HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SITE 0153

INDIANAPOLIS, INDIANA

U.S. EPA ID NUMBER: INN000510936

PREPARED BY:

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

OFFICE OF LAND QUALITY

SITE INVESTIGATION PROGRAM

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EXECUTIVE SUMMARY

The Indiana Department of Environmental Management (IDEM) has prepared this Human Health and Ecological Risk Assessment (HHERA) and follow-on documents {Feasibility Study (FS) and Remedial Investigation (RI)} to fulfill the requirements of the Memorandum of Agreement (MOA), which deferred listing of the Site ("Site 0153") on the Superfund National Priorities List (NPL).

Citizens Water (Citizens) operates the public drinking water supply for the City of Indianapolis, Indiana. In 2013, Citizens notified IDEM that low levels of chlorinated volatile organic compounds (cVOCs) had been detected in the untreated groundwater ("raw") at certain wells located within the Riverside and White River Wellfields ("the Wellfields"). In 2014, IDEM sampled and found low levels of cVOCs in five of the 17 water production wells. Detected cVOC concentrations in the raw water samples were below the maximum contaminant levels (MCLs) allowed by the United States Environmental Protection Agency (U.S. EPA) under the Safe Drinking Water Act (SDWA).

On April 7, 2016, U.S. EPA published a Proposed Rule in the Federal Register, proposing to include the Site on the U.S. EPA's NPL. In response to public sentiment and updated information from Citizens, IDEM subsequently requested that U.S. EPA defer listing the Site on the Superfund NPL. On June 8, 2017, U.S. EPA and IDEM entered into a MOA in which Site 0153 was deferred to IDEM's State Cleanup Program as a Superfund alternative. The MOA outlined an Alternative Plan for addressing contamination at Site 0153. As a part of the Alternative Plan, IDEM and Citizens committed to response actions to address detections of VOCs in the Wellfields and ensure protection of human health and the environment.

- IDEM would conduct a comprehensive search for Potentially Responsible Parties (PRPs) to identify the potential sources of contamination identified in the wellfields.
- IDEM would oversee investigations of the potential sources of contamination and manage identified sources of contamination through one of the various remediation programs at IDEM, to eliminate their VOC impact contributions to the Wellfields.
- Citizens would remove production well WR-3 from service, install aeration equipment to reduce VOCs, and complete confirmatory sampling of post-treatment water before returning the well to service.

- Citizens would complete the same response action (removal from service, installation of aeration equipment, and completion of confirmatory sampling prior to returning a well to service) if another production well exceeds a drinking water MCL in the future.
- Citizens would develop and implement a Groundwater Monitoring Plan and increase the frequency of sampling of production wells to quarterly for VOCs to monitor concentrations in the wellfields, provide a plan to address potential detections, and ensure continued safety of the drinking water.

In addition to the proposed response actions, this HHERA was performed to evaluate current and future exposure to cVOCs to end users of public supply water. This HHERA focused on cVOCs typical of solvent releases and their degradation by-products observed in the Wellfields located within Site 0153. Individual PRP site risks are detailed and available for review in files located on the IDEM's Virtual File Cabinet (VFC). The purpose of the HHERA was to characterize potential adverse human health effects from exposure to public supply water, thereby satisfying one of the necessary steps outlined in the MOA to address investigation and remediation, as well as for de-proposing Site 0153 from the NPL.

In accordance with the SDWA, Citizens currently samples treated (finished) water (i.e. water exiting the production plant) and has repeatedly demonstrated that the finished water does not contain detectable concentrations of cVOCs. As a conservative approach, the HHERA focused on assessing risk associated with the combined, mixed Wellfield/Surface Water output prior to any additional treatment efforts conducted by Citizens before public distribution. The potential for adverse health effects via the ingestion, dermal contact (e.g. showering), and inhalation exposure pathways were evaluated for residents (both adult and children), commercial workers, construction workers, and visitor/trespasser scenarios. Based on the highest exposure potential, the exposure of residents to public supply water via ingestion and dermal contact were used as the benchmark for quantitative assessment, whereas other receptor populations and exposure pathways were evaluated qualitatively.

Cancer risks and non-cancer toxicities were quantified using U.S. EPA's Risk Assessment Guidance for Superfund and U.S. EPA-developed online risk assessment tools, in tandem with analytical data provided from Citizens. An assessment of the Wellfields surface water and production water mixing strategies were performed to derive a reasonable potential cVOC contribution from impacted groundwater in production wells to the public water supply. A representative exposure concentration for each constituent of potential concern (COPC) was derived and used in quantitative risk calculations.

Ultimately, the calculated theoretical lifetime excess cancer risk and non-cancer toxicities were within the acceptable ranges established by the U.S. EPA. Even in the absence of additional production plant treatments, there is no reasonable potential for adverse human health effects to receptor populations from public supply water use.

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ABBREVIATIONS & ACRONYMS

1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethene
1,1,1-TCA	1,1,1-Trichloroethane
ADAF	Age-Dependent Adjustment Factor
ADD	Average Daily Dose
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
B	Dimensionless Ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis
BW	Body Weight
C	Concentration
CAF_o	Cancer Adjustment Factor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cDCE	cis-1,2-Dichloroethene
CE	Chloroethane
C_{ing}	Concentration of a chemical in food or other exposure media
Citizens	Citizens Water
CNTS	Covenant Not to Sue
COC	Chemical of Concern
COPCs	Constituents of Potential Concern
CR	Contact Rate
CRW	Combined Raw Water
CSF_d	Dermal Cancer Slope Factor
CSF_o	Cancer Slope Factor
CSM	Conceptual Site Model
cVOC	Chlorinated Volatile Organic Compound
C_w	Concentration in Water
DAD	Dermally Absorbed Dose
DA_{event}	Absorbed Dose per Event
ED	Exposure Duration
EF	Exposure Frequency
E_{ing}	Ingestion Exposure
EPC	Exposure Point Concentration
ERC	Environmental Restrictive Covenant
ESA	Ecologically Susceptible Areas
ETR	Endangered, Threatened, and/or Rare
EV	Event Frequency
FA	Fraction Absorbed Water
GIABS	Gastrointestinal Absorption Factor
HHERA	Human Health and Ecological Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HRS	Hazard Ranking System

IARC	International Agency for Research on Cancer
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IR	Ingestion Rate
IRIS	Integrated Risk Information System
ISDH	Indiana State Department of Health
K_p	Dermal Permeability Coefficient
LADD	Lifetime Average Daily Dose
LOAEL	Lowest Observed Adverse Effect Level
MAF_o	Mutagenic Adjustment Factor
MCL	Maximum Contaminant Level
mg/kg-day	Milligrams per kilogram per day
mi^2.	Square Mile
MOA	Memorandum of Agreement
NCP	National Contingency Plan
NFA	No Further Action
NOAEL	No Observed Adverse Effect Limit
NPL	National Priorities List
PA	Preliminary Assessment
PCE	Tetrachloroethene
ppb	Parts Per Billion
POD	Point of Departure
PRP	Potentially Responsible Party
PWRW	Production Well Raw Water
QA/QC	Quality Assurance/Quality Control
RA	Risk Assessment
RAGS	U.S. EPA Risk Assessment Guidance for Superfund
RBSC	Risk-Based Screening Criteria
RCG	Remediation Closure Guide
RfC	Reference Concentration
RfD_d	Dermal Reference Dose
RfD_o	Reference Dose
RI	Remedial Investigation
RL	Reporting Limit
RME	Reasonable Maximum Exposure
RS	Riverside
RSL	Regional Screening Level
SA	Skin Surface Area Available
SCP	State Cleanup Program
SDWA	Safe Drinking Water Act
SI	Site Inspection
SIRW	Surface Intake Raw Water
SL	Screening Level
SLERA	Screening Level Ecological Risk Assessment
t*	Time to Reach Steady-State
TCE	Trichloroethylene

tDCE	Trans-1,2-Dichlorethene
THQ	Target Hazard Quotient
TR	Target Risk
UCL	Upper Confidence Limit
U.S. EPA	United States Environmental Protection Agency
VC	Vinyl chloride
VFC	Virtual File Cabinet
VOC	Volatile Organic Compound
VRP	Voluntary Remediation Program
Wellfields	White River and Riverside Municipal Wellfields
WR	White River
τ_{event}	Dermal Exposure Event Duration

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1.0 INTRODUCTION

The 0153/Riverside Groundwater Contamination Site ("Site 0153" or "Site") is located in Indianapolis, Marion County, Indiana and consists of an area of impacted groundwater in vicinity of the Riverside and White River Municipal Wellfields (the Wellfields). The Wellfields are owned and operated by Citizens Water (Citizens). Low levels of chlorinated volatile organic compounds (cVOCs) have been detected in untreated ("raw") groundwater samples collected from certain water production wells. Treated (finished) water and the drinking water provided to customers by Citizens has met and continues to meet all requirements of the Safe Drinking Water Act (SDWA).

In order to address the impacts to the Wellfields, the Indiana Department of Environmental Management (IDEM) is managing potential individual sources within Site 0153 through one of the various State remediation programs. The IDEM initially identified 89 potential sources of cVOC impacts within a five-year time of groundwater travel to the Wellfields; however, a definitive source(s) of cVOCs impacting the Wellfields has not been identified to-date. It is likely that a number of individual sources may be contributing to a commingled groundwater plume, which are together, impacting the Wellfields. Individual Potentially Responsible Parties (PRPs) have been and will be responsible for conducting their own site investigations and remediation, under directive from the IDEM, to eliminate their potential cVOC impact contributions to the two Wellfields. During this investigation, Citizens has continued to monitor cVOC levels within the production wells, while the IDEM has actively pursued identifying PRPs within the boundary of Site 0153, narrowed the list of PRPs, and provided oversight to PRPs currently managed within a remediation program at the IDEM.

To date, IDEM has now sent 140 Request for Information (RFI) letters to current/historic owners and operators of a total of 104 properties (i.e. PRPs). The IDEM has sent a total of 25 Notice of Liability (NOL) letters, including sites that were already enrolled in an IDEM remediation program prior to the formation of Site 0153. The NOL requires PRPs to confirm the potential for release or spill of chemicals, and requires completion of an investigation and cleanup, if necessary. Of the 25 facilities that received NOLs, 17 facilities are actively investigating contamination and 8 have received a No Further Action (NFA) or similar closure letter.

Additionally, IDEM has created a focused area of interest by identifying and prioritizing facilities with significant contamination[1]. Facilities with significant contamination (or suspected of having significant contamination) in close proximity to the Wellfields are considered high-priority properties. Facilities with significant contamination (or suspected of having significant contamination) within the Site 0153 area, but located farther from the Wellfields, are considered medium-priority properties. Facilities in which investigation results have identified limited or less significant contamination are considered low-priority properties. All the high-, medium-, and low-priority PRPs are currently enrolled in one of the IDEM remediation programs and are at various stages of the investigation/remediation process[2].

1.1 Purpose of the Human Health Risk Assessment

The purpose of this this Human Health and Ecological Risk Assessment (HHERA) is to provide a qualitative assessment and, where appropriate, quantitative analyses, in a conservative manner, of the likelihood that adverse health effects may be associated with potential exposures to constituents in environmental media associated with the Site. This HHERA is designed to provide a sound basis for current and future risk management decisions. In accordance with the *Memorandum of Agreement between United States Environmental Protection Agency, Region 5 and the Indiana Department of Environmental Management for the 0153/Riverside Groundwater Contamination Site, Indianapolis, Indiana* (MOA) (IDEM/U.S. EPA, 2017), the IDEM has completed this HHERA for Site 0153 in Indianapolis, Marion County, Indiana. The United States Environmental Protection Agency (U.S. EPA) has deferred Site 0153 for inclusion on the National Priorities List (NPL) and is allowing the IDEM to ensure necessary investigations and response actions are completed at the Site under the IDEM's State Cleanup Program (SCP) (or similar program e.g. Voluntary Remediation Program [VRP]). As indicated in the MOA, IDEM response actions for the Site must be substantially similar to that of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Contingency Plan (NCP). This HHERA consists of a mix of qualitative and quantitative analyses of the potential for adverse effects to human health and the environment that may be associated with constituents present in environmental media associated with the Site. The HHERA has been conducted in a manner necessary to meet the requirements of a "CERCLA-protective cleanup" (IDEM/U.S. EPA, 2017). A copy of the MOA is provided as **Appendix A**.

IDEM is managing characterization and cleanup of potential sources within the area of Site 0153 under individual State Programs. The purpose of this HHERA is characterize, assess, and summarize risks to human health and the environment associated with the groundwater produced from the Wellfields. To that end, the focus of the HHERA is the Wellfields and not individual

[1] In general, significant contamination was determined using the concentration and depth of dissolved cVOCs identified in groundwater, proximity to the Wellfields, and geologic conditions identified during investigation.
[2] Refer to RI Figure 6 for the location of priority sites in the focused area of interest. Refer to RI Table 4 for information regarding the investigation/remediation status of the priority sites identified in the focused area of interest.

PRP sites in the immediate or surrounding area. Risk Assessment at individual sites within Site 0153 boundaries, if necessary, will be conducted separately and as dictated under IDEM State Programs IDEM directed individual site risk assessments will address any PRP off-Site risks to residential /commercial properties including to potable wells or related to vapor intrusion, and soil. If required and following completion, individual site risks assessments at PRP sites will be available for review on the IDEM's VFC.

1.2 Site Background

Site 0153 consists of an area of impacted groundwater in vicinity of the Wellfields. The Site 0153 study area is depicted on **Figure 1**. A mix of residential, commercial, industrial, and recreational properties lie in close proximity to the Wellfields. Major water bodies within the Site include the White River, Fall Creek, and the Indianapolis Water Company Canal.

1.2.1 Study Area (Riverside and White River Wellfields)

INFORMATION REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION

1.2.2 Site History

Citizens operates the public drinking water supply for the City of Indianapolis, Indiana. As part of its drinking water operations, Citizens mixes groundwater from its wellfields with surface water from the Indianapolis Central Canal. The combined raw water (CRW) is then treated and filtered. This finished drinking water is then distributed to customers. To ensure the safety of the drinking water, Citizens routinely samples the "finished" water for over 300 constituents, including cVOCs. In addition, Citizens has routinely collected and analyzed untreated groundwater samples from individual production wells.

On February 20, 2013, IDEM staff received notice from Citizens that cVOCs were being detected in the "raw" groundwater prior to treatment at the Riverside Municipal Wellfield. Citizens was concerned that the increasing levels of vinyl chloride (VC) in production well RS-29 were approaching the maximum contaminant level (MCL), which is the drinking water standard established by the U.S. EPA pursuant to the SDWA. Citizens expressed concern that the increasing VC levels might adversely impact the use of the well to supply drinking water to residents in Indianapolis. The Riverside Wellfield lies adjacent to the White River Wellfield. Both wellfields have been impacted by cVOCs migrating to their respective production wells.

As part of the Superfund site assessment process and under a Cooperative Agreement with the U.S. EPA, the IDEM prepared a Preliminary Assessment (PA) Report (IDEM, 2013) and a Site Inspection (SI) Report (IDEM, 2014). A copy of the PA Report and the SI Report are provided in **Appendix B** and **Appendix C,** respectively. (**APPENDICES REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION)**. Using data collected during the SI, a Hazard Ranking System (HRS) documentation record was submitted to U.S. EPA determining that the Site qualified for inclusion on the Superfund NPL.

In a letter dated August 13, 2015, IDEM's former Commissioner, Thomas Easterly, requested inclusion of the Site on the NPL of hazardous waste sites. In April 2016, U.S. EPA published a Proposed Rule in the Federal Register, proposing to include Site 0153 on the U.S. EPA's NPL. The IDEM, responsive to public requests, subsequently determined that it would be in the best interests of the State and the City of Indianapolis to address the Site in the IDEM's SCP rather than via the federal Superfund Process. During 2016, IDEM officials, the Governor's Office, the Mayor's office, Citizens, and members of the general public requested in letters, meetings, and formal comments on U.S. EPA's proposed rule that U.S. EPA should not list the Site on the NPL, and instead allow IDEM to manage the investigation and remedial actions of Site 0153 pursuant to a state-lead "Alternative Plan." In a letter dated August 18, 2016, the IDEM's former Commissioner, Carol Comer, formally withdrew support for and rescinded IDEM's August 2015 request to include the Site 0153 on the NPL.

After receipt of public comments opposed to listing the Site on the NPL, U.S. EPA began discussions with IDEM in October 2016 to identify the criteria that IDEM would need to satisfy in order for U.S. EPA to consider allowing IDEM to manage Site 0153 in lieu of U.S. EPA. These discussions resulted in the execution of the Site 0153 MOA on June 8, 2017. The MOA specifies the expectations and obligations of each agency regarding Site 0153 and memorializes the agreements necessary to ensure that the response actions undertaken at Site 0153 achieve a "CERCLA-protective cleanup".

1.3 Regulatory Framework and Approach

The HHERA has been prepared pursuant to the risk assessment obligation of the MOA. This HHERA addresses *Section III.D – Cleanup Levels* of the MOA, which obligated Site 0153 to pursue CERCLA-protective cleanups, requiring demonstration of:

- an acceptable risk level for carcinogens between 10^{-6} and 10^{-4};
  - The risk level agreed upon in the MOA was $1x10^{-5}$.
- a Hazard Index (HI) of 1.0 or less for non-carcinogens; and
- no significant adverse impacts to ecological receptors.

1.4 Risk Assessment Approach

The scientific basis and validity of values used in this assessment are considered and discussed in the context of primary research literature in order to provide a frame of reference for the conclusions. The actual levels of human exposure and the potential health risks associated with exposure to constituents at the Site are likely to be significantly lower than the quantitative estimates described in this assessment, due to the conventional practice of using conservative assumptions in preparing a Risk Assessment (RA).

The required components of the RA conform to the U.S. EPA Risk Assessment Guidance for Superfund (RAGS), Part A (U.S. EPA, 1989), which state that RAs performed will include the following five components:

- **Identification of Constituents of Potential Concern (COPCs)**
  - This section will discuss data collection efforts including source characterization and the development of a conceptual Site model (CSM), resulting in identification of COPCs with regard to potential health effects;
- **Exposure Assessment**
  - Identification of the exposure pathways and potential future receptors likely to be exposed to Site COPCs, including ingestion, inhalation, dermal contact and volatilization;
- **Toxicity Assessment**
  - A description of the relationship between the magnitude of exposure (dose) and the probability of occurrence of adverse health effects (response) associated with the COPCs;
- **Risk Characterization**
  - Evaluates if the risks meet human health protection goals in comparison to state and federal benchmarks regarding health risks; and
- **Uncertainty Analysis**
  - The RA report will include an evaluation of the degree of uncertainty specific to the assessment.

1.5 Risk Assessment Organization

This report is organized in a manner consistent with U.S. EPA guidance, as follows:

- **Section 1:**
  - Presents the introduction to the report objectives, the required components, and the organizational structure.
- **Section 2**
  - Presents the procedures for identifying COPCs for the Site.
- **Section 3**
  - Identifies likely human and/or ecological receptors for the Site and presents the exposure factors that are used to estimate the extent of exposure for each receptor.

- **Section 4**
  - Describes the standard procedures for deriving toxicity values and presents the U.S. EPA recommended toxicity values for the COPCs.
- **Section 5**
  - Quantifies and summarizes the potential risks associated with exposure to the COPCs.
- **Section 6**
  - Describes the uncertainties associated with the calculated exposures and potential health risks.
- **Section 7**
  - Presents the conclusions of the HHERA.
- **Section 8**
  - Presents the references cited in the HHERA.

2.0 IDENTIFICATION OF CONSTITUENTS OF POTENTIAL CONCERN

The purpose of this section is to discuss the data collection efforts resulting in identification of COPCs with regard to potential human health effects. COPCs for a HHERA are defined as those constituents present that will comprise the significant portion of the calculated non-cancer hazard and theoretical excess lifetime cancer risk values (U.S. EPA, 1989).

First, the types of environmental media being evaluated will be examined. Risks to environmental media that can be addressed qualitatively will be done so in this section. The list of detected constituents in environmental media will then be reduced to a subgroup of constituents to be evaluated quantitatively in the HHERA. This stepwise reduction allows the elimination of constituents that will clearly not pose a contribution to overall Site risk.

2.1 Environmental Media Definitions

A basic HHERA evaluates all potentially contaminated media, areas, chemicals, and routes of transport. A CSM was developed for the area surrounding the Wellfields to provide information on how groundwater and cVOC impacts move from surrounding areas to the production wells. The CSM also illustrates how the hydrological cycle interacts with the local geology to allow cVOC impacts to interact with exposure pathways (soil, groundwater, and vapor intrusion). Finally, the CSM presents how the complete exposure pathways will be controlled through either an IDEM remediation program or through the Site 0153 Alternative Plan, detailed in the MOA, for the production wells at the Wellfields. The CSM for the Site is depicted graphically on **Figure 2**. The following environmental media have been considered as part of the HHERA:

- **Outdoor Air**: Also referred to as ambient air, outdoor air is characterized as that portion of the atmosphere, external to buildings, to which the general public has access, or to which public access is precluded by a fence or other physical barrier.

- **Indoor Air**: Conversely, indoor air is characterized as the portion of the atmosphere internal to buildings or other public access barriers.
- **Private Well Groundwater:** Private groundwater wells are those used to supply water to residential homes and commercial buildings.
- **Trench Groundwater:** If a deep trench is excavated, direct contact with groundwater to construction personnel may be possible.
- **Trench Air:** If the ambient temperature is high enough, groundwater in a trench may vaporize within the confines of the trench.
- **Finished Water:** Prior to distribution, Citizens treats a mix of groundwater from production wells and surface water via various internal processes to ensure that water is fit for public consumption. The final product distributed to consumers is considered “finished” water.
- **Production Well Raw Water (PWRW):** Production well raw water refers to “raw” groundwater extracted from production wells prior to mixing or other treatment processes.
- **Surface Intake Raw Water (SIRW):** Surface intake raw water refers to water extracted from the Indianapolis Central Canal that is mixed with production water prior to treatment at the Citizens White River finished water distribution plant.

2.2 Environmental Media Excluded from the HHERA

2.2.1 Utility Property Outdoor Air

cVOCs have migrated to the production wells from source(s) within the Site 0153 boundary. The target risk for the Site is groundwater ingestion and municipal wells are screened at depths greater than 50 ft. Impacts to outdoor air through groundwater volatilization for cVOCs observed at depth is highly unlikely.

As presented in the Site 0153 Remedial Investigation (RI) Report (IDEM, 2020) and the Feasibility Study (IDEM, 2020), production well WR-3 was removed from service due to concentrations of trichloroethene (TCE) above the MCL in PWRW samples. In accordance with the Alternative Plan outlined in the MOA, Citizens installed aeration treatment for WR-3 as an engineered control. As a conservative approach, aeration treatment was also considered for the outdoor air pathway. As part of the aeration treatment design, testing, and installation effort Citizens has conducted all necessary air emission calculations and state/federal permitting (if required) to ensure that potential emissions from remedial treatment are protective of human health and the environment.

Based on the information provided above, the outdoor air pathway has been excluded from the HHERA.

2.2.2 Utility Property Indoor Air

As noted above in Section 1 and throughout the RI, cVOC impacts from off-Site sources have migrated to the Wellfields. The cVOCs observed in the Wellfield are not from shallow releases at the utility property. Current low-level cVOC concentrations in the Wellfields are not expected to result in vapor intrusion issues in structures above the Wellfields. Potential vapor intrusion issues at off-Site structures from potential sources within the 0153 boundary will be addressed in individual site investigations, conducted by PRPs, under the direction of IDEM. Therefore, IDEM considers the exposure pathway of volatilization of cVOCs from groundwater into indoor air within structures on the utility property incomplete.

Although considered incomplete, IDEM conducted an initial risk screening due to the low-level cVOC concentrations observed in the Wellfield. To complete this initial screening, IDEM reviewed the following:

- Trichloroethene (TCE) groundwater data obtained from routine monitoring of production wells,
    - All production wells are screened at depths greater than 50 feet below ground surface; and
- U.S. EPA Vapor Intrusion Screening Level (VISL) Calculator.

The U.S. EPA VISL Calculator identifies that TCE groundwater concentrations below 7.44 parts per billion (ppb) would be unlikely to result in an exceedance of U.S. EPA commercial indoor air screening levels and do not warrant further investigation of the vapor intrusion exposure pathway. TCE concentrations in PWRW have not been above 7 pbb since 2006, in production well WR-3. As noted previously, production well WR-3 has a recently installed engineered control. Since installation, the pre- and post-treatment confirmatory samples have not exceeded the TCE MCL of 5 ppb. Thus, the utility properties would have low risk for vapor intrusion from PWRW at these depths and concentrations. It should also be noted that the utility properties are access-controlled commercial properties.

Information regarding vapor intrusion investigations at PRP sites (if conducted to date) can be found in the RI (refer to RI Table 4 and Appendix D Site Summaries). Specific PRP vapor intrusion reports and data are available for review on the IDEM's VFC.

2.2.3 Other Excluded Environmental Media

As detailed in the Alternative Plan outlined in the MOA, the IDEM committed to the following plan aspects:

- Coordination with the Marion County Public Health Department (MCPHD) to determine if cVOC concentrations are present above an MCL in any private wells within the five-year time of travel;

- Identify any completed exposure pathways (including ingestion and vapor intrusion);
- Delineate groundwater impacts; and
- Address sources of contamination as necessary and practical.

As noted in Section 1 and the RI, IDEM is managing characterization and cleanup of potential sources within the area of Site 0153 under individual State Programs. By doing so, this allows for potentially timelier and more effective cleanups than through the more formal federal Superfund process. Prior to formation of Site 0153, several of the surrounding sites potentially contributing impacts to the Wellfields were already enrolled in an IDEM remediation program, making a federal Superfund designation redundant and unnecessary. Many of the sites had already completed remediation under a State Program or were on track to do so, which contributed to the decreasing concentrations observed in the Wellfields. Although a definitive source(s) has not been identified to date, individual potential sources to the Wellfields are currently being addressed through various State Programs. Additionally, further investigations of potential sources to the Wellfields will continue.

As part of these investigation and remediation efforts under State Programs, IDEM will require, as needed, individual PRP site risk assessments. All IDEM required risk assessments will address each of the MOA items noted above, as well as risks associated with Site 0153 groundwater contamination on a site-by-site basis. In addition, the MCPHD has investigated some private wells within the five-year time of travel, continues to address private well contamination issues (if any), and conducts sampling as needed. Therefore, potential exposures associated with the following exposure scenarios are not included as part of this HHERA, as they will be evaluated on a site-by-site basis under State programs:

- Indoor air for residential and commercial scenarios;
- Groundwater from private supply wells for residential or commercial use; and
- Trench groundwater and trench vapors for construction worker exposure.

A summary of the environmental media, exposure pathways, and their respective risk assessment approach is presented on **Table 1**.

2.3 Finished Water Qualitative Risk Assessment

Citizens routinely analyzes their finished water for over 300 different constituents as part of their mandatory reporting obligations under the SDWA. The finished water is analyzed on a quarterly basis for VOCs. A summary of finished water cVOC analytical results between 2016 and 2020 is presented in **Table 2.**

The U.S. EPA policy presented in *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991) states: "*For ground water actions, MCLs and non-zero MCL[Goals] will generally be used to gauge whether remedial action is warranted.*" Therefore, MCLs are applicable or relevant and appropriate requirements for public drinking water supply systems. Since the finished water produced at the White River treatment plant is consistently below the MCL and the cVOCs identified in production water have not been detected in finished water, no further evaluation is warranted.

2.4 Production Water Samples Included in the Risk Assessment

Site 0153 originally qualified for the NPL based on detections of cVOCs in several groundwater production wells. These detections are believed to be associated with the historic use and releases of chlorinated solvents from off-Site properties in the surrounding area. As such, the HHERA focuses on cVOCs associated with chlorinated solvents traditionally utilized in dry-cleaning, industrial, and manufacturing activities.

The cVOCs associated with chlorinated solvents that will be evaluated in the HHERA include tetrachloroethene (PCE), TCE, and 1,1,1-trichloroethane (1,1,1-TCA), as well as the respective degradation by-products. Degradation mechanisms and by-products are presented on **Figure 3 (PCE)** and **Figure 4 (TCE)** for reference. The union of the two degradation pathways results in the following nine cVOCs that will be evaluated as part of the HHERA:

- PCE
- TCE
- 1,1,1-TCA
- cis-1,2-Dichloroethene (cDCE)
- trans-1,2-Dichloroethene (tDCE)
- 1,1-Dichloroethene (1,1-DCE)
- 1,1-Dichloroethane (1,1-DCA)
- Vinyl chloride (VC)
- Chloroethane (CE)

Citizens monitors cVOC concentrations from production wells in accordance with their ongoing Water Quality Monitoring Plan (Citizens, 2019). This plan specifies the frequency of monitoring, sample collection procedures, laboratory procedures, event triggers, and corrective actions associated with the water quality monitoring program.

Analytical results from PWRW samples collected since 2004 have been presented in **Table 3**. This data set includes 150 water samples from the White River Wellfield and 486 water samples from the Riverside Wellfield. Production water samples are analyzed by U.S. EPA Drinking Water Method 524.2.

2.5 Detected Constituents

Available data from the production well samples have been examined to determine the list of applicable COPCs for the HHERA and are presented on **Table 5**. At least one detection of the following seven chemicals have been identified in PWRW samples:

- PCE
- TCE
- 1,1,1-TCA
- cDCE
- tDCE
- 1,1-DCA
- VC

2.6 Data Usability

U.S. EPA provides guidance for data usability in RAs. Data usability is the process of assuring or determining that the quality of the data generated meets the intended use (U.S. EPA, 1992). Analytical data have been evaluated with respect to data usability prior to inclusion in this HHERA as described in the following sections.

2.6.1 Laboratory Performance

Analytical results for PWRW and finished water samples have historically been generated by Citizens' in-house water quality laboratory (Citizens lab). The Citizens lab is certified for drinking water analyses by the Indiana State Department of Health (ISDH) (ISDH, 2020). The certification process follows U.S. EPA protocols for the certification of laboratories analyzing drinking water (U.S. EPA, 2005). The Citizens lab therefore maintains sufficient quality assurance and quality control procedures to be compliant with relevant U.S. EPA guidance. Analytical data generated by the laboratory would therefore be of sufficient quality for use in this HHERA.

2.6.2 Reporting Limits

Selecting the analytical method for optimal RLs is critical to the data usability in RAs. The Citizens lab utilizes U.S. EPA Method 524.2 to analyze cVOCs. The default reporting limit (RL) for this method is 0.5 micrograms per liter (µg/L) for each compound analyzed. The most stringent MCL of the detected chemicals in either production water or finished water is for VC with a MCL of 2 µg/L. Thus, the default RLs the Citizens lab are appropriate to evaluate the risk to human health being assessed in this RA.

However, in some cases, even with the best analytical methods, RLs may exceed risk-based screening criteria (RBSCs) as described in Section 2.7. If RLs are consistently greater than these RBSCs, the confidence of the results of the RA can be affected. There is a possibility that constituents are present at levels between the RBSC and the RL. Therefore, as part of this RA, both the RLs and the detected concentrations for constituents have been compared to the appropriate RBSCs.

The Citizens lab default RL exceeds the RBSC for the following detected cVOCs (published RBSC in parentheses):

- TCE (0.28 µg/L)
- VC (0.019 µg/L)

RBSCs for Site cVOCs are presented on the excerpt of the U.S. EPA Regional Screening Level (RSL) tables included as **Table 4** (U.S. EPA, 2019)**.** However, both TCE and VC have been detected at least once during monitoring, and the maximum detected concentration will be used during the screening evaluation. Therefore, although the default RLs do not meet the RBSCs for all detected compounds, COPCs will still be screened appropriately.

2.6.3 Qualified Data and Method Detection Limits

For analytical results, qualifiers are attached to certain data by either the laboratories conducting the analyses or by persons performing data validation. These qualifiers often pertain to quality assurance or quality control (QA/QC) problems and indicate questions concerning chemical identity, chemical concentration, or both. Qualifiers must be addressed before the chemical can be used in quantitative risk assessment (U.S. EPA, 1989).

Analytical data generated by the Citizens lab has been validated by laboratory personnel in accordance with U.S. EPA drinking water laboratory criteria prior to being made available to the public. All validated, qualified data have been considered usable for this assessment. No results from the Site data set have been rejected or deemed unusable.

Laboratory "J" flags indicate an estimated detection of an analyte between the MDL and the RL. This qualifier flag indicates a certainty in the presence of analyte, but uncertainty in the magnitude of the reported detection. The MDL concentrations for each analyte of interest are a calculation based on the standard deviation of at least seven replicates multiplied by the Student's t-table value for n-1. MDL studies are conducted annually as part of the ISDH certification and therefore vary from year to year. From 2019 onward, Citizens has internally reported J-flagged data. In accordance with regulatory guidance (U.S. EPA, 1991b), these estimated results will be incorporated into the quantitative assessment of risk. The implications of including qualified results in the RA will be discussed in the Uncertainty Analysis section of this report.

2.6.4 Quality Control Samples

Although they may be used to assess data usability, quality control samples, including method blanks, trip blanks, rinsate blanks, equipment blanks, laboratory control spike samples and/or matrix spike samples are generally not evaluated as part of determining Site specific risk. The quality control samples associated with routine monitoring are used to validate final production or "finished" water results at the laboratory level prior to results being published. Therefore, no quality control samples have been evaluated as part of the HHERA.

2.6.5 Frequency of Detection / Data Density Assessment

In order to ensure that the frequency assessments have not been diluted by pooling the White River (WR) production water data with the Riverside (RS) wellfield data, the evaluation of contaminant frequency has been performed on both wellfields individually. The listing of detected compounds and their associated general statistics (i.e. frequency and maximum concentration) separated by wellfield is presented on **Table 5**.

TCE and tDCE have been detected at least once but in less than 5% of the samples analyzed throughout routine monitoring, specifically in the Riverside Wellfield. tDCE will not be carried forward as a COPC based on insufficient frequency of detection in both wellfields. Although TCE does not meet frequency criteria for the Riverside Wellfield, TCE will be carried forward as a COPC for the RA since TCE meets frequency criteria in the White River wellfield and data from both wellfields will be incorporated to account for wellfield mixing.

2.7 Identification of Constituents of Potential Concern

Although many different agents have been detected in the water samples, through the preliminary reduction steps as described in the following sections, many of these do not pose a concern under customary RA standards and were eliminated from further consideration. Agents that have not been eliminated by this reduction process have been identified as COPCs and will be carried through to the Site-specific, quantitative portion of the RA.

It is important to recognize that the selection of an agent as a COPC does not necessarily indicate that it poses a significant health risk. The selection of an agent only indicates that there is a need to evaluate it quantitatively in the HHERA to determine if the exposure levels may be associated with a significant health risk.

2.7.1 Risk Based Screening Criteria

U.S. EPA maintains the RSL database, most recently updated in November 2019 (U.S. EPA, 2019), and defines screening levels for a cancer risk of 1×10^{-6} and a target hazard quotient (THQ) of both 0.1 and 1.0. These values are derived based on the methods outlined in U.S. EPA's RAGS Part B (U.S. EPA, 1991).

For agents in water, the COPC identification process consists of a comparison of the maximum detected concentration of each agent with the minimum of either the current published MCL or the residential tap water screening level at the chosen THQ. This minimum value is considered the RBSC. The RBSCs used in this assessment are generic values that are based on default exposure parameters and factors that represent reasonable maximum exposure (RME) conditions for chronic exposures.

Specifically, the RBSCs utilized for this risk assessment are the most conservative risk-based values corresponding to a 10^{-6} risk level for carcinogens, and non-carcinogenic constituents reflecting a THQ of 0.1. U.S. EPA's calculation of groundwater RSBCs considers incidental ingestion of water, inhalation of volatiles, and dermal exposures. Those agents whose maximum detected concentrations are below the applicable comparison values were eliminated as a COPC. Agents that are above these screening levels are retained for further evaluation, unless they do not meet the frequency criteria described above.

The results of the COPC identification process are presented in **Table 5**. For each detected agent, **Table 5** presents the detection frequency, the minimum and maximum detected concentrations, the sample with the minimum and maximum detected concentrations, and the applicable U.S. EPA RBSCs.

2.7.2 Summary of Constituents of Potential Concern

Based on the processes described above, of the seven detected constituents, only three have been determined to be COPCs for the Site: cDCE, TCE, and VC. In Section 3, exposure pathways will be evaluated for completeness. Then, in Section 4, intake estimates will be calculated for these three compounds and the potential toxicity for exposed receptors will be determined.

