understand the potential risks from ingestion of TCP in drinking water.

Exponent has conducted a risk assessment using standard EPA risk assessment methodology, EPA regulatory risk values, and Moorestown Township site-specific information related to the TCP water concentrations and the duration of time that the community may ingest the drinking water containing TCP.

The potential for non-cancer risks is found to be low, with margins of exposure over 1000-times lower than the drinking water equivalent level (DWEL). The DWEL is a water concentration to which an individual could be exposed for a lifetime with the expectation that adverse, non-cancer effects would not occur.

Cancer risks were estimated and represent an upper bound estimate of the increased or extra cancer risk from exposure to TCP, where the extra cancer risk is above the background rate of cancer. Potential cancer risks were estimated as two separate scenarios: potential future exposures or total cumulative exposure. These scenarios will hereafter be described as *Future* or *Cumulative* and represent the assumptions associated with these respective scenarios. *Future* exposure examines the potential extra cancer risk from re-opening the wells containing TCP and using the water for an additional two years before a treatment system is installed to remove the TCP from the water. The extra cancer risks from *Cumulative* exposure address the risks from four years of past exposures, as well as two years of future exposure.

Future extra cancer risks range from 4 in 100,000 (infant RME) to 3 in ten million (adult CTE). *Cumulative* extra cancer risks are estimated to range between 3 in 100,000 (infant RME) and 6 in ten million (adult CTE). All estimated extra cancer risks from exposure to TCP in drinking water are below the EPA target of a 1 in 10,000 extra cancer risk for drinking water contaminants. Given the anticipated short term exposure to TCP a more conservative cancer risk level is not warranted.

Note that this Executive Summary does not contain all of Exponent's technical evaluations, analyses, conclusions, and recommendations. Hence, the main body of this report is at all times the controlling document.

Background

1, 2, 3,-Trichloropropane (TCP) was first detected at the North Church Water Treatment Plant in the Township of Moorestown, NJ, in March 2013. TCP is not a regulated drinking water contaminant and no drinking water standard has been derived by the U.S. Environmental Protection Agency (EPA) or the NJ Department of Environmental Protection (NJ DEP). The NJ DEP has established a ground water quality criteria for TCP of 0.005 µg/L, but this value is not enforceable because this low concentration cannot routinely be measured by available analytical methods. In these cases, where analytical methods may not be available to consistently detect chemical concentrations at the health-based criteria levels, a practical quantitation level (PQL) is adopted. The PQL for TCP is 0.030 µg/L and like the ground water criterion for TCP, the PQL is not an enforceable standard.

Over the following 18 months following the initial detection of TCP in March of 2013, three additional water samples also found detectable concentrations of TCP. The four samples measured TCP at concentrations between 0.038 and 0.067 µg/L. All of these concentrations exceed the PQL for the state of NJ. The two wells, Well 7 and Well 9, were closed on October 6, 2014 at the recommendation of the NJ DEP due to a concern regarding potential health effects.

Currently, the wells remain closed and the Township of Moorestown is purchasing water as a replacement for these water sources. Exponent was asked to evaluate the potential health risks from ingestion of the drinking water from the North Church Street Water Treatment Plant until installation of a treatment system planned for two years after re-opening of the wells. This risk assessment can be used by the community to make an informed decision regarding the potential risks associated with re-opening these wells. Exponent has evaluated the potential future risk for cancer effects from ingestion of drinking water from these wells over the next two years, the time estimated for installation of a treatment system to remove the TCP. Exponent also has estimated the total cumulative upper bound extra cancer risk resulting from ingestion of TCP in drinking water during the past four years prior to the well closings and two additional years of

future exposures after re-opening (total of six years). In addition, the potential for non-cancer effects from TCP exposure has been evaluated.

This report provides a summary of the EPA regulatory risk values for TCP, a description of the methods used to estimate risks, the results of the evaluation of potential risks from the ingestion of water containing TCP, and a description of what these risks mean.

Regulatory Values for Estimating Potential Risks from 1, 2, 3-Trichloropropane (TCP) Exposure

A number of experimental animal studies have been conducted on TCP that investigated both non-cancer and carcinogenic effects. EPA has reviewed these studies and selected certain studies to develop values to predict the potential risks from exposure to TCP (EPA 2009a). Below is a brief summary of the non-cancer and cancer regulatory values and their basis. In the subsequent section these values will be used together with site-specific exposure assumptions to estimate the potential risks from the ingestion of the well water in the Township of Moorestown.