3.0 EXPOSURE ASSESSMENT

"Human exposure science is the study of human contact with chemical, physical or biological agents occurring in their environments. Exposure science describes the environment, the behavior of agents in the environment, the characteristics and activities of human receptors and the processes that lead to human contact and uptake of agents. Exposure science uses this information to describe conditions in the real world that could lead to human health risks" (U.S. EPA, 2019b).

Exposure assessment applies the doctrines of exposure science and is the process of measuring or estimating the magnitude, frequency, and duration of human exposure to an agent in the environment. This section of the RA discusses the mechanisms by which people might encounter COPCs and the approximate magnitude, frequency, and duration of contact between potential human receptors and COPCs. The quantitative assessment of exposure, based on COPC concentrations and the degree of absorption of each COPC, provides the basis for estimating constituent intake (dose) and associated health risks. The exposure assessment follows the recommendations for conducting an assessment as outlined in the U.S. EPA RA Guidance (U.S. EPA, 1989), and generally, follows four distinct steps:

1. Characterization of the exposure setting and potential receptors;
2. Identification of exposure pathways;
3. Development of exposure point concentrations, and;
4. Quantification of chemical intakes.

3.1 Exposure Assessment Definitions

Since the publication of RAGS in the late 1980s, the risk assessment lexicon varies depending on where and when a guidance document was authored and the state of exposure science at the time of writing. To ensure standardized language, this HHERA will incorporate the definitions, excerpted from U.S. EPA, 2019b. HHERA definitions are presented in **Appendix D**.

3.2 Site-Specific Exposure Assessment Methodology

This RA will address the risk from groundwater exposure to potential receptor populations. For each population, viable exposure routes will be evaluated. Risk will be assessed for potential receptor populations based on both non-cancer toxicity and cancer risk.

For the commercial exposures, the receptor population will be assumed to consist of only adults. For residential exposures, toxic non-cancer endpoints and cancer risk will be assessed for both children and adults. Residential cancer risk will be assessed assuming a resident is exposed to Site groundwater from birth to age 26 (U.S. EPA, 2019), accounting for age-related differences in water ingestion and dermal absorption. The age-related differences in risk will be assessed because of the disproportionate absorption uptake differences in both ingestion and dermal routes for ages zero to six relative to ages six to 26. In addition, residential risk will incorporate Age-Dependent Adjustment Factors (ADAFs) that account for the disproportionate response in children to mutagenic carcinogens. Children and teenagers are expected to have an increased response to mutagenic carcinogens by up to a factor of 10.

The Exposure Point Concentration (EPC), or the value used to represent RME for the populations, will be determined assuming the potential for equal exposure to each member of the population across the Site (i.e. one exposure area). The derived EPC to be used in the intake calculations will factor in concepts of wellfield and surface water mixing to be representative of the mixed surface water and production well water immediately prior to treatment at the distribution plant.

3.3 Pathways of Human Exposure,

- A source or agent released from a source;
- An exposure medium;

- A point of potential contact for the receptor with the exposure medium (i.e. exposure point); and
- An exposure route at the contact point (e.g., ingestion, dermal contact or inhalation).

An exposure pathway is considered complete when each of the above elements are present. Once agents are released into an environmental medium, they may migrate from one medium to another, and the resultant exposure pathway transforms the risk potential. The RA includes assessment of the direct exposure pathways as well as those transformed exposure pathways. Pathways are considered complete when receptor contact with an environmental medium that contains Site COPCs is likely.

3.3.1 Agents Released from a Source

Three chlorinated solvent related cVOCs have been identified as COPCs for direct contact with groundwater based on the results of **Section 2**, specifically cDCE, TCE, and VC

3.3.2 Exposure Media

Four unique exposure media have been identified as part of a potentially complete exposure pathway:

- Groundwater containing cVOCs;
- Public supply water, which is a combination of groundwater and surface water;
- Outdoor air in proximity to the production well aeration treatment system; and
- Indoor air or sub-slab soil gas resulting from volatilization of groundwater (i.e. vapor intrusion).

These pathways are illustrated on the exposure conceptual site model flow diagram included as **Figure 5**. As outlined in **Table 1** and described in **Section 2**, evaluation of exposure to groundwater containing cVOCs and vapor intrusion from groundwater volatilization will be addressed through State-led cleanup and remediation programs for each potential contributor to the impacted groundwater of Site 0153.

As described in **Section 2**, the indoor air exposure pathway on the Citizens Water White River Treatment Plant utility property from volatilization of impacted groundwater is considered incomplete. The outdoor air exposure medium on utility properties only applies to potential emissions from the aeration system installed to treat impacted groundwater. Citizens has evaluated these emissions as part of the design, testing and installation of the aeration system on well WR-3. Citizens has incorporated these emissions, as necessary, into the overall air permitting requirements associated with operations at the Treatment Plant.

Thus, as part of this HHERA, the potential exposure pathway being evaluated is direct contact exposure with public supply water. This pathway is currently complete but under control via the treatment plant processes. Control has been demonstrated by the absence of solvent cVOCs in the finished water, as presented in **Table 2.** As a conservative approach, the HHERA will focus on assessing risks associated with the combined, mixed PWRW/SIRW output prior to any additional treatment efforts conducted by Citizens before public distribution.

3.3.3 Potential Receptors

The receptors at the Site must be identified to evaluate potential exposure pathways. Potential receptors are identified based on those having unrestricted use of public supply water. This RA addresses potential exposure to agents in groundwater from the Site. The following receptors have been considered as part of the RA:

- Adult and Child Residents
- Commercial Workers
- Construction Workers
- Visitors and Trespassers
- Ecological Receptors

3.3.3.1 Adult and Child Residents

Residents are receptors of finished water. Residents are assumed to be children and adults, present at their residence for 350 days per year. The direct contact pathways consist of ingestion and dermal contact, each with a unique set of default input parameters.

The residential assessment also accounts for mutagenic compounds, where early-life exposure to mutagenic agents may have compounded mutagenic effects depending on stage-of-life.

3.3.3.2 Commercial Workers

Commercial workers in the area of the distribution network are receptors of finished water. The base assumptions for the commercial worker scenario (e.g., exposure frequency and duration) are less conservative than the residential scenario and are restricted to adult exposure. Thus, if residential exposure results in acceptable risk, commercial worker risk is also acceptable.

3.3.3.3 Construction Workers

Construction workers in the area of the distribution network have a risk of being exposed to finished water when using the public supply for construction activities (e.g., concrete mixing and general washing) as well as for drinking water. The risks associated with the ingestion of or dermal contact with “finished” water in the construction worker scenario would be captured in the commercial worker scenario, except the construction worker scenario would present less conservative intake parameters (e.g., shorter exposure durations and exposure frequencies). Therefore, the construction worker exposure pathway would only be evaluated if the commercial worker scenario demonstrated unacceptable risk.

3.3.3.4 Visitors and Trespassers

Visitors and trespassers have two different conceptual definitions depending on the exposure route being evaluated. Visitors/trespassers on the utility property could encounter production well water, although with the water being contained within a closed system, contact is highly unlikely. Since the point at which water enters the treatment system is also in a fenced area, monitored by video surveillance, the visitor/trespasser exposure scenario on the treatment plant property is highly unlikely and will not be quantitatively evaluated.

Visitors/trespassers to the Site 0153 area, to either residents or commercial business, may also be exposed to finished water. The risks associated with the consumption of finished water in the visitor/trespasser scenario would be captured in the residential and commercial scenarios, except the visitor/trespasser scenario would involve greatly reduced exposure durations and exposure frequencies. Thus, the visitor/trespasser exposure pathway will only be quantitatively evaluated if the residential or commercial scenarios demonstrate unacceptable risk.

3.3.3.5 Ecological Receptors

The MOA specifies that ecological risk should be evaluated as part of the HHERA. Screening Level Ecological Risk Assessments (SLERAs) include a desktop review to determine if ecologically susceptible areas (ESAs) exist at or near the Site and whether a release could have occurred within or migrated to ESAs resulting in a completed exposure pathway (IDEM, 2012). If not, further ecological risk assessment is not necessary.

Ecologically susceptible areas are locations that merit consideration of potential effects on ecological receptors. Because endangered, threated, and/or rare (ETR) species may reside in underground cave systems, karst terrain is also considered an ecologically susceptible area along with surface waters, wetlands, riparian areas, parks, preserves, and other protected habitats. The locations of national parks, forests, and wildlife refuges, state parks, nature preserves, and other protected areas were evaluated as part of this document. No national parks, forests, and wildlife refuges are in Marion County. However, three state parks are in Marion County: Fort Harrison State Park, Eagle Creek State Park, and White River State Park. White River State Park, which includes the Indianapolis Zoo and White River Gardens, is located within Site 0153.

A review of state and federally listed ETR species and critical habitats revealed 60 reported ETR species and eight high quality natural communities documented within Marion County, Indiana (Indiana Department of Natural Resources (IDNR), 2019). According to the United

States Fish and Wildlife Service, the only federally-listed endangered species within Marion County are: the Bald Eagle, which prefer to breed and winter in forested areas adjacent to large bodies of water; the Indiana Bat and Northern Long-Eared Bat, which prefer caves/mines for hibernation and small stream corridors and woods for breeding and foraging habitats; and, the Rusty Patched Bumble Bee, which prefers grasslands and undisturbed soil for nesting and hibernating.

As mentioned in Section 2.0, any additional evaluation of ESAs will be performed on a site-by-site basis as part of risk assessment activities involved in the State remediation programs. To date, investigations of individual PRP sites has not identified the need to conduct an ecological investigation. Ecological investigations for individual sites within the 0153 boundary will be addressed, if necessary, in individual site investigations conducted by PRPs under the direction of IDEM. Therefore, further evaluation of ESAs is outside the scope of this document.

3.3.3.6 Summary of Potential Receptors

As described in the previous sections, the risk assessment will focus on residential and commercial worker receptors. If unacceptable cancer risk or non-cancer toxicity is demonstrated, the construction worker and visitor/trespasser pathways may also be evaluated.

3.3.4 Exposure Routes

As described in the exposure media section, only the public water supply will be evaluated as part of this HHERA. The exposure routes associated with exposure to public water supply will be the ingestion, dermal contact, and inhalation exposure routes[3].

3.3.5 Exposure Pathway Summary

Complete exposure pathways require exposure media with elevated levels of COPCs and receptors with the opportunity to contact these media. The previous sections described the potential exposure pathways as well as the likely human receptors. **Figure 5** presents an exposure conceptual site model flow diagram, which identifies receptors and potential exposure pathways, and the status of each pathway. The status categories presented on the diagram include:

- "**Incomplete**": human and/or ecological receptors are not exposed to COPCs;
- "**Complete, but under control**", meaning that the potential for exposure to COPCs exists, but current or future engineering controls are in place or will be implemented to prevent unacceptable risk from occurring, or that potential exposure risks will be evaluated and managed via State-led programs.

[3] The inhalation pathway from public supply water (e.g., inhalation of shower vapor or vapors generated when cooking with potable water) is considered to have insignificant contribution to overall risk.

Exposures resulting from complete pathways are addressed either quantitatively or qualitatively in this assessment, except where excluded as noted on the figure and further described in **Section 2**.

3.4 Quantification of Exposure Point Concentrations

Potential exposure to constituents in the environment is directly proportional to their concentrations in environmental media and characteristics of exposure (e.g., frequency and duration). The concentrations of an agent that a receptor may contact in an environmental medium generally are referred to as EPCs. The analytical results for samples from a given medium were utilized to derive a single EPC for each COPC that conservatively represents the level of that COPC to which potential receptors may be exposed.

3.4.1 Exposure Point Concentrations Dataset

The 95% Upper Confidence Limit (UCL) of the mean is considered an appropriate estimation of an RME EPC (U.S. EPA, 1991a). U.S. EPA guidance for the calculation of EPCs in risk assessments recommends using "*at least 10 data points (e.g. 5 wells and 2 rounds of data representative of current conditions) to compute a 95% Upper Confidence Limit (UCL)*" as the EPC (U.S. EPA, 2014a). In general, this HHERA uses existing available data, omitting data from abandoned or out-of-service wells, thereby creating a snapshot of the actual risk to end-users given current conditions. Quantitatively evaluating risk on historical data when concentrations in the wellfield were greater, or including wells that have since been taken offline, would overestimate potential risk and not represent a RME scenario. Thus, EPCs will be calculated based on the four sampling events of 2019 for each active production well in the wellfield, for each respective wellfield, prior to EPC weighting as described in the next section. The datasets used to calculate EPCs are presented in **Table 6**.

3.4.2 Raw Water EPC Contribution Weighting

To present a RME under current conditions, this HHERA will assess the risk contribution from the Wellfields (RS and WR) by creating a combined input stream, weighting the contribution of COPCs from both wellfields based on ratios of gallons pumped, then combining again with surface water and weighting the wellfield versus surface water contribution.

An evaluation of pumping data from both wellfields was performed and is summarized on **Table 7 (Table 7 - INFORMATION REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION**). Although these contribution values vary from year to year, the 16-year average presents a reasonable approximation of the standard operating condition.

These percentages will be used to weight the EPC contribution from both Wellfields to be used in the final intake equation.

Furthermore, an assessment of surface water intake was performed, also presented on **Table 7 (Table 7 - INFORMATION REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION**). Mixing of surface water with production water is performed prior to treatment. Based on 16 years of intake data, the combined input stream (both wellfield and surface water) consists of approximately 89% surface water and 11% combined wellfield water. **INFORMATION REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION**. Thus, the 16-year average was used as the proportion for mixing. The final EPC will be weighted using the proportional contribution of COPCs from groundwater and surface water.

3.4.3 Exposure Point Concentrations Based on Measured Data

EPCs are estimated using measured concentrations in environmental media or estimated based on chemical fate and transport models. Depending on the statistical distribution of the data (e.g. normal, lognormal, gamma), the proportion of the samples reported as non-detect, and the total number of samples, there are several statistical techniques that may be used to estimate EPCs. U.S. EPA Supplemental RA Guidance stipulate that EPC estimates should be based on the 95% upper confidence limit (UCL) of the arithmetic mean to estimate an RME scenario. RME conditions are defined by U.S. EPA as the "highest exposure that is reasonably expected to occur at the Site." The 95% UCL is used to evaluate all COPCs, with a few exceptions as noted below.

In this assessment, the U.S. EPA software package, ProUCL Version 5.1.002, was used to calculate EPCs (U.S. EPA, 2016). This program performs statistical calculations on data sets with or without non-detect results. The first step in the data evaluation process is to determine the best fit distribution of the data. Data is tested first to determine if the distribution is normal, lognormal, or gamma at □ = 0.05. The ProUCL output files provide detailed information on statistics generated for each distribution type and identify the recommended UCL ("Suggested UCL to Use"). In cases where ProUCL presents more than one "Suggested UCL to Use", the UCL that is calculated using the statistical test best suited to the identified distribution is selected.

The statistical outputs generated from ProUCL document the UCL calculations for each of the COPCs being evaluated for the direct contact pathway and are provided in **Appendix E**.

For each COPC, the final EPC is identified as the lower of the UCL or the maximum detected concentration. If the complete dataset for an agent is non-detect, then half the method detection limit was utilized as the EPC. The UCLs, distribution types, and final EPCs for direct contact are presented in **Table 8 (Table 8 - INFORMATION REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION**).

3.5 Estimation of Absorbed Dose Exposure

The U.S. EPA's Guidelines for Exposure Assessment define exposure as "the contact between an agent and an external boundary of a receptor for a specific duration" (U.S. EPA, 2019). These agents are contained in an environmental medium such as water, soil, or air. Generally, two steps are required for an agent to enter a body; an applied dose of an agent makes contact with an absorption barrier of the body (e.g., skin or gastrointestinal tract wall), then crosses the absorption barrier to inside the receptor (uptake). The final amount of agent that enters the receptor is the internal dose (a.k.a absorbed dose) or intake. For most exposure routes, intake is evaluated in terms of how much of the carrier medium containing the agents crosses the absorption barrier (e.g., amount of water ingested, volume of air inhaled).

Two types of doses, applied and internal, are defined for evaluating agent exposure (U.S. EPA, 2019). The applied dose is the amount of an agent present at an absorption barrier (e.g., lung) and available for absorption. The internal dose is the amount of agent absorbed across the barrier and available for internal biological interactions. It is the portion of the internal dose that reaches cells, sites, or membranes where adverse effects occur. Doses are generally presented as dose rates (dose per unit time) on a per unit body weight basis (units of mg/kg-day).

The average dose of an agent over the course of an exposure period is used when calculating potential non-carcinogenic health effects. This dose is termed the Average Daily Dose (ADD). Potential carcinogenic health effects are evaluated in terms of an individual's theoretical increased risk of developing cancer over a lifetime. Although the duration of exposure to an agent release generally does not last for an entire lifetime, agent intake for carcinogens is estimated as the average dose over the average human lifetime (70 years). This lifetime dose applies specifically to the evaluation of carcinogenic effects and is termed the Lifetime Average Daily Dose (LADD). In a RA, the calculated ADD or LADD are quantified using assumptions about the duration, frequency, and magnitude of exposure experienced by each potential receptor, and assumptions about the agent properties that influence absorption. In **Section 4**, these calculated ADDs and LADDs will be multiplied by their corresponding reference dose or cancer slope factor to determine non-cancer toxicity and cancer risk, respectively.

3.5.1 General Form of COPC Intake Calculations

The general form of the equation used to evaluate agent intake is presented below. The inputs and units for each term are slightly different, depending on the pathway being evaluated; therefore, the specific equations and factors for each of the exposure pathways are discussed in subsequent sections.

$$Intake\ \frac{\frac{mg}{kg}}{day} = \frac{C\ x\ CR\ x\ EF\ x\ ED}{BW\ x\ AT}$$

Where:

C = Constituent concentration
CR = Contact rate
EF = Exposure Frequency
ED = Exposure Duration
BW = Body Weight
AT = Averaging time

U.S. EPA presents the equations for calculation of carcinogenic risk and non-cancer toxicity on the U.S. EPA RSL User's Guide website (U.S. EPA, 2019c). These equations as written present a solution for a "screening level" with target risk (TR) or THQ as an equation input. To quantitatively calculate cancer risk or non-cancer toxicity, these equations are modified to solve for TR or THQ, respectively. When modified, the screening level in the equation is substituted with the derived EPC, thereby calculating TR or THQ using calculated Site-specific exposure data. The generic equations presented by U.S. EPA are provided for reference in **Appendix F.**

3.5.2 Dermal Absorption of Constituents from Water

Dermal exposure for a given exposure event can be estimated as the concentration or mass of the agent in the medium contacting the skin. A general equation for estimating dermal exposure is shown below (U.S. EPA, 2007):

$$DAD = \frac{DA_{event} * EV * ED * EF * SA}{BW * AT}$$

Where:

DAD = dermal absorbed dose (mg/kg-d)
DA_{event} = absorbed dose per event (mg/cm^2-event)
SA = skin surface area available (cm^2)
EV = event frequency (events/d)
ED = exposure duration (yr)
BW = body weight (kg)
AT = averaging time (d)

The applied dose in a dermal exposure pathway is the amount of agent in the volume of water contacting the skin. Only a small fraction of this amount of the agent will penetrate the skin and enter the body of a receptor. Dermal exposure calculations are calculated as an absorbed dose and require calculating the fraction of the agent absorbed dermally from groundwater contact, which, for water exposure, is a function of the dermal permeability coefficient (K_p, usually in cm/h), the concentration of the COPC in groundwater, and the duration of the contact event. The relationship is expressed as follows:

$$DA_{event} = K_p * C_w * \tau_{event}$$

Where:

DA_{event} = absorbed dose per event (mg/cm^2-event)
K_p = dermal permeability coefficient (cm/h)
C_w = concentration in water (mg/cm^3)
τ_{event} = dermal exposure event duration (h/event)

K_p is agent specific; however, the remainder of the inputs have residential default values established. Default equation inputs for tap water exposure are listed as outputs from the U.S. EPA's RSL calculator[4] and are presented in **Appendix F.** Agent-specific default values, such as K_p, are included in the outputs from the U.S. EPA RSL calculator in **Appendix G.**

3.5.3 Groundwater Ingestion

Ingestion exposures occur when a receptor eats, drinks, or inadvertently introduces an agent into the gastrointestinal tract. Soil, dust, or foreign objects can be ingested, and ingestion of both food and nonfood items can contribute to an individual's exposure. Once ingested, a chemical can directly impact the gut tissues or be absorbed through the gut into the bloodstream. Dietary (e.g., food, liquids) and nondietary (e.g., soil, dust, other materials) exposure can be estimated as shown in the equation below (U.S. EPA, 2001):

$$E_{ing} = C_{ing} * IR$$

Where:

E_{ing} = ingestion exposure (mass per time)
C_{ing} = concentration of the chemical in food or other exposure media (mass of chemical per mass of medium or mass of chemical per volume of medium)
IR = ingestion rate (mass of medium ingested during the exposure per time)

[4] U.S. EPA RSL calculator available at: https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

3.6 Exposure Factors

The quantitative estimation of agent intake involves incorporation of numerical assumptions for a variety of exposure parameters. Where guidance was available, exposure assumptions used in these intake calculations were based on U.S. EPA (U.S. EPA, 2017b) recommended values. Exposure assumptions utilized in this RA are described below.

3.6.1 Factors Affecting All Pathways

The following factors are consistent across each of the exposure pathways considered in this assessment. As described above, only values for commercial and residential receptors will be presented in this section.

3.6.1.1 Exposure Frequency

Default exposure factors for residents, both children and adults, are provided by U.S. EPA. The exposure frequency for residents is 350 days per year and 250 days per year for commercial workers.

3.6.1.2 Exposure Duration

The exposure duration used to evaluate non-carcinogenic effects for an adult resident is 26 years, while the exposure duration used to evaluate non-carcinogenic effects for a child resident is six years. The carcinogenic exposure duration for a resident is age-adjusted over the span of 26 years, with the first six years incorporating child exposure inputs. Mutagenic exposure is also evaluated over a 26-year period. Commercial worker exposure durations are assumed to be 25 years (U.S. EPA, 2014).

3.6.1.3 Exposure Time

The exposure time used to evaluate residential scenarios is 24 hours per day, while the exposure time used to evaluate commercial worker scenarios assumes eight hours per day.

3.6.1.4 Body Weight

The default value for average body weight of an adult is 80 kg based on U.S. EPA (U.S. EPA, 2014). This value is used for the body weight of the adult resident and the commercial worker. The average body weight of a child is 15 kg (U.S. EPA, 2014).

3.6.1.5 Averaging Time

As described above, the doses for non-carcinogenic health effects are averaged over the specific period of exposure for a given receptor (i.e. 26 years for an adult resident and six years for a child resident). Non-carcinogenic averaging times are calculated by multiplying the exposure duration for the receptor by 365 days per year, or 9,490 days for an adult resident or commercial worker and 2,190 days for a child resident.

Carcinogenic health effects are calculated over a lifetime exposure. The U.S. EPA value for average lifetime, 70 years, is used for exposure duration, resulting in a carcinogenic averaging time of 25,550 days.

3.6.1.6 Reference Dose (RfD_o)

The RfD_o is an estimate of a daily oral exposure of a toxic substance. RfD_o is chemical-specific and can be found in reference databases (such as the U.S. EPA Integrated Risk Information System [IRIS]) as the maximum acceptable oral dose of a toxic substance. The agent-specific reference doses and the originating reference database are presented on **Table 9.**

3.6.1.7 Cancer Slope Factor (CSF_o)

The CSF_o is chemical-specific, and is used to estimate carcinogenic exposure, defined as the increased cancer risk from a lifetime exposure to a substance via inhalation or ingestion. The agent-specific cancer slope factors and the originating reference database are presented on **Table 9.**

3.6.2 Dermal Pathway Exposure Factors

3.6.2.1 Dimensionless Ratio, "B"

The term B in the dermal exposure equation is agent-specific and is defined as the dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (U.S. EPA, 2004). Agent-specific values are presented on the U.S. EPA RSL Calculator outputs in **Appendix G**.

3.6.2.2 Exposure Time (ET_{event})

Exposure time is a U.S. EPA default value and defined as the time spent in an exposure event such as showering or swimming, measured in hours per event. The exposure time for a resident, either adult or child, is 24 hours per day. The exposure time for a commercial worker is eight hours per day.

3.6.2.3 Event Frequency (EV)

Event frequency is a U.S. EPA default value and defined as the number of exposure events such as the ones described above, per year, that a typical person will partake. Event frequency is assumed to be one event per day for both mutagenic and non-mutagenic compounds. EV values are presented in **Appendix G.**

3.6.2.4 Fraction Absorbed Water (FA)
FA is chemical-specific and defined as the percentage of the chemical that enters the body through exposure. This value provides an estimation of the loss of chemicals due to desquamation of the skin (U.S. EPA, 2019). Agent-specific values are presented on the U.S. EPA RSL Calculator outputs in **Appendix G**.

3.6.2.5 Dermal Permeability Coefficient of a Compound in Water (K_p)
K_p is agent-specific, measured in centimeters per hour, and used to account for variability of types of skin and how a chemical will travel throughout the body. Agent-specific values are presented on the U.S. EPA RSL Calculator outputs in **Appendix G**.

3.6.2.6 Skin Surface Area (SA)
The skin surface areas used in the assessment of exposure to soil for the adult and child resident are 19,652 cm^2 and 6,365 cm^2, respectively (U.S. EPA, 2014).

Potentially exposed commercial workers are assumed to wear appropriate clothing during outdoor activities that may direct contact, such as long sleeve shirts and long pants. Therefore, the commercial worker skin surface area available for dermal contact with water is assumed to be the hands, forearms, and head. The exposed skin surface area corresponding to these body parts for the commercial worker receptor groups is approximately 3,527 cm^2, based on guidance from U.S. EPA (U.S. EPA, 2014).

3.6.2.7 Lag Time per Event (τ_{event})
τ_{event} is agent-specific, measured in hours per event. The lag time measures the amount of time that must pass in the event for the chemical to dissolve through layers of skin. Agent-specific values are presented on the U.S. EPA RSL Calculator outputs in **Appendix G**.

3.6.2.8 Time to Reach Steady-State (t*)
t* is agent-specific, measured in hours per event. The time to reach steady state is based on half-lives of chemicals and can be described as the elapsed time when the rate of dissolution on the skin is equal to the rate of input (U.S. EPA, 2004). Agent-specific values are presented on the U.S. EPA RSL Calculator outputs in **Appendix G**.

3.6.3 Ingestion Pathway Exposure Factors

3.6.3.1 Water Ingestion Rate (IR)
The IR is a U.S. EPA default value, measured in liters per day, defined as the amount of water ingested per day by a consumer. IR is assumed to be 0.78 liter per day for children and 2.5 liters per day for adults (U.S. EPA, 2014).

3.6.4 Determining Intake for Age-Adjusted Future Residents

For COPCs that exhibit a carcinogenic risk to future residents, U.S. EPA recommends age-adjusting the intake equations to account for the evolving physical and exposure characteristics of the representative populations. This method accounts for differences in physical characteristics (e.g., body weight and skin surface area) and absorption differences (e.g., skin absorption factors) and provides a weighting based on the exposure duration for each sub-population.

For agents with a mutagenic mode of action, the ADAFs are also incorporated as multipliers in the age-adjusted intake equation for carcinogenic COPCs. Details on the equations used to determine age-adjusted intake for direct contact exposure pathways (ingestion and dermal contact) for carcinogenic risk for both mutagenic and non-mutagenic modes of action are presented in **Appendix F**.

3.6.5 Mutagenic Modes of Action for Potential Carcinogens

U.S. EPA (U.S. EPA, 2005a) addresses cancer risks associated with early-life exposures specifically potency adjustment for carcinogens acting through a mutagenic mode of action (mutagens) (U.S. EPA, 2005b). Consistent with U.S. EPA mutagen definitions, for the Site, TCE and VC have been identified as potential carcinogens with a mutagenic mode of action. For each of these COPCs, ADAFs are applied to the intake factors for early-life age groups, as follows:

- Based on higher carcinogenic risk in infancy, a factor of 10 is applied to the intake factors for residential child to evaluate exposures from age zero up to age two.
- The risk is reduced in early childhood, therefore a factor of three is applied to the intake factors for residential child to evaluate exposures from age two to age six.
- The risk remains elevated compared to adult factors during the early adventurer life phase, therefore a factor of three is applied to the intake factors for residential child to evaluate exposures from age six to 16.
- The ADAF from ages 16-26 assumes adult factors and is therefore a factor of one.
- No adjustment is made to evaluate exposures for non-residential receptors (i.e., the commercial worker), or the residential adult whose exposure occurs within the adult age range.

Additionally, in accordance with early life exposure studies (U.S. EPA, 2005b), both VC and TCE have unique assessment equations used to calculate carcinogenic risk and non-cancer toxicity, which are presented in **Appendix F**.

3.6.6 Mutagenic Modes of Action for Trichloroethene

The evaluation of risk associated with TCE requires an adjustment to account for the joint contribution of cancer risk and mutagenic risk. The adjustment factors for cancer (CAF_o) and mutagens (MAF_o) are defined in the U.S. EPA RSL User's Guide (U.S. EPA, 2019c) and are presented in the equations and variable definitions included in **Appendix F**.

4.0 TOXICITY ASSESSMENT

The toxicity assessment, also known as the dose-response assessment, provides a description of the relationship between a dose of a constituent and the anticipated incidence of an adverse health effect. The U.S. EPA has developed dose-response assessment techniques to set "acceptable" levels of human exposure to agents in the environment. These U.S. EPA-derived risk values address both sub-chronic and chronic non-carcinogenic health effects and potential carcinogenic health risks.

4.1 Evaluation of Non-carcinogenic Responses

The sections that follow discuss the mechanisms of non-carcinogenic response and the derivation of acceptable dose levels. The way these levels are used in this RA and some of the limitations of these values are also covered. The limitations are addressed in greater detail in the uncertainty analysis section of this report (**Section 6**).

4.1.1 Background

Non-carcinogenic biological effects of stressors occur only after a threshold dose is achieved (Casarett, 2001). Physiological mechanisms exist that will minimize the adverse effect, through pharmacokinetic means such as absorption, distribution, excretion, or metabolism (Casarett, 2001). Therefore, a range of exposures and resulting doses exist that can be tolerated by a receptor with essentially no risk of developing adverse effects. The threshold dose for a compound is usually estimated from the no observed adverse effect level (NOAEL), the lowest observed adverse effect level (LOAEL), or the point of departure from a dose-response model.

4.1.2 Non-carcinogenic Toxicity Values

U.S. EPA uses the point of departure from a dose-response model and uncertainty factors to derive Reference Doses (RfDs) and Reference Concentrations (RfCs) for human exposure. An RfD or RfC is an estimate of a daily exposure level (dose) that is unlikely to present an appreciable risk of deleterious effects during a lifetime. U.S. EPA has derived both chronic and sub-chronic RfDs. For this assessment, chronic RfDs/RfCs have been conservatively used to evaluate all receptors.

RfDs (used to evaluate the oral exposure route) are expressed in units of dose (mg/kg-day), while RfCs (used to evaluate the inhalation exposure route) are expressed as concentrations (mg/m^3). Both types of toxicity values incorporate uncertainty factors to account for limitations in the quality or quantity of available data.

Dermal contact RfDs are calculated from oral RfDs. An oral RfD is converted to a dermal absorbed dose (dermal RfD [RfD_d]) by multiplying the oral RfD by a gastrointestinal absorption factor (GIABS) (U.S. EPA, 2004). Oral ingestion toxicity values are not a perfect substitute for dermal toxicity as the ingestion route accounts for how much of an agent is absorbed through the intestinal lining. Thus, the GIABS corrects for this difference.

Chronic Dermal Reference Dose [RfD_d] = RfD_o x GIABS

The GIABS absorption efficiency factors recommended by U.S. EPA have been used in this assessment, specifically 100% (i.e. GIABS equal to one) for all COPCs (U.S. EPA, 2019).

4.1.3 Estimating the Likelihood of Adverse Non-carcinogenic Response

The likelihood of occurrence of adverse non-carcinogenic effects depends on the relationship between the RfD and the estimated average agent dose received by the receptor. Doses less than the RfD are not likely to be associated with any adverse health effects and are, generally, not of regulatory concern. Doses that exceed the RfD are considered to present the potential for adverse effects.

Non-carcinogenic responses are numerically compared by their hazard quotient (HQ). The HQ is calculated by dividing the ADD by the RfD (or adjusted dermal reference dose) as presented below.

$$\frac{\boldsymbol{ADD}}{\boldsymbol{RfD}} = \boldsymbol{HQ}$$

The ADD is the estimated daily dose of an agent averaged over the specific duration of exposure, which may not necessarily be an entire lifetime. Each calculation with a specific combination of COPC, receptor, and exposure pathway, will have a distinct ADD and calculated HQ. HQs associated with all COPCs for a pathway are summed to yield the HI, as indicated:

$HQ_I + HQ_{II} + HQ_{III} + \ldots = HI$

If a receptor is subject to exposure through more than one pathway, the HIs for all pathways are summed. A calculated HI of one or less (i.e. $\leq$1.0) indicates that an adverse effect would not be anticipated. HIs are most appropriately derived for stressors that act on the same target organ or have similar critical effect. Therefore, if the total HI across all COPCs exceeds one, it is appropriate to segregate the COPCs by critical effect and mechanism of action and to derive separate HIs for each group (U.S. EPA, 1989). Critical effects of COPCs are listed on **Table 9**.

Two mutual critical effects were identified in COPC toxic endpoints. Hepatic (liver) failure is documented as non-cancer critical effects for both TCE and VC. Urinary failure is documented as non-cancer critical effects for both cDCE and TCE.

4.2 Evaluation of Potential Carcinogenic Responses

The sections that follow discuss the assumed mechanisms of carcinogenic response and the derivation of carcinogenic toxicity values. The way these values are used in this RA and some of the limitations of these values are also covered. The limitations are addressed in greater detail in the uncertainty section of this report (**Section 6**).

4.2.1 Background

U.S. EPA typically has required that potentially carcinogenic agents be treated as if minimum threshold doses do not exist (U.S. EPA, 2005a). The regulatory dose-response curve used for carcinogens only allows for zero risk at zero dose. Thus, for all environmental doses, some level of risk is assumed to be present using this highly conservative model.

Mathematical dose-response models are used to estimate the theoretical response at various environmental doses. U.S. EPA commonly uses the "linearized multistage model" for low dose extrapolation. This model assumes that the effect of the carcinogenic agent on tumor formation seen at high doses is basically the same at low doses (i.e., the slope of the dose-response curve can be extrapolated linearly toward the origin). U.S. EPA's Guidelines for Carcinogen Risk Assessment recommends that the linearized multistage model be employed in the absence of adequate information to the contrary (U.S. EPA, 2005a). Thus, although the doses being evaluated as part of the HHERA are in the low parts per billion (ppb) range, a carcinogenic risk is still viable and needs to be quantified.

4.2.2 Potential Carcinogenic Toxicity Values

Under RAGS guidance, U.S. EPA evaluates available scientific information, using a weight-of-evidence approach, to determine whether a constituent poses a carcinogenic hazard in humans. U.S. EPA uses this weight-of-evidence approach to group constituents according to their potential for carcinogenic effects based on clinical evidence (U.S. EPA, 1989)

- Group A – Human Carcinogen
- Group B – Probably Human Carcinogen
- Group C – Possible Human Carcinogen
- Group D – Insufficient Data to Classify as a Human Carcinogen
- Group E – Not a Human Carcinogen

In addition, constituents may have been assessed for carcinogenicity using U.S. EPA's Guidelines for Carcinogen Risk Assessment (U.S. EPA, 2005a). Under this guidance, standard descriptors are used as part of the hazard narrative to express the conclusion regarding the weight-of-evidence for carcinogenic hazard potential. There are five recommended standard hazard descriptors:

- "Carcinogenic to Humans"
- "Likely to Be Carcinogenic to Humans"
- "Suggestive Evidence of Carcinogenic Potential"
- "Inadequate Information to Assess Carcinogenic Potential"
- "Not Likely to Be Carcinogenic to Humans"

Both TCE and VC are classified as Carcinogenic to Humans (International Agency for Research on Cancer [IARC], 2019). "U.S. EPA has determined that cis-1,2-dichloroethene is not classifiable as to its human carcinogenicity" (Agency for Toxic Substances and Disease Registry [ATSDR], 2011), therefore it would fall under the fourth category, Inadequate Information to Assess Carcinogenic Potential.

Cancer slope factors (CSFs) are the toxicity values used in quantitatively assessing potential carcinogenic effects from exposure. CSFs are defined as the plausible upper bound, approximating a 95% confidence limit, of the increased cancer risk across a lifetime exposure to a given level of a carcinogen.