Non-cancer effects

Non-cancer risks are traditionally managed using reference doses (RfDs), which is "[a]n estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure of a chemical to the human population (including sensitive subpopulations) that is likely to be without risk of deleterious non-cancer effects during a lifetime."[1] In other words, exposure to doses less than the RfD is not expected to cause non-cancer effects. EPA's chronic oral RfD for TCP is 0.004 mg/kg/day. This value was based on the observation of an increase in liver weight in male rats exposed to TCP for two years, which is approximately the duration of their lifetime (EPA 2009a). The RfD for TCP includes incorporation of a 300-fold uncertainty factor applied to the TCP dose eliciting liver effects in rats to account for extrapolation from animal data to humans, the potential for sensitive human subpopulations, and what is considered a data gap in the understanding of TCP toxicity (lack of an experimental study evaluating developmental effects).

EPA has estimated a concentration in drinking water that is equivalent to the RfD; this value is described as a DWEL. The DWEL is the estimated water concentration based on a lifetime of exposure "assuming 100% exposure from that medium, at which adverse, noncarcinogenic health effects would not be expected to occur" (EPA 2012). The DWEL for TCP is 0.1 mg/L or

[1] http://www.epa.gov/ttn/atw/hlthef/hapglossaryrev.html

100 µg/L (EPA 2012) and will be compared to the TCP water concentrations detected in the Township of Moorestown wells in the following section of this report.

Potential for Cancer Effects

Cancer risks are estimated from cancer slope factors (CSFs) derived from measurement of dose-dependent cancer responses in experimental animal studies. A CSF is the upper bound, approximating a 95% confidence limit, estimate of the increased or extra cancer risk from a lifetime of ingesting the compound of interest. EPA (2009b) reviewed two cancer studies on TCP, one in rats and another in mice, conducted by the National Toxicology Program (NTP 1993) to derive a CSF value of 30 per mg/kg/day[2]. The CSF is based on the observation of multiple tumors (predominately forestomach tumors) in female mice, which represents the most sensitive gender and species in the NTP cancer studies. Selection of forestomach cancer as the basis for estimating the CSF is regarded as providing a conservative estimate of potential human cancer in that this response resulted from daily application of TCP directly into the animals' stomachs by a stomach tube. This type of chemical dosing, while common to animal toxicity studies, is different from real-world human exposures resulting from ingesting much lower concentrations of TCP in drinking water. TCP is considered a mutagen and causes cancer by this mode of action. Because it is a mutagen, EPA requires an additional adjustment factor to provide further protection of early life exposures that are assumed to lead to increased susceptibility. This factor is called the age-dependent adjustment factor (ADAF). The ADAFs for each age group are described later in the report with the other assumptions used to calculate potential extra cancer risks.

Cancer risks are traditionally described as the number of additional cancers that could develop as a result of exposure to that compound in specified population size. For example, cancer risk is expressed as the number of excess cancers in 10,000, 100,000 or a million individuals (10^{-4} to 10^{-6}). Regulation of contaminants in water is typically established based on theoretical cancer risks within this range. In 2012, EPA presented water concentrations for regulated contaminants

[2] EPA states that this CSF should not be used when exposures are greater than 0.6 mg/kg/day, which is approximately equivalent to a water concentration of 6,000 µg/L based on a 10 kg child consuming 1 L/day.

at a cancer risk level of 1 in 10,000 or 10^{-4} to provide comparisons to lifetime non-cancer benchmark concentrations, but noted that a more conservative risk level of 1 in 100,000 (10^{-5}) or 1 in million (10^{-6}) may be appropriate in some exposure-specific conditions (EPA 2012). Given the background rate of cancer in the U.S. population, these estimated additional cancers, even at 1 in 10,000 would not be detectable in a community.

In the next section, the potential intake of TCP from drinking water is combined with the CSF to estimate the potential extra cancer risk.