The CSF (used to evaluate the oral route of exposure) is expressed in units of reciprocal dose $(\text{mg/kg-day})^{-1}$. Similar to the relationship of oral toxicity to dermal toxicity described in the previous section, the GIABS factor is used to relate dermal cancer risk to oral cancer risk. An oral CSF is converted to an absorbed dose by dividing the CSF by the GIABS, hence:

$$\textbf{Dermal Cancer Slope Factor } [\mathbf{CSF_d}] = \frac{\boldsymbol{CSF_O}}{\mathbf{GIABS}}$$

The GIABS absorption efficiency factors recommended by U.S. EPA are 100% for all COPCs evaluated. (U.S. EPA, 2019).

4.2.3 Estimating the Theoretical Excess Lifetime Cancer Risk

For carcinogenic stressors, a RA evaluates the degree to which a receptor may have an increased likelihood of developing cancer over a lifetime due to exposure to Site-associated agents. At environmental dosage levels, the CSF is assumed to be constant and potential carcinogenic risk to be directly related to intake. In order to estimate the theoretical excess lifetime cancer risk, the LADD of a constituent is multiplied by the CSF as shown:

LADD x CSF = Cancer Risk

For each pathway, these calculations are carried out for each applicable agent, and the risks are summed to obtain the total risk due to that pathway. The total theoretical excess lifetime cancer risk for a particular receptor is then calculated as the sum of the risks from all exposure pathways for that receptor.

4.3 Toxicity Values for COPCs

The toxicity values for each COPC are presented in **Table 9** including the chronic non-carcinogenic oral RfDs and the carcinogenic oral CSFs. **Table 9** also lists the target organ or critical effect for each non-carcinogenic COPC. Gastrointestinal absorption efficiency factors and dermal toxicity values are estimated from the oral values in accordance with U.S. EPA's RAGS and are also presented in **Table 9**. Toxicity values have been obtained from the U.S. EPA Regional Screening Level tables, which follow the hierarchy set by U.S. EPA (U.S. EPA, 2019).

5.0 RISK CHARACTERIZATION

Risk characterization is the final step of the human health RA process. It includes a description of the nature and magnitude of the potential for occurrence of adverse health effects under reasonable maximal exposure conditions. In this step, the toxicity assessment and Site-specific exposure assessment are integrated into quantitative and qualitative estimates of potential health risks. Potential non-carcinogenic and carcinogenic health risks are calculated and summarized individually for each receptor exposed to COPCs at the Site. Estimated risks are combined across COPCs and exposure pathways as appropriate. The following subsections describe the methodology and results for the evaluation of non-carcinogenic and potential carcinogenic effects.

5.1 U.S. EPA RSL Calculator

U.S. EPA's online RSL calculator[5] is employed to determine cancer risk and HI for COPCs for the residential ingestion and dermal pathways. The RSL calculator was designed to determine applicable screening levels given Site-specific inputs. However, as discussed in **Section 3**, the equations utilized within the calculator can be adjusted to solve for HQ and/or cancer risk. By selecting the "*Risk Output"* function on the web interface, the calculator will derive risk values based on either default or user-defined exposure factors given a user-defined source concentration.

The inputs for the web interface of the online calculator are listed below. The resultant output is included as a PDF in **Appendix G.**

- **INITIAL WEB INPUTS**
  - *Screening Level Type*: Regional Screening Levels
  - *Hazard Quotient*: 1
  - *Target Risk*: 10^{-6}

[5] Available at https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

- *Scenario*: Resident
- *Media*: Tap water
- *Screening Level Choice*: Site-Specific
    - *Chemical Info Type*: Database Hierarchy Defaults
- *Risk Output*: Yes
- *RfD/RfC Choice*: Chronic
- *Select Chemicals:*
    - Trichloroethylene (CAS 79-01-6);
    - Dichloroethylene, 1,2-cis- (CAS 156-59-2)
    - Vinyl Chloride (CAS 75-01-4)
- *Select All Chemicals*: [Unchecked]
- *Select Include Metadata*: [Checked]

- **SECONDARY WEB INPUTS**
    - *Tap Water Concentrations (µg/L):*
        - Trichloroethylene: 0.0501 µg/L
        - Dichloroethylene, 1,2-cis-: 0.301 µg/L
        - Vinyl Chloride: 0.0830 µg/L
    - Remaining fields unchanged from default values

5.2 Non-carcinogenic Effects

Potential non-carcinogenic effects associated with exposure to COPCs from the Site are estimated as described in **Section 4**. The total HIs are then calculated for each receptor by combining pathway-specific HIs. A HI value equal to or less than 1.0 indicates that an adverse effect would not be anticipated (U.S. EPA, 1989). Conversely, a target-organ specific HI greater than 1.0 indicates that additional evaluation of the toxicity is warranted.

Appendix G presents the total HIs for each receptor exposed to COPCs associated with the Site. The total non-cancer HIs are less than the benchmark of 1.0 for the future residents indicating that the likelihood of adverse non-cancer effects would be negligible. Exposure factor inputs and agent-specific results, including target-organ specific HIs, for each receptor are presented in **Appendix G** and **Table 10**, respectively. Total HI results for each receptor are summarized in Table 5.2 below**.**

Table 5.2
Summary of Receptor Hazard Indices
via Direct Contact Pathways

Receptor	Ingestion HQ	Dermal HQ	Total HI
Future Adult Resident	0.00834	0.00110	0.00944
Future Child Resident	0.0139	0.00165	0.0156
Total Future Resident	**0.0222**	**0.00275**	**0.0250**

As described in **Section 3**, the exposure factors for ingestion or dermal contact by a commercial worker include less conservative assumptions regarding exposure frequency, exposure duration, and other exposure factors (e.g., skin surface area). The quantitative assessment of toxicity hazard to a future resident incorporates conservative exposure factors. If the toxicity hazard for the future resident is acceptable (i.e. less than 1.0), then it is also acceptable for all other receptors with less conservative exposure factors (i.e. commercial worker, construction worker, or recreator). Thus, a Site-specific commercial toxicity hazard index has not been calculated.

It should be noted that the U.S. EPA RSL Calculator automatically provides quantitative estimates of non-carcinogenic inhalation health risks. Although inhalation was not considered as a significant completed exposure pathway in this HHERA, the calculated hazard indices are also less than the benchmark of 1.0 for future residents.

5.3 Potential Carcinogenic Effects

Theoretical excess lifetime cancer risks associated with exposure to COPCs from the Wellfields have been calculated as described in **Section 4**. Summed theoretical excess risks are calculated for each receptor by combining pathway-specific risks. The results are then compared with target benchmarks for acceptable risk. U.S. EPA considers theoretical excess lifetime cancer risks in the range of $1x10^{-4}$ to $1x10^{-6}$ to be acceptable (U.S. EPA, 1991).

Table 10 presents the theoretical excess lifetime cancer risks for each receptor exposed to COPCs associated with the Site. The potential cumulative cancer risks are within the U.S. EPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$ for the future residents (and thus commercial workers as described in **Section 5.2**), indicating that the likelihood of unacceptable potential cancer risk is negligible for these receptors. Pathway-specific results for each receptor are summarized in Table 5.3 below.

Again, it should be noted that the U.S. EPA RSL Calculator automatically provides quantitative estimates of inhalation cancer risks. Although inhalation was not considered as a significant completed exposure pathway in this HHERA, the calculated values are within the acceptable cancer risk range for future residents.

Table 5.3
Summary of Theoretical Excess Lifetime Cancer Risk via Direct Contact Pathways

Receptor	Ingestion Risk	Dermal Risk	Total Risk
Age-Adjusted Future Resident	$3.91x10^{-6}$	$3.07x10^{-7}$	$4.22x10^{-6}$

6.0 UNCERTAINTY ANALYSIS

Uncertainties are inherent in a quantitative RA and an analysis of the potential areas of uncertainty are a standard component of the RA process. The uncertainty analysis provides a context for better understanding the assessment conclusions by identifying the uncertainties that have most significantly affected the assessment results. U.S. EPA guidance stresses the importance of providing a complete analysis of uncertainties so that risk management decisions take these uncertainties into account when evaluating RA conclusions (U.S. EPA, 1992). The major sources of uncertainty in the HHERA are identified qualitatively below.

6.1 Uncertainties in Sampling Methodology

Water samples collected from the production wells were obtained from a collection point after the groundwater was withdrawn from the production wells. Some volatile loss may have occurred during sample collection. U.S. EPA Superfund protocols recommend sampling for cVOCs under low-flow conditions to minimize loss of cVOCs during sampling. The effect of the current sampling methods on concentrations of cVOCs is not quantifiable; however, volatile loss due to agitation during pumping would likely result in a low bias, or underestimation, of cVOC concentrations in groundwater. Although the production well results may have a low bias compared to actual concentrations in groundwater, the corresponding human health risk is based on the concentrations of cVOCs in the public supply water (i.e. water post-extraction from production wells). This uncertainty would therefore have no effect on the quantification of risk performed in this HHERA.

6.2 Uncertainties in Hazard Identification

Uncertainties in the hazard identification step of the RA are primarily associated with the available analytical data and the selection process for identification of COPCs. Multiple uncertainties exist in the process of identifying COPCs which include uncertainties associated with the number of samples selected for use in the RA, limitations of the COPC identification process, and the use of estimated data in quantitative assessment.

6.2.1 Sampling Strategy

The production wells are regularly sampled, usually once a quarter. As pumping rates may change daily, there is the potential that the presence of cVOCs were simply missed by any single sampling event due to the pumping regime in place at the time of sampling. This uncertainty is mitigated by the abundance of data over a large time period with minor deviations in the number and concentrations of the analytes detected in a particular well.

6.2.2 Analytical Limitations and Identification of COPCs

The default laboratory RLs for VOCs via U.S. EPA Method 524.2 is 0.5 µg/L. Any contaminant above a RBSC of $1x10^{-6}$ or HQ of 0.1 is carried forward in the quantitative RA.

However, as described previously, there exists the possibility that a cVOC may be present at a level above a RBSC but below the RL or MDL. If a cVOC was detected in production water, it either definitively screened out or was retained for further evaluation as a COPC. The potential presence of an unidentified compound above the RBSC adds uncertainty to the overall HHERA. It should be noted that if a compound were to exist under this scenario, the compounds has been consistently below RLs over the 16 years of monitoring and would unlikely affect the conclusions of overall risk.

6.2.3 Managing Non-Detect Data

Left-censored (i.e. non-detect) data are challenging to interpret when quantitatively evaluating risk. If a result is reported as non-detect, the U.S. EPA considers it acceptable to assume the presence of cVOCs at a concentration equal to half the MDL of the performing laboratory. This practice is a conservative approach and may overestimate the potential risk by attributing concentrations where none are present.

6.2.4 COPC Additivity

The cancer risk of each COPC or common critical effect was considered as additive to all other risks, when, in reality, this is a conservative assumption.

6.2.5 Use of Qualified Data

The reported value of "J-flagged" results are considered estimated and are assumed to approximate the actual value. This qualified data is appropriate to use when establishing presence/absence of a constituent and in determining the Site-wide EPC. However, as it is only an approximation of the actual value, the true dataset distribution is subject to uncertainty. Regardless, the inclusion of this data is appropriate in establishing Site-wide concentrations and quantifying overall potential risks.

6.3 Uncertainties in Exposure Assessment

The U.S. EPA approach to exposure assessment generally requires standard default exposure equations rather than determining Site-specific exposures via targeted studies. Under this approach, if an agent is identified as a COPC for a particular population and environmental medium it is assumed that exposure to that substance will occur at levels consistent with the default scenario. The default scenarios used in the human health RA evaluate current and future potential exposure pathways under RME conditions. The RME scenario is defined as the highest exposure that is reasonably expected to occur at a Site (U.S. EPA, 1989) and is unlikely to be reflective of actual conditions.

6.3.1 Use of Default Exposure Factors

The RA uses upper percentiles for each of the exposure factor inputs into the equations that are used to derive risk. The combination of upper end exposure estimates across exposure frequency, time and duration are all expected to occur in all of the exposed population all of the time. If any one of them are not at upper end percentiles, then the risk is overestimated.

Reviewing equation input parameters, which are all at upper percentile values, leads one to conclude the risk estimates are very conservative. The same is true of the toxicity parameters as they are meant to protect sensitive individuals and are also upper percentile values in terms of protectiveness. Some equations (e.g. dermal contact) have multiple upper end input parameters. This is a considerable margin of safety given that it is extremely unlikely to expect all exposure to occur all the time at these upper percentiles.

Risks from dermal exposures were calculated based on a dermal toxicity extrapolated from oral values using a GIABS absorption fraction of 1. The default assumption of 100% absorption compared to oral values may overestimate the dermal risk. However, the degree of bias from this uncertainty with this assumption is believed to be small.

6.3.2 Production Mixing Assumptions

A review of available production information was performed to determine the long-term averages for production water contribution from each wellfield. The actual ratios of Riverside Wellfield contribution to White River Wellfield contribution are frequently shifted depending on production needs, operational performance, and seasonal effects. The use of a long-term averages may inadvertently minimize the actual contribution of the more impacted wells in the wellfield on any given day.

Likewise, surface water intake was assessed to determine long-term averages as compared to combined wellfield contribution. The gallons of surface water intake are also frequently changed. The average contribution may inadvertently minimize the actual contribution of the contaminants from the wellfield. Additionally, calculations are based on combined mixed water output prior to additional treatments, therefore actual risks are expected to be lower.

The use of average production information to represent a system in flux is believed to be an appropriate method for the application of mixing ratios. Furthermore, it is believed that based on the lengthy timeframe of available data (i.e. greater than a decade of operational data), the average represents a reasonable approximation of operational conditions.

6.3.3 Surface Water Baseline Concentration Assumptions

In order to provide a RME scenario which incorporates mixing of SIRW and PWRW, a baseline concentration of cVOCs had to be attributed to the SIRW. No SIRW-specific studies have been performed. Thus, the minimum concentration of half the laboratory specific MDL was attributed to the surface water contribution for cVOCs. This assumption may overestimate potential exposure risk.

6.3.4 Water Ingestion Rate (IR)

The U.S. EPA has released updated studies quantifying the ingestion of community water by age groups. Using *Table 3-1 – Recommended Values for Drinking Water Ingestion Rates (2-day average community water intake)* (U.S. EPA, 2019), under the Consumers-Only header, the estimated consumption for the "All Ages" category is 2.974 liters per day, instead of the default values of 2.5 liters per day used by the U.S. EPA RSL Calculator (U.S. EPA, 2014). If the increased value for daily ingestion is utilized rather than the default value used by the RSL calculator, the output calculations result in only a negligible increase to the Cancer Risk and Hazard Index totals presented in this HHERA (i.e. cumulative cancer risks well within the U.S. EPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$ and a non-carcinogenic HI well below 1.0).

6.3.5 Sensitive Subpopulations

The magnitude of sensitive subpopulations in the study area is unknown. Sensitive subpopulations cannot reasonably be excluded from the receptor populations, which increases uncertainty in calculated risk using default methodologies. The use of upper percentile default exposure parameters and toxicity factors (e.g., RfD, CSF, etc.) have been incorporated into this HHERA which provide a wide margin of safety and are protective of the sensitive subpopulations presumed present in the receptor populations.

6.3.6 Environmental Fate and Transport Uncertainty

cVOCs in groundwater originate from multiple off-Site sources from areas hydraulically upgradient of the wellfields. Currently, the release mechanisms and transport dynamics from these multiple sources are not completely understood. However, the IDEM is actively engaged in identifying, investigating, and remediating potential sources and their respective impacts to groundwater under state programs (e.g. State Cleanup Program). Thus, although there is uncertainty in the fate and transport of existing releases, the combination of natural degradation processes during contaminant transport and future remedial efforts will continue to decrease cVOC concentrations observed in the wellfield over time. Since exposure risk to future residents is based on current cVOC levels and these levels are anticipated to reduce over time, the potential future risk may be overestimated.

6.4 Uncertainties in Toxicity Assessment

6.4.1 Limitations of Toxicity Studies

Approaches typically utilized for designating reference doses have a wide margin of safety. The U.S. EPA applies uncertainty factors (ranging from three to 10) to the NOAEL for a constituent in a toxicity study to account for factors such as animal-to-human extrapolation, inter-individual variation in the human population, limitations in data quality or incomplete studies (U.S. EPA, 2016a). Some of this uncertainty may be reduced if the absorption, distribution, metabolic fate, and excretion parameters of an agent are known. Because the fate and mechanism of action of an agent may differ in animals and humans, effects observed in animals may not be observed in humans, and vice versa. Interspecies dose conversion may also be limited by differences in lifespan, body size, breathing rates, or the route of administration utilized in a study.

6.4.2 cis-1,2-Dichloroethene Carcinogenic Risk

According to U.S. EPA's IRIS database (U.S. EPA, 2010), there is inadequate information to assess the carcinogenic potential of cis-1,2-DCE. No epidemiologic studies have been identified that review possible long-term effects of cis-1,2-DCE exposure. Likewise, no cancer bioassays of cis-1,2-DCE are available. Genotoxicity and mutagenicity studies do exist, but have provided mixed results and have been considered inconclusive. Therefore, the potential exists for cDCE to have a theoretical lifetime excess cancer risk, but it is currently not quantifiable given the limitations of the field of study and available information.

6.4.3 Upper Bound CSFs

The U.S. EPA CSFs are considered plausible upper bounds of risk at a 95% confidence level. Thus, actual risks are likely to be much lower.

Additionally, dose-response models used to assess observed data are used to derive a Point of Departure (POD), or the estimated dose near the lower end of the observed range without significant extrapolation (U.S. EPA, 2005a). Typically, for low-dose linear models, a line is extrapolated from the POD of the dose-response model and forced through the origin. The slope of this line (i.e. slope factor) is an upper-bound estimate of risk per increment of dose. Since these dose-response models do not empirically evaluate low-dose response and use mathematical extrapolation to assess the proportional risk, there is uncertainty in the application of these derived cancer slope factors. Realistically, when biological factors are considered, the best estimate of the risk at very low concentrations is often zero.

6.4.4 Assessment of the Mutagenic Mode of Action

U.S. EPA guidance suggests that some agents (e.g., TCE and VC) may act as mutagens, and therefore require a modified approach to address the potential for risk during early life stage exposure (U.S. EPA, 2005b). Therefore, this RA has incorporated age-dependent adjustment factors for the residential child receptors (ages 0 up to age 16). However, this approach is considered speculative, and the guidance emphasizes that the preferable approach is to estimate risk based on analyses of data rather than on default adjustment factors. "*When data are available for a susceptible life stage, they should be used directly to evaluate risks for that chemical and that life stage on a case-by-case basis*" (U.S. EPA, 2005b). The use of default adjustment factors in the risk calculations for the potential mutagens has resulted in calculated potential risks for young children that are three to 10 times greater than would be calculated using the standard, linear low-dose extrapolation approach (due to the toxicity values being multiplied by a factor of three or 10 depending on the age group). The use of default adjustment factors incorporates a margin of safety into the risk calculations, but also potentially overestimates risk.

6.5 Uncertainties in Risk Characterization

The typical approach to RA, and that used for the Site, involves conservatively multiplying a combination of average and upper bound exposure assumptions together to evaluate exposure. U.S. EPA RAGS specifies that numerous factors in the exposure equation should each be represented by the 95% UCL on the mean for that variable (U.S. EPA, 1989). These factors include the exposure point concentration, the contact rate with the environmental medium, and the exposure frequency and duration.

In summary, estimates of exposure and risk are subject to multiple uncertainties that may result in an overestimation or underestimation of risk. While the magnitude and directional bias for many of these uncertainty factors is unknown, it is most likely that the conservative approach of using upper bound and RME estimates have likely overestimated the risks described in this HHERA.

7.0 CONCLUSIONS

IDEM prepared the HHERA to provide a qualitative assessment and, where appropriate, quantitative analyses, in a conservative manner, of the potential for adverse health effects from exposure to constituents in environmental media associated with the Wellfields. The purpose of the HHERA is to characterize, assess, and summarize risks to human health and the environment associated with the groundwater produced from the Wellfields. Due to the fact that current and historic finished drinking water results are below MCLs, quantitative analysis of finished drinking water is not warranted or necessary and the quantitative portion of the HHERA concentrated on the PWRW produced from the Wellfields.

Site 0153 was proposed for the NPL based on detections of cVOCs in PWRW drawn from certain well located within the Wellfields. The potential source(s) of cVOCs detected in the Wellfields is believed to have migrated to these production wells from historic releases from off-Site properties in the surrounding area. Based on the detections of cVOCs in the Wellfields, the HHERA focused on cVOCs associated with chlorinated solvents traditionally utilized in dry-cleaning, industrial, and manufacturing activities. COPCs for risk assessing purposes were developed utilizing production well analytical results collected from the Wellfields since 2004. COPCs utilized in the HHERA include: TCE, cis-1,2-DCE, and VC.

An exposure assessment was completed to determine potential exposure pathways, potential future receptors that could be exposed to Wellfield COPCs, and potential exposure routes. The HHERA focused on the public water supply and calculated risk based on Residential (Adult and Child) receptors and potential dermal and ingestion exposure routes. Operating data, including standard mixing of groundwater and surface water prior to treatment, from 2004 – 2019 were incorporated into the risk calculation to provide accuracy.

The U.S. EPA RSL calculator was utilized to determine both carcinogenic risk and non-carcinogenic hazard index for COPCs in the combined, blended Wellfield/Surface Water output. The HHERA Risk Characterization identified results well within U.S. EPA-acceptable levels (i.e. no unacceptable risk). Total calculated Carcinogenic Risk of $4.22x10^{-6}$. U.S. EPA considers theoretical excess lifetime cancer risks in the range of $1x10^{-6}$ to $1x10^{-4}$ to be acceptable under CERCLA. Additionally, the MOA identified the target risk criteria for Site 0153 to be at or below $1x10^{-5}$ (which the calculated value, 4.22×10^{-6}, falls below). Total calculated Non-Carcinogenic Hazard Index of 0.0250. U.S. EPA considers any Hazard Index of <1.0 acceptable under CERCLA.

As indicated by the results of the HHERA, there is no reasonable potential for adverse effects to human health or the environment.

8.0 REFERENCES

ATSDR, 2011. *Toxic Substances Portal – 1,2-Dichloroethene.* Agency for Toxic Substances and Disease Registry Website. Accessed May 4, 2020. Available at: https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=463&tid=82

Citizens, 2019. *Water Quality Monitoring Plan for Groundwater from Production Wells: Revision 1.1.* Citizens Water Indianapolis. January 15, 2019.

Hydro Geo Chem, 2011. *Natural Attenuation of Chlorinated Aliphatic Hydrocarbons (CAH): Version 1.0.* Hydro Geo Chem, Inc. Accessed April 24, 2020. Available at: http://www.hgcinc.com/voc%20degradation%20pathways.pdf

IARC, 2019. *IARC Monographs on the Identification of Carcinogenic Hazards to Humans: List of Classifications.* World Health Organization - International Agency for Research on Cancer website. Accessed on May 4, 2020. Available at: https://monographs.iarc.fr/list-of-classifications

IDEM, 2012. *Remediation Closure Guide.* Indiana Department of Environmental Management. March, 2012. Available at: http://www.in.gov/idem/cleanups/files/remediation_closure_guide.pdf

IDEM, 2013. *Site 0153/Riverside Groundwater Contamination Site: Preliminary Assessment Report.* IDEM. November 1, 2013. VFC Document #80021869.

IDEM, 2014. *Site 0153/Riverside Groundwater Contamination Site: Site Inspection Report.* IDEM. October 23, 2014. VFC Document #80261509.

IDEM/U.S. EPA, 2017. *Memorandum of Agreement between United States Environmental Protection Agency, Region 5 and Indiana Department of Environmental Management for the 0153/Riverside Ground Water contamination Site, Indianapolis, Indiana.* IDEM and U.S. EPA. June 8, 2017. VFC Document #80474567.

IDEM, 2020. *Site 0153: Remedial Investigation Report.* Indiana Department of Environmental Management. November 2020.

IDEM, 2020a. *Site 0153: Feasibility Study Report.* Indiana Department of Environmental Management. November 2020.

IDNR, 2019. *List of Endangered, Threatened, & Rare Species by County.* Retrieved from Endangered Plant and Wildlife Species: Accessed February 4, 2020. Available at: https://www.in.gov/dnr/naturepreserve/4666.htm

ISDH, 2020. *Drinking Water Laboratory Certification.* Indiana State Department of Health. Accessed April 14, 2020. Available at: https://www.in.gov/isdh/24859.htm

Casarett, 2001. *Casarett and Doull's Toxicology: The Basic Science of Poisons, 6th Edition*. Louis J. Casarett, John Doull, and Curtis D Klaassen. 2001.

U.S. EPA, 1989. *Risk Assessment Guidance for Superfund. Volume I, Part A. Human Health Evaluation Manual (EPA 540-1-89-002)*. U.S. EPA Office of Emergency and Remedial Response. December 1989. Available at: https://www.epa.gov/

U.S. EPA, 1991. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions: OSWER Directive 9355.0-30.* U.S. EPA Office of Solid Waste and Emergency Response. April 22, 1991. Available at: https://www.epa.gov/sites/production/files/2015-11/documents/baseline.pdf

U.S. EPA, 1991a. *Exposure Point Concentrations in Groundwater – Region III Technical Guidance Manual: EPA/903/8-91-002*. U.S. EPA Hazardous Waste Management Division. November, 1991. Available at: https://www.epa.gov/sites/production/files/2015-09/documents/exposure_point_conc.pdf

U.S. EPA, 1991b. *Regional Guidance on Handling Chemical Concentration Data Near the Detection Limit in Risk Assessments.* U.S. EPA Region 3 Hazardous Waste Management Division Office of Superfund Programs. November 4, 1991. Accessed February 4, 2020. Available at: https://www.epa.gov/risk/regional-guidance-handling-chemical-concentration-data-near-detection-limit-risk-assessments

U.S. EPA, 1991c. *Risk Assessment Guidance for Superfund. Volume I, Part B. Development of Risk-Based Remediation Goals: OSWER Directive 9285.7-018.* U.S. EPA Office of Emergency and Remedial Response. December 1991. Available at: https://www.epa.gov/

U.S. EPA, 1992. *Guidance for Data Usability in Risk Assessment (Part A): Publication 9285.7-09A*. U.S. EPA Office of Solid Waste and Emergency Response. April 1992. Available at: https://rais.ornl.gov/documents/USERISKA.pdf

U.S. EPA, 2000. *Vinyl chloride; CASRN 75-01-4*. IRIS Chemical Assessment Summary. Available at: https://cfpub.epa.gov/ncea/iris2/

U.S. EPA, 2001. *Draft Protocol for Measuring Children's Non-Occupational Exposure to Pesticides by all Relevant Pathways: EPA/600/R-03/026.* U.S. EPA Office of Research and Development, National Exposure Research Laboratory. September 2001. Available at: https://nepis.epa.gov/

U.S. EPA, 2001a. *Chloroform; CASRN 67-66-3*. Integrated Risk Information System (IRIS) Chemical Assessment Summary. Available at: https://cfpub.epa.gov/ncea/iris2/

U.S. EPA, 2004. *Risk Assessment Guidance for Superfund. Volume 1 - Human Health Evaluation Manual, Part E (Supplemental Guidance for Dermal Risk Assessment): EPA/540/R/99/005*. U.S. EPA Office of Superfund Remediation and Technology Innovation. July 2004. Available at: https://www.epa.gov/

U.S. EPA, 2005. *Manual for the Certification of Laboratories Analyzing Drinking Water, Criteria and Procedures Quality Assurance, Fifth Edition: U.S. EPA 815-R-05-004.* U.S. EPA Office of Groundwater and Drinking Water. January 2005. Available at: https://nepis.epa.gov/

U.S. EPA, 2005a. *Guidelines for Carcinogen Risk Assessment. EPA/630/P-03/-1F.* United States Environmental Protection Agency. March 2005. Available at: https://www.epa.gov/sites/

U.S. EPA, 2005b. *Supplemental Guidance for Assessing Susceptibility from Early-life Exposure to Carcinogens: EPA/630/R-03/003F.* U.S. EPA Risk Assessment Forum. March 2005. Available at: https://www.epa.gov/

U.S. EPA, 2007. *Dermal Exposure Assessment: A Summary of EPA Approaches: EPA 600/$-07/040F.* U.S. EPA National Center for Environmental Assessment. September 2007. Available at: https://ofmpub.epa.gov/

U.S. EPA, 2010. *cis-1,2-dichloroethylene; CASRN 156-59-2*. IRIS Chemical Assessment Summary. Available at: https://cfpub.epa.gov/ncea/

U.S. EPA, 2014. *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors: OSWER Directive 9200.1-120.* U.S. EPA Office of Superfund Remediation and Technology Innovation. February 6, 2014. Available at: https://www.epa.gov/

U.S. EPA, 2014a. *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance.* U.S. EPA Office of Superfund Remediation and Technology Innovation. March 11, 2014. Available at: https://nepis.epa.gov/

U.S. EPA, 2016. *ProUCL Version 5.1.00*. Software package and guidance manual developed by Lockheed Martin Environmental Services, and distributed by U.S. EPA, Office of Research and Development. United States Environmental Protection Agency. Available at: https://www.epa.gov/land-research/proucl-software

U.S. EPA. (2016a). *Integrated Risk Information System (IRIS).* United States Environmental Protection Agency. Retrieved from www.epa.gov/iris

U.S. EPA, 2019. *Regional Screening Levels for Chemical Contaminants at Superfund Sites (Cancer Risk* $1x10^{-6}$*, THQ 0.1)*. United States Environmental Protection Agency. Accessed February 3, 2020. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

U.S. EPA, 2019a. *Guidelines for Human Exposure Assessment: EPA/100/B-19/001.* U.S. EPA Risk Assessment Forum. October 2019. Available at: https://www.epa.gov/

U.S. EPA, 2019b. *Update for Chapter 3 of the Exposure Factors Handbook: Ingestion of Water and Other Select Liquids*. United States Environmental Protection Agency. Available at: https://cfpub.epa.gov/ncea/

U.S. EPA, 2019c. *Regional Screening Levels – User's Guide*. United States Environmental Protection Agency. Accessed April 3, 2020. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide

FIGURES

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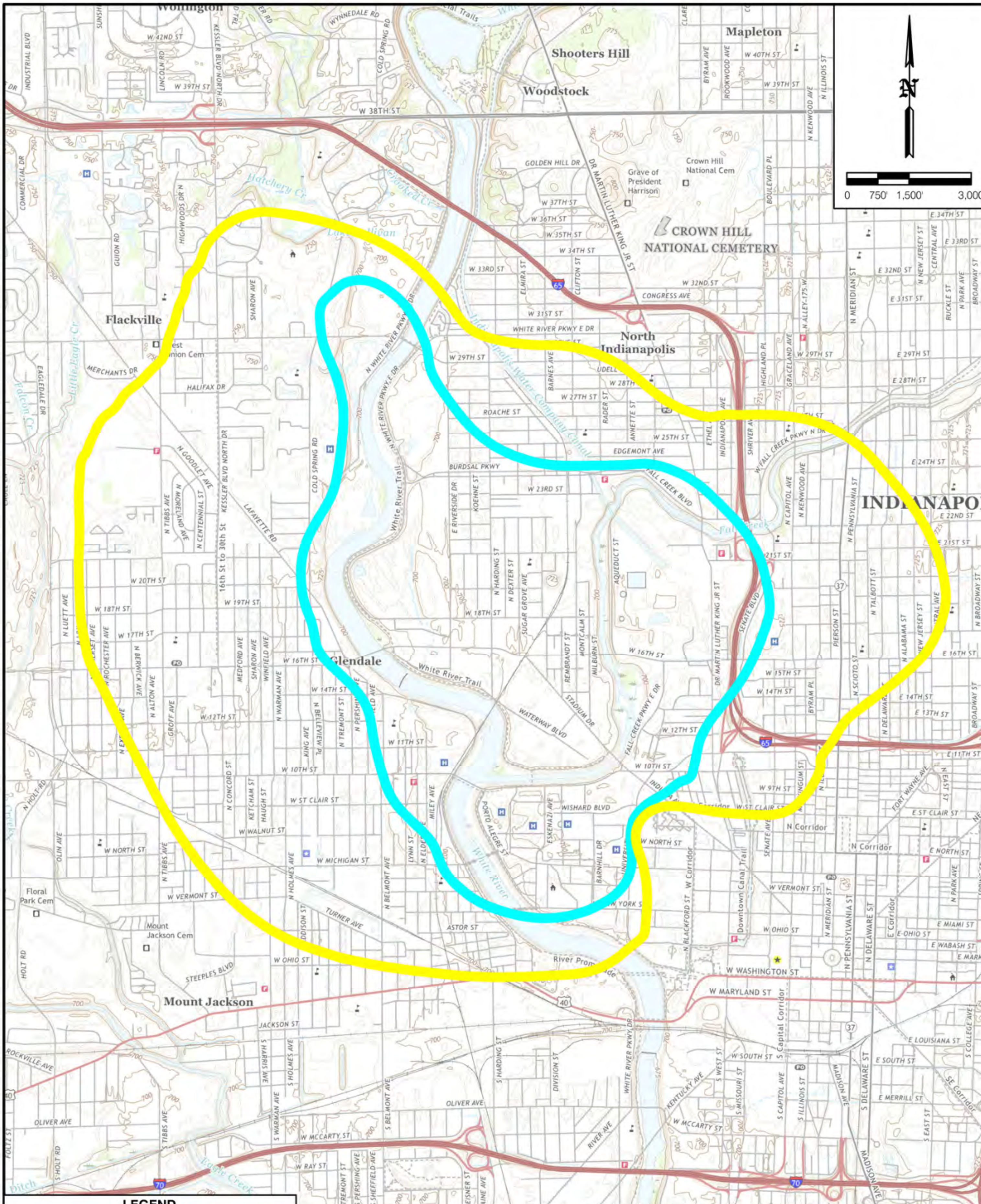


LEGEND

= Wellhead 1-Year Time Of Travel

= Wellhead 5-Year Time Of Travel

Site 0153 Vicinity Map

Figure 1

PROPERTIES WITHIN 5-YEAR TOT

Media	Complete Exposure Pathway?	Controls?
Soil	Controlled	IDEM Remediation Program
Groundwater	Controlled	IDEM Remediation Program
Vapor ntrusion	Controlled	IDEM Remediation Program

WHITE RIVER

Media	Complete Exposure Pathway?	Controls?
Surface Water	Controlled	IDEM Remediation Program
Sediment	Controlled	IDEM Remediation Program

RIVERSIDE PRODUCTION WELLS

Media	Complete Exposure Pathway?	Controls?
Soil	N/A	N/A
Groundwater	Controlled	Site 0153 Alternative Plan
Vapor Intrusion	N/A	N/A

PROPERTIES WITHIN 5-YEAR TOT

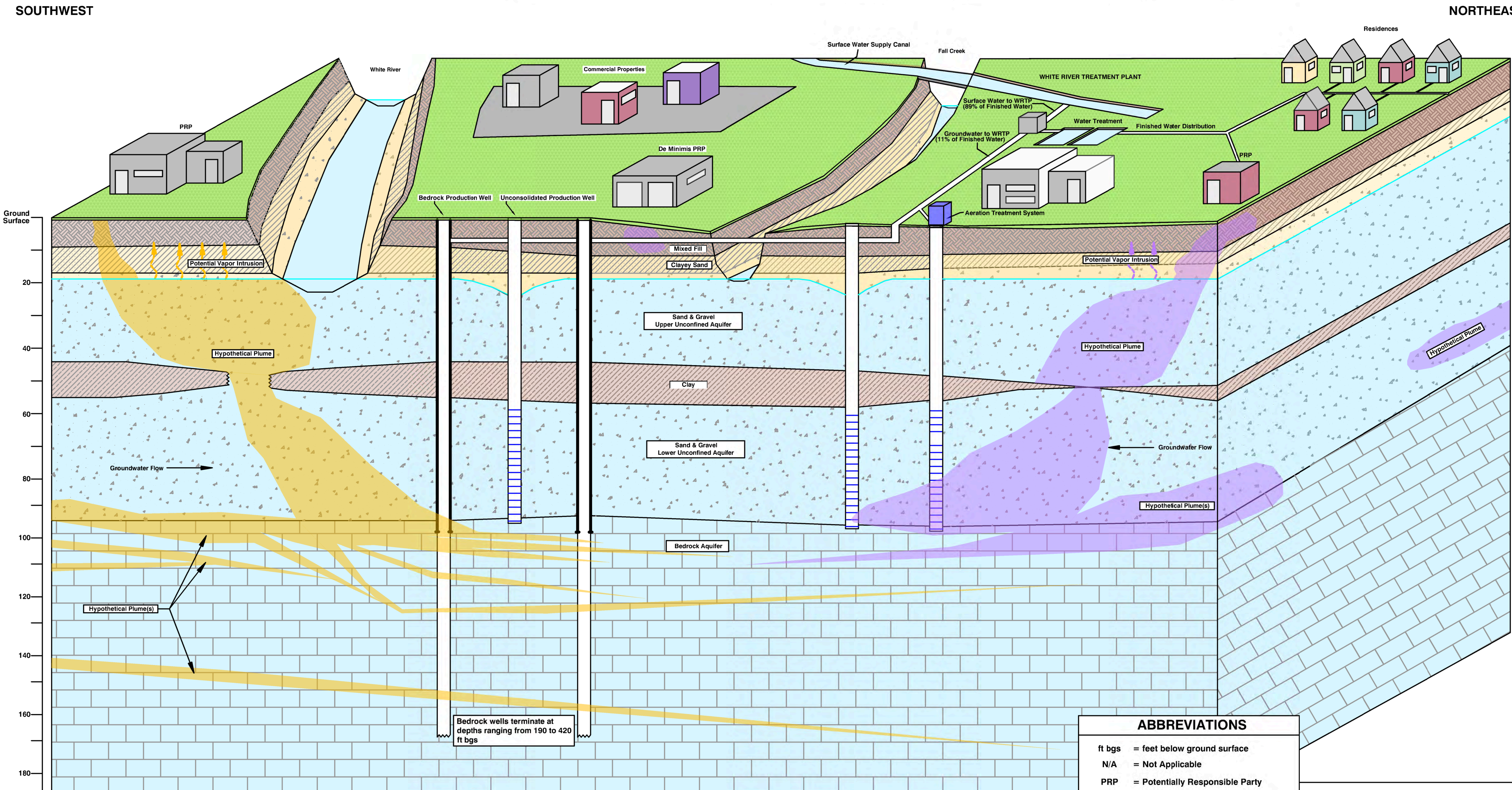
Media	Complete Exposure Pathway?	Controls?
Soil	Controlled	IDEM Femediation Program
Groundwater	Controlled	IDEM Femediation Program
Vapor Intrusion	Controlled	IDEM Femediation Program

WHITE RIVER PRODUCTION WELLS

Media	Complete Exposure Pathway?	Controls?
Soil	Controlled	N/A
Groundwater	Controlled	Site 0153 Alternative Plan, including aeration
Vapor Intrusion	N/A	N/A

PROPERTIES WITHIN 5-YEAR TOT

Media	Complete Exposure Pathway?	Controls?
Soil	Controlled	IDEM Remediation Program
Groundwater	Controlled	IDEM Remediation Program
Vapor Intrusion	Controlled	IDEM Remediation Program



ABBREVIATIONS

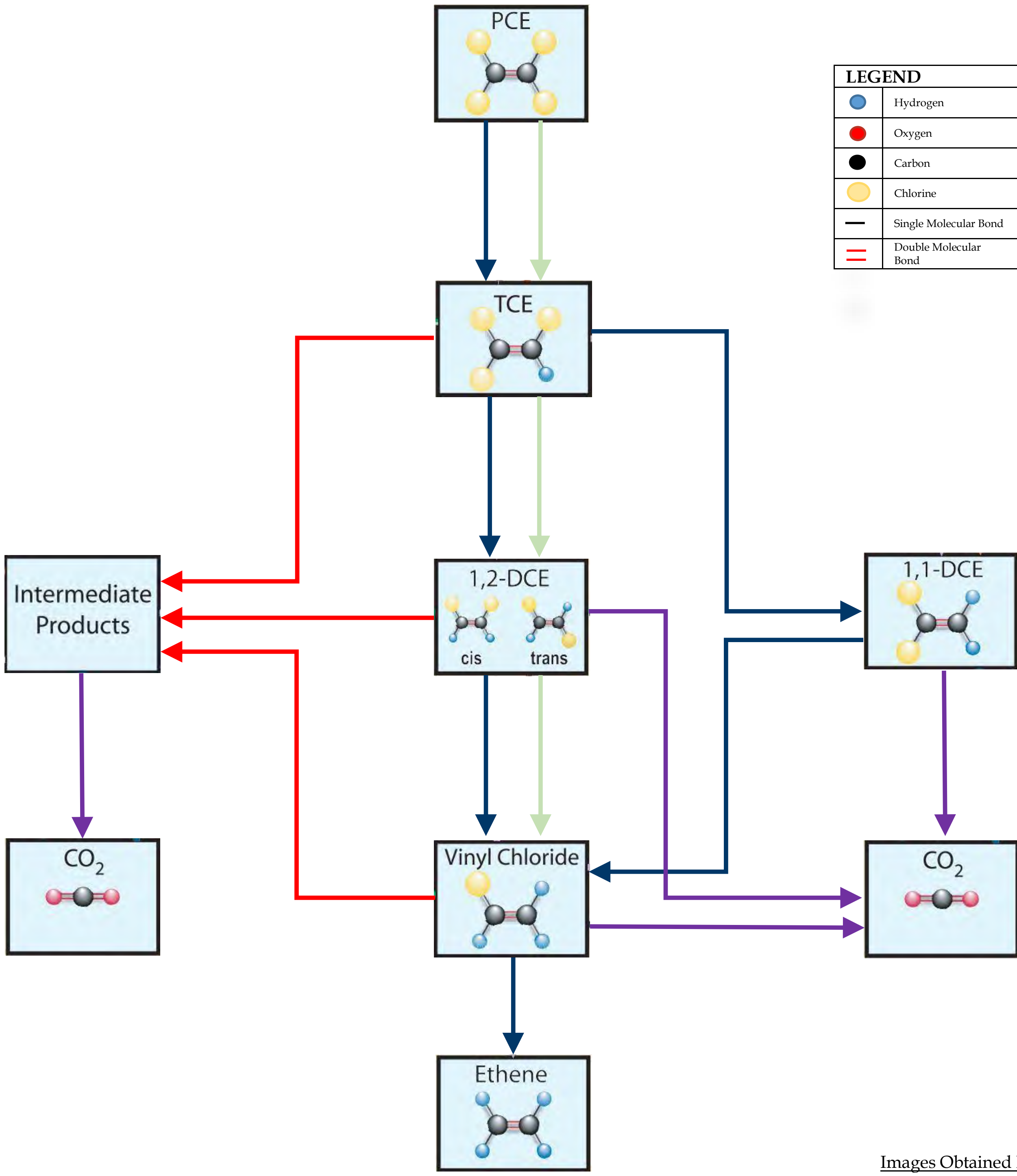
ft bgs = feet below ground surface
N/A = Not Applicable
PRP = Potentially Responsible Party
TOT = Time Of Travel
WRTP = White River Treatment Plant

Site 0153 Conceptual Site Model

Figure 2

FIGURE 3

Natural Attenuation of Chlorinated Volatile Organic Compounds (cVOCs)
Tetrachloroethene Degradation



Images Obtained From:
Hydro Geo Chem,2011

Common Name:	Compound:
1,1-DCE	1,1-Dichloroethene
1,2-DCE (cis[1])	cis-1,2-Dichloroethene
1,2-DCE (trans[1])	trans-1,2-Dichloroethene
PCE	Tetrachloroethene
TCE	Trichloroethene

[1]cis and trans are isomers; cis form is more prevalent as a reaction by-product.

Reaction Types:

Abiotic: Reactions occur without microbial influence. Reactions include: OH/Cl substitution (hydrolysis), HS/Cl substitution (from sulfides), reductive dechlorination (ferrous iron) and elimination of HCl (dehydro-halogenation).

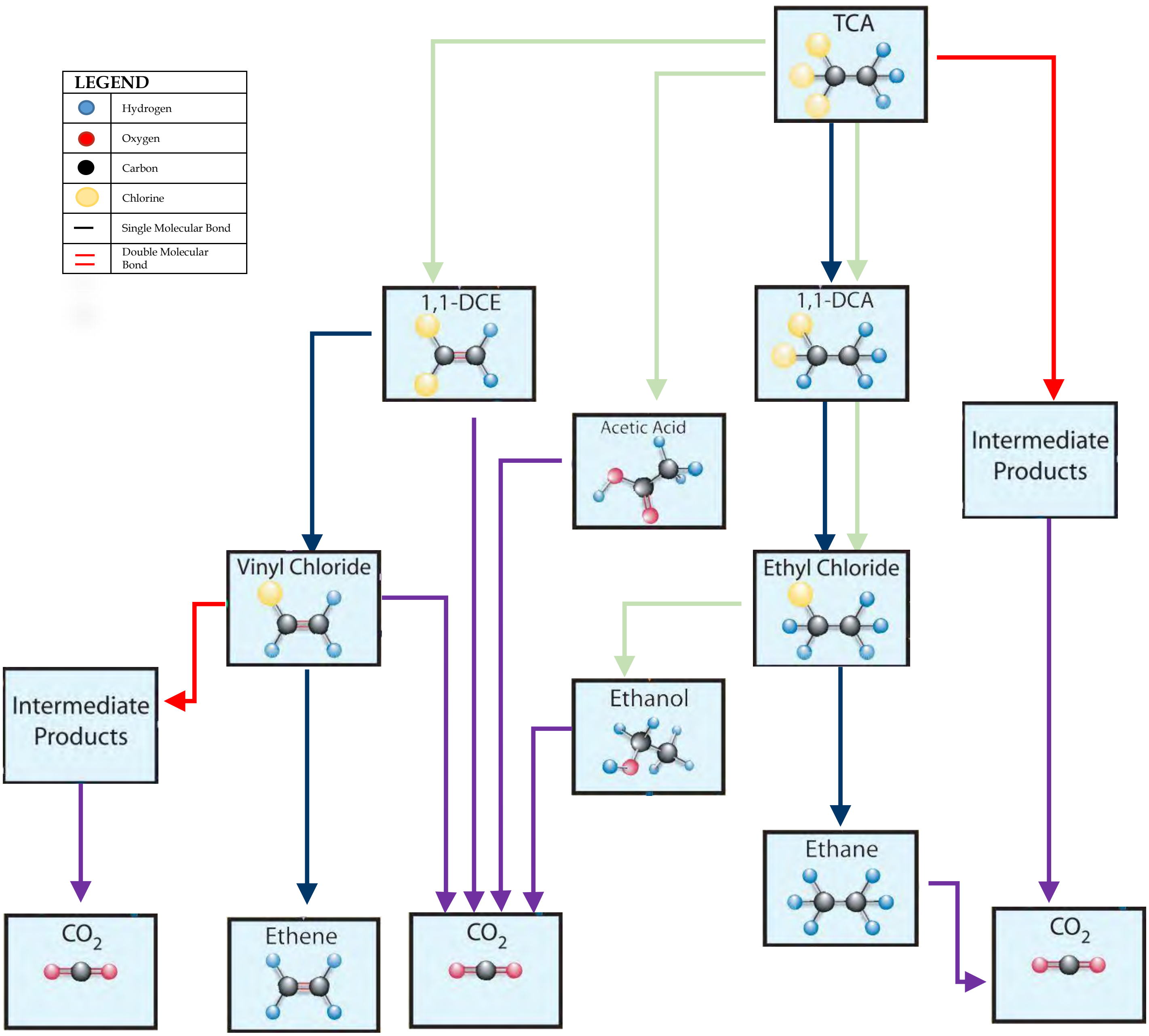
Halorespiration: Anaerobic reductive dechlorination that replaces Cl with H.

Aerobic/Anaerobic Oxidation: cVOCs act as electron donors and sources of organic carbon for microbes. In aerobic oxidation, oxygen acts as the electron acceptor; in anaerobic oxidation, other compounds such as nitrate, ferric iron, or sulfate, act as electron acceptors.

Cometabolism: Enzymes from microbes partially degrade cVOCs. These reactions are limited, and the microbe obtains no energy through the reaction.

FIGURE 4

Natural Attenuation of Chlorinated Volatile Organic Compounds (cVOCs)
1,1,1-Trichloroethane Degradation



Images Obtained From:
Hydro Geo Chem, 2011

Common Name:	Compound:
1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethene
TCA	1,1,1-Trichloroethane

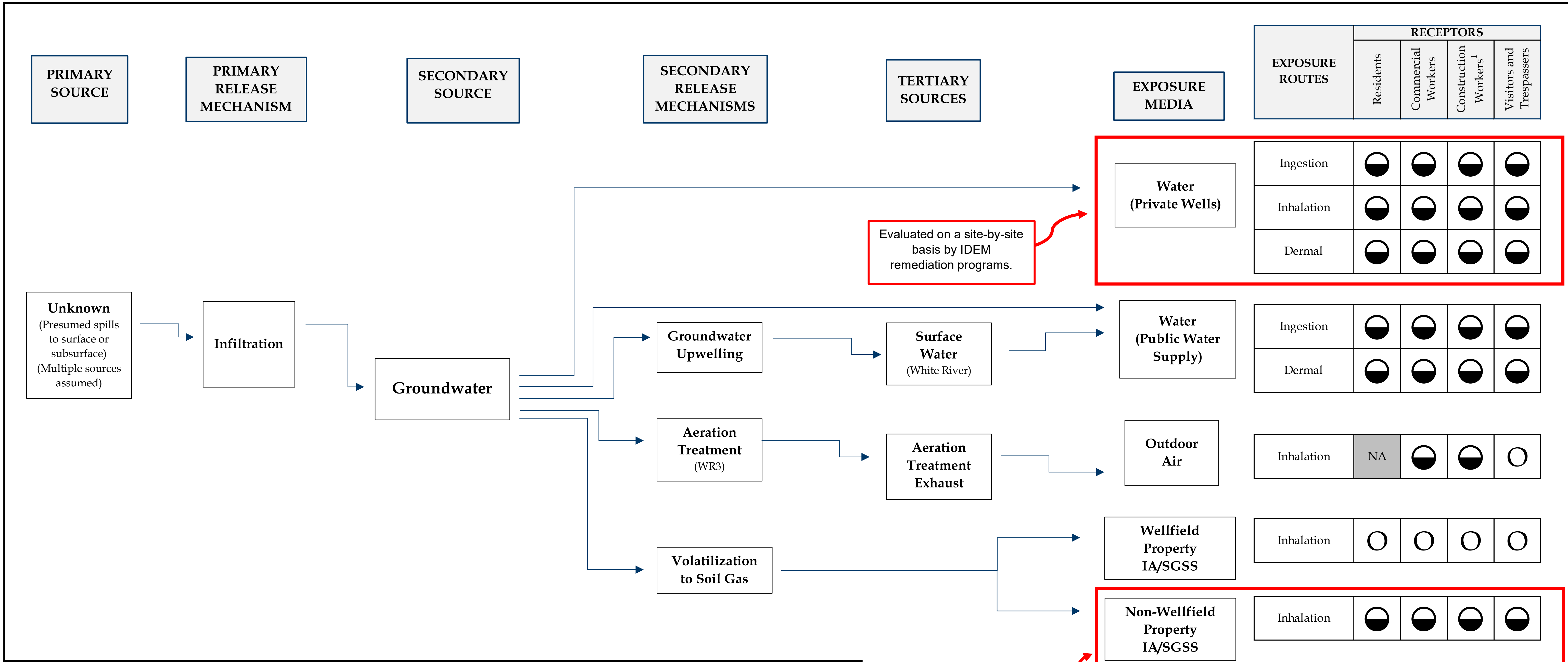
Reaction Types:

Abiotic: Reactions occur without microbial influence. Reactions include: OH/Cl substitution (hydrolysis), HS/Cl substitution (from sulfides), reductive dechlorination (ferrous iron) and elimination of HCl (dehydro-halogenation).

Halorespiration: Anaerobic reductive dechlorination that replaces Cl with H.

Aerobic/Anaerobic Oxidation: cVOCs act as electron donors and sources of organic carbon for microbes. In aerobic oxidation, oxygen acts as the electron acceptor; in anaerobic oxidation, other compounds such as nitrate, ferric iron, or sulfate, act as electron acceptors.

Cometabolism: Enzymes from microbes partially degrade cVOCs. These reactions are limited, and the microbe obtains no energy through the reaction.



LEGEND:

Half-filled circle = Exposure pathway complete, but under control; pathway described in the Human Health Risk Assessment

Open circle = Incomplete pathway

NA = Pathway not applicable

IA / SGSS = Indoor Air / Sub-slab Soil Gas

1 = The construction worker to groundwater exposure pathway assumes exposure to contaminated groundwater via trenching or other construction activity and is denoted as **complete, but under control** in the "Water (Private Wells)" category.
IDEM = Indiana Department of Environmental Management

FIGURE 5
Exposure Conceptual Site Model Flow Diagram
Human Health Risk Assessment
Site 0153

TABLES

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Site 0153

TABLE 1
SELECTION OF EXPOSURE PATHWAYS

Scenario Timeframe	Environmental Media	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route(s)	Location: (Utility Property; Plume Extent; or Supply Extent)	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current / Future	Groundwater	Outdoor Air	Emissions from aeration treatment of impacted production wells	Commercial / Industrial Worker	Adult	Inhalation	Utility Property	Excluded	The target risk for the Site is groundwater ingestion and municipal wells are screened at depths greater than 50 ft. Impacts to outdoor air through groundwater volatilization for cVOCs observed at depth is highly unlikely. As part of the aeration treatment design, testing, and installation effort Citizens will conduct all necessary air emission calculation and state/federal permitting (if required) to ensure that potential emissions from remedial treatment are protective of human health and the environment.
			Volatilization from groundwater plume to soil gas to outdoor air						
		Indoor Air	Volatilization from groundwater plume to soil gas to indoor air	Commercial / Industrial Worker	Adult	Inhalation	Plume Extent	Excluded	In Attachment A of the 2015 Memorandum of Agreement, under Section 2 of the Alternative Plan, the IDEM has committed to the following plan aspects: -- Determine cVOC concentrations in any private wells within the 5-yr time of travel -- Identify any completed exposure pathways (including ingestion and vapor intrusion) -- Delineate groundwater impacts -- Address sources of contamination as necessary and practical. The IDEM will be addressing the clean-up of source properties through various State-led programs, and each clean-up will require the assessment of risk element. Therefore, individual risks associated with the overall groundwater contamination plume will be assessed on a site-by-site basis by the State.
				Resident	Adult; Child	Inhalation	Plume Extent	Excluded	
		Groundwater	Tap water (Private Well Supply)	Commercial / Industrial Worker	Adult	Dermal; Ingestion	Plume Extent	Excluded	
				Resident	Adult; Child	Dermal; Ingestion	Plume Extent	Excluded	
		Groundwater	Groundwater in a Trench	Construction Worker	Adult	Dermal; Ingestion	Utility Property	Excluded	
		Trench Air	Trench Air			Inhalation		Excluded	
		Finished Water	Tap water (Public Supply)	Commercial / Industrial Worker	Adult	Dermal; Ingestion	Supply Extent	Qualitative	Under current and anticipated future conditions, production waters containing cVOC contamination in excess of the MCL will be treated prior to mixing and other processing. The resultant finished water will be verified to contain concentrations less than the federal MCL. As the federal MCL was established to be protective of human health, no additional evaluation of risk for consumers of finished water is necessary.
		Finished Water		Resident	Adult; Child	Dermal; Ingestion	Supply Extent	Qualitative	
		Production Water	Tap water (Public Supply)	Commercial / Industrial Worker	Adult	Dermal; Ingestion	Supply Extent	Quantitative	The quantitative approach would incorporate the current Citizens Water production scenario, i.e., wellfield mixing between the White River and Riverside wellfields and surface water mixing from the White River. Using post-mixing raw water concentrations in the intake assumption will provide a conservative estimate of potential risk.
		Production Water		Resident	Adult; Child	Dermal; Ingestion	Supply Extent	Quantitative	
		Indoor Air	Volatilization from groundwater plume to soil gas to indoor air	Commercial / Industrial Worker	Adult	Inhalation	Utility Property	Qualitative	The inhalation exposure route for vapor intrusion associated with raw water from the Wellfields is incomplete due to the low-level of cVOCs observed at depths greater than 50 ft below grade surface.

Abbreviations & Notes

cVOC = Chlorinated Volatile Organic Compounds

HHRA = Human Health Risk Assessment

IDEM = Indiana Department of Environmental Management

MCL = Maximum Contaminant Limit

Plume Extent = the extent of the contaminated groundwater plume

Supply Extent = the extent of the Citizens Water utility supplying water to homes and businesses

Utility Property = White River and Riverside Wellfield properties owned and operated by Citizens Water

(grey box) = Pathway excluded from HHRA

(white box) = Pathway addressed in HHRA

TABLE 2

RIVERSIDE AND WHITE RIVER
FINISHED WATER cVOC ANALYTICAL RESULTS

August Mack ENVIRONMENTAL

		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		**5**	**5**	**200**	**70**	**100**	**7**	**NE**	**2**	**NE**
Sample ID	**Date Collected**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
WHITE RIVER PLANT (WR PD)	02/08/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/11/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/09/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/07/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/08/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/16/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/15/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/27/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/16/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/15/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/12/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/11/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/15/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/12/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/11/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/12/2020	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

cVOC = Chlorinated Volatile Organic Compound
USEPA = United States Environmental Protection Agency
PD = Pump Discharge
NE = Not Established
NDP = No Data Provided
BRL = Below Laboratory Reporting Limits
All results and Screening Levels are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of screening level exceedances:

^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	**Date Collected**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS7	07/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	**0.67**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	**0.55**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/02/2007	<0.50	<0.50	<0.50	**2.23**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	**1.74**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	**0.52**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	**3.20**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	**3.40**	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	**3.92**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	**4.00**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	**6.01**	<0.50	<0.50	<0.50	**0.55**	<0.50
	12/02/2009	<0.50	<0.50	<0.50	**1.83**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	**0.96**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	**1.43**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/20/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	**1.00**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	**0.55**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/02/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	**0.57**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/21/2017	<0.50	<0.50	<0.50	**0.70**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/27/2018	<0.50	<0.50	<0.50	**0.71**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	**1.13**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	**0.30** J	<0.50	<0.50	<0.50	<0.50	<0.50
	08/27/2019	<0.50	<0.50	<0.50	**1.00**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	**1.78**	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

BRL = Below Laboratory Reporting Limits
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NDP = No Data Provided
USEPA = United States Environmental Protection Agency
All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS8	07/22/2005	<0.50	<0.50	<0.50	**1.72**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	**5.17**	<0.50	<0.50	<0.50	**1.52**	<0.50
	04/20/2006	<0.50	<0.50	<0.50	**6.30**	<0.50	<0.50	<0.50	**1.56**	<0.50
	07/18/2006	<0.50	<0.50	<0.50	**5.01**	<0.50	<0.50	<0.50	**0.57**	<0.50
	10/25/2006	<0.50	<0.50	<0.50	**7.79**	<0.50	<0.50	<0.50	**1.28**	<0.50
	02/02/2007	<0.50	<0.50	<0.50	**9.44**	<0.50	<0.50	<0.50	**1.61**	<0.50
	04/25/2007	<0.50	<0.50	<0.50	**8.21**	<0.50	<0.50	<0.50	**1.02**	<0.50
	10/03/2007	<0.50	<0.50	<0.50	**9.03**	<0.50	<0.50	<0.50	**1.35**	<0.50
	07/24/2008	<0.50	<0.50	<0.50	**7.24**	<0.50	<0.50	<0.50	**0.61**	<0.50
	10/22/2008	<0.50	<0.50	<0.50	**10.4**	<0.50	<0.50	<0.50	**1.10**	<0.50
	03/25/2009	<0.50	<0.50	<0.50	**6.97**	<0.50	<0.50	<0.50	**0.83**	<0.50
	12/02/2009	<0.50	<0.50	<0.50	**4.48**	<0.50	<0.50	<0.50	**1.13**	<0.50
	03/03/2010	<0.50	<0.50	<0.50	**4.92**	<0.50	<0.50	<0.50	**0.99**	<0.50
	08/25/2010	<0.50	<0.50	<0.50	**3.64**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	**2.52**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	**6.39**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	**5.86**	<0.50	<0.50	<0.50	**0.56**	<0.50
	02/19/2013	<0.50	<0.50	<0.50	**6.38**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	**7.06**	<0.50	<0.50	<0.50	**0.56**	<0.50
	05/20/2014	<0.50	<0.50	<0.50	**5.79**	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	**3.02**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	**6.69**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	**3.09**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	**5.30**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/02/2017	<0.50	<0.50	<0.50	**5.87**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	**3.58**	<0.50	<0.50	<0.50	<0.50	<0.50
	09/19/2017	<0.50	<0.50	<0.50	**2.56**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/21/2017	<0.50	<0.50	<0.50	**2.03**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	**4.12**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	**4.83**	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	**4.28**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/15/2018	<0.50	<0.50	<0.50	**2.57**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	**4.85**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	**4.35**	<0.50	<0.50	<0.50	<0.50	<0.50
	08/27/2019	<0.50	<0.50	<0.50	**4.84**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	**4.59**	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes
BRL = Below Laboratory Reporting Limits
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The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

August Mack ENVIRONMENTAL		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS9	07/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	**0.80**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	**0.92**	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	**0.56**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	**1.07**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/02/2007	<0.50	<0.50	<0.50	**1.51**	<0.50	<0.50	<0.50	**0.51**	<0.50
	04/25/2007	<0.50	<0.50	<0.50	**0.91**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	**1.73**	<0.50	<0.50	<0.50	**0.56**	<0.50
	01/09/2008	<0.50	<0.50	<0.50	**2.86**	<0.50	<0.50	<0.50	**0.52**	<0.50
	04/15/2008	<0.50	<0.50	<0.50	**2.26**	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	**2.14**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	**2.07**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	**2.82**	<0.50	<0.50	<0.50	**0.58**	<0.50
	10/20/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	**0.63**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	**0.65**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	**0.84**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	**1.13**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	**0.68**	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	**0.52**	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	**1.18**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	**0.68**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	**1.14**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	**0.85**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	**0.67**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/21/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/15/2018	<0.50	<0.50	<0.50	**0.57**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/16/2019	<0.50	<0.50	<0.50	**0.97**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	**0.30** J	<0.50	<0.50	<0.50	<0.50	<0.50
	08/27/2019	<0.50	<0.50	<0.50	**0.59**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	**2.42**	<0.50	<0.50	<0.50	<0.50	<0.50

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August Mack Environmental		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS17	10/19/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/01/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/20/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/21/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

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The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		**5**	**5**	**200**	**70**	**100**	**7**	**NE**	**2**	**NE**
Sample ID	**Date Collected**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
RS18	07/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/09/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/01/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/20/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/21/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/21/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/15/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

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TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

August Mack ENVIRONMENTAL		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS19	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/20/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/23/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/21/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/28/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

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TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		**5**	**5**	**200**	**70**	**100**	**7**	**NE**	**2**	**NE**
Sample ID	**Date Collected**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
RS22	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/17/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/11/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/21/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/27/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/28/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

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August Mack ENVIRONMENTAL		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	**Date Collected**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS26	07/22/2005	<0.50	<0.50	<0.50	**0.58**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	**0.55**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	**0.63**	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	**0.62**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/02/2007	<0.50	<0.50	<0.50	**1.18**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	**0.54**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	**1.35**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	**1.14**	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	**0.96**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	**1.67**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	**1.06**	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	**1.43**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	**1.26**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	**1.01**	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	**0.65**	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	**2.47**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	**2.26**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/21/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	**2.12**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	**0.60**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/27/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/16/2019	<0.50	<0.50	<0.50	**0.36** J	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	**0.16** J	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

BRL = Below Laboratory Reporting Limits
J = Result is estimated between the MDL and reporting limit.
MDL = Method Detection Limit
NDP = No Data Provided
USEPA = United States Environmental Protection Agency
All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	**Date Collected**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS29	04/06/2004	<0.50	<0.50	NDP	**14.2**	<0.50	<0.50	<0.50	**2.25** ^	<0.50
	07/22/2005	<0.50	<0.50	<0.50	**11.7**	<0.50	<0.50	<0.50	**1.47**	<0.50
	01/25/2006	<0.50	<0.50	<0.50	**18.4**	**0.54**	<0.50	<0.50	**3.07** ^	<0.50
	04/20/2006	<0.50	<0.50	<0.50	**13.9**	<0.50	<0.50	<0.50	**1.81**	<0.50
	07/18/2006	<0.50	<0.50	<0.50	**13.1**	<0.50	<0.50	<0.50	**1.31**	<0.50
	10/25/2006	<0.50	<0.50	<0.50	**12.3**	<0.50	<0.50	<0.50	**1.34**	<0.50
	02/02/2007	<0.50	<0.50	<0.50	**13.7**	<0.50	<0.50	<0.50	**1.32**	<0.50
	04/25/2007	<0.50	<0.50	<0.50	**10.8**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	**13.5**	<0.50	<0.50	<0.50	**1.23**	<0.50
	03/03/2010	<0.50	<0.50	<0.50	**15.1**	<0.50	<0.50	<0.50	**1.63**	<0.50
	08/25/2010	<0.50	<0.50	<0.50	**10.5**	<0.50	<0.50	<0.50	**0.91**	<0.50
	03/17/2011	<0.50	<0.50	<0.50	**12.2**	<0.50	<0.50	<0.50	**1.10**	<0.50
	03/08/2012	<0.50	<0.50	<0.50	**16.6**	<0.50	<0.50	<0.50	**1.02**	<0.50
	11/28/2012	<0.50	<0.50	<0.50	**15.4**	<0.50	<0.50	<0.50	**1.17**	<0.50
	02/19/2013	<0.50	<0.50	<0.50	**16.1**	<0.50	<0.50	<0.50	**0.57**	<0.50
	11/25/2013	<0.50	<0.50	<0.50	**15.7**	<0.50	<0.50	<0.50	**1.09**	<0.50
	05/20/2014	<0.50	<0.50	<0.50	**15.3**	<0.50	<0.50	<0.50	**0.67**	<0.50
	09/19/2014	<0.50	<0.50	<0.50	**10.8**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	**9.91**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	**12.2**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	**9.05**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	**10.6**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	**10.3**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	**9.29**	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	**10.5**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/21/2017	<0.50	<0.50	<0.50	**9.58**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	**8.55**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	**9.54**	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	**9.14**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/15/2018	<0.50	<0.50	<0.50	**10.8**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/16/2019	<0.50	<0.50	<0.50	**6.59**	<0.50	<0.50	<0.50	**0.19** J	<0.50
	04/29/2019	<0.50	<0.50	<0.50	**6.76**	<0.50	<0.50	<0.50	<0.50	<0.50
	08/27/2019	<0.50	<0.50	<0.50	**6.54**	<0.50	<0.50	<0.50	<0.50	<0.50
RS30	09/18/2018	<0.50	<0.50	<0.50	**2.81**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/17/2019	<0.50	<0.50	<0.50	**1.55**	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

BRL = Below Laboratory Reporting Limits

J = Result is estimated between the MDL and reporting limit.

MDL = Method Detection Limit

NDP = No Data Provided

USEPA = United States Environmental Protection Agency

All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:

^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

August Mack ENVIRONMENTAL

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RSA	12/17/2004	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/22/2004	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/28/2005	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/21/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/19/2005	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/01/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/24/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/17/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/17/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/21/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/27/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/27/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

BRL = Below Laboratory Reporting Limits
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The following notes summarize the symbol and color of MCL exceedances:
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TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RSB	12/22/2004	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/27/2005	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/19/2005	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/01/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/27/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/27/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/15/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/30/2019	<0.50	**0.41** J	<0.50	**0.55**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	**0.25** J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2019	<0.50	**0.25** J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	**0.29** J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

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The following notes summarize the symbol and color of MCL exceedances:

^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

August Mack ENVIRONMENTAL

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	**Date Collected**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RSC	07/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/19/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/02/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/27/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/03/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/04/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/18/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/09/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/18/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/27/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/27/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

BRL = Below Laboratory Reporting Limits
J = Result is estimated between the MDL and reporting limit.
MDL = Method Detection Limit
NDP = No Data Provided
USEPA = United States Environmental Protection Agency
All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
August Mack ENVIRONMENTAL		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RSD	10/19/2005	<0.50	<0.50	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/27/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/02/2007	<0.50	<0.50	<0.50	**0.57**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/29/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/20/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/21/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/15/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/13/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/02/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/05/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/27/2019	<0.50	<0.50	<0.50	**0.23** J	<0.50	<0.50	<0.50	<0.50	<0.50
	10/16/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

BRL = Below Laboratory Reporting Limits
J = Result is estimated between the MDL and reporting limit.
MDL = Method Detection Limit
NDP = No Data Provided
USEPA = United States Environmental Protection Agency
All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		**5**	**5**	**200**	**70**	**100**	**7**	**NE**	**2**	**NE**
Sample ID	**Date Collected**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
WR7	04/06/2004	<0.50	**0.52**	NDP	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/21/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	**0.54**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/19/2006	<0.50	**0.55**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	**0.62**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/31/2007	<0.50	**0.52**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	**0.52**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	**0.53**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	**0.61**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/21/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/17/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/21/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/14/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/13/2016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/22/2017	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/27/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/22/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/29/2019	<0.50	**0.20** J	<0.50	**0.21** J	<0.50	<0.50	<0.50	<0.50	<0.50
	08/26/2019	<0.50	**0.14** J	<0.50	**0.26** J	<0.50	<0.50	<0.50	<0.50	<0.50
	10/15/2019	<0.50	**0.22** J	<0.50	**0.31** J	<0.50	<0.50	<0.50	<0.50	<0.50

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The following notes summarize the symbol and color of MCL exceedances:
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TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	**Date Collected**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
WR8	07/21/2005	<0.50	<0.50	<0.50	**0.95**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	**1.09**	<0.50	<0.50	**0.57**	<0.50	<0.50
	04/19/2006	<0.50	**0.52**	<0.50	**0.90**	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	**0.73**	<0.50	**1.12**	<0.50	<0.50	**0.51**	<0.50	<0.50
	10/25/2006	<0.50	**1.76**	<0.50	**0.91**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/31/2007	<0.50	**0.58**	<0.50	**1.02**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	**0.84**	<0.50	**1.05**	<0.50	<0.50	**0.51**	<0.50	<0.50
	10/03/2007	<0.50	**1.09**	<0.50	**0.96**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	**0.81**	<0.50	**0.94**	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	**0.84**	<0.50	**0.97**	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	**1.02**	<0.50	**0.93**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	**1.69**	<0.50	**0.91**	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	**1.87**	<0.50	**0.67**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	**0.81**	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	**0.66**	<0.50	**0.91**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	**0.81**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	**0.60**	<0.50	**0.92**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	**0.94**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	**0.57**	<0.50	**1.07**	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	**0.65**	<0.50	**1.14**	<0.50	<0.50	**0.54**	<0.50	<0.50
	05/21/2014	<0.50	**0.64**	<0.50	**1.02**	<0.50	<0.50	<0.50	<0.50	<0.50
	09/17/2014	<0.50	<0.50	<0.50	**0.94**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	**0.55**	<0.50	**1.13**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/21/2015	<0.50	**0.64**	<0.50	**1.14**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/14/2016	<0.50	**0.67**	<0.50	**1.00**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2016	<0.50	**0.81**	<0.50	**0.90**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	**0.71**	<0.50	**0.92**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	**0.63**	<0.50	**1.17**	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	**0.81**	<0.50	**1.01**	<0.50	<0.50	<0.50	<0.50	<0.50
	11/22/2017	<0.50	**0.87**	<0.50	**0.65**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	**0.53**	<0.50	**0.93**	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	**0.65**	<0.50	**1.27**	<0.50	<0.50	<0.50	<0.50	<0.50
	08/22/2018	<0.50	**0.50**	<0.50	**1.00**	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2018	<0.50	**0.70**	<0.50	**1.10**	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	**0.64**	<0.50	**1.36**	<0.50	<0.50	**0.47** J	<0.50	<0.50
	04/29/2019	<0.50	**0.44** J	<0.50	**1.19**	<0.50	<0.50	**0.36** J	<0.50	<0.50
	08/26/2019	<0.50	**0.47** J	<0.50	**1.13**	<0.50	<0.50	**0.40** J	<0.50	<0.50
	10/15/2019	<0.50	**0.59**	<0.50	**1.35**	<0.50	<0.50	**0.42** J	<0.50	<0.50

Abbreviations & Notes

BRL = Below Laboratory Reporting Limits

J = Result is estimated between the MDL and reporting limit.