Assessment of Potential Risks from Drinking Water

As described above, two wells have been reported to contain TCP, wells 7 and 9. Two other water sources contribute to the water system in Moorestown: New Jersey American Water (NJAW) and Kings Highway Water Treatment Plant (KHWY). No detectable TCP has been reported for these other water sources. Based on the history of water use at the North Church Street Water Treatment plant between 2012 and 2014, the two wells (#7 and #9) provided an average daily flow of 1.58 million gallons per day and the other water sources provided 1.40 million gallons per day. Therefore, the drinking water concentrations at tap of a residence would be a blend of all water sources. The overall drinking water concentration is based on an average concentration based on a ratio of 0.53 of the water sourced from wells #7 and #9 relative to all water sources: (1.58/(1.58+1.4)) = 0.53.

Non-cancer Risk Assessment

The potential for non-cancer risks are evaluated by comparing the EPA DWEL with the detected concentrations in the wells. The following table provides a summary of the detected concentrations compared to the DWEL of 100 µg/L.

Date of sample	TCP concentration (µg/L)	Relative difference to TCP DWEL
3/12/2013	0.038	2,631
9/10/2013	0.051	1,960
6/25/2014	0.066	1,515
9/10/2014	0.067	1,492

The relative differences between the detected concentrations from the Township of Moorestown wells and the DWEL are all greater than 1000, demonstrating the potential for non-cancer effects from TCP in drinking water is extremely unlikely. Not only does a large margin of exposure exist relative to the DWEL for TCP, but the RfD for TCP includes conservative assumptions that are designed to protect humans, including sensitive individuals within the population. These comparisons do not include the fact that the water is obtained from multiple sources, which provides an additional 2-fold difference from the TCP DWEL.

Cancer Risk Assessment

An assessment of *Future* exposures was conducted to evaluate the potential risk associated with two years of exposure to TCP in drinking water if the wells were re-opened and the water was consumed by residents until a treatment system is installed. For this assessment two categories of exposed individuals were considered. The first category is the reasonable maximum exposed (RME) person, which is intended to represent a conservative estimate of drinking water exposure that is well above average exposure, but still within the range of possible exposures. The second category is the central tendency exposed (CTE), which is used to estimate the risk for the average or typical individual in the population. For both categories, three different age groups were evaluated to account for differences in body weight and volume of water ingested: an adult greater than 16 years of age, a child between 2 and 16 years of age, and an infant less than 2 years of age.

A second assessment was conducted to assess the *Cumulative* exposure from TCP in drinking water, taking into account both past exposure (four years while the wells were open) and future exposures (two years after well re-opening). In this assessment the same RME and CTE categories were used. Three age groups were evaluated, each with a total of six years exposure: adult, child, and an infant (two years exposure) with an additional four years exposure as a child. The combined exposure for an infant/child represents the worst-case of an infant who was born in September 2011 and ingested the well water for the first six years of life. Children born later or moving into the community after this date will have lower exposure and lower associated risks.

The possibility that children may be more susceptible to cancer from TCP exposures than adults is addressed through application of an additional ADAF of 3 for children and 10 for infants to the cancer risks estimated for adults. EPA applies these factors for chemicals which cause cancer by causing mutations, which is the case for TCP.

Lifetime additional cancer risks for TCP are calculated by multiplying estimates of the daily doses in each exposure category and age-group, with additional adjustments accounting for the less-than-lifetime exposures in the Township of Moorestown, by the CSF. The following

formula was used to calculate the potential extra cancer risks for the ingestion of drinking water containing TCP:

$$Cancer\ risk = \frac{(C\ x\ IR\ x\ EF\ x\ ED)}{(BW\ x\ AT)}\ x\ CSF\ x\ ADAF$$

Where,

C = Chemical concentration in water, blended sources, µg/L
IR = ingestion rate, water, L/day
EF = exposure frequency, days/year
ED = exposure duration, years
BW = body weight, kg
AT = averaging time, lifetime days
CSF = cancer slope factor
ADAF = age-dependent adjustment factor

Future Exposure and Risk

Table 1 provides the assumptions used to estimate risks from *Future* exposures.