MDL = Method Detection Limit

NDP = No Data Provided

USEPA = United States Environmental Protection Agency

All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:

^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	**Date Collected**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
WR9	07/21/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/19/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/31/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	**6.12** ^	**6.54**	<0.50	<0.50	<0.50	**2.46**	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.51**	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	**1.28**	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/09/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	**0.52**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.52**	<0.50	<0.50
	05/21/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/17/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/21/2015	<0.50	**2.87**	**1.87**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/14/2016	<0.50	**0.70**	**0.62**	<0.50	<0.50	<0.50	**0.55**	<0.50	<0.50
	10/12/2016	<0.50	**1.20**	**0.84**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/01/2017	<0.50	**0.60**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/14/2017	<0.50	**0.54**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/29/2017	<0.50	**0.68**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/22/2017	<0.50	**0.91**	**0.57**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/20/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	06/06/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/22/2018	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/12/2018	<0.50	**0.55**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/15/2019	<0.50	**0.32** J	**0.21** J	<0.50	<0.50	<0.50	**0.42** J	<0.50	<0.50
	04/29/2019	<0.50	**0.22** J	<0.50	<0.50	<0.50	<0.50	**0.33** J	<0.50	<0.50
	08/26/2019	<0.50	**0.19** J	**0.23** J	**0.19** J	<0.50	<0.50	**0.34** J	<0.50	<0.50
	10/15/2019	<0.50	**0.19** J	<0.50	**0.19** J	<0.50	<0.50	**0.38** J	<0.50	<0.50

Abbreviations & Notes

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MDL = Method Detection Limit
NDP = No Data Provided
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All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

August Mack ENVIRONMENTAL

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	Date Collected	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
The following wells have been abandoned or taken out of service over the course of monitoring. Data presented is for reference only.										
WR3 (Out of Service - June 2016)	04/07/2004	<0.50	6.95 ^	NDP	1.74	<0.50	<0.50	0.90	<0.50	<0.50
	01/26/2005	<0.50	6.78 ^	NDP	1.60	<0.50	<0.50	0.87	<0.50	<0.50
	04/21/2005	<0.50	7.20 ^	1.26	1.68	<0.50	<0.50	0.84	<0.50	<0.50
	07/21/2005	<0.50	7.57 ^	1.31	1.87	<0.50	<0.50	0.92	<0.50	<0.50
	10/19/2005	<0.50	6.65 ^	1.29	1.57	<0.50	<0.50	0.83	<0.50	<0.50
	01/25/2006	<0.50	8.18 ^	1.27	1.81	<0.50	<0.50	0.95	<0.50	<0.50
	04/19/2006	<0.50	7.69 ^	1.23	1.63	<0.50	<0.50	0.88	<0.50	<0.50
	10/25/2006	<0.50	5.64 ^	0.94	1.30	<0.50	<0.50	0.74	<0.50	<0.50
	01/31/2007	<0.50	6.92 ^	1.26	1.42	<0.50	<0.50	0.83	<0.50	<0.50
	04/25/2007	<0.50	5.37 ^	0.91	1.40	<0.50	<0.50	0.82	<0.50	<0.50
	07/23/2008	<0.50	4.67	<0.50	1.69	<0.50	<0.50	0.66	<0.50	<0.50
	10/22/2008	<0.50	5.27 ^	0.55	1.95	<0.50	<0.50	0.79	<0.50	<0.50
	12/02/2009	<0.50	4.43	0.58	1.43	<0.50	<0.50	0.60	<0.50	<0.50
	03/03/2010	<0.50	5.55 ^	0.75	1.63	<0.50	<0.50	0.72	<0.50	<0.50
	08/25/2010	<0.50	5.60 ^	0.83	1.59	<0.50	<0.50	0.78	<0.50	<0.50
	03/17/2011	<0.50	6.09 ^	0.83	1.32	<0.50	<0.50	0.63	<0.50	<0.50
	11/28/2012	<0.50	6.54 ^	0.88	1.59	<0.50	<0.50	0.82	<0.50	<0.50
	02/19/2013	<0.50	6.12 ^	0.71	1.70	<0.50	<0.50	0.79	<0.50	<0.50
	11/25/2013	<0.50	5.33 ^	0.84	1.69	<0.50	<0.50	0.69	<0.50	<0.50
	02/19/2014	<0.50	6.36 ^	0.96	1.63	<0.50	<0.50	0.76	<0.50	<0.50
	05/21/2014	<0.50	6.11 ^	0.72	2.01	<0.50	<0.50	0.79	<0.50	<0.50
	09/17/2014	<0.50	5.24 ^	0.61	1.67	<0.50	<0.50	0.61	<0.50	<0.50
	03/10/2015	<0.50	5.68 ^	0.76	1.72	<0.50	<0.50	0.66	<0.50	<0.50
	10/21/2015	<0.50	5.44 ^	0.62	1.70	<0.50	<0.50	<0.50	<0.50	<0.50
	03/14/2016	<0.50	5.55 ^	0.70	1.67	<0.50	<0.50	0.68	<0.50	<0.50
WR6 (Out of Service - 2007) (Abandoned)	04/06/2004	<0.50	12.7 ^	NDP	1.26	<0.50	<0.50	1.84	<0.50	<0.50
	01/26/2005	<0.50	12.4 ^	NDP	1.22	<0.50	<0.50	1.43	<0.50	<0.50
	04/21/2005	<0.50	13.3 ^	9.99	1.26	<0.50	<0.50	1.44	<0.50	<0.50
	07/21/2005	<0.50	15.9 ^	11.5	1.39	<0.50	<0.50	1.67	<0.50	<0.50
	10/19/2005	<0.50	15.6 ^	NDP	1.42	<0.50	<0.50	1.59	<0.50	<0.50
	01/25/2006	<0.50	18.9 ^	12.1	1.44	<0.50	<0.50	1.61	<0.50	<0.50
	04/19/2006	<0.50	19.2 ^	12.3	1.25	<0.50	<0.50	1.42	<0.50	<0.50
	10/25/2006	<0.50	18.3 ^	12.0	1.11	<0.50	<0.50	1.26	<0.50	<0.50

Abbreviations & Notes

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USEPA = United States Environmental Protection Agency
All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 3
RIVERSIDE AND WHITE RIVER PRODUCTION WATER cVOC ANALYTICAL RESULTS

		Chlorinated Volatile Organic Compounds (cVOCs)								
		Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Vinyl Chloride	Chloroethane
USEPA Maximum Contaminant Level		5	5	200	70	100	7	NE	2	NE
Sample ID	**Date Collected**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
RS2 (Out of Service - March 2015) (Abandoned)	07/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/02/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	**3.25**	<0.50	<0.50	<0.50	**0.51**	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/17/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/20/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	09/17/2014	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/10/2015	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RS27 (Out of Service - March 2014) (Abandoned)	07/22/2005	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/20/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/18/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/25/2006	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/02/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/25/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/03/2007	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	01/09/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	04/15/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	07/23/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	10/22/2008	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/25/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	12/02/2009	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/03/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	08/25/2010	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	03/08/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/28/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	02/19/2013	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RS28 (Out of Service - 1989) (Abandoned)	09/18/2012	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Abbreviations & Notes

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MDL = Method Detection Limit
NDP = No Data Provided
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All results and MCLs are reported in micrograms per liter (µg/L).

The following notes summarize the symbol and color of MCL exceedances:
^ = At or Above USEPA Maximum Contaminant Level (MCL)

TABLE 4

Regional Screening Level (RSL) Summary Table (TR=1E-06, HQ=0.1) November 2019 (Excerpt)

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; W = TEF applied; E = RPF applied; G = user's guide Section 5; M = mutagen; V = volatile; R = RBA applied ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = ceiling limit exceeded; s = Csat exceeded.

Contaminant		Screening Levels		
Analyte	CAS No.	Tapwater (ug/L)	key	MCL (ug/L)
Dichloroethane, 1,1-	75-34-3	2.8E+00	c	
Dichloroethylene, 1,1-	75-35-4	2.8E+01	n	7.0E+00
Dichloroethylene, 1,2-cis-	156-59-2	3.6E+00	n	7.0E+01
Dichloroethylene, 1,2-trans-	156-60-5	3.6E+01	n	1.0E+02
Ethyl Chloride (Chloroethane)	75-00-3	2.1E+03	n	
Tetrachloroethylene	127-18-4	4.1E+00	n	5.0E+00
Trichloroethane, 1,1,1-	71-55-6	8.0E+02	n	2.0E+02
Trichloroethylene	79-01-6	2.8E-01	n	5.0E+00
Vinyl Chloride	75-01-4	1.9E-02	c	2.0E+00

TABLE 5

IDENTIFICATION OF CONSTITUENTS OF POTENTIAL CONCERN (COPCs)
SITE 0153

Site 0153 Chlorinated Volatile Organic Compounds (cVOCs)			Analytical Metadata									COPC Screening		
			Frequency of Detection	Frequency	Minimum Detected Water Concentration (C_{water})	Sample with Minimum Detect	Minimum Detect Sample Date	Maximum Detected Water Concentration (C_{water})	Sample with Maximum Detect	Maximum Detect Sample Date	Minimum of USEPA RSL or MCL (TR 1x10-6; 0.1 THQ)	Acceptable Frequency (>5%)	Max C_{water} Greater than USEPA RSL/MCL?	Final COPCs included in the RA
			detect / total samples	Percentage	µg/L	Well ID	Date	µg/L	Well ID	Date	µg/L			
cVOCs	Riverside Wellfield	Tetrachloroethene	0/486	0.00%	NA	NA	NA	NA	NA	NA	4.1	No	No	No
		Trichloroethene *	5/486	1.03%	0.25 J	RSB	4/29/2019	0.52	RS7	10/3/2007	0.28	No	Yes	No
		1,1,1-Trichloroethane	0/477	0.00%	NA	NA	NA	NA	NA	NA	200	No	No	No
		cis-1,2-Dichloroethene	145/486	29.84%	0.16 J	RS26	4/29/2019	18.4	RS29	1/25/2006	3.6	Yes	Yes	Yes
		trans-1,2-Dichloroethene	1/486	0.21%	0.54	RS29	1/25/2006	0.54	RS29	1/25/2006	36	No	No	No
		1,1-Dichloroethene	0/486	0.00%	NA	NA	NA	NA	NA	NA	7	No	No	No
		1,1-Dichloroethane	0/486	0.00%	NA	NA	NA	NA	NA	NA	2.8	No	No	No
		Vinyl Chloride *	37/486	7.61%	0.19 J	RS29	1/16/2019	3.07	RS29	1/25/2006	0.019	Yes	Yes	Yes
		Chloroethane	0/486	0.00%	NA	NA	NA	NA	NA	NA	2,100	No	No	No
	White River Wellfield	Tetrachloroethene	0/150	0.00%	NA	NA	NA	NA	NA	NA	4.1	No	No	No
		Trichloroethene *	90/150	60.00%	0.14 J	WR7	8/26/2019	19.2	WR6	4/19/2006	0.28	Yes	Yes	Yes
		1,1,1-Trichloroethane	34/144	23.61%	0.21 J	WR9	1/15/2019	12.3	WR6	4/19/2006	200	Yes	No	No
		cis-1,2-Dichloroethene	77/150	51.33%	0.19 J	WR9	8/26/2019	2.01	WR3	5/21/2014	3.6	Yes	No	No
		trans-1,2-Dichloroethene	0/150	0.00%	NA	NA	NA	NA	NA	NA	36	No	No	No
		1,1-Dichloroethene	0/150	0.00%	NA	NA	NA	NA	NA	NA	7	No	No	No
		1,1-Dichloroethane	48/150	32.00%	0.33 J	WR9	4/29/2019	2.46	WR9	1/9/2008	2.8	Yes	No	No
		Vinyl Chloride *	0/150	0.00%	NA	NA	NA	NA	NA	NA	0.019	No	No	No
		Chloroethane	0/150	0.00%	NA	NA	NA	NA	NA	NA	2,100	No	No	No

Abbreviations:

* = Constituent is a mutagen
µg/L = micrograms per liter
COPCs = Constituents of Potential Concern
C_{water} = Detected Water Concentration
J = Value estimated between the RL and MDL
MCL = Maximum Contamination Limit
MDL = Method Detection Limit
NA = Not Applicable
RA = Risk Assessment
RL = Reporting Limit
RSL = Regional Screening Level
THQ = Target Hazard Quotient
TR = Target Cancer Risk
USEPA = United States Environmental Protection Agency
VOCs = Volatile Organic Compounds

Notes:

Constituents are included as a COPCs in the risk assessment if their maximum detected water concentration (C_{water}) is greater than the minimum of the USEPA Residential Tapwater RSL or the MCL (TR 1x10-6; 0.1 THQ) and their frequency exceeds 5%.

In the case that two detection/sample date pairs have the same maximum or minimum, the most recent detection/sample date is used.

If a constituent is identified as a COPC in either wellfield, both wellfields will be evaluated for that COPC.

TABLE 6

DATASETS USED FOR EPC CALCULATION
SITE 0153

Wellfield ID	Well ID	Sample Date	Constituents of Potential Concern					
			cis-1,2-Dichloroethene (MDL = 0.177µg/L)		Trichloroethene (MDL = 0.065µg/L)		Vinyl Chloride (MDL = 0.165µg/L)	
			RAW DATA	EPC DATA	RAW DATA	EPC DATA	RAW DATA	EPC DATA
Riverside (RS)	RS Well 7	1/15/2019	**1.13**	**1.13**	<0.50	0.0325	<0.50	0.0825
		4/29/2019	**0.30**	**0.30 J**	<0.50	0.0325	<0.50	0.0825
		8/27/2019	**1.00**	**1.00**	<0.50	0.0325	<0.50	0.0825
		10/16/2019	**1.78**	**1.78**	<0.50	0.0325	<0.50	0.0825
	RS Well 8	1/15/2019	**4.85**	**4.85**	<0.50	0.0325	<0.50	0.0825
		4/29/2019	**4.35**	**4.35**	<0.50	0.0325	<0.50	0.0825
		8/27/2019	**4.84**	**4.84**	<0.50	0.0325	<0.50	0.0825
		10/16/2019	**4.59**	**4.59**	<0.50	0.0325	<0.50	0.0825
	RS Well 9	1/16/2019	**0.97**	**0.97**	<0.50	0.0325	<0.50	0.0825
		4/29/2019	**0.30**	**0.30 J**	<0.50	0.0325	<0.50	0.0825
		8/27/2019	**0.59**	**0.59**	<0.50	0.0325	<0.50	0.0825
		10/16/2019	**2.42**	**2.42**	<0.50	0.0325	<0.50	0.0825
	RS Well 17	1/15/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		4/29/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		8/26/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		10/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
	RS Well 18	1/15/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		4/29/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		8/26/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		10/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
	RS Well 19	1/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		4/29/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		8/26/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		10/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
	RS Well 22	1/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		4/29/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		8/26/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		10/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
	RS Well 26	1/16/2019	**0.36**	**0.36 J**	<0.50	0.0325	<0.50	0.0825
		4/29/2019	**0.16**	**0.16 J**	<0.50	0.0325	<0.50	0.0825
	RS Well 29	1/16/2019	**6.59**	**6.59**	<0.50	0.0325	**0.19**	**0.19 J**
		4/29/2019	**6.76**	**6.76**	<0.50	0.0325	<0.50	0.0825
		8/27/2019	**6.54**	**6.54**	<0.50	0.0325	<0.50	0.0825
	RS Well A	1/15/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		4/29/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		8/26/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		10/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
	RS Well B	1/15/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		1/30/2019	**0.55**	**0.55**	**0.41**	**0.41 J**	<0.50	0.0825
		4/29/2019	<0.50	0.0885	**0.25**	**0.25 J**	<0.50	0.0825
		8/26/2019	<0.50	0.0885	**0.25**	**0.25 J**	<0.50	0.0825
		10/16/2019	<0.50	0.0885	**0.29**	**0.29 J**	<0.50	0.0825
	RS Well D	1/15/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
		8/27/2019	**0.23**	**0.23 J**	<0.50	0.0325	<0.50	0.0825
		10/16/2019	<0.50	0.0885	<0.50	0.0325	<0.50	0.0825
White River (WR)	WR Well 7	1/15/2019	**0.50**	**0.50**	<0.50	0.0325	<0.50	0.0825
		4/29/2019	**0.21**	**0.21 J**	**0.20**	**0.20 J**	<0.50	0.0825
		8/26/2019	**0.26**	**0.26 J**	**0.14**	**0.14 J**	<0.50	0.0825
		10/15/2019	**0.31**	**0.31 J**	**0.22**	**0.22 J**	<0.50	0.0825
	WR Well 8	1/15/2019	**1.36**	**1.36**	**0.64**	**0.64**	<0.50	0.0825
		4/29/2019	**1.19**	**1.19**	**0.44**	**0.44 J**	<0.50	0.0825
		8/26/2019	**1.13**	**1.13**	**0.47**	**0.47 J**	<0.50	0.0825
		10/15/2019	**1.35**	**1.35**	**0.59**	**0.59**	<0.50	0.0825
	WR Well 9	1/15/2019	**0.50**	**0.50**	**0.32**	**0.32 J**	<0.50	0.0825
		4/29/2019	**0.50**	**0.50**	**0.22**	**0.22 J**	<0.50	0.0825
		8/26/2019	**0.19**	**0.19 J**	**0.19**	**0.19 J**	<0.50	0.0825
		10/15/2019	**0.19**	**0.19 J**	**0.19**	**0.19 J**	<0.50	0.0825

Notes & Abbreviations:

EPC = Exposure Point Concentration
MDL = Method Detection Limit

The first column presents laboratory data as reported. The second column presents final data used in EPC calculation.
Only 2019 data is included in EPC calculation to be reflective of current conditions.
If a raw result is non-detect, EPC data is assumed to be detected at half the associated MDL.
Results and MDLs reported in micrograms per liter (µg/L).
J = Result is reported between the MDL and the reporting limit, and is considered estimated.
Results and MDLs provided by Citizens Water internal laboratory.

TABLE 7

WELLFIELD MIXING RATIOS

AND

SURFACE WATER MIXING RATIOS

TABLE REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION

TABLE 8

MIXED EXPOSURE POINT CONCENTRATION RESULTS

TABLE REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION

TABLE 9

TOXICITY AND CANCER RISK FACTORS
FOR CONSTITUENTS OF POTENTIAL CONCERN
SITE 0153

Definitions			
Chronic Dermal Reference Dose (RfD_d) (mg/kg-day) =			RfD_o x GIABS
Dermal Cancer Slope Factor (CSF_d) ($(mg/kg\text{-}day)^{-1}$) =			CSF_o / GIABS
Factor	**Symbol**	**Units**	**Source**
Chronic Oral Reference Dose	RfD_o	mg/kg-day	Constituent-specific (see Key below)
Chronic Oral Cancer Slope Factor	CSF_o	$(mg/kg\text{-}day)^{-1}$	
Gastrointestinal Absorption Factor	GIABS	unitless	

Constituent-Specific Factors & Values

Constituents of Potential Concern (COPCs)		Ingestion Factors: Chronic Oral Reference Dose (RfD_o) mg/kg-day	Key	Ingestion Factors: Chronic Oral Cancer Slope Factor (CSF_o) $(mg/kg\text{-}day)^{-1}$	Key	Dermal Factor: Gastrointestinal Absorption Factor (GIABS) unitless	Associated Risk Effects: Primary Target Systems/ Critical Effects	Associated Risk Effects: Hazard Description
VOCs	cis-1,2-Dichloroethene	0.002	I	NE		1.0	Urinary	Inadequate Information to Assess Carcinogenic Potential
	Trichloroethene *	0.0005	I	0.046	I	1.0	Developmental, cardiovascular, hematologic, hepatic (liver), urinary	Carcinogenic to Humans
	Vinyl Chloride *	0.003	I	0.72	I	1.0	Hepatic	Carcinogenic to Humans

Abbreviations & Notes:
* = Constituent is a mutagen.
C = California EPA
I = USEPA Integrated Risk Information System (IRIS)
Key = Reference database for factor based on USEPA Superfund Hierarchy
mg/kg = milligrams per kilogram
NE = Not Established (CSF_o are not available in USEPA Hierarchy)
USEPA = United States Environmental Protection Agency

TABLE 10

SUMMARY OF COPC RISK RESULTS
SITE 0153

Constituents of Potential Concern (COPCs)	EPCs (µg/L)	Age Adjusted Future Resident			Child Resident		Adult Resident		Combined Adult and Child Residents
		Ingestion CR	Dermal CR	Theoretical Lifetime Excess CR	Ingestion HQ	Dermal HQ	Ingestion HQ	Dermal HQ	Total HQ
cis-1,2-Dichloroethene	0.301	NA	NA	NA	0.00750	0.000829	0.00451	0.000550	**0.0134**
Trichloroethene	0.0501	4.24E-08	6.73E-09	**4.91E-08**	0.00500	0.000727	0.00300	0.000482	**0.00921**
Vinyl Chloride	0.083	3.87E-06	3.00E-07	**4.17E-06**	0.00138	0.0000930	0.000829	0.0000642	**0.00237**
Total CR/HI for Exposure Unit		3.91E-06	3.07E-07	**4.22E-06**	0.0139	0.00165	0.00834	0.00110	**0.0250**
Target CR/HI		**1.0E-04 to 1.0E-06**			**Less than 1.0**				

Abbreviations:
CR = Cancer Risk
EPCs = Exposure Point Concentrations (reported in micrograms per liter [µg/L]).
HI = Hazard Index
HQ = Hazard Quotient
NA = Not Applicable (Cancer Slope Factor is not available in USEPA Hierarchy)
RSL = Regional Screening Level
USEPA = United States Environmental Protection Agency

Notes:
CR and HQ results calculated via the USEPA RSL Online Calculator.
Due to a rounding difference, the Total CR was reported by the USEPA RSL Calculator as 4.23E-06.

APPENDIX A

Memorandum of Agreement for the 0153/Riverside Ground Water Contamination Site, Indianapolis, Indiana

MEMORANDUM OF AGREEMENT

BETWEEN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION 5

AND

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

FOR THE

0153/ RIVERSIDE GROUND WATER CONTAMINATION SITE, INDIANAPOLIS, INDIANA

I. PURPOSE

This Memorandum of Agreement (MOA) specifies the plans and expectations of the Indiana Department of Environmental Management (IDEM) and the United States Environmental Protection Agency (EPA) at the Riverside Ground Water Contamination Superfund Site (Site) in order to ensure that the response actions undertaken at the Site are substantially similar to actions that would otherwise be taken under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP). Once the Site remedial action is successfully completed, it is expected that EPA will have no further interest in considering the Site for final listing on the National Priorities List (NPL) and that the Site will be de-proposed from the NPL.

II. BACKGROUND

The Site is located in Indianapolis, Marion County, Indiana. On February 20, 2013, IDEM staff received notice from Citizens Energy Group (Citizens) that elevated levels of vinyl chloride (VC) and cis-1,2-dichloroethene (cis-1,2-DCE) were being detected in the groundwater prior to treatment ("raw water") at the Riverside Municipal Wellfield. Citizens was concerned that the increasing levels of VC in Well RS29 were approaching the Maximum Contaminant Level (MCL) for VC, which might adversely impact the use of that well to supply drinking water to residents in Indianapolis. Riverside and White River Wellfields supply drinking water to over 17,000 people in Indianapolis.

On May 20 and 21, 2014, IDEM staff conducted a groundwater Site Inspection at the Riverside and White River Wellfields. A total of 25 water samples, taken prior to entry into the treatment facility, were obtained. The samples consisted of 19 groundwater samples, four (4) duplicate samples, and two (2) trip blanks. The ground water samples were collected from 19 municipal wells located in the Riverside and White River Wellfields. All samples were analyzed for volatile organic compounds (VOCs) only. Vinyl chloride, cis-1,2-DCE, trichloroethylene (TCE), and 1,1,1 trichloroethane were the primary VOCs detected. Although VOCs were detected in some of the municipal wells, none of the concentrations of VOCs exceeded any MCL set by EPA in raw water. All raw water is treated and tested by Citizens prior to distribution and no VOCs have been detected in water leaving the utility (finished water) which is the water sent to customers.

Using the data collected during the Site Inspection, a Hazard Ranking System (HRS) documentation record was submitted to EPA determining that the Site qualified for the NPL. The HRS documentation identified approximately 89 potential sources of VOC contamination to the Riverside and White River Wellfields' five-year time of travel of groundwater. More than fifteen (15) sites are already in one of IDEM's remediation programs, and have either addressed the potential sources at their site or are on track to do so. As described more fully in Section IV B. below, a number of individual sources may be contributing to a commingled volatile organic compound (VOC) groundwater plume, and an undetermined number of individual Potentially Responsible Parties (PRPs) would be held responsible for conducting site investigations and remediation of their sites. For an illustration of the potential Site area, *see* **Attachment B.**

On August 13, 2015, IDEM's former Commissioner, Thomas Easterly, requested inclusion of the Site on the NPL. In April 2016, EPA proposed to add the Site to the NPL in the Federal Register. IDEM has since determined that it would be in the best interests of the State and City, and responsive to the majority of the public's requests, to address the Site in IDEM's State Cleanup program. IDEM officials, along with members of the City of Indianapolis Mayor's office, and Citizens requested, in letters written in May 2016 and also at a meeting in July 2016, that EPA allow IDEM to manage the investigation and remedial actions at the Site (**Attachment B**). The August 18, 2016 letter from former Commissioner Carol Comer formally withdrew support for including the Site on the NPL.

In October 2016, EPA Region 5 began discussions outlining certain criteria that IDEM would need to satisfy in order for EPA to consider allowing IDEM to manage the Site in lieu of EPA. After taking into consideration community feedback, IDEM has renamed the Site as "Site 0153" and all future documentation from IDEM will reflect the name change. Based on IDEM's strategy plan and commitments made in this agreement meeting the deferral criteria, EPA is allowing IDEM to ensure necessary investigations and response actions are completed at the Site. Once the required response actions at the Site are successfully completed, it is expected that EPA will have no further interest in considering the Site for listing, unless there is a release or potential for release that poses an imminent threat to human health or the environment. In addition, when response actions are completed, the Site may be archived in the Superfund Enterprise Management System (SEMS).

III. **IMPLEMENTATION**

A. **State Program**- IDEM is authorized under state law to implement a hazardous substances remediation program which should ensure that response actions at the Site are carried out and that these actions are protective of human health and the environment. Furthermore, IDEM has sufficient capabilities, resources, expertise and authorities to ensure that a remediation is completed to the protective levels required under CERCLA and will coordinate with EPA, other interested agencies, and the public on different phases of implementation.

B. **Site Eligibility**- The State of Indiana has expressed interest in having the Site listing deferred and in IDEM overseeing the response at the Site under state law. IDEM agrees to pursue response actions at the Site in a timely manner. EPA and IDEM agree that a deferral should address the Site sooner than, and at least as quickly as EPA would expect to respond. The Site is included in the SEMS inventory and has been assessed and scored for listing on the NPL. The State will not request, nor utilize, Superfund trust fund money to implement any portion of the actions required by this Agreement.

C. **Community Acceptance**- During the public comment period for the proposed NPL listing (published in the Federal Register April 7, 2016, with the public comment period ending on September 5th, 2016), community groups held public meetings to discuss the proposed listing. IDEM and EPA provided outreach to the affected community in at least three (3) public meetings held in April and July of 2016. IDEM and EPA explained to the community the differences between a response action under state law pursuant to the terms of a proposed Deferral Agreement and a response conducted under the NCP and requested feedback from the community. IDEM informed EPA of its outreach efforts and conveyed the general results of the feedback and viewpoints of the community. Comments provided as part of the public comment period showed that community members mostly supported EPA deferral of the Site, but they also requested more involvement in the process. EPA participated in a public meeting with IDEM held on March 25, 2017 to inform the public of the deferral process and to explain IDEM's strategy to address the Site. The response from the community was mixed, with some preferring to list the Site on the NPL while the majority were in favor of EPA deferring the Site to IDEM oversight. The community requests will be addressed as part of the Community Involvement Plan required by IDEM's Site Investigation Strategy (**Attachment C**).

EPA is aware that the Riverside Civic League sent IDEM a list of requests entitled "Requests of the Local Plan Principle" in a letter dated August 23, 2016 (Letter) and that IDEM responded to the requests made in the Letter (Response). IDEM will complete a Community Involvement Plan, as described in **V. Community Participation** of this MOA. Target completion date of the Community Involvement Plan is Fall 2017 (*see* **IV. Procedural Requirements B. Schedule for Performance**). The Riverside Civic League Letter and IDEM Response will become part of the Community Involvement Plan.

D. **Cleanup Levels**- IDEM will pursue CERCLA-protective cleanups[1] of the Site that will be substantially similar to a CERCLA response. The response action will be protective of human health and the environment, as generally defined for individual human exposure, by remediating to an acceptable risk level for carcinogens between 10^{-4} and 10^{-6} and for non-carcinogens a Hazard Index of 1 or less; and no significant adverse impacts to ecological receptors. IDEM has proposed using a 10^{-5} risk level as a screening level for determining the need for further remedial investigation and risk assessment, which is within EPA's acceptable risk level range for

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[1] The term CERCLA-protective cleanup is defined in OSWER Directive 9375 - 6-11 . *Guidance on Deferral of NPL Listing Determinations While States Oversee Response Actions* (May 3. 1995)

carcinogens. The response actions will also address sources of contamination to the extent feasible. IDEM will give preference to solutions that will be reliable over the long term. In addition, IDEM will ensure that any remedy selected at the Site will comply with all applicable or relevant and appropriate[2] federal requirements and any more stringent applicable or relevant and appropriate State requirements to the maximum extent practicable under IDEM's State authorities. Soils, sediments, subsurface intrusion, surface and groundwater will be investigated and assessed as part of the comprehensive risk assessment that will be conducted at the Site. The comprehensive risk assessment will include the consideration of potential exposure pathways to residents and sensitive populations that might exist in and around the Riverside neighborhood. EPA anticipates that the CERCLA- protective remedy includes the recognition that ground waters of the United States are valued natural resources, and that response actions will ensure the remedies are protective and will not present a threat to the Riverside and White River Wellfields.

E. **Natural Resources Trustees**- IDEM will promptly notify the appropriate State and Federal trustees for natural resources of discharges and releases at the Site that are injuring or that may injure natural resources, and include the trustees, as appropriate, in activities at the Site. The State shall, consistent with CERCLA and the NCP, seek to coordinate necessary assessments, evaluations, investigations, and planning with State, Affected Tribal and Federal Trustees.

IV. PROCEDURAL REQUIREMENTS

A. **Roles and Responsibilities**- IDEM has primary responsibility, with minimal EPA involvement, to provide for a timely CERCLA-protective cleanup under state authority and to support the public's right of participation in the decision-making process. EPA's role will generally be limited to review of IDEM semi-annual and annual reports and consultation on the proposed remedy. However, EPA may request reports, data, or other documentation related to the remedial activities at the Site, as it deems appropriate, or arrange for IDEM to provide certain draft documents for EPA review as they are prepared. EPA will not provide financial assistance for site activities to the State, affected Tribes or the community during a deferral.

In the event that community members or affected Tribal governments request that EPA reconsider deferral of the Site or request EPA's intervention in response actions, the EPA agrees to meet with IDEM to discuss the community concerns and to review the response actions in light of this MOA and the EPA's Deferral Guidance, and make a decision regarding whether terminating the deferral is warranted.

The following are the contacts for the agencies (any changes may be made by notice):

[2] The phrase "applicable or relevant and appropriate requirements" shall be defined by reference to Section 121 of CERCLA, 42 U.S.C. § 9621, the National Contingency Plan *(see* 40 C.F.R. § 300.5 definitions of applicable requirements" and "relevant and appropriate requirements"). and applicable EPA Guidance.

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IDEM Legal	**EPA Legal**
Tim Junk Ind. Dept. of Environmental Management Office of Legal Counsel IGCN 13th Floor 100 N. Senate Ave. Indianapolis, IN 46204 317-2349581 tjunk@idem.in.gov	Nola Hicks US Environmental Protection Agency Office of Regional Counsel C-14J 77 W. Jackson Blvd. Chicago, IL 60604 312-886-7949 hicks.nola@epa.gov

B. **Schedule for Performance**- Due to the nature of the Site, including 1) the number of individual sources that may be contributing to a commingled plume; 2) that individual Potentially Responsible Parties (PRPs) will be conducting the site investigations and remediation; and 3) that some PRPs are already managed within a remediation program at IDEM, the parties agree that a Schedule for Performance regarding the Site as a whole will necessarily be broad and speculative. A tentative proposed schedule of events for the Site cleanup is set forth in the following table. The Target Completion timelines in the table are subject to change. EPA shall be notified of a change in a Target Completion as soon as IDEM becomes aware that such a change is necessary or unavoidable.

Task	Target Completion
Complete Community Involvement Plan	**Fall of 2017**
Begin Phase I Remedial Investigation	**Within 3 months of issuance of Notice Letters**
Prepare Removal Work Plan as necessary	**If any imminent threat is discovered, removal will be expedited.**
Complete additional Remedial Investigation as necessary	**Following submittal of Remedial Investigation Report and IDEM request for additional RI**
Complete Human Health and Ecological Risk Assessment	**Six months after final RI information is gathered.**
Complete Feasibility Study	**90 days post complete RI and HHERA.**
Proposed Remedial Action Public Comment Period	**30 days from publication of draft Proposed Plan.**
Record of Decision	**180 days from end of Public Comment Period.**
Remedial Design	**One year from publication of Record of Decision.**
Implement Remedial Action	**Six months from final Remedial Design/Technical Specifications**

C. **Documentation Submissions to EPA**- IDEM will make available all Site data, reports, and other documentation to EPA upon request.

D. **IDEM Reporting to EPA**- IDEM will provide written reports to EPA at least annually on whether the conditions in this Agreement are being met and on the progress in the investigation, assessment and response actions. In addition, IDEM will report in writing to EPA at least semi-annually on any difficulties that it is having meeting the conditions of this Agreement. Following the submission of a report required or requested, EPA may request a briefing or meeting with IDEM to discuss the report(s).

E. **Proposed Remedial Action**- IDEM will provide a written report to EPA on the proposed remedial action (Draft Record of Decision Staff Report) both before and after soliciting public comment. EPA and IDEM will determine prior to the briefing the appropriate staff to review the proposed remedial action report and attend the briefings.

V. COMMUNITY PARTICIPATION

IDEM will ensure public involvement that is substantially similar to the intent of the NCP and in accordance with the Community Involvement Plan (CIP). which IDEM will have finalized by the fall of 2017. IDEM will ensure the following actions are undertaken as required by the CIP:

A. Site files will be maintained at the IDEM project manager's office or as required by the CIP.

B. Site related documents will be made available online in IDEM's Virtual File Cabinet (VFC) at https://vfc.idem.in.gov/DocumentSearch.aspx under State Cleanup Site No. 0153 and as required by the CIP. The community groups expressing an interest in the Site will be included in discussions to determine the best and most efficient way to provide information to the groups. This information will become a part of the CIP.

C. Through the CIP, or other agreement with IDEM, the affected community will be able to acquire technical assistance in interpreting information with regard to the nature of the hazard, investigations, and studies conducted, and implementation decisions at the Site. This technical assistance will be in the form of an appropriate conveyance that can be used to hire a technical expert to explain monitoring reports and decision documents and advise the community.

VI. COMPLETION OF STATE RESPONSE ACTION

Certification and Confirmation- Once IDEM considers the response action at the Site to be complete, it will certify to EPA, any affected Tribal Governments with which it has MOUs, and the affected community that the remedy has been successfully completed and intended cleanup levels achieved. As part of the certification, IDEM will submit for EPA review a response action completion documentation substantially similar to that described in the June 1992 OSWER Direct "Remedial Action Report; Documentation for Operable Unit Completion" (OSWER Directive 9355.0-39FS). EPA will review the certification and supporting information, and may choose to initiate a deferral completion inquiry to confirm the certification. EPA will work with IDEM to address any data deficiencies hindering the confirmation and agree to a time frame for completion of the inquiry. If the response at the Site is confirmed as complete, the Site will not be further evaluated for NPL listing, unless EPA receives information of a release or potential release at the site which poses a significant threat to human health or the environment. Upon completion of response actions and confirmation by EPA, the Site will be archived in SEMS.

VII. AGREEMENT TERMINATION AND MODIFICATION

EPA may terminate this Memorandum of Agreement at any time after providing 30 days' notice to IDEM which notice shall include the basis for such termination as provided in this paragraph. This Memorandum of Agreement may be terminated: 1) if the response is not CERCLA-protective; 2) is unreasonably delayed; 3) is inconsistent with this Memorandum of Agreement; 4) does not adequately address the concerns of the affected community or affected Tribal governments with whom IDEM has MOUs, or 5) for other reasons constituting a violation of this agreement, such as the State's inability to enforce compliance; or the absence of appropriate funding to complete the response action. IDEM may also choose at any time, after 30 days' notice to EPA, to terminate this Memorandum of Agreement for any reason. During any 30-day notice period required by this paragraph, EPA and IDEM agree to meet to discuss the decision to terminate this Memorandum of Agreement.

Upon termination of this Memorandum of Agreement, EPA will consider taking any necessary response actions including initiating the rulemaking process to formally list the Site on the NPL. EPA and IDEM will coordinate efforts to notify the community of the termination of this Memorandum of Agreement. These actions will assure the public that EPA will continue to respond at the Site. At EPA's request, IDEM will provide to EPA all information in its possession regarding the Site to the extent permitted by State law.

This Memorandum of Agreement adheres to EPA's "Guidance of Deferral of NPL Listing Determinations While States Oversee Response Actions" (OSWER Directive 9375.6 11) dated May 3, 1995. If there are any conflicting provisions, this Agreement prevails. Furthermore, this Deferral Agreement may be modified at any time upon agreement of both parties. Notwithstanding any provision of this Deferral Agreement, EPA and IDEM retain their respective authorities and reserve all rights to take any and all response actions authorized by law.

VIII. AGREEMENT APPROVALS

[signature] 6/8/17

Robert A. Kaplan, Acting Regional Administrator
Region 5, United Stated Environmental Protection Agency
Date

[signature] 6/8/17

Bruno L. Pigott, Commissioner
Indiana Department of Environmental Management
Date

ATTACHMENTS

(A) Letters/Comments Requesting Deferral (Comer, Citizens, Hoggsett)
(B) Map Showing PRPs and Wellfields
(C) Site Investigation Strategy

Attachment A

Indiana Department of Environmental Management
We Protect Hoosiers and Our Environment.
100 N. Senate Avenue • Indianapolis, IN 46204
(800) 451-6027 • (317) 232-8603 • www.idem.IN.gov

Michael R. Pence
Governor

Carol S. Comer
Commissioner

August 18, 2016

Mr. Robert Kaplan
Acting Regional Administrator
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Mail Code: R-19J
Chicago, Illinois 60604-3507

Re: Proposed Riverside National Priorities List Site EPA-HQ-OLEM-2016-0153

Dear Mr. Kaplan:

By this letter, the Indiana Department of Environmental Management (IDEM) withdraws and rescinds the August 13, 2015, letter from IDEM's former Commissioner requesting inclusion of the Riverside Ground Water Contamination site (identified by the U.S. Environmental Protection Agency as Site 0153) on the National Priorities List (NPL) of hazardous waste sites, a copy of which is attached as Exhibit A. IDEM respectfully requests that U.S. EPA not include Site 0153 on the NPL and proposes an alternative approach to protecting public health and the environment by addressing the presence of Chlorinated Volatile Organic Compounds (CVOCs) at Site 0153. IDEM worked with Citizen's Energy Group (Citizens), the City of Indianapolis (the City) and the Marion County Public Health Department (MCPHD) to develop a proposed alternative plan (the Plan) to address Site 0153. Exhibit B outlines the current version of that Plan, which was jointly drafted by IDEM, Citizens, the City and MCPHD.

Background

Site 0153 is located on the northwest side of downtown Indianapolis. While Site 0153 is not yet delineated, it is generally comprised of two multi-well wellfields known as the Riverside and White River wellfields. These wellfields, owned and operated by Citizens, provide drinking water to a portion of the City of Indianapolis. Marion County officials indicate that seven private drinking water wells may exist within Site 0153.

Though low levels of CVOCs are present in the raw water drawn from some of the wells in the wellfields, the drinking water provided to Citizens' customers does not contain, and has never contained, CVOCs. The drinking water provided to Citizens' customers is completely safe to drink.

Basis for Withdrawal

Information available to IDEM at the time of the August 13, 2015, letter indicated that certain wells in the wellfields were impacted by CVOCs at levels that caused concern for public health. There was also a concern that the CVOCs could migrate to other wells in the wellfields, and that concentrations could increase, creating the potential for harm to public health. Based on the data provided at that time, IDEM sought inclusion of Site 0153 on the NPL. However, that data reflected only a snapshot in time and is now outdated.

In April of 2016, Citizens provided IDEM additional technical information that had not previously been shared with the agency. That data led IDEM to re-evaluate its initial request for listing Site 0153 on the NPL. Exhibit B contains illustrations of this data, which span the time period from 2006 to 2016 and indicate that the levels of CVOCs in both wellfields are decreasing. In addition, with the exception of one well (WR3), all CVOCs in the raw water supply are below U.S. EPA's Maximum Contaminant Levels (MCLs) for drinking water.

Fifteen sites that may have contributed to the CVOC contamination are currently in one of IDEM's remediation programs. Many of those sites have already addressed their contamination sources, while others are on track to do so. IDEM believes these efforts have contributed, at least in part, to the declining levels of CVOCs in the groundwater.

In light of the new information and greater understanding of activities in the area, IDEM no longer believes Site 0153 is an NPL caliber site that should be addressed by the Superfund program. Had all of these data and factors been known in August of 2015, IDEM would not have proposed Site 0153 for the Superfund program. For these reasons, IDEM respectively requests that U.S. EPA not include Site 0153 on the NPL.

Alternative Plan

Withdrawing Site 0153 from inclusion on the NPL does not eliminate the need to address the CVOC contamination at Site 0153. Steps must still be taken to protect public health and the environment from the contamination. The proposed Plan is designed for that purpose. Exhibit B is a draft document, and the Plan may evolve over time in response to new information or additional comments from the public, U.S. EPA, and others. As you review the proposed Plan, please consider the following:

1. IDEM fully supports the Plan and will dedicate four project managers and one attorney to this project to ensure its full and complete implementation under the auspices of IDEM's State Cleanup Program.

2. IDEM will also:

   a. determine whether any private drinking water wells exist within the five year time of travel of groundwater and if so, test those wells for CVOC contamination. If shown to be contaminated, IDEM will devise a plan to ensure an alternate water source is provided.

   b. conduct a comprehensive search for potentially responsible parties through all reasonably available records, and pursue all identifiable responsible parties to obtain their cooperation in remediating Site 0153, including contributing to the cost of remediation.

   c. review and scrutinize all sites in reasonable proximity of Site 0153 that are currently being addressed in our State Cleanup Program and Voluntary Remediation Program (VRP) for their possible roles as Responsible Parties.

   d. collect soil, vapor and groundwater samples through the agency's push-probe drilling equipment (Geoprobe) where no RPs can be found, but sources are suspected.

   e. identify any completed exposure pathways (including human consumption of groundwater and vapor intrusion) and devise plans to eliminate those pathways.

   f. delineate groundwater impacts, to the extent feasible.

   g. address the sources of contamination as necessary and as practical through mechanisms such as, but not limited to, physical removal, institutional controls and monitoring.

   h. report regularly to U.S. EPA on the progress of implementing the Plan and enter into a Memorandum of Understanding with U.S. EPA to memorialize IDEM's obligations under the Plan.

   i. ensure that Citizens discharges all of its responsibilities under the Plan, including:

      i. conducting more frequent sampling in the wellfields,
      ii. removing WR3 from service and installing aeration equipment to reduce CVOCs before the well is put back in service, and

iii. removing any other production wells from service that exceed a drinking water MCL, and installing aeration equipment to reduce CVOC concentrations before the well is put back in service.

3. The Indiana Governor's Office has committed to funding the Plan.

4. IDEM has engaged local neighborhood residents and stakeholders and found that many have expressed concerns with the proposal to list Site 0153 on the NPL, and have expressed support for the alternative Plan.

5. The City of Indianapolis supports the Plan. Mayor Hogsett and his Administration have been actively engaged in the Plan's development and prefer the Plan to listing Site 0153 on the NPL.

6. The Marion County Public Health Department supports the Plan and prefers the Plan to listing Site 0153 on the NPL.

7. The Plan is locally driven, which will facilitate its implementation and allow for a quick response to challenges that arise during its implementation.

8. IDEM is confident that the Plan can be completed in less time and with fewer resources than a traditional Superfund investigation and cleanup.

9. IDEM commits to continuing to keep residents and stakeholders informed and up-to-date. IDEM engaged local community members as the Plan was developed to ensure that all stakeholders understood the nature of the Plan as well as to address community members' concerns. IDEM will hold regularly scheduled public meetings, prepare and disseminate materials tracking the Plan's progress, and maintain a dedicated web page to provide the local community with easy access to the materials, the public meeting schedule, and other information related to the implementation of the Plan. IDEM has already established the website and published information at: www.idem.in.gov/Site0153.

10. If IDEM's request is approved, the agency commits to changing the name of the Site from Riverside to Site 0153, pursuant to the concerns and request of the local community.

With regard to a timeline for implementing the Plan, although we are confident that this project can be handled more quickly under the Plan we have proposed than under the Superfund program, IDEM estimates that it will take at least six years to complete, given the magnitude of the work.

As you can see, the Plan has broad, bipartisan support among local stakeholders. IDEM commends Citizens, the City of Indianapolis, the Marion County Public Health Department and the members of the public who have participated in this process for helping develop a proposal that protects the health of Hoosiers in the Riverside community by addressing the CVOC contamination in a cost-effective manner. They have all been partners in the effort to solve this problem, and we welcome their continued dedication to our community and to protecting public health and the environment.

Should you or your staff have additional questions or need further information, my staff and I would be happy to meet with you in person or by teleconference. My administrative assistant, Mary Fields at 317-232-8611, would be happy to coordinate schedules.

Thank you for your consideration. We look forward to working with you on this matter.

Sincerely,

Carol S. Comer
Commissioner
Indiana Department of Environmental Management

cc: Joe Hogsett, Mayor, Indianapolis
Joseph Sutherland, Citizen's Energy Group

Exhibit A

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We Protect Hoosiers and Our Environment.

100 N. Senate Avenue • Indianapolis, IN 46204

(800) 451-6027 • (317) 232-8603 • www.idem.IN.gov

Michael R. Pence
Governor

Thomas W. Easterly
Commissioner

August 13, 2015

Ms. Susan Hedman
Regional Administrator
U.S. EPA, Region V, R-19J
77 West Jackson Boulevard
Chicago, Illinois 60604-3507

Dear Ms. Hedman:

Re: Proposed Inclusion of the Riverside Ground Water Contamination Site Indianapolis, Marion County, Indiana on the National Priorities List of Hazardous Waste Sites

The Indiana Department of Environmental Management (IDEM) is providing this letter to convey its support to the United States Environmental Protection Agency (U.S. EPA) regarding inclusion of the Riverside Ground Water Contamination site on the National Priorities List (NPL) of hazardous waste sites. The Riverside Ground Water Contamination site is a contaminated ground water plume that encompasses an area of approximately 62 acres and affects two wellfields.

The Citizens Energy Group operates the drinking water utility for the city of Indianapolis. Raw water sample results obtained by IDEM from five (5) municipal wells confirmed detections of vinyl chloride (VC) and trichloroethylene (TCE). The VC and TCE levels in two of the wells exceed U.S. EPA Superfund Chemical Data Matrix benchmarks. The impacted wells provide drinking water to more than 10,000 people in Indianapolis. IDEM has identified over 100 potential sources of contamination to the well fields, including sites in the Voluntary Remediation Program, RCRA Corrective Action Program, Brownfields Program, and the State Cleanup Program, but a definitive source of the contamination has not been identified.

This site qualifies for inclusion on the NPL because:

1) The site meets the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria for listing on the NPL, scoring sufficiently high pursuant to the Hazard Ranking System (HRS).

2) The site requires a long-term response action.

An NPL listing would allow for proper and timely investigation of the nature and extent of the contamination of the potential sources and enable the U.S. EPA to determine cleanup alternatives for the impacted areas, thereby protecting human health and the environment. The NPL listing appears to be the most viable alternative for addressing the existing environmental problems.

As the Commissioner of IDEM, I am authorized by Indiana Governor Michael R. Pence to act in these matters on his behalf. I have considered my staff's recommendations and I fully support the designation of the Riverside Ground Water Contamanition site for inclusion on the NPL. I request that the U.S. EPA assign a Remedial Project Manager and/or On-Scene Coordinator to implement the process. If you require any additional information or have any questions, please contact Mark Jaworski of the Site Investigation Program at 317/233-2407 or via e-mail at mjaworsk@idem.in.gov.

Sincerely,

Thomas W. Easterly
Commissioner

cc: Denise Boone, U.S. EPA
Nuria Muniz, U.S. EPA
Mark Jaworski, IDEM
Rex Osborn, IDEM

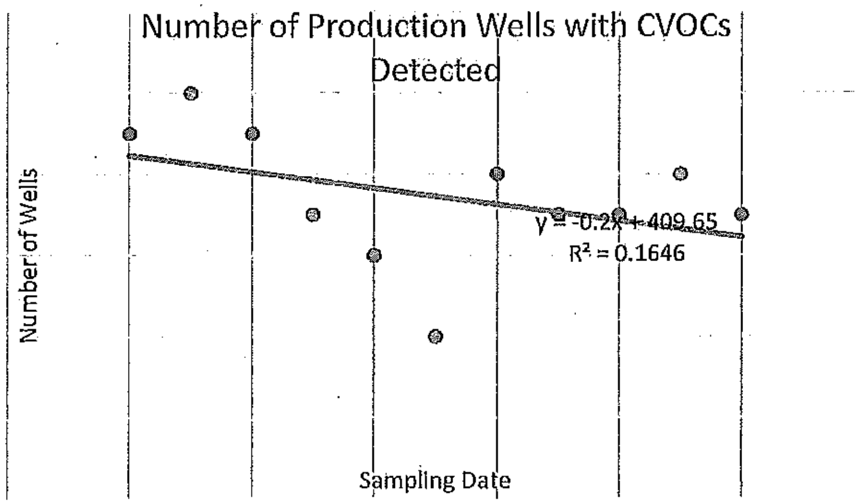
Exhibit B

Proposed Alternative to U.S. EPA Proposed Rule
"Riverside Groundwater Contamination Site"

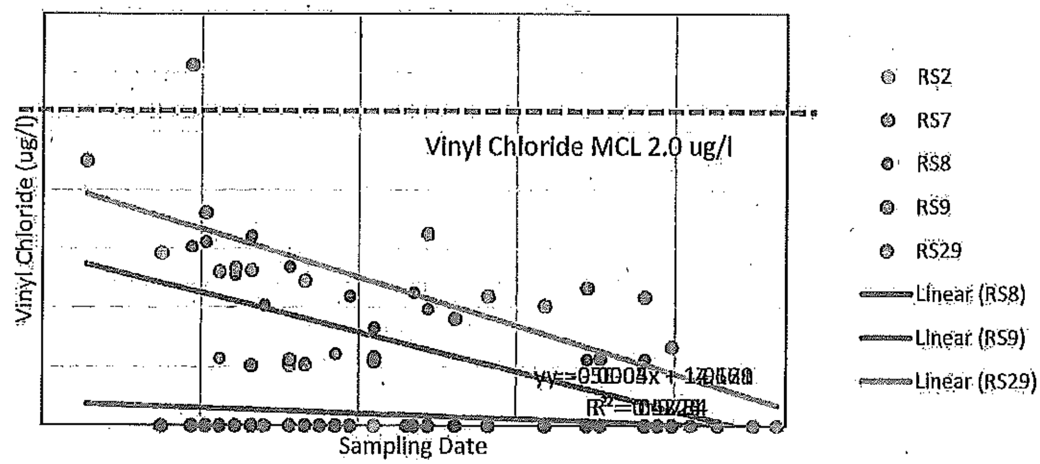
August 18, 2016

Trace levels of certain chlorinated solvents (also called "chlorinated volatile organic compounds" or "CVOCs") have been detected in some of the groundwater production wells in the Riverside and White River Groundwater Production Well Fields owned and operated by Citizens Water in Indianapolis (collectively, the "Well Fields"). These detections have led the U.S. Environmental Protection Agency (U.S. EPA) to propose to list the "Riverside Groundwater Contamination Site" as a federal Superfund Site.

Sampling data initially provided to the Indiana Department of Environmental Management (IDEM) by Citizens Water, and forwarded to EPA as part of the Superfund scoring process, is outdated. Citizens has recently provided additional sampling information to IDEM, and with the exception of one production well, "White River 3" (WR-3), trace detections of CVOCs in these wells are currently below U.S. EPA's drinking water standards that apply to finished drinking water. In addition, as the following graphs demonstrate, overall concentrations of CVOCs in the Well Fields are declining:



Citizens Riverside and White River Well Field
Vinyl Chloride Detections



Notwithstanding these detections, no CVOCs have ever been detected in the drinking water supplied to Citizens Waters' customers. In addition, five Citizens' production wells and a geothermal well in the Riverside Well Field are planned to be removed and relocated as part of a planned redevelopment project in the area called "16 Tech." The closure and abandonment of these wells will alter groundwater flow and CVOC distribution and concentrations in the Well Fields.

Various state and local stakeholders have developed a proposed alternative to a Superfund listing to address CVOCs detected in area groundwater and to ensure human health and the environment are protected. The elements of this alternative proposal are described below.

<u>Citizens Water Plan to Ensure Continued Safety of Public Water and to Assist in Source Assessment & Mitigation</u>

Despite the current safety of the drinking water supplied to customers and the declining CVOC trend, Citizens Water would be willing to take the following measures as an alternative to a Superfund listing to ensure the continued safety of its drinking water and to assist State and local governmental agencies with assessing and mitigating potential contaminant source areas in the vicinity of the Well Fields:

1. Citizens would take production well WR-3 out of service, install an aeration treatment system to reduce CVOC levels, and then test the water post-treatment to ensure levels are below EPA's drinking water standards. Upon receipt of satisfactory test results, Citizens would return WR-3 to service. At that point, all "raw water" being produced by Citizens'

production wells would be below EPA's finished water standards before it is mixed with surface water and treated in Citizens' treatment process.

2. Citizens would take the same measures at any production well in the future if verified sample results exceed drinking water standards, thus ensuring that water produced from Citizens' production wells – even <u>before</u> mixing and treatment – would continue to be below EPA's standards.

3. Citizens would increase the frequency of its voluntary sampling for VOCs from the production wells and monitoring wells in the Well Fields from semi-annual to quarterly, and would share those results with IDEM as they are received.

4. Citizens would develop and implement a Groundwater Quality Monitoring Plan required by the recently adopted Indianapolis/Marion County ordinance to track CVOC concentrations in the Well Fields, and would develop a plan to address those detections to ensure continued safety of drinking water. The results of this sampling program would be shared with U.S. EPA, IDEM, and the four local agencies identified in the ordinance to help determine if further measures are warranted.

5. Citizens would support State and local governmental agencies, including IDEM, the City of Indianapolis, and the Marion County Public Health Department (MCPHD), in their efforts to assess and, if necessary, mitigate impacts associated with potential CVOC source areas in the general area identified by EPA in its proposed listing rule. Citizens would support the MCPHD in connection with its review of any requests to install any new private groundwater wells in the area of concern, and support efforts to connect any existing, impacted private groundwater wells to water supplied by Citizens. Citizens would also review environmental remediation proposals submitted to or developed by IDEM for any source area located with the then-current Five-Year Time-of-Travel, and provide comments to IDEM and the Responsible Party(ies) regarding the effectiveness of the proposal to protect the Well Fields. Finally, Citizens would use the results of its on-going Groundwater Quality Monitoring Plan described above to help evaluate these proposals.

Citizens would be willing enter into an agreement with U.S. EPA and IDEM that includes these commitments.

<u>State and Local Government Plans for Assessing and Mitigating Potential CVOC Source Areas</u>

Various governmental agencies and other stakeholders have developed the following multi-pronged plan to identify and address potential CVOC source areas that could adversely impact area groundwater, the Well Fields, or other receptors (*e.g.*, private wells, vapor intrusion issues) that they would be willing to implement in lieu of a Superfund listing:

1. IDEM, the City and MCPHD have substantial information about various potential source areas of CVOCs in and around the Well Fields, including soil and groundwater data, some of which are currently in IDEM programs such as the Voluntary Remediation Program, State

Clean-Up Program or Leaking Underground Storage Tank program. The City and MCPHD would provide information in their possession relating to these source areas to IDEM. IDEM would then review and assess all relevant information and data to identify those sites currently in IDEM programs that warrant additional investigation, given their potential contribution to CVOC impacts in the area of the Well Fields.

2. IDEM would review its existing soil and groundwater data, and any information from the City and MCPHD, to determine what data gaps exist in the area of the Well Fields, and to identify the existence of sites potentially impacting groundwater in that area that are not currently in one of IDEM's programs, and which might be a source of CVOCs.

3. To fill these data gaps and identify potential CVOC sources, property owners and/or other responsible parties would conduct investigations on properties under their ownership or control, at their own cost. As necessary and appropriate, IDEM would exercise its regulatory authority to require the performance of those investigations. Further, IDEM could also conduct its own investigations as needed utilizing funding sources such as monies from known responsible parties. All such investigations would be focused on those areas in which existing data and information indicates a reasonable likelihood of CVOCs. The purpose of these investigations would be to generate meaningful soil and groundwater data to identify potential source areas that would then be the subject of further investigation and/or IDEM enforcement.

4. The City and MCPHD would work collaboratively with IDEM to develop IDEM's priority list for further investigation, identify property owners, and obtain access agreements. To the extent necessary, Citizens Water would work alongside these entities to engage with the public with regard to this effort. The City would also direct Brownfield grant money to assist in performing environmental assessments for "orphan share" sites in the area of the Well Fields.

5. MCPHD would work with IDEM, Citizens Water, and the City to identify potential private wells in the area, to sample those wells for which access is granted, and to evaluate options to connect any impacted private wells to public water. MCPHD would also use its existing authority to evaluate requests to install new private drinking water wells within the area of concern, and to work with all interested stakeholders in connection with any such requests.

6. With information supplied by Citizens regarding current and future pumping scenarios, IDEM will determine the appropriate boundaries for the area to be evaluated.

7. In order to assist the local community's efforts to monitor the development and implementation of the Plan, IDEM, the City, and MCPHD will secure funding that will allow the local community to engage the services of its own consultant with the technical expertise to facilitate meaningful community involvement.

regulations.gov

Comment submitted by Joseph H. Hogsett, Mayor, City of Indianapolis

Site Data

Regulatory Agenda

Agency Report

The is a Comment on the Environmental Protection Agency (EPA) Proposed Rule: National Priorities List

For related information, Open Docket Folder

Comment Period Closed Sep 6 2016, at 11:59 PM ET

Required by Statute

ID: EPA-HQ-OLEM-2016-0153-0135

Tracking Number: 1k0-8rqg-drl0

Document Information

Date Posted:
Sep 12, 2016

RIN:
Not Assigned

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Comment

SUBJECT: Docket EPA-HQ-OLEM-2016-0153 Comment

FROM: The Consolidated City of Indianapolis and Marion County, Indiana

TO:
--OLEM via Regulations.gov
--Mr. Robert Kaplan
Acting Regional Administrator
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Mail Code: R-19J Chicago, Illinois 60604-3507
--Terry Jeng
jeng.terry@epa.gov

The Consolidated City of Indianapolis and Marion County, Indiana ("City") fully supports the proposed alternative plan ("Plan") to address the Riverside Ground Water site (identified by the U.S. Environmental Protection Agency as Site 0153.)

The City also concurs with the Indiana Department of Environmental Management's (IDEM's) letter dated August 18, 2016, withdrawing its request regarding Site 0153. IDEM indicates that due to new data and additional investigation, IDEM no longer believes Site 0153 is an NPL caliber site and should not have been proposed as such.

Since becoming aware of this situation earlier this year, City efforts have been dedicated to obtaining an outcome that protects the public's health and the safety of our drinking water supply. At the urging of local civic leaders, City representatives have convened and participated in community discussions centered on creating a local alternative that could achieve these critical public health results in a way that would be more beneficial to the interests of the affected neighborhoods than an NPL listing of this site.

It is significant that the development of that Plan engaged all sectors of the community - neighborhood residents, area businesses, the water utility, as well as both state and local agencies including the local health department. The City believes that under the proposed Plan, state and local agencies are uniquely positioned to obtain and react to new data, respond to community concerns, and implement remediation in a timely manner.

The City's primary concern is the health and safety of its citizens. Based on the most up-to-date information made available by IDEM and Citizens Energy Group, the City is convinced that the City's drinking water supply and the health of its residents will be thoroughly protected by the Plan proposed by IDEM. While the City appreciates the ongoing role that the EPA will play as a regulatory agency, the City believes that a local solution in this instance will be successful and provide an efficient, responsive effort to address public health and environmental concerns within the affected area.

Respectfully,

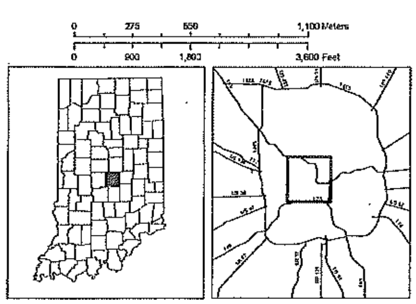
Joseph H. Hogsett
Mayor of Indianapolis, Indiana

Possible Contamination Sources
Within the 5 Year Time of Travel Wellhead Protection Area

Attachment B

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
Shane Moore, Office of Land Quality
Date: 10/13/2016
Sources:
Non Orthophotography
Data – Obtained from the State of Indiana Geographical Information Office Library
Document - Potential Sources of Chlorinated Solvents Reference 4 (table on pages 381-385)
- Well Head Protection Area Reference 60
- RS 29 Reference 4, pages 71-74
- Plume created based on results in Reference 4, page 119
Orthophotography - Obtained from Indiana Map Framework Data (www.indianamap.org)
Map Projection: UTM Zone 16 N   Map Datum: NAD83



- Possible GW Contamination Sources
- PWS Well RS 29
- GroundWater Plume Boundary
- Wellhead 5 Year Delineation
- Wellhead 1 Year Delineation

Table 1: Riverside Potential Sources

Label	Name	Address	Distance (ft)	Distance (m)	AI_ID_	Other_ID_s	Reported_R	Documented	Take_Sampl	Type_	Notes___M	Label
0	DPW/Merrs Corp	1021 Burdsall	7124.96589	2171.689534	22656	BFD 4980024	Y	N	0	Maintenance	MCHD Violations for salt and solid waste	0
1	Northside Trucking/Pallent Repair	1037 W 25th St	7870.690845	2398.986493	16605	IND058477936	N	Y	1	haz waste hauler	Haz waste Notice lists F001-F012, etc see.VFC 42735550	1
2	Chevron Chemical Co./Saint Clair Properties Limited Warehouse (Carrier/Bryant)	1100 W 21st	5275.529258	1607.981266	15981	IND982219107	Y	Y	1	manufacturing	Brownfields/ City of Indy Phase1 Report is VFC 66905974 /Andrea R. new wells planned by Dec 2013	2
3	Industrial Coatings / United Coatings/ IU Methodist & Neuropsych Center	1102 W 16th	3044.156364	927.8588301	17130 / 16168	IND984956888/ IND984866202	Y	N	0	manufacturing	conditionally exempt generator - no groundwater impacts, release to soil only	3
4	Benham Press / Disc Graphics / Awning Partners Sign Group	1160 W 16th	2793.303994	851.3990302	22076	IND006066641 / BFD 4030010	Y	?	?	printer, etc.	RCRA violations, paint waste violations VFC 62498373 Has an ERC, part of Brownfields? Has MWs too	4
5	Central Soya	2235 Montcalm / 1102 - 1160 W 18th	3813.330067	1162.302967	16021	IND006413272 / FID 18135	Y	N	0	Grain facility, LUST	Releases of soybean oil	5
6	Aero Industries / Fruehauf Corp / Mayflower/ Lincoln Technical Institute	1201 Stadium Dr	2194.383977	668.8482147	16396	IND150600344	N	Y	1	maintenance	F002 (spent CVOCs) / F004 ; MCHD Violations	6
7	Indianapolis Water Company	1220 Waterway	1058.077666	322.5020624	13668	IND006938351 / FID 011510	Y	N	0	water company	diesel LUST has NFA; has a maitenance shop. Conditionally exempt F001	7

8	Perry Manufacturing / Overbay-Tehan Corp.	1233 W 18th / 1244 W 16th (& 2535 Burton??)	3439.662543	1048.409109	18377	FID 10100	N	N	?	manufacturing	gas/diesel USTs, large old building along tracks, make scaffolding now	8
9	West 16th Garage / Lloyd L & Louis L Shonkwiler / Microtel Inn & Suites	1244 W 16th	2855.068742	870.2249247	18506	FID 10100 / 200804504	Y	N	1	Truck Maintenance	adj. to south of Perry / only BTEX+MTBE sampling	9
10	Johnson Controls	1255 N Senate	6631.647237	2021.326013	17486	IND964976381	N	Y	?	manufacturing	small generator F002, D001, D005; Part of 14th St Corridor CVOC plume	10
11	Stewart Manufacturing	1280 N Senate	6630.146539	2020.8686	n/a	n/a	Y	Y	1	n/a	part of Co-mingled 14th St Corridor CVOC plume	11
12	Henley's Cabinets / Custom Printing /Chemcraft Satron Finishes Inc.	1310 N Capitol	7164.748709	2183.815337	16911	IND 982616112	N	Y	?	furniture refinishing	small generator F003, F005, D007, D008, D018, D035, D039, D040 listed PCE and TCE - Within the 14th ST Corridor Plume	12
13	H-N Advertising & Display Co / Bowes Industries	1324-1334 N Capitol	7152.405368	2180.053086	23884	IND006035968 / FID 21455	N	N	0	printing/ manufacturing	UST (unknown)	13
14	Sherwin William distributor	1401 Milburn	2651.273252	808.1080612	n/a	n/a	N	N	0	distributor	no data on VFC, etc.	14
15	Karstadt-Reed Dry Cleaners	1449 N Illinois	7800.715192	2377.657915	n/a	n/a	Y	Y	1	dry cleaner	Top of the 14th St Corridor Co-mingled CVOC plume	15
16	Stromberg Sales /Paradigm Group	1525 Riverside	2613.773254	796.6780624	21138	FID 22445	N	N	0	car sales	diesel, gasoline and fuel oil releases	16
17	Component Machine	1631 N Gent Ave	2830.787449	862.8239868		200412100	Y	Y	1	manufacturing	State Cleanup Documented TCE/PCE in groundwater Jerry O. & Scott Johanson	17

18	ITT Hoffman / Kindred Hospital / Vencor	1700 W 10th	1513.261015	461.2419426	16313	IN0032921	Y	N	1	manufacturer	water violation 1986, removed contaminted soil w/Cr Ni & Pb in 1990 (made plumbing fixtures)	18
19	Gardner Mirror Corporation / Wallace Expanding Machines	1705 Lafayette / 24 W 19th Street	4752.040298	1448.421836	16850	IND98490467 / FID 16834	N	N	0	manufacturing	diesel UST removed	19
20	Indiana Retirement Home	1731 N Capitol	7620.183089	2322.631731	n/a	n/a	N	N	0	nursing care?	listed as a "landfill" for medical/solid waste per 2007 WHPA	20
21	Southeastern Trailways	1810 W 16th	3165.631437	964.8844312		FID 000274 / INDR000016873	Y	Y	0	buses	Documented part of Flexdar plume (non-contributor)	21
22	Harold Richards	1825 Montcalm	3951.188357	1204.322173	n/a	n/a	N	N	0	central soya	fuel storage for Central Soya? Nothing in VFC	22
23	Peerless Pump / Sterling Fluid Manufacturing	2005 Dr MLK Jr	6726.549613	2050.252256	11493	IND990734873	Y	N (?)	1	manufacturing	State Cleanup (Nilia) LUST diesel, gas and stoddard (BTEX+ MTBE only) verbal report that CityofIN may have Ph2 data showing CVOCs	23
24	Citizens Coke Langsdale	2150 Dr MLK Jr	7147.645689	2178.602336	n/a	VRP	Y	N	?	Coal MGP	Bill Holland is PM. Full VOCs on Groundwater??	24
25	White Metal Manufacturing / Rexall Drug & Chemical Co / DART Industries / Draft-Kraft / Wheeling Stamping (*part of Rumpke now??)	2099 Montcalm	5247.574699	1599.460717	25759	IND980606396	n/a	?(likely)	1	manufacturing	PA/VSI in 1984 no samples taken MCHD records	25

26	Rumpke /Republic Recycling / United Brake Systems / Heavy Duty Friction Service Group	2235 Montcalm	5878.553654	1791.783096	24663	VRP 6030103 / FID 1570 / IND006062616	Y	N	?	recycling/former manufacturing	possible asbestos/ LUST for diesel&waste oil / Small quantity generator of D001 / VRP included north&south of 21st / residual were metals & PAHs& TMBs / Damon R. VFC# 62825015	26
27	Industrial Heat Treating / BodyCote Thermal	2131 Dr. MLK Jr. / 500 W 21st St	7028.999468	2142.438969	11491	IND006417315	Y	Y	1	manufacturing	Complaint (VFC 38838458) re: drums, fire, release Small generator of F001, F010, F011, & F012 & P030 MCHD had PA/VSI from 1992 TWO VAPOR DEGREASERS	27
28	Dorothy Shamrock Coal	2110-2112 Dr. MLK Jr.	6895.780734	2101.8339	20624	4960013	Y	N	0	coal yard	PAHs, oil staining, see VFC 14540029, MCHD files	28
29	Excelsior Laundry and Cleaners	2179 N Illinois	9408.696645	2867.770646	15994	IND016405854	N	Y	1	dry cleaner	active dry cleaners	29
30	45 Minute Cleaners	2179 N Pennsylvania	10137.22308	3089.825495	16751	IND981783475	N	Y	1	dry cleaner	closed dry cleaners	30
31	Sparkle Cleaners	2198 N Meridian	9944.458007	3031.070703	17902	IND0000481325	N	Y	1	dry cleaner	active ? As recent as 2009	31
32	Sparkle Cleaners	2119 Central	11624.45728	3543.134464	?	?	N	?	1	dry cleaner	nothing in IDEM file but the name?? No documents	32
33	Jim's Dry Cleaners	2605 W 16th	5445.400131	1659.757907	26751	IN0000204065	N	Y	1	dry cleaner	inspection in 2001 not sure if active now	33

34	Reuas Engineering	555 W 16th	5014.922147	1528.548221	15986	IN006067243	N	N	?	?	small generator F012 (quenching wastewater solids w/cyanide)	34
35	McBroom Electric Co.	800 W 16th	4162.822778	1268.828342	17874	IND042612321 / INR000015778 / FID 5818	N	Y	1	electrical manufacturing	F001 (spent chlorinateds) and D040 (TCE)	35
36	McFarling Foods	333 W 16th	6742.281683	2055.047391	18336	FID 6056 / BFD 4980005	Y	N	0	food storage	Brownfield; within the 14th St Corridor Plume / USTs, diesel fuel, etc.	36
37	Schuchman Metals / Langsdale Metals /Republic Services	829 Langsdale	6381.719104	1945.147921	20353 / 26312	IND 042812321 / FID 15160 / LUST199307532	Y	N (?) sampled?	1	salvage junk yard	Site Investigation VFC 5983115 / Rosy H. is PM / mostly BTEX data any full VOCs?? Aluminum smelting refractory brick	37
38	Republic Services / SMI Recycling/ Circle City	832 Langsdale	6592.625368	2009.432148	14525	IND 980904213 Landfill 49-06	N	N	1	salvage junk yard	combined w/above property? Legal Survey VFC 63589110, asbestos/air permits	38
39	Prototype/ PCG Pump & Engine	1125 W 16th	2907.468732	886.1964413	na	n/a	N	N	?	??	print shop? No RCRA - listed in WHPA list, not in VFC	39
40	Capitol Tool & Dye	1141 W 16th	2833.277885	863.5830717	n/a	n/a	N	N	0	machine shop	not in VFC	40
41	Executive 1 Hour Cleaners	2658 N Harding	8371.348688	2551.586999	n/a	n/a	N	?	1	dry cleaners	not in VFC	41
42	Martin Luther King Corridor	MLK & W 16th	5652.83534	1722.984157	22740	BFD 4980006	Y	Y	1		MLK Corridor Plume Andrea Robertson	42
43	Universal Sign	507-545 W 16th	5295.846747	1614.174037	22740	BFD 4980006	Y	Y	1	manufacturing	MLK Corridor Plume	43
44	Parker Properties	524-570 W 16th	4943.641074	1506.821751	22740	BFD 4980006	Y	Y	1	repair	MLK Corridor Plume	44