Table 1: Exposure Assumptions Used in Future Risk Scenario				
Exposure/Risk Parameters	**Reasonable Maximum Exposure (RME)**	**Central Tendency Exposure (CTE)**	**Units**	**Reference**
CSF	30	30	per mg/kg-d	EPA 2009b
Chemical concentration in water from blended sources	0.000056	0.00004	mg/L	Site specific
Averaging time (lifetime)	28,470	28,470	d	EPA 2011
Adult (> 16 yrs.)				
Ingestion Rate	3.0	1.0	L/d	EPA 2011
Exposure Frequency	365	259	d/yr	EPA 2011
Exposure Duration	2	2	yrs	Site Specific
Body Weight	80	80	kg	EPA 2011
ADAF	1	1	unitless	EPA 2005
Child (2 - < 16 yrs.)				
Ingestion Rate	1.4	0.4	L/d	EPA 2011
Exposure Frequency	365	259	d/yr	EPA 2011
Exposure Duration	2	2	yrs	Site specific
Body Weight	36.6	36.6	kg	EPA 2011
ADAF	3	3	unitless	EPA 2005
Infant (< 2 yrs.)				
Ingestion Rate	0.93	0.30	L/d	EPA 2011
Exposure Frequency	365	259	d/yr	EPA 2011
Exposure Duration	2	2	yrs	Site specific
Body Weight	9.62	9.62	kg	EPA 2011
ADAF	10	10	unitless	EPA 2005
ADAF- age-dependent adjustment factor, CSF – cancer slope factor, d – day, kg – kilogram, L – liter, mg – milligram, y/yrs. – year(s)				

In most cases the assumptions are recommended EPA values. For the RME individual we selected the 95th percentile values and for the CTE individual we relied on average values. Only the chemical concentration and the exposure duration were site-specific values. The basis for these values is described below.

Four water samples with detectable TCP levels are available and the concentrations range from 0.038 to 0.067 µg/L over an 18 month period. For the RME, in order to be conservative and account for a possible increase in water concentration since the wells were closed and until a treatment system is installed, it is assumed that the water concentration increases at 0.019 µg/L. This is the average annual change in TCP water concentration observed for the period between March 2013 and September 2014. For the CTE it is assumed TCP concentrations will increase, but at a lower rate. Based on the 0.001 µg/L difference in concentration seen in the last 3 month period between June 2014 and September 2014, the CTE water concentrations are assumed to increase 0.004 µg/L per year. The actual TCP concentration used in the formula is an annual average of the projected future water concentrations for the two year period, September 2015 through September 2017, which was adjusted by the blending ratio of 0.53 to reflect the mixing of water from multiple sources. The use of an annual average concentration assumes that an individual is drinking all of their water from this source for the entire two year period. Anyone who does not consume water for the full two years, or consumes water from other sources, will experience lower risks than those estimated.

The exposure duration for the potential extra cancer risks for the *Future* risk estimates is two years for all age groups. This is the estimate of time provided by the Alaimo Group that will be needed for installation of a treatment system for TCP.

Based on the assumptions and the formula described above, the potential extra cancer risk was estimated for the ingestion of water the Township of Moorestown's North Church Street Water Treatment Plant. Table 2 presents the estimated risk for the three age groups under both the RME and CTE.

Table 2: Estimated Extra Cancer Risk from Two Years Future Exposure

	Future **Scenario (RME)**	***Future*** **Scenario (CTE)**
Adult (> 16 yrs.)	2 in 1,000,000	3 in 10,000,000
Child (2 - < 16 yrs.)	5 in 1,000,000	8 in 1,000,000
Infant (< 2 yrs.)	4 in 100,000	7 in 1,000,000

The estimated risks from ingestion of TCP in drinking water in the Township of Moorestown, NJ fall well within the range of acceptable additional cancer risks: 1 in 10,000 and 1 in 1,000,000, with the exception of the adult CTE, which resulted in an estimated extra cancer risk that is even lower (3 in ten million). It is important to recognize that the cancer risk estimates have been estimated in a highly conservative manner. First, the exposure assumptions are conservative. For example, it is assumed that an adult consumes 3 liters (0.79 gallons or 100 ounces) of water from this source, every day for the two year period. This does not take into account consumption of water from other sources (e.g., bottled water, water from other systems when working or traveling outside of the Township of Moorestown). The RME estimates assume that the TCP water concentration will continue to increase at the same rate observed over the 18 month sampling period; the CTE estimates also assume the concentrations will increase, but at a lower rate than used for the RME individual. Secondly, the CSF is an upper bound estimate of the true cancer risk that is conservatively-based on tumor data from the most sensitive species and the most sensitive gender. Finally, an additional 10- or 3- fold adjustment factor is applied to infants and children, respectively, to provide additional protection from early life exposures.