45	Challenge Machine	506 N Elder	3139.651731	956.9658171	15984	IND006066906	N	N	?	machine shop	vacant, west of White River, reported no hazmat	45
46	Republic Creosoting Company	738 Miley	2413.405927	735.6061029	25775	IND980606511	N	N	?	creosoting	west of river, inspections only no samples	46
47	B&W Constructors	560 N Elder	2957.353515	901.4013224	n/a	n/a	N	N	0	metal fab	west of river, not in VFC	47
48	Addie's 45 Minute Dry Cleaners /Forty Five Minute Cleaners	960 Indiana Ave	3510.188754	1069.905498	n/a	INR000007419	N	Y	1	dry cleaners	South of Fall Creek, MCHD violations	48
49	Meadors Tool & Dye / Perry Manufacturing / Sanitec of Indiana Treatment Facility	2020 Montcalm	4764.470015	1452.210414	21973 / 19818	INR000104935 / SW 49-54	N	N	0	manufacturer / medical waste disposal	D001, D002 Large quantity generator "waste oxidizng solid"	49
50	Stanley Signs	1133 Burdsall	6981.689131	2128.018779	18260	INR000103101	N	N	0	signs/paints	D001, F003, F005 conditionally exempt (no chlorinateds)	50
51	Hittle Tool & Dye	2122 Dr. MLK Jr	6960.634406	2121.601299	16164	IND006065536	N	N	1	machine shop	conditionally exempt DOO1 HISTORICAL CONCERNS??	51
52	Bredenstein Printing	1922 Dr. MLK Jr	6309.375088	1923.097465	n/a	n/a	N	N	?	printer, etc.	not in VFC	52
53	Michigan Auto / U Pull & Pay	940 W 16th St	3662.760462	1116.409353	39533	INR000124114	N	N	1	salvage yard	D001 minor violations, no CVOCs listed, MCHD mosquito violations	53
54	American 1 Hour Cleaners / Morleys Cleaners	1901 Lafayette / 1901 N Belleview Place	5916.811727	1803.444157	24157	IND984898528	N	Y	1	dry cleaners	F002 , D039	54
55	Service Labs / Servaas Laboratories	1200 Waterway	1299.380653	396.0512104	20412	IND981090749	N	N	0	lab for water co	F005, U159 (spent petroleum-solvents)	55
56	Motor Pool (Stadium)	1448 Stadium	2035.013254	620.2720201	n/a	n/a	N	N	0	vehicle storage	not in VFC	56

57	Quality Linen Service / Quality Products Inc.	1277 W 29th	9574.788013	2918.395293	17350	INR000007450 / FID 9848	N	Y	1	industrial	violations w/PCE handling, same owner as Master Wear in Martinsville, gasoline UST, D005, D007, D008	57
58	D-A Lubricant Company	1340 W 29th	9602.08112	2926.714232	11500 / 23836/ *14562*	VRP 6020701 / IND006065296 / BFD 4130103	Y	N	1	lubricant manufacturing	Contaminant list did NOT include CVOCs (BTEX/TPH/PAH only) (*AI id is mixed w/Portage Co. site) F005, D035, D001, Ph1 ESA in Dec. 2012 VFC 67345008; began manufacturing in 1919	58
59	Tri-State Bearings / "Vacant Building"	1640 Alonso Watford Sr Dr	5188.278764	1581.387317	n/a	n/a	N	?	?	?	historically industrial area / MLK Plume / address in VFC but no records	59
60	One Stop Salvage Co.	502 W 16th Place	5450.079404	1661.184149	n/a	n/a	N	N	?	salvage yard	MCHD found complaint unjustified	60
61	Star Service Station	502 W 16th Street	5468.470352	1666.78971	21590	VRP 6960401 FID 19333 and 016513	Y	N	0	service station	LUST	61
62	D&M Auto Parts	505 W 16th St	5425.207608	1653.603226	n/a	n/a	N	N	?	salvage yard	MCHD complaints	62
63	Speedway Volkswagen / Speedway International Inc.	1930 W 16th	3557.254863	1084.251247	24974	IND016445512 / 200011210/ FID 11445	Y	Y	1	dealership	waste oil tank removed pre-1986 PCE in groundwater sample	63
64	Parcel 1099990 ? ("not sure")	1600 Dr. MLK Jr	5682.9698	1732.169139	n/a	n/a	Y	Y	1	?	MCHD complaint - drums of PCE from Morley's Cleaners on a vacant lot near 16th & MLK; Part of MLK Plume??	64

65	Site Oil Company /Abandon Site	1402 Dr. MLK Jr	5249.936808	1600.180688	25135	BFD 4030001 / FID 22845	Y	N	0	service station	USTs and a "pit" Brownfield NFA 21823335 complete scan; no CVOCs encountered	65
66	M&L Auto Repair	1520 Dr. MLK Jr	5450.992343	1661.462413	N/a	n/a	N	?	1	truck&bus repair	not in VFC	66
67	Bock Equipment Company / American Block	1900 Dr. MLK Jr	6245.121897	1903.513093	n/a	n/a	Y	Y	1	contractors	MLK 16th Street Plume MCHD documented TCE in soil	67
68	National Sand Blasting	2278 Montcalm	5928.057557	1806.871886	n/a	n/a	N	Y	1	sand blaster	MCHD complaints, PERC listed in MCHD inspection; issues w outdoor chemical storage - paint room venhilation No VFC	68
69	Reynolds Recycling	2089 Montcalm	5187.208557	1581.061117	n/a	n/a	N	N	0	recycling	MCHD complaint; probably part of another address?	69
70	Fall Creek and 16th Park	?	4534.655831	1382.163053	N/a	n/a	N	N	1	former dump	city dump on 1915 Sanborn Map; aerial photographs	70
71	Flexdar	1825 W 18th	3884.81138	1184.090471		SCP 200404159	Y	Y	1	manufacturer	in State Cleanup. Source of "Flexdar Plume"	71
72	S. Cohn and Sons/ Suron	1402 N Capitol	7219.727315	2200.572815	28328	SCP 6070101	Y	Y	1	former manufacture	Within the 14th St Corridor plume; contributor; State Cleanup Jeff K.	72
73	Michaelis / Fame Laundry	1352 N Illinios	7678.383245	2340.371138	23287	BFD 4091202	Y	Y	1	dry cleaner	Within the 14th St Corridor plume; contributor; State Cleanup; Jeff K	73

74	Greater Diversified Supply	1234 N Capitol	7105.892105	2165.875844	n/a	SCP 200606202	Y	Y	1	dry cleaner	Known to have PCE in groundwater; State Cleanup Kevin H.	74
75	Stewart Manufacturing	1280 N Senate	6630.146539	2020.8686		6040306	Y	Y	1	manufacturer	VRP; within the 14th St Corridor plume; contributor; Jeff K	75
76	19th St Corridor Plume	19th and Cornell	13253.09327	4039.5427	?	?	Y	Y	1	?	State Cleanup ; known to have PCE & VC	76
77	Wash Rite Company Inc	1720 Alvord St	13613.79537	4149.484697	n/a	200803020	Y	Y	1	dry cleaner	part of 19th St Corridor Plume; Jerry O.	77
78	Courtsey Cleaners	805 W 10th St	4102.339736	1250.393112	n/a	n/a	N	Y	1	dry cleaner	in VFC w/no records	78
79	Printing Partners / Vacant Commercial	929 W 16th St	3547.854148	1081.38591		INR000135772	N	Y	1	printer	D001, D002, D011, D018 & D039 (PCE) see VFC 68611483	79
80	Rex Metal Craft	1716 Rembrandt	3338.377005	1017.537279	16694	IND981002348	N	N	0	metal fab	F003 (waste non-halogenated)	80
81	CSX/Moorefield Yard	250 N Belmont	5249.447301	1600.031486	n/a	n/a	?	?	?	former rail yard	Several sites are now ontop of here at Belmont & New York	81
82	Shell Oil	Belmont	4038.030296	1230.791595	22624	BFD 4980013	Y	Y	1	bulk station	Former bulk facility, was part of/next to? CSX yard, has TCE in H20	82
83	Dickey & Sons Tool	2450 Turner Ave	5856.294618	1784.998543	17386	BFD 4090206	Y	Y	1	machine shop	TCE extends off-site	83
84	Herff Jones	1411 N Capitol	7269.422505	2215.719909	18857	BFD 4040007	Y	N	0	class rings	Sampled full scan, no CVOCs detected	84
85	Indy Parks	1426 W 29th	9628.949194	2934.90362	19673	BFD 4020002	Y	N	0	garage	former parks maintenance garage / some full scan VOCs no CVOCs detected (AI Id is mixed w/ SCP cleaners in Peru??)	85

86	Goodwill Industries	1635 W Michigan	2873.251611	875.767063	20195	IND006938278	Y	Y	1	industry	F002 and D001 small generator/ former CSX yard??	86
87	EMP Corporation / American Metals Industries	413 N Tremont	5028.455232	1532.673106	16851	IND984890475	N	N	0	metals	waste type not listed; out of business	87
88	Thomas L Green Co.	202 N Miley	4835.26133	1473.787606	19941	IND006066450	N	N	0	manufacturer	made buscuit plant equipment F005	88
89	Dewercs One LLC / Tuchman's Cleaners	30th & Kessler	8354.95763	2546.591004	23805	VRP 6051002	Y	Y	?	dry cleaner	kicked out of VRP last sampled in 2010	89

Site Investigation Strategy
Site 0153 Plume (formerly Riverside Groundwater Contamination)
Indianapolis, IN
EPA ID# INN000510936

This document presents the Site Investigation Strategy (SIS) for the Site 0153 (formerly Riverside) groundwater contamination plume located in downtown Indianapolis, IN. The purpose of this document is to present the strategy for addressing the contamination present in the Riverside and White River wellfields, including: identifying Potentially Responsible Parties, delineating the nature and extent of contamination, determining the potential risk of the contamination and any completed exposure pathways, and selecting an appropriate remedial action to mitigate that risk or exposure.

Background

Site 0153 is located in Indianapolis, Marion County, Indiana. On February 20, 2013, IDEM staff received notice from Citizens Energy Group that elevated levels of vinyl chloride (VC) and cis-1,2-dichloroethene (cis-1,2-DCE) were being detected in their Riverside municipal wellfield. Citizens Energy was concerned that the increasing levels of VC in Well RS29 are approach9ing the Maximum Contaminant Levels (MCL) for VC, which may adversely impact the use of that well to supply drinking water to residents in Indianapolis. The MCL for VC is 2.0 µg/L. The Riverside/White River Wellfield supplies drinking water to over 17,000 people in Indianapolis.

On May 20 and 21, 2014, IDEM staff conducted a site inspection at the Riverside Groundwater Contamination site. A total of 25 raw water samples were obtained. The samples consisted of 19 ground water samples, four (4) duplicate samples, and two (2) trip blanks. The ground water samples were collected from 19 municipal wells located in the Riverside and White River Wellfields. All samples were analyzed for volatile organic compounds(VOCs) only. Vinyl chloride, cis-1,2-DCE , trichloroethylene (TCE), and 1,1,1 trichloroethane were the primary VOCs detected. Although VOCs were detected in some of the municipal wells, the concentrations of the VOCs did not exceed any MCL set by the EPA in raw water. All raw water is treated and tested by Citizens Water Utility prior to distribution and no VOCs have been detected in finished water sent to customers. Results of water system tests can be found on the State Drinking Water Information System (SDWIS) website at https://myweb.in.gov/IDEM/DWW/index.jsp.

The Hazard Ranking System (HRS) documentation record submitted to EPA currently has identified upwards of 89 potential sources of VOC contamination to the White River and Riverside Wellfields' five-year time of travel of groundwater. More than fifteen (15) sites are in one of IDEM's remediation programs, and have either addressed their potential sources or are on track to do so. For an illustration of the site area, including potential identified site sources, see Attachment A.

On August 13, 2015, IDEM's former Commissioner, Thomas Easterly, requested inclusion of the Site on the National Priorities List (NPL). However, IDEM has since determined it would be in the best interests of the site, and responsive to citizen requests, to address the site in IDEM's State Cleanup program. Commissioner Carol Comer sent a letter to EPA on August 18, 2016, formally withdrawing support for the Riverside Groundwater Contamination Site (now known as Site 0153) to be included on the NPL (Attachment B).

Path Forward

The Site exhibits unacceptable levels of groundwater contamination from multiple sources, and threatens municipal drinking water supplies. Additional information regarding the nature and extent of VOC contamination, any possible sources of contamination, and potentially completed exposure pathways must be collected. IDEM commits to following a CERCLA-like strategy to evaluate the contamination at Site 0153 as outlined below:

Preliminary Data Gathering/Conceptual Site Model Development

There are currently 15 potential contamination source sites in the Site 0153 five-year time of travel for groundwater that are in one of IDEM's remediation programs. The information collected for these sites to date is valuable to building a conceptual site model (CSM). IDEM staff will ask the programs for these sites to submit their most recent groundwater, soil, and vapor intrusion data sets as well as monitoring well construction data as electronic records to IDEM's SAMPDB sample database. IDEM's GIS section will use that information to build a site overview map and base conceptual site model. These sites will be asked to perform a data gap analysis to determine whether they need additional investigation and monitoring wells to evaluate potential contributions to the wellfield.

- Immediate Impact Mitigation:

  As part of this preliminary data gathering activity, IDEM staff will determine whether any private drinking water wells exist within the five-year time of travel of groundwater to the Riverside and White River Wellfields, and if so, test those wells for VOC contamination. If shown to be contaminated, IDEM will devise a plan to ensure an alternate water source is provided.

PRP Search

Using the preliminary CSM as a guide, IDEM will conduct a comprehensive search for potentially responsible parties (PRPs) through all reasonably available records, and pursue all identifiable potentially responsible parties to obtain their cooperation in investigating and remediating Site 0153. IDEM staff will attempt to create a cooperative approach, wherein all identified PRPs work together to investigate both their own potential site-specific contamination issues as well as their potential contribution to the plume affecting the Riverside and White River wellfields (PRP Cooperative). IDEM staff will work with the responsible parties to develop a multi-party Agreed Order on Consent to complete this work. If a site is identified but no Responsible Parties can be found, IDEM will undertake the work to address that site. Due to the density of sites and the nature of the contamination, there is a potential for commingled plumes. Other sources and responsible parties do not preclude delineation of on-site sources. IDEM will use all available enforcement authority to ensure all potentially responsible parties participate in this process.

Site Investigation

IDEM staff will take a tiered approach to understanding the nature of the contamination at Site 0153:

- Site-specific investigation of the nature and extent of impacts on individual properties will be completed by PRPs with oversight by IDEM project managers and Science Services staff, using the principles outlined in the Non-Rule Policy Documents "Remediation Closure Guide" and "Remediation Program Guide - State Cleanup Program" (Attachment C).
- Vicinity-wide evaluation of the entire project area, including understanding how the sites are connected, multiple plume behavior analysis, and identification of sources to the Riverside and White River Wellfield contamination will be undertaken by the PRP Cooperative, with oversight and input from the Lead IDEM Project Manager and Lead IDEM Geologist. The Lead Project Manager and Lead Geologist will review all site investigation work plans and reports to ensure each investigation is conducted with the overall goal of determining potential contribution to Site 0153 in mind.

Sampling on all sites will include soil, vapor, and groundwater samples. Initial samples will be analyzed for the full suite of potential contaminants in order to determine the correct list of contaminants of concern. Each site will be delineated horizontally and vertically until groundwater and soil impacts are below the RCG Residential Tap Water/Residential Soil standards. All sites must coordinate to gauge and sample wells on a regular basis. This information will be valuable to determining the potential source of contamination. Because of the toxicity of the contamination and the drinking water receptor, the delineation must be confirmed with repeatable groundwater data (wells). All data will be submitted to IDEM's SAMPDB database.

Risk Assessment/Cleanup Goals

IDEM staff will evaluate all Site Investigation-generated data against the IDEM Residential standards for soil, groundwater, and soil vapor. Those standards are derived using EPA Region 5 standards and calculated to be protective at a level of $1x10^{-5,}$ which is within the Superfund acceptable risk range of $1x10^{-6}$ to $1x10^{-4.}$

Site Technical Decision Points

Once an individual site has been delineated to residential levels and all data and information has been submitted to the satisfaction of the site Project Manager, the site will be directed to mitigate any source areas, vapor intrusion, or other local, on-property impacts. This remedial decision, including all supporting information, conclusions, risk evaluations, and impact to local communities, will be detailed in a Site Decision Document submitted to IDEM for review and approval by the Site Project Manager, Site Technical Staff, Lead Project Manager, Lead Geologist, and the State Cleanup Section Chief.

When the majority of sites have determined their nature and extent impacts and all data has been collected and evaluated, the PRP Cooperative, with comment from the IDEM Lead Project Manager and Lead Geologist, will draft a document that provides an overview of all relevant site-wide data and the conclusions regarding the nature of the groundwater contamination affecting the wellfields, all relevant source areas, and potential risk for future contamination to the wellfields. The PRP Cooperative will also draft a feasibility analysis of potential cleanup strategies that will protect the existing wells and reduce or eliminate impacts to the wellhead protection area.

Decision Document

IDEM staff will evaluate the results of the Site Investigation and Feasibility Analysis documents and will draft a Decision Document that will summarize the results of the investigations, risk evaluations, and feasibility analysis (including potential 30-year cost evaluations) of all potential cleanup actions for the Site 0153 plume. This document will evaluate the potential cleanup actions using the Superfund Nine Criteria, which include:

Threshold Criteria
1. Overall protection of human health and the environment
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Primary Balancing Criteria
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility or volume
5. Short-term effectiveness
6. Implementability
7. Cost

Modifying Criteria
8. State (EPA) acceptance
9. Community acceptance

The draft Decision Document will be presented to the public as a proposal at a public meeting, and any written or oral comments will be gathered and responded to before the Decision Document is signed by the Assistant Commissioner of the Office of Land Quality. The PRP Cooperative will also be presented a copy of the draft Decision Document and given the opportunity to comment.

Site 0153 Responsible Party Agreement
All parties/property owners that are shown to have a plume source or contributing areas will be asked to come to an agreement to fund the remedial action chosen in the Decision Document. This agreement will include each site's cost contribution and future financial assurances, as well as the structure of the

collective group's responsibility to implement the remedial action, the role of IDEM staff to approve remedial design and remedial action activities, and future operations and maintenance responsibilities.

Site 0153 Public Participation Plan

IDEM staff commit to holding at least a quarterly meeting in the Site 0153 area to update the public regarding progress at the site. In addition, links to publicly available site documents will be placed on the Site 0153 website. The documents will also be placed in an information repository that will be established in a local library or other public location. The draft site Decision Document will be presented to the public for input and comment before the document is final. IDEM staff are committed to communicating with the public in an open and transparent way in order to keep them informed of the site activities in their area. IDEM staff will also determine if any other methods of communication are preferred by the community and will revise this approach as necessary to ensure the needs of the community are being met. IDEM will ensure that both Spanish and English translations of outreach information are available. In addition, financial assistance to citizens groups to be able interpret any site-related technical documents will be made available either through PRPs or IDEM itself if no PRPs are identified.

Citizens Water Utility

Citizens Water has stated it would be willing to take the following measures to ensure the continued safety of its drinking water and to assist State and local governmental agencies with assessing and mitigating potential contaminant source areas in the vicinity of the Wellfields:

- Citizens would take production well WR-3 out of service, install an aeration treatment system to reduce VOC levels, and then test the water post-treatment to ensure VOC levels are below EPA's maximum contaminant limits (MCLs) for drinking water. Upon receipt of sustained satisfactory test results, Citizens would return WR-3 to service. At that point, all "raw water" being produced by Citizens' two production wells would be below EPA's standards before it is mixed with surface water and treated in Citizens' treatment process.
- Citizens would take the same measures at any production well in the future if verified sample results exceed MCLs, thus ensuring that water produced from Citizens' production wells, even before mixing and treatment, would continue to be below EPA Safe Drinking Water Act Maximum Contaminant Level (MCL) standards.
- Citizens would increase the frequency of its voluntary sampling for VOCs from the production wells and monitoring wells in the Wellfields from semi-annual to quarterly, and would share those results with IDEM as they are received.
- Citizens has developed and implemented Groundwater Quality Monitoring Plan, dated January 17, 2017as required by a recently adopted Indianapolis/Marion County ordinance, to track CVOC concentrations in the Wellfields. The results of this sampling program will be shared with EPA, IDEM, and the four local agencies identified in the ordinance to help determine if further measures are warranted.

IDEM Commitments

IDEM understands that the nature and complexity of Site 0153 will require a large allocation of resources to complete successfully. Therefore, the Governor's Office and IDEM commit to hiring an additional three project managers, a geologist, and an attorney to be dedicated to the project. In addition, state funding has been secured in the amount of $1 million per year to ensure work is completed in a timely manner.

IDEM staff believe this strategy will result in a complete and thorough evaluation of the contamination affecting the White River and Riverside wellfields, will be protective of human health and the environment, be responsive to the concerns expressed by local agencies, and will be acceptable to the citizens who live in the area.

List of Anticipated Deliverables

Site 0153 Remedial Investigation

A comprehensive evaluation of the nature and extent of contamination affecting the Riverside and White River Wellfields, including groundwater, soil, and vapor intrusion evaluations as well as source identification.

Site 0153 Risk Assessment

Evaluation of all data generated in the Remedial Investigation to determine if the site poses a risk to human health or the environment. This document will clarify contaminants of concern, compare concentrations against IDEM's Residential and Industrial closure values, and will determine the appropriate cleanup criteria for the site.

Site 0153 Feasibility Analysis

This document will determine potential remedies for any unacceptable risk associated with Site 0153. The document will also list potential Applicable or Relevant and Appropriate Requirements as well as cost evaluations for the potential remedies.

Site 0153 Decision Document

This document will summarize the results of the Remedial Investigation, the Risk Assessment, and the Feasibility studies, as well as summarize all ARARs for the site. The document will then outline the remedy preferred by IDEM and the PRPs. This document will be then made available in draft for public comment. All written public comments will be responded to as an addendum to the Decision Document.

Community Involvement Plan

This document will outline the ways in which IDEM intends to communicate with the public, including primary contacts, strategies for email and print communications, commitments to public meetings, location of a public information repository, how to find public records, availability sessions, and any other methods of communication and location of information relevant to the site. The public will be solicited for their input into this plan before it is drafted to ensure the plan meets the community's needs.

APPENDIX B

Preliminary Assessment Report, Indiana Department of Environmental Management, November 1, 2013

APPENDIX REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION

APPENDIX C

Site Inspection Report, Indiana Department of Environmental Management, dated October 23, 2014

APPENDIX REDACTED DUE TO CLAIM OF CONFIDENTIALITY – CONFIDENTIAL – NOT SUBJECT TO PUBLIC DISCLOSURE FOR REASONS OF PUBLIC SAFETY, AND CONFIDENTIAL BUSINESS INFORMATION

APPENDIX D

Definitions

APPENDIX D
EXPOSURE ASSESSMENT DEFINITIONS

- **Absorption barrier**: Any exposure surface that can retard the rate of penetration of an agent into a receptor. Examples of absorption barriers are the skin, respiratory tract lining and gastrointestinal tract wall (outer and inner exposure surfaces).
- **Agent**: A chemical, physical or biological entity that contacts a receptor.
- **Bioavailability**: The extent to which an agent can be absorbed by an organism and be available for metabolism or interaction with biologically significant receptors. Bioavailability involves both release from a medium (if present) and absorption by an organism.
- **Biomarker (Biological marker)**: An indicator of changes or events in biological systems. Biomarkers of exposure refer to cellular, biochemical, analytical or molecular measurements obtained from biological media such as tissues, cells or fluids that are indicative of exposure to an agent. Biomarkers of effect indicate cellular, biochemical or molecular changes occurring as a result of human exposure to the agent.
- **Combined Raw Water**: The mixed intake of production well raw water and surface intake raw water.
- **Dose**: Types of doses include:
    - *Applied*: amount of agent at an absorption barrier.
    - *Biologically effective*: amount of agent that reaches the target internal organ, tissue or toxicity pathway where the adverse effect occurs.
    - *Delivered*: amount of agent transported to the location where the adverse effect occurs.
    - *Absorbed/Internal*: amount of agent that enters a receptor by crossing an exposure surface acting as an absorption barrier.
    - *Potential*: amount of agent that enters a receptor after crossing an exposure surface that is not an absorption barrier.
- **Dose rate**: The dose per unit time.
- **Exposure**: The contact between an agent and the external boundary (exposure surface) of a receptor for a specific duration. Types of exposure include:
    - *Aggregate exposure:* combined exposure of a receptor to a specific agent from all sources across all routes and pathways.
    - *Cumulative exposure:* total exposure to multiple agents that causes a common toxic effect(s) on human health by the same, or similar, sequence of major biochemical events.
- **Exposure assessment**: The process of estimating or measuring the magnitude, frequency and duration of exposure to an agent and the size and characteristics of the population exposed.
- **Exposure duration**: The length of time of contact with an agent. For example, if a receptor is in contact with an agent expressed as x minutes per day for y days per year, the exposure duration is the y variable.
- **Exposure factors**: Factors related to human behavior and characteristics that help determine a receptor's exposure to an agent.
- **Exposure frequency**: The number of exposure events in an exposure duration.
- **Exposure pathway**: The course an agent takes from the source to the receptor.
- **Exposure period**: The time of continuous contact between the agent and receptor. For example, if a receptor is in contact with an agent for x minutes per day, for y days per year, the exposure period is the x variable.
- **Exposure point**: The location at which the receptor contacts the agent.

APPENDIX D
EXPOSURE ASSESSMENT DEFINITIONS

- **Exposure point concentration**: An estimation of exposure parameters in specific media (e.g., air, water, sediment).
- **Exposure route**: The way an agent enters a receptor after contact (e.g., by ingestion, inhalation, dermal application).
- **Exposure scenario**: A combination of facts, assumptions and inferences that define a discrete situation in which a potential exposure might occur.
- **Exposure science**: A discipline that characterizes and predicts the intersection of an agent and receptor in space and time.
- **Exposure surface (Contact boundary)**: A surface on a receptor where an agent is present. For example:
    - Outer exposure surfaces (e.g., the exterior of an eyeball, the skin surface, a conceptual surface over the nose and open mouth).
    - Inner exposure surfaces (e.g., gastrointestinal tract, respiratory tract, urinary tract lining).
- **Finished water:** Raw water that undergoes a treatment process prior to distribution to recipients.
- **Medium**: The material (e.g., air, water, soil, food, consumer products) surrounding or containing an agent.
- **Production Well Raw Water**: Water extracted from the local groundwater aquifer via production wells.
- **Receptor**: Any biological entity (e.g., a human, human population, lifestage within a human population) that receives an exposure or dose.
- **Source**: The origin of an agent for the purposes of an exposure assessment.
- **Stressor**: Any chemical, physical or biological entity that induces an adverse response.
- **Supply water**: Synonymous with finished water.
- **Surface Intake Raw Water**: Water extracted from the White River for use in drinking water production.
- **Uptake (Absorption)**: The process by which an agent crosses an absorption barrier.

APPENDIX E

ProUCL Outputs

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/22/2020 8:23:15 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

RS c12DCE

General Statistics

Total Number of Observations	45	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	0.0885	Mean	1.125
Maximum	6.76	Median	0.0885
SD	1.997	Std. Error of Mean	0.298
Coefficient of Variation	1.775	Skewness	1.94

Normal GOF Test

Shapiro Wilk Test Statistic	0.576	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.339	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.625	95% Adjusted-CLT UCL (Chen-1995)	1.706
		95% Modified-t UCL (Johnson-1978)	1.639

Gamma GOF Test

A-D Test Statistic	6.211	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.823	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.336	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.461	k star (bias corrected MLE)	0.445
Theta hat (MLE)	2.44	Theta star (bias corrected MLE)	2.527
nu hat (MLE)	41.48	nu star (bias corrected)	40.05
MLE Mean (bias corrected)	1.125	MLE Sd (bias corrected)	1.686
		Approximate Chi Square Value (0.05)	26.55
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	26.18

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.697	95% Adjusted Gamma UCL (use when n<50)	1.72

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.711	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.343	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.425	Mean of logged Data	-1.278
Maximum of Logged Data	1.911	SD of logged Data	1.587

Assuming Lognormal Distribution

95% H-UCL	2.061	90% Chebyshev (MVUE) UCL	1.803
95% Chebyshev (MVUE) UCL	2.201	97.5% Chebyshev (MVUE) UCL	2.753
99% Chebyshev (MVUE) UCL	3.838		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	1.614	95% Jackknife UCL	1.625
95% Standard Bootstrap UCL	1.612	95% Bootstrap-t UCL	1.754
95% Hall's Bootstrap UCL	1.663	95% Percentile Bootstrap UCL	1.606
95% BCA Bootstrap UCL	1.684		
90% Chebyshev(Mean, Sd) UCL	2.018	95% Chebyshev(Mean, Sd) UCL	2.422
97.5% Chebyshev(Mean, Sd) UCL	2.983	99% Chebyshev(Mean, Sd) UCL	4.086

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	2.422

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/22/2020 8:23:41 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

RS TCE

General Statistics

Total Number of Observations	45	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.0325	Mean	0.0563
Maximum	0.41	Median	0.0325
SD	0.0795	Std. Error of Mean	0.0118
Coefficient of Variation	1.412	Skewness	3.363

Normal GOF Test

Shapiro Wilk Test Statistic	0.343	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.529	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0762	95% Adjusted-CLT UCL (Chen-1995)	0.0821
		95% Modified-t UCL (Johnson-1978)	0.0772

Gamma GOF Test

A-D Test Statistic	15.16	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.548	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.134	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.561	k star (bias corrected MLE)	1.471
Theta hat (MLE)	0.0361	Theta star (bias corrected MLE)	0.0382
nu hat (MLE)	140.4	nu star (bias corrected)	132.4
MLE Mean (bias corrected)	0.0563	MLE Sd (bias corrected)	0.0464
		Approximate Chi Square Value (0.05)	106.8
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	106.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0698	95% Adjusted Gamma UCL (use when n<50)	0.0703

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.337	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.532	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.427	Mean of logged Data	-3.231
Maximum of Logged Data	-0.892	SD of logged Data	0.636

Assuming Lognormal Distribution

95% H-UCL	0.0587	90% Chebyshev (MVUE) UCL	0.0629
95% Chebyshev (MVUE) UCL	0.0696	97.5% Chebyshev (MVUE) UCL	0.0789
99% Chebyshev (MVUE) UCL	0.0971		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0758	95% Jackknife UCL	0.0762
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0918	95% Chebyshev(Mean, Sd) UCL	0.108
97.5% Chebyshev(Mean, Sd) UCL	0.13	99% Chebyshev(Mean, Sd) UCL	0.174

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.108

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/22/2020 8:23:57 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

RS VC

General Statistics

Total Number of Observations	45	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	0.0825	Mean	0.0849
Maximum	0.19	Median	0.0825
SD	0.016	Std. Error of Mean	0.00239
Coefficient of Variation	0.189	Skewness	6.708

Normal GOF Test

Shapiro Wilk Test Statistic	0.152	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.537	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0889	95% Adjusted-CLT UCL (Chen-1995)	0.0914
		95% Modified-t UCL (Johnson-1978)	0.0893

Gamma GOF Test

A-D Test Statistic	16.97	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.539	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.131	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	50.13	k star (bias corrected MLE)	46.81
Theta hat (MLE)	0.00169	Theta star (bias corrected MLE)	0.00181
nu hat (MLE)	4512	nu star (bias corrected)	4213
MLE Mean (bias corrected)	0.0849	MLE Sd (bias corrected)	0.0124
		Approximate Chi Square Value (0.05)	4063
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	4058

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.088	95% Adjusted Gamma UCL (use when n<50)	0.0881

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.152	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.537	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.495	Mean of logged Data	-2.476
Maximum of Logged Data	-1.661	SD of logged Data	0.124

Assuming Lognormal Distribution

95% H-UCL	0.0874	90% Chebyshev (MVUE) UCL	0.0894
95% Chebyshev (MVUE) UCL	0.0915	97.5% Chebyshev (MVUE) UCL	0.0945
99% Chebyshev (MVUE) UCL	0.1		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0888	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0921	95% Chebyshev(Mean, Sd) UCL	0.0953
97.5% Chebyshev(Mean, Sd) UCL	0.0998	99% Chebyshev(Mean, Sd) UCL	0.109

Suggested UCL to Use

95% Student's-t UCL	0.0889	or 95% Modified-t UCL	0.0893

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/22/2020 8:29:36 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

WR c12DCE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	0.19	Mean	0.641
Maximum	1.36	Median	0.5
SD	0.474	Std. Error of Mean	0.137
Coefficient of Variation	0.739	Skewness	0.666

Normal GOF Test

Shapiro Wilk Test Statistic	0.808	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.284	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.886	95% Adjusted-CLT UCL (Chen-1995)	0.894
		95% Modified-t UCL (Johnson-1978)	0.891

Gamma GOF Test

A-D Test Statistic	0.726	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.205	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.249	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.005	k star (bias corrected MLE)	1.559
Theta hat (MLE)	0.32	Theta star (bias corrected MLE)	0.411
nu hat (MLE)	48.11	nu star (bias corrected)	37.42
MLE Mean (bias corrected)	0.641	MLE Sd (bias corrected)	0.513
		Approximate Chi Square Value (0.05)	24.41
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	22.82

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.982	95% Adjusted Gamma UCL (use when n<50)	1.051

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.872	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.192	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.661	Mean of logged Data	-0.715
Maximum of Logged Data	0.307	SD of logged Data	0.779

Assuming Lognormal Distribution

95% H-UCL	1.203	90% Chebyshev (MVUE) UCL	1.098
95% Chebyshev (MVUE) UCL	1.304	97.5% Chebyshev (MVUE) UCL	1.59
99% Chebyshev (MVUE) UCL	2.153		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.866	95% Jackknife UCL	0.886
95% Standard Bootstrap UCL	0.854	95% Bootstrap-t UCL	0.95
95% Hall's Bootstrap UCL	0.824	95% Percentile Bootstrap UCL	0.873
95% BCA Bootstrap UCL	0.892		
90% Chebyshev(Mean, Sd) UCL	1.051	95% Chebyshev(Mean, Sd) UCL	1.237
97.5% Chebyshev(Mean, Sd) UCL	1.495	99% Chebyshev(Mean, Sd) UCL	2.001

Suggested UCL to Use

95% Adjusted Gamma UCL	1.051

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/22/2020 8:29:49 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

WR TCE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.0325	Mean	0.304
Maximum	0.64	Median	0.22
SD	0.189	Std. Error of Mean	0.0545
Coefficient of Variation	0.621	Skewness	0.62

Normal GOF Test

Shapiro Wilk Test Statistic	0.913	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.256	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.402	95% Adjusted-CLT UCL (Chen-1995)	0.404
		95% Modified-t UCL (Johnson-1978)	0.404

Gamma GOF Test

A-D Test Statistic	0.4	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.248	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.321	k star (bias corrected MLE)	1.797
Theta hat (MLE)	0.131	Theta star (bias corrected MLE)	0.169
nu hat (MLE)	55.71	nu star (bias corrected)	43.12
MLE Mean (bias corrected)	0.304	MLE Sd (bias corrected)	0.227
		Approximate Chi Square Value (0.05)	29.06
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	27.31

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.452	95% Adjusted Gamma UCL (use when n<50)	0.481

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.877	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.216	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.427	Mean of logged Data	-1.42
Maximum of Logged Data	-0.446	SD of logged Data	0.804

Assuming Lognormal Distribution

95% H-UCL	0.624	90% Chebyshev (MVUE) UCL	0.56
95% Chebyshev (MVUE) UCL	0.667	97.5% Chebyshev (MVUE) UCL	0.816
99% Chebyshev (MVUE) UCL	1.108		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.394	95% Jackknife UCL	0.402
95% Standard Bootstrap UCL	0.388	95% Bootstrap-t UCL	0.424
95% Hall's Bootstrap UCL	0.395	95% Percentile Bootstrap UCL	0.391
95% BCA Bootstrap UCL	0.396		
90% Chebyshev(Mean, Sd) UCL	0.468	95% Chebyshev(Mean, Sd) UCL	0.542
97.5% Chebyshev(Mean, Sd) UCL	0.645	99% Chebyshev(Mean, Sd) UCL	0.847

Suggested UCL to Use

95% Student's-t UCL	0.402

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX F

Risk Assessment Equations

HHERA EQUATION VARIABLE DEFINITIONS

Symbol	Definition (units)	Default	Reference
Screening Levels (SLs)			
Resident SLs			
$SL_{water\text{-}nc\text{-}ing}$	Resident Tapwater Noncarcinogenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}nc\text{-}der}$	Resident Tapwater Noncarcinogenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}ca\text{-}ing}$	Resident Tapwater Carcinogenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}ca\text{-}der}$	Resident Tapwater Carcinogenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}water\text{-}ca\text{-}vc\text{-}ing}$	Resident Tapwater Carcinogenic Vinyl Chloride Ingestion (µg/L)	Vinyl Chloride-specific	Determined in this calculator
$SL_{res\text{-}water\text{-}ca\text{-}vc\text{-}der}$	Resident Tapwater Carcinogenic Vinyl Chloride Dermal (µg/L)	Vinyl Chloride-specific	Determined in this calculator
$SL_{water\text{-}tce\text{-}ing}$	Resident Tapwater Trichloroethylene Ingestion (µg/L)	Trichloroethylene-specific	Determined in this calculator
$SL_{water\text{-}tce\text{-}der}$	Resident Tapwater Trichloroethylene Dermal (µg/L)	Trichloroethylene-specific	Determined in this calculator
Toxicity Values			