Cumulative Risk

Table 3 provides the assumptions used in the *Cumulative* risk scenario.

Table 3: Exposure Assumptions Used in Cumulative Risk Scenario				
Exposure/Risk Parameters	**Reasonable Maximum Exposure (RME)**	**Central Tendency Exposure (CTE)**	**Units**	**Reference**
Chemical concentration in water from blended sources	0.000036	0.000027	mg/L	Site specific
CSF	30	30	per mg/kg-d	EPA 2009b
Averaging time (lifetime)	28,470	28,470	d	EPA 2011
Adult (> 16 yrs.)				
Ingestion Rate	3.0	1.0	L/d	EPA 2011
Exposure Frequency	365	259	d/yr	EPA 2011
Exposure Duration	6	6	yrs	Site Specific
Body Weight	80	80	kg	EPA 2011
ADAF	1	1	unitless	EPA 2005
Child (2 - < 16 yrs.)				
Ingestion Rate	1.4	0.4	L/d	EPA 2011
Exposure Frequency	365	259	d/yr	EPA 2011
Exposure Duration	6	6	yrs	Site specific
Body Weight	36.6	36.6	kg	EPA 2011
ADAF	3	3	unitless	EPA 2005
Infant (< 2 yrs.)				
Ingestion Rate	0.9	0.3	L/d	EPA 2011
Exposure Frequency	365	259	d/yr	EPA 2011
Exposure Duration	2	2	yrs	Site specific
Body Weight	9.62	9.62	kg	EPA 2011
ADAF	10	10	unitless	EPA 2005
ADAF- age-dependent adjustment factor, CSF – cancer slope factor, d – day, kg – kilogram, L – liter, mg – milligram, y/yrs. – year(s)				

As described above, the majority of the assumptions are recommended EPA values and the same values were used in the *Cumulative* risk estimates. Only the chemical concentration and the exposure duration were modified to reflect the longer duration of exposure. The basis for these values is described below.

Four water samples with detectable TCP levels are available for the time period between March 2013 and September 2015. For the RME estimate, it has been assumed that the TCP water concentration increased from zero to 0.038 µg/L at the same rate that the concentrations changed over the 18-month period when samples were collected. This back-calculation predicts that water concentration were approximately zero in September 2011. However, it must be recognized that due to analytical limitations TCP cannot be reliably detected at concentrations below 0.030 µg/L. The same assumptions about increases in water concentration in the *Future* scenario were also applied to the last two years of exposure in the *Cumulative* scenario. Thus, the TCP concentration used in the RME risk formula was the average annual water concentration for the six years from September 2011 through September 2017. For the CTE estimate, the water concentration represents the same rate of increase in water concentration from September 2011 through October 2014, but assumes the slower rate of increase as projected for the CTE in the *Future* scenario. The annual average water concentration was adjusted by the blending ratio of 0.53 to reflect the mixing of water from multiple sources. The use of an average annual concentration assumes that an individual is drinking water from this source for the entire six year period. Anyone who does not consume the supplied water for the full six years will experience lower risks than those estimated.

As described above, the back-calculation of TCP water concentration predicts a zero concentration approximately two years prior to the first sample collection or September 2011. The total exposure duration is based on two years of predicted past exposure prior to initiation of sampling of TCP water concentrations, one and a half years of exposure during the sampling period, and two years of potential future exposure, which was rounded up to a total exposure duration of six years. Therefore, it is assumed that the *Cumulative* exposure to TCP would be six years for the adult and the older child. However, the exposure duration for the infant is only two years[3]..

[3] An alternative scenario was considered where an infant would be exposed for two years and then exposed as a child for four years to evaluate the maximum duration of exposure; however, this total risk for an infant/child was less than that for the infant alone. This is because the infant/child scenario assumes that the infant is exposed in the first two years when water concentrations are lower and the infant only exposure is based on a higher water concentration.

Based on the assumptions and the formula described above, the potential *Cumulative* extra cancer risk was estimated for the ingestion of water the Township of Moorestown's North Church Street Water Treatment Plant. Table 4 presents the estimated risk for the three age groups under both the RME and CTE.

Table 4: Estimated Extra Cancer Risk from Six Years Cumulative Exposure

Age Group	*Cumulative* Cancer Risk (RME)	*Cumulative* Cancer Risk (CTE)
Adult (> 16 yrs)	3 in 1,000,000	6 in 10,000,000
Child (2 - < 16 yrs)	9 in 1,000,000	2 in 1,000,000
Infant (2yrs)	3 in 100,000	5 in 1,000,000

The *Cumulative* extra cancer risks from ingestion of TCP in drinking water in the Township of Moorestown are slightly higher than the *Future* extra cancer risks for both adult and child risk estimates for RME and CTE, but remain within the range of acceptable additional cancer risks: 1 in 10,000 and 1 in 1,000,000. The *Cumulative* extra cancer risks for the infant (two years) under the RME and the CTE are approximately one-third and two-times lower than the infant extra cancer risk estimated in the *Future* scenario, respectively. This is because in both cases it is assumed that the TCP concentrations increase over time. The estimated extra cancer risk for the adult CTE is very low (6 in ten million).

As described in the *Future* scenario, the *Cumulative* scenario has been estimated in a conservative manner. Several conservative factors are incorporated in these estimates including the exposure assumptions, the derivation of the CSF itself, and the addition of the ADAF for the infant and older child. In addition, the *Cumulative* scenario assumes ingestion of the water containing TCP for six years, which essentially assumes that the wells were not closed and exposure was continuous, which may overestimate the risk.

Conclusions

TCP has been detected in the water supply of the Township of Moorestown, NJ. No drinking water standards are available for this compound; therefore, Exponent was requested to conduct a risk assessment of the potential risks from ingestion of TCP in drinking water.

The potential for non-cancer risks are low, with margins of exposure of over 1000-times lower than the DWEL. The DWEL is a water concentration to which an individual could be exposed for a lifetime with the expectation that adverse, non-cancer effects would not occur.

Potential extra cancer risks from ingestion of TCP were estimated for both *Future* and *Cumulative* exposure scenarios. *Future* exposure evaluates the potential extra cancer risk that would result only from re-opening and using the wells containing TCP for an additional two years while a treatment system is installed to remove TCP from the water. The extra cancer risks from *Cumulative* exposure address the risks from past exposures (four years), as well as potential future exposures (two years). The *Future* extra cancer risks range from 4 in 100,000 (infant RME) to 3 in ten million (adult CTE). The *Cumulative* extra cancer risks are estimated to range between 3 in 100,000 (infant RME) and 6 in ten million (adult CTE).

All estimated cancer risks for TCP Township of Moorestown, NJ are below the EPA target of a 1 in 10,000 extra cancer risk for drinking water contaminants. Given the anticipated short term exposure to TCP a more conservative cancer risk level is not warranted.

References

National Toxicology Program (NTP). 1993. Toxicology and carcinogenesis studies of 1, 2, 3-trichloropropane (CAS No. 96-18- 4) in F344/N/N rats and B6C3F1 mice (gavage studies). Public Health Service, U.S. Department of Health and Human Services; NTP TR 384. NIH Publication No. 94-2839. Research Triangle Park, NC: National Institute of Environmental Health Sciences.

U.S. Environmental Protection Agency (EPA). 2012. 2012 Edition of the Drinking Water Standards and Health Advisories. Office of Water U.S. Environmental Protection Agency Washington, DC. EPA 822-S-12-001.

U.S. Environmental Protection Agency (EPA). 2011. Exposure Factors Handbook: 2011 Edition. Office of Research and Development. EPA/600/R-090/052F. | September.

U.S. Environmental Protection Agency (EPA). 2009b. 1, 2, 3-Trichloropropane (CASRN 96-18-4). Integrated Risk Information System (IRIS).

U.S. Environmental Protection Agency (EPA). 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. EPA/630/R-03/003F. March.