Table extracted from USEPA's Regional Screening Levels Users Guide.
Available at https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide

RfD_o or RFDOC	Chronic Oral Reference Dose (mg/kg-day)	Contaminant-specific	EPA Superfund hierarchy
CSF_o or SFO	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Contaminant-specific	EPA Superfund hierarchy
CAF_o	Oral toxicity value adjustment factor for cancer	0.804	U.S. EPA 2004
MAF_o	Oral toxicity value adjustment factor for mutagens	0.202	U.S. EPA 2004
Miscellaneous Variables			
FA	Fraction absorbed water	Contaminant-specific	U.S. EPA 2004
B	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	Contaminant-specific	U.S. EPA 2004
t*	Time to reach steady state	Contaminant-specific	U.S. EPA 2004
τ_{event}	Lag time per event	Contaminant-specific	U.S. EPA 2004
TR	target risk	1×10^{-6}	Selected by user
THQ	target hazard quotient	0.1	Selected by user
K_p	Dermal Permeability Constant (cm/hour)	Contaminant-specific Inorganic default = 0.001	U.S. EPA 2004 Exhibit 3-1 and Section 3.1.2.1

Table extracted from USEPA's Regional Screening Levels Users Guide.
Available at https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide

$K_{p,ve}$	Steady-state Permeability Coefficient (cm/hour)	Contaminant-specific	U.S. EPA 2004
K_{ew}	Equilibrium Partition Coefficient between epidermis and water (unitless)	1 - assuming epidermis behaves essentially as water	U.S. EPA 2004
D_e	Effective Diffusivity of absorbing chemical in the epidermis (cm^2/sec)	$(7.1 \times 10^{-6}) / (\sqrt{MW})$	U.S. EPA 2004
L_e	Effective Thickness of the Epidermis (cm)	10^{-2}	U.S. EPA 2004
AT_{res-c}	Averaging time - resident child (days)	365 x ED_{res-c} = 2190	U.S. EPA 1989 (pg. 6-23)
AT_{res-a}	Averaging time - resident adult (days)	365 x ED_{res} = 9490	U.S. EPA 1989 (pg. 6-23)
AT_{res}	Averaging time - resident age adjusted (days)	365 x LT = 25550	U.S. EPA 1989 (pg. 6-23)
AT_{w-a}	Averaging time - composite worker (days)	365 x ED_w = 9125 (non-carcinogenic)	U.S. EPA 1989 (pg. 6-23)
AT_w	Averaging time - composite worker (days)	365 x LT = 25550 (carcinogenic)	U.S. EPA 1989 (pg. 6-23)
AT_{iw-a}	Averaging time - indoor worker (days)	365 x ED_{iw} = 9125 (non-carcinogenic)	U.S. EPA 1989 (pg. 6-23)
AT_{iw}	Averaging time - indoor worker soil (days)	365 x LT = 25550 (carcinogenic)	U.S. EPA 1989 (pg. 6-23)
AT_{ow-a}	Averaging time - outdoor worker (days)	365 x ED_{ow} = 9125 (non-carcinogenic)	U.S. EPA 1989 (pg. 6-23)

Table extracted from USEPA's Regional Screening Levels Users Guide.
Available at https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide

AT_{ow}	Averaging time - outdoor worker (days)	365 x LT = 25550 (carcinogenic)	U.S. EPA 1989 (pg. 6-23)
AT_{cw-a}	Averaging time - construction worker (days)	EWcw x 7 (d/wk) x EDcw = 350 (non-carcinogenic)	U.S. EPA 1989 (pg. 6-23)
AT_{cw}	Averaging time - construction worker (days)	365 x LT = 25550 (carcinogenic)	U.S. EPA 1989 (pg. 6-23)
LT	Lifetime (years)	70	U.S. EPA 1989 (pg. 6-22)
Ingestion and Dermal Contact Rates			
IRW_{res-c}	Resident Drinking Water Ingestion Rate - Child (L/day)	0.78	U.S. EPA 2011, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years)
IRW_{res-a}	Resident Drinking Water Ingestion Rate - Adult (L/day)	2.5	U.S. EPA 2011, Table 3-33; 90th percentile of consumer-only ingestion of drinking water (>= 21 years)
$IFW_{res-adj}$	Resident Drinking Water Ingestion Rate - Age-adjusted (L/kg)	327.95	Calculated using the age adjusted intake factors equation
$IFWM_{res-adj}$	Resident Mutagenic Drinking Water Ingestion Rate - Age-adjusted (L/kg)	1019.9	Calculated using the age adjusted intake factors equation

$DFW_{res\text{-}adj}$	Resident water dermal contact factor- age-adjusted (cm^2 - event/kg)	2610650	Calculated using the age adjusted intake factors equation
$DFWM_{res\text{-}adj}$	Resident Mutagenic water dermal contact factor- age-adjusted (cm^2 - event/kg)	8191633	Calculated using the age adjusted intake factors equation
$SA_{res\text{-}c}$	Resident surface area water - child (cm^2)	6365	U.S. EPA 2014, weighted average of mean values for children <6 years.
$SA_{res\text{-}a}$	Resident surface area water - adult (cm^2)	19652	U.S. EPA 2014, weighted average of mean values for adults, male and female 21+.
$SA_{0\text{-}2}$	Resident/Recreator surface area water - age segment 0-2 (cm^2)	6365	U.S. EPA 2014, weighted average of mean values for children <6 years.
$SA_{2\text{-}6}$	Resident/Recreator surface area water - age segment 2-6 (cm^2)	6365	U.S. EPA 2014, weighted average of mean values for children <6 years.
$SA_{6\text{-}16}$	Resident/Recreator surface area water - age segment 6-16 (cm^2)	19652	U.S. EPA 2014, weighted average of mean values for adults, male and female 21+.
$SA_{16\text{-}26}$	Resident/Recreator surface area water - age segment 16-26 (cm^2)	19652	U.S. EPA 2014, weighted average of mean values for adults, male and female 21+.
$BW_{res\text{-}c}$	Resident Body Weight - child (kg)	15	U.S. EPA 1991a (pg. 15)

$BW_{res\text{-}a}$	Resident Body Weight - adult (kg)	80	U.S. EPA 2011, Table 8-3; weighted mean values for adults 21 - 78
$BW_{0\text{-}2}$	Resident/Recreator Body Weight - age segment 0-2 (kg)	15	U.S. EPA 1991a (pg. 15)
$BW_{2\text{-}6}$	Resident/Recreator Body Weight - age segment 2-6 (kg)	15	U.S. EPA 1991a (pg. 15)
$BW_{6\text{-}16}$	Resident/Recreator Body Weight - age segment 6-16 (kg)	80	U.S. EPA 2011, Table 8-3; weighted mean values for adults 21 - 78
$BW_{16\text{-}26}$	Resident/Recreator Body Weight - age segment 16-26 (kg)	80	U.S. EPA 2011, Table 8-3; weighted mean values for adults 21 - 78
GIABS	Fraction of contaminant absorbed in gastrointestinal tract (unitless) Note: if the GIABS is >50% then it is set to 100% for the calculation of dermal toxicity values.	Contaminant-specific Inorganic default = 1.0 VOC default = 1.0 SVOC default = 1.0	U.S. EPA 2004 (Exhibit 4-1 and section 4.2)
DA_{event}	Absorbed dose per event ($\mu g/cm^2$ - event)	Contaminant-specific	U.S. EPA 2004 (Equation 3.2 and 3.3)
Exposure Frequency, Exposure Duration, and Exposure Time Variables			
EF_{res}	Resident Exposure Frequency (days/year)	350	U.S. EPA 1991a (pg. 15)

EF_{res-a}	Resident Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{res-c}	Resident Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{w}	Composite Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
EF_{iw}	Indoor Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
EF_{ow}	Outdoor Worker Exposure Frequency (days/year)	225	U.S. EPA 2002 (Exhibit 1-2)
EF_{cw}	Construction Worker Exposure Frequency (days/year)	250	U.S. EPA 2002 Exhibit 5-1
EF_{0-2}	Resident/Recreator Exposure Frequency - age segment 0-2 (days/year)	Resident - 350 Recreator - Site-specific	Resident - U.S. EPA 1991a (pg. 15) Recreator - Site-specific
EF_{2-6}	Resident/Recreator Exposure Frequency - age segment 2-6 (days/year)	Resident - 350 Recreator - Site-specific	Resident - U.S. EPA 1991a (pg. 15) Recreator - Site-specific
EF_{6-16}	Resident/Recreator Exposure Frequency - age segment 6-16 (days/year)	Resident - 350 Recreator - Site-specific	Resident - U.S. EPA 1991a (pg. 15) Recreator - Site-specific
EF_{16-26}	Resident/Recreator Exposure Frequency - age segment 16-26 (days/year)	Resident - 350 Recreator - Site-specific	Resident - U.S. EPA 1991a (pg. 15) Recreator - Site-specific

ED_{res}	Resident Exposure Duration (years)	26	EPA 2011, Table 16-108; 90th percentile for current residence time.
$ED_{res\text{-}c}$	Resident Exposure Duration - child (years)	6	U.S. EPA 1991a (pg. 15)
$ED_{res\text{-}a}$	Resident Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
ED_{w}	Composite Worker Exposure Duration - (years)	25	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration - (years)	25	U.S. EPA 1991a (pg. 15)
ED_{ow}	Outdoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ED_{cw}	Construction Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
$ED_{0\text{-}2}$	Resident/Recreator Exposure Duration - age segment 0-2 (years)	2	U.S. EPA 2005 (pg. 37)
$ED_{2\text{-}6}$	Resident/Recreator Exposure Duration - age segment 2-6 (years)	4	U.S. EPA 2005 (pg. 37)
$ED_{6\text{-}16}$	Resident/Recreator Exposure Duration - age segment 6-16 (years)	10	U.S. EPA 2005 (pg. 37)
$ED_{16\text{-}26}$	Resident/Recreator Exposure Duration - age segment 16-26 (years)	10	U.S. EPA 2005 (pg. 37)

ET_{res-a}	Resident Exposure Time (hours/day)	24	The whole day
ET_{res-c}	Resident Exposure Time (hours/day)	24	The whole day
ET_{res}	Resident Exposure Time (hours/day)	24	The whole day
ET_{w}	Composite Worker Exposure Time (hours/day)	8	The work day
ET_{iw}	Indoor Worker Exposure Time (hours/day)	8	The work day
ET_{ow}	Outdoor Worker Exposure Time (hours/day)	8	The work day
ET_{cw}	Construction Worker Exposure Time (hours/day)	8	The work day
$ET_{event-res-c}$	Resident Water Exposure Time - child (hours/event)	0.54	U.S. EPA 2011, Table 16-28; weighted average of 90th percentile time spent bathing (birth to <6 years)
$ET_{event-res-a}$	Resident Water Exposure Time - adult (hours/event)	0.71	U.S. EPA 2011, Tables 16-30 and 16-31; weighted average of adult (21 to 78) 90th percentile of time spent bathing/ showering in a day, divided by mean number of baths/showers taken in a day.

$ET_{event\text{-}res\text{-}adj}$	Resident Water Exposure Time - age-adjusted (hours/event)	0.6708	Calculated using the age adjusted intake factors equation
$ET_{event\text{-}res\text{-}madj}$	Resident Exposure Time - age-adjusted (hours/event)	0.6708	Calculated using the age adjusted intake factors equation
$ET_{0\text{-}2}$	Resident/Recreator Exposure Time - age segment 0-2 (hours/day)	Resident - 24 Recreator - Site-specific	Resident - The whole day Recreator - Site-specific
$ET_{2\text{-}6}$	Resident/Recreator Exposure Time - age segment 2-6 (hours/day)	Resident - 24 Recreator - Site-specific	Resident - The whole day Recreator - Site-specific
$ET_{6\text{-}16}$	Resident/Recreator Exposure Time - age segment 6-16 (hours/day)	Resident - 24 Recreator - Site-specific	Resident - The whole day Recreator - Site-specific
$ET_{16\text{-}26}$	Resident/Recreator Exposure Time - age segment 16-26 (hours/day)	Resident - 24 Recreator - Site-specific	Resident - The whole day Recreator - Site-specific
$ET_{event\text{-}res(0\text{-}2)}$	Resident Exposure Time - age segment 0-2 (hours/event)	0.54	Calculated based on the ET given for ETevent-res-c
$ET_{event\text{-}res(2\text{-}6)}$	Resident Exposure Time - age segment 2-6 (hours/event)	0.54	Calculated based on the ET given for ETevent-res-c
$ET_{event\text{-}res(6\text{-}16)}$	Resident Exposure Time - age segment 6-16 (hours/event)	0.71	Calculated based on the ET given for ETevent-res-a

$ET_{event-res(16-26)}$	Resident Exposure Time - age segment 16-26 (hours/event)	0.71	Calculated based on the ET given for ETevent-res-a
EV_{res-c}	Resident Events - child (events/day)	1	U.S. EPA 2004; Exhibit 3-2
EV_{res-a}	Resident Events - adult (events/day)	1	U.S. EPA 2004; Exhibit 3-2
EV_{0-2}	Resident/Recreator Events - age segment 0-2 (events/day)	Resident - 1 Recreator - Site-specific	U.S. EPA 2004; Exhibit 3-2
EV_{2-6}	Resident/Recreator Events - age segment 2-6 (events/day)	Resident - 1 Recreator - Site-specific	U.S. EPA 2004; Exhibit 3-2
EV_{6-16}	Resident/Recreator Events - age segment 6-16 (events/day)	Resident - 1 Recreator - Site-specific	U.S. EPA 2004; Exhibit 3-2
EV_{16-26}	Resident/Recreator Events - age segment 16-26 (events/day)	Resident - 1 Recreator - Site-specific	U.S. EPA 2004; Exhibit 3-2

Residential Tap Water Ingestion	Noncarcinogenic – Child	• ingestion of water $SL_{res\text{-}wat\text{-}nc\text{-}ing\text{-}c}(\mu g/L) = \frac{THQ \times AT_{res\text{-}c}\left(\frac{365\ days}{year} \times ED_{res\text{-}c}(6\ years)\right) \times BW_{res\text{-}c}(15\ kg) \times \left(\frac{1000\ \mu g}{mg}\right)}{EF_{res\text{-}c}\left(\frac{350\ days}{year}\right) \times ED_{res\text{-}c}(6\ years) \times \frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)} \times IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right)}$
	Noncarcinogenic - Adult	• ingestion of water $SL_{res\text{-}wat\text{-}nc\text{-}ing\text{-}a}(\mu g/L) = \frac{THQ \times AT_{res\text{-}a}\left(\frac{365\ days}{year} \times ED_{res}(26\ years)\right) \times BW_{res\text{-}a}(80\ kg) \times \left(\frac{1000\ \mu g}{mg}\right)}{EF_{res\text{-}a}\left(350\ \frac{days}{year}\right) \times ED_{res}(26\ years) \times \frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)} \times IRW_{res\text{-}a}\left(\frac{2.5\ L}{day}\right)}$
	Age-Adjusted Carcinogenic	• ingestion of water $SL_{res\text{-}wat\text{-}ca\text{-}ing}(\mu g/L) = \frac{TR \times AT_{res}\left(\frac{365\ days}{year} \times LT(70\ years)\right) \times \left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1} \times \left(IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right)\right)}$ where: $IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right) = \left(\frac{EF_{res\text{-}c}\left(\frac{350\ days}{year}\right) \times ED_{res\text{-}c}(6\ years) \times IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right)}{BW_{res\text{-}c}(15\ kg)} + \frac{EF_{res\text{-}a}\left(\frac{350\ days}{year}\right) \times \left(ED_{res}(26\ years) - ED_{res\text{-}c}(6\ years)\right) \times IRW_{res\text{-}a}\left(\frac{2.5\ L}{day}\right)}{BW_{res\text{-}a}(80\ kg)}\right)$

Residential Tap Water Ingestion (Cont.)	Vinyl Chloride - Carcinogenic	• ingestion of water $SL_{res\text{-}wat\text{-}ca\text{-}vc\text{-}ing}(\mu g/L) = \dfrac{TR}{\left(\dfrac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1} \times IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right) \times \left(\frac{mg}{1000\ \mu g}\right)}{AT_{res}\left(\frac{365\ days}{year}\right) \times LT\ (70\ years)}\right) + \left(\dfrac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1} \times IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right) \times \left(\frac{mg}{1000\ \mu g}\right)}{BW_{res\text{-}c}\ (15\ kg)}\right)}$ where: $IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right) = \left(\dfrac{EF_{res\text{-}c}\left(\frac{350\ days}{year}\right) \times ED_{res\text{-}c}\ (6\ years) \times IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right)}{BW_{res\text{-}c}\ (15\ kg)} + \dfrac{EF_{res\text{-}a}\left(\frac{350\ days}{year}\right) \times \left(ED_{res}\ (26\ years) - ED_{res\text{-}c}\ (6\ years)\right) \times IRW_{res\text{-}a}\left(\frac{2.5\ L}{day}\right)}{BW_{res\text{-}a}\ (80\ kg)}\right)$
	Trichloroethene - Carcinogenic and Mutagenic	• ingestion of water $SL_{res\text{-}wat\text{-}tce\text{-}ing}(\mu g/L) = \dfrac{TR \times AT_{res}\left(\frac{365\ days}{year} \times LT\ (70\ years)\right) \times \left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1} \times \left(\left(CAF_o\ (0.804) \times IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right)\right)\right) + \left(MAF_o\ (0.202) \times IFWM_{res\text{-}adj}\left(\frac{1019.9\ L}{kg}\right)\right)}$ where: $IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right) = \left(\dfrac{ED_{res\text{-}c}\ (6\ years) \times EF_{res\text{-}c}\left(\frac{350\ days}{year}\right) \times IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right)}{BW_{res\text{-}c}\ (15\ kg)} + \dfrac{\left(ED_{res}\ (26\ years) - ED_{res\text{-}c}\ (6\ years)\right) \times EF_{res\text{-}a}\left(\frac{350\ days}{year}\right) \times IRW_{res\text{-}a}\left(\frac{2.5\ L}{day}\right)}{BW_{res\text{-}a}\ (80\ kg)}\right)$ where: $IFWM_{res\text{-}adj}\left(\frac{1019.9\ L}{kg}\right) = \left(\dfrac{ED_{0\text{-}2}\ (2\ years) \times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right) \times IRW_{0\text{-}2}\left(\frac{0.78\ L}{day}\right) \times 10}{BW_{0\text{-}2}\ (15\ kg)} + \dfrac{ED_{2\text{-}6}\ (4\ years) \times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right) \times IRW_{2\text{-}6}\left(\frac{0.78\ L}{day}\right) \times 3}{BW_{2\text{-}6}\ (15\ kg)} + \dfrac{ED_{6\text{-}16}\ (10\ years) \times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right) \times IRW_{6\text{-}16}\left(\frac{2.5\ L}{day}\right) \times 3}{BW_{6\text{-}16}\ (80\ kg)} + \dfrac{ED_{16\text{-}26}\ (10\ years) \times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right) \times IRW_{16\text{-}26}\left(\frac{2.5\ L}{day}\right) \times 1}{BW_{16\text{-}26}\ (80\ kg)}\right)$

Table extracted from USEPA's Regional Screening Levels Users Guide.
Available at https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide

Residential Tap Water Dermal	Noncarcinogenic - Child	• dermal FOR INORGANICS: $SL_{res\text{-}wat\text{-}nc\text{-}der\text{-}c}\ (\mu g/L) = \dfrac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hour}\right)\times ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hours}{event}\right)}$ FOR ORGANICS: IF $ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hours}{event}\right)\le t^*\ (hours)$, then $SL_{res\text{-}wat\text{-}nc\text{-}der}\ (\mu g/L) = \dfrac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hour}\right)\sqrt{\dfrac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hours}{event}\right)}{\pi}}}$ or, IF $ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hours}{event}\right) > t^*\ (hours)$, then $SL_{res\text{-}wat\text{-}nc\text{-}der}\ (\mu g/L) = \dfrac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hour}\right)\times\left[\dfrac{ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\dfrac{1+3B+3B^2}{(1+B)^2}\right)\right]}$ where: $DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) = \dfrac{THQ\times AT_{res\text{-}c}\left(\frac{365\ days}{year}\times ED_{res\text{-}c}\ (6\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_{res\text{-}c}\ (15\ kg)}{\left(\dfrac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times EV_{res\text{-}c}\left(\frac{1\ events}{day}\right)\times ED_{res\text{-}c}\ (6\ years)\times EF_{res\text{-}c}\left(\frac{350\ days}{year}\right)\times SA_{res\text{-}c}\ (6365\ cm^2)}$

Residential Tap Water Dermal (Cont.)	Noncarcinogenic - Adult	• dermal FOR INORGANICS: $SL_{res\text{-}wat\text{-}nc\text{-}der\text{-}a}\,(\mu g/L) = \dfrac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hour}\right)\times ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hours}{event}\right)}$ FOR ORGANICS: IF $ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hours}{event}\right) \le t^*\ (hours)$, then $SL_{res\text{-}wat\text{-}nc\text{-}der}\,(\mu g/L) = \dfrac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hour}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hours}{event}\right)}{\pi}}}$ or, IF $ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hours}{event}\right) > t^*\ (hours)$, then $SL_{res\text{-}wat\text{-}nc\text{-}der}\,(\mu g/L) = \dfrac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hour}\right)\times\left[\frac{ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$ where: $DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right) = \dfrac{THQ\times AT_{res\text{-}a}\left(\frac{365\ days}{year}\times ED_{res}\,(26\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_{res\text{-}a}\,(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times EV_{res\text{-}a}\left(\frac{1\ events}{day}\right)\times ED_{res}\,(26\ years)\times EF_{res\text{-}a}\left(\frac{350\ days}{year}\right)\times SA_{res\text{-}a}\,(19652\ cm^2)}$

Residential Tap Water Dermal (Cont.)	Carcinogenic	• dermal FOR INORGANICS $SL_{res\text{-}wat\text{-}ca\text{-}der}(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hour}\right)\times ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}$ FOR ORGANICS IF $ET_{event\text{-}res\text{-}adj}\left(\frac{hours}{event}\right)\leq t^{*}(hours)$, then $SL_{res\text{-}wat\text{-}ca\text{-}der}(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hour}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{\pi}}}$ or, IF $ET_{event\text{-}res\text{-}adj}\left(\frac{hours}{event}\right) > t^{*}(hours)$, then $SL_{res\text{-}wat\text{-}ca\text{-}der}(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hour}\right)\times\left[\frac{ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$ where: $DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) = \frac{TR\times AT_{res}\left(\frac{365\ days}{year}\times LT(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFW_{res\text{-}adj}\left(\frac{2{,}610{,}650\ events\text{-}cm^2}{kg}\right)}$ where: $DFW_{res\text{-}adj}\left(\frac{2{,}610{,}650\ events\text{-}cm^2}{kg}\right) = \left(\frac{EF_{res\text{-}c}\left(\frac{350\ days}{year}\right)\times EV_{res\text{-}c}\left(\frac{1\ events}{day}\right)\times ED_{res\text{-}c}(6\ years)\times SA_{res\text{-}c}(6365\ cm^2)}{BW_{res\text{-}c}(15\ kg)}+\frac{EF_{res\text{-}a}\left(\frac{350\ days}{year}\right)\times EV_{res\text{-}a}\left(\frac{1\ events}{day}\right)\times\left(ED_{res}(26\ years)-ED_{res\text{-}c}(6\ years)\right)\times SA_{res\text{-}a}(19652\ cm^2)}{BW_{res\text{-}a}(80\ kg)}\right)$ and: $ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right) = \left(\frac{\left(ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hours}{event}\right)\times ED_{res\text{-}c}(6\ years)+ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hours}{event}\right)\times\left(ED_{res}(26\ years)-ED_{res\text{-}c}(6\ years)\right)\right)}{ED_{res}(26\ years)}\right)$

<table>
<tr>
<td>Residential Tap Water Dermal (Cont.)</td>
<td>Vinyl Chloride - Carcinogenic</td>
<td>

- dermal

$$\text{IF } ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right) \le t^{*}\ (hours), \text{then } SL_{res\text{-}wat\text{-}ca\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)\times\left(\frac{1000\ cm^{3}}{L}\right)}{2\times FA\times K_{p}\left(\frac{cm}{hour}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right) > t^{*}\ (hours), \text{then } SL_{res\text{-}wat\text{-}ca\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)\times\left(\frac{1000\ cm^{3}}{L}\right)}{FA\times K_{p}\left(\frac{cm}{hour}\right)\times\left[\frac{ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^{2}}{(1+B)^{2}}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right) = \frac{TR}{\left(\frac{CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times\left(\frac{DFW_{res\text{-}adj}\left(\frac{2{,}610{,}650\ events\text{-}cm^{2}}{kg}\right)}{AT_{res}\left(\frac{365\ days}{year}\right)\times LT\ (70\ years)}\right)+\left(\frac{EV_{res\text{-}c}\left(\frac{1\ events}{day}\right)\times SA_{res\text{-}c}\left(6365\ cm^{2}\right)}{BW_{res\text{-}c}\ (15\ kg)}\right)}$$

where:

$$DFW_{res\text{-}adj}\left(\frac{2{,}610{,}650\ events\text{-}cm^{2}}{kg}\right) = \left(\frac{EF_{res\text{-}c}\left(\frac{350\ days}{year}\right)\times EV_{res\text{-}c}\left(\frac{1\ events}{day}\right)\times ED_{res\text{-}c}\ (6\ years)\times SA_{res\text{-}c}\left(6365\ cm^{2}\right)}{BW_{res\text{-}c}\ (15\ kg)} + \frac{EF_{res\text{-}a}\left(\frac{350\ days}{year}\right)\times EV_{res\text{-}a}\left(\frac{1\ events}{day}\right)\times ED_{res\text{-}a}\ (20\ years)\times SA_{res\text{-}a}\left(19652\ cm^{2}\right)}{BW_{res\text{-}a}\ (80\ kg)}\right)$$

and:

$$ET_{event\text{-}res\text{-}adj}\left(\frac{0.6708\ hours}{event}\right) = \left(\frac{\left(ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hours}{event}\right)\times ED_{res\text{-}c}\ (6\ years) + ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hours}{event}\right)\times\left(ED_{res}\ (26\ years) - ED_{res\text{-}c}\ (6\ years)\right)\right)}{ED_{res}\ (26\ years)}\right)$$

</td>
</tr>
</table>

Residential Tap Water Dermal (Cont.)	Trichloroethene - Carcinogenic and Mutagenic	• dermal FOR ORGANICS: IF $ET_{event-res-adj}\left(\frac{hours}{event}\right) \le t^{*}$ (hours) then $SL_{res-wat-tce-der}(\mu g/L) = \frac{DA_{tce-event}\left(\frac{ug}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hour}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{event-res-adj}\left(\frac{0.6708\ hours}{event}\right)}{\pi}}}$ or, IF $ET_{event-res-adj}\left(\frac{hours}{event}\right) > t^{*}$ (hours) then $SL_{res-wat-tce-der}(\mu g/L) = \frac{DA_{tce-event}\left(\frac{ug}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hour}\right)\times\left[\frac{ET_{event-res-adj}\left(\frac{0.6708\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$ where: $DA_{tce-event}\left(\frac{ug}{cm^2-event}\right)=\frac{TR\times AT_{res}\left(\frac{365\ days}{year}\times LT(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\times\left(\left(CAF_o(0.804)\times DFW_{res-adj}\left(\frac{2{,}610{,}650\ events-cm^2}{kg}\right)\right)+\left(MAF_o(0.202)\times DFWM_{res-adj}\left(\frac{8{,}191{,}633\ events-cm^2}{kg}\right)\right)\right)}$ where: $DFW_{res-adj}\left(\frac{2{,}610{,}650\ events-cm^2}{kg}\right)=\left(\frac{EV_{res-c}\left(\frac{1\ events}{day}\right)\times ED_{res-c}(6\ years)\times EF_{res-c}\left(\frac{350\ days}{year}\right)\times SA_{res-c}(6365\ cm^2)}{BW_{res-c}(15\ kg)}+\frac{EV_{res-a}\left(\frac{1\ events}{day}\right)\times ED_{res-a}(20\ years)\times EF_{resw-a}\left(\frac{350\ days}{year}\right)\times SA_{res-a}(19652\ cm^2)}{BW_{res-a}(80\ kg)}\right)$ where: $DFWM_{res-adj}\left(\frac{8{,}191{,}633\ events-cm^2}{kg}\right)=\left[\left(\frac{EV_{0-2}\left(\frac{1\ events}{day}\right)\times ED_{0-2}(2\ years)\times EF_{0-2}\left(\frac{350\ days}{year}\right)\times SA_{0-2}(6365\ cm^2)\times 10}{BW_{0-2}(15\ kg)}\right)+\left(\frac{EV_{2-6}\left(\frac{1\ events}{day}\right)\times ED_{2-6}(4\ years)\times EF_{2-6}\left(\frac{350\ days}{year}\right)\times SA_{2-6}(6365\ cm^2)\times 3}{BW_{2-6}(15\ kg)}\right)+\left(\frac{EV_{6-16}\left(\frac{1\ events}{day}\right)\times ED_{6-16}(10\ years)\times EF_{6-16}\left(\frac{350\ days}{year}\right)\times SA_{6-16}(19652\ cm^2)\times 3}{BW_{6-16}(80\ kg)}\right)+\left(\frac{EV_{16-26}\left(\frac{1\ events}{day}\right)\times ED_{16-26}(10\ years)\times EF_{16-26}\left(\frac{350\ days}{year}\right)\times SA_{16-26}(19652\ cm^2)\times 1}{BW_{16-26}(80\ kg)}\right)\right]$ and: $ET_{event-res-adj}\left(\frac{0.6708\ hours}{event}\right)=\frac{\left(ET_{event-res(0-2)}\left(\frac{0.54\ hours}{event}\right)\times ED_{0-2}(2\ years)+ET_{event-res(2-6)}\left(\frac{0.54\ hours}{event}\right)\times ED_{2-6}(4\ years)+ET_{event-res(6-16)}\left(\frac{0.71\ hours}{event}\right)\times ED_{6-16}(10\ years)+ET_{event-res(16-26)}\left(\frac{0.71\ hours}{event}\right)\times ED_{16-26}(10\ years)\right)}{ED_{0-2}(2\ years)+ED_{2-6}(4\ years)+ED_{6-16}(10\ years)+ED_{16-26}(10\ years)}$

Residential Tap Water Supporting Equations	Child	• Child $ED_{res\text{-}c}\,(6\text{ years}) = ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})$ $BW_{res\text{-}c}\,(15\text{ kg}) = \frac{BW_{0\text{-}2}\,(15\text{ kg}) \times ED_{0\text{-}2}\,(2\text{ years}) + BW_{2\text{-}6}\,(15\text{ kg}) \times ED_{2\text{-}6}\,(4\text{ years})}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})}$ $EV_{res\text{-}c}\left(\frac{1\text{ event}}{\text{day}}\right) = \frac{EV_{0\text{-}2}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{0\text{-}2}\,(2\text{ years}) + EV_{2\text{-}6}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{2\text{-}6}\,(4\text{ years})}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})}$ $EF_{res\text{-}c}\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{0\text{-}2}\,(2\text{ years}) + EF_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{2\text{-}6}\,(4\text{ years})}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})}$ $ET_{event\text{-}res\text{-}c}\left(\frac{0.54\text{ hours}}{\text{event}}\right) = \frac{ET_{event\,(0\text{-}2)}\left(\frac{0.54\text{ hours}}{\text{event}}\right) \times ED_{0\text{-}2}\,(2\text{ years}) + ET_{event\,(2\text{-}4)}\left(\frac{0.54\text{ hours}}{\text{event}}\right) \times ED_{2\text{-}6}\,(4\text{ years})}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})}$ $ET_{res\text{-}c}\left(\frac{24\text{ hours}}{\text{day}}\right) = \frac{ET_{0\text{-}2}\left(\frac{24\text{ hours}}{\text{day}}\right) \times ED_{0\text{-}2}\,(2\text{ years}) + ET_{2\text{-}6}\left(\frac{24\text{ hours}}{\text{day}}\right) \times ED_{2\text{-}6}\,(4\text{ years})}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})}$ $SA_{res\text{-}c}\left(6365\text{ cm}^2\right) = \frac{SA_{0\text{-}2}\left(6365\text{ cm}^2\right) \times ED_{0\text{-}2}\,(2\text{ years}) + SA_{2\text{-}6}\left(6365\text{ cm}^2\right) \times ED_{2\text{-}6}\,(4\text{ years})}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})}$ $IRW_{res\text{-}c}\left(\frac{0.78\text{ L}}{\text{day}}\right) = \frac{IRW_{0\text{-}2}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times ED_{0\text{-}2}\,(2\text{ years}) + IRW_{2\text{-}6}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times ED_{2\text{-}6}\,(4\text{ years})}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years})}$

Table extracted from USEPA's Regional Screening Levels Users Guide.
Available at https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide

Residential Tap Water Supporting Equations (Cont.)	Adult: Exposure Factors	• Adult $$ED_{res\text{-}a}\,(20\text{ years}) = ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})$$ $$BW_{res\text{-}a}\,(80\text{ kg}) = \frac{BW_{6\text{-}16}\,(80\text{ kg}) \times ED_{6\text{-}16}\,(10\text{ years}) + BW_{16\text{-}26}\,(80\text{ kg}) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$ $$EV_{res\text{-}a}\left(\frac{1\text{ event}}{\text{day}}\right) = \frac{EV_{6\text{-}16}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + EV_{16\text{-}26}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$ $$EF_{res\text{-}a}\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + EF_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$ $$ET_{event\text{-}res\text{-}a}\left(\frac{0.71\text{ hours}}{\text{event}}\right) = \frac{ET_{event\,(6\text{-}16)}\left(\frac{0.71\text{ hours}}{\text{event}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + ET_{event\,(16\text{-}26)}\left(\frac{0.71\text{ hours}}{\text{event}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$ $$ET_{res\text{-}a}\left(\frac{24\text{ hours}}{\text{day}}\right) = \frac{ET_{6\text{-}16}\left(\frac{24\text{ hours}}{\text{day}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + ET_{16\text{-}26}\left(\frac{24\text{ hours}}{\text{day}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$ $$SA_{res\text{-}a}\left(19652\text{ cm}^2\right) = \frac{SA_{6\text{-}16}\left(19652\text{ cm}^2\right) \times ED_{6\text{-}16}\,(10\text{ years}) + SA_{16\text{-}26}\left(19652\text{ cm}^2\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$ $$IRW_{res\text{-}a}\left(\frac{2.5\text{ L}}{\text{day}}\right) = \frac{IRW_{6\text{-}16}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + IRW_{16\text{-}26}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$

Residential Tap Water Supporting Equations (Cont.)	Age-adjusted Exposure Durations, Frequencies, and Times	• Age-adjusted $ED_{res}\left(26 \text{ years}\right) = ED_{0\text{-}2}\left(2 \text{ years}\right) + ED_{2\text{-}6}\left(4 \text{ years}\right) + ED_{6\text{-}16}\left(10 \text{ years}\right) + ED_{16\text{-}26}\left(10 \text{ years}\right)$ $EF_{res}\left(\frac{350 \text{ days}}{\text{year}}\right) = \frac{EF_{0\text{-}2}\left(\frac{350 \text{ days}}{\text{year}}\right) \times ED_{0\text{-}2}\left(2 \text{ years}\right) + EF_{2\text{-}6}\left(\frac{350 \text{ days}}{\text{year}}\right) \times ED_{2\text{-}6}\left(4 \text{ years}\right) + EF_{6\text{-}16}\left(\frac{350 \text{ days}}{\text{year}}\right) \times ED_{6\text{-}16}\left(10 \text{ years}\right) + EF_{16\text{-}26}\left(\frac{350 \text{ days}}{\text{year}}\right) \times ED_{16\text{-}26}\left(10 \text{ years}\right)}{ED_{0\text{-}2}\left(2 \text{ years}\right) + ED_{2\text{-}6}\left(4 \text{ years}\right) + ED_{6\text{-}16}\left(10 \text{ years}\right) + ED_{16\text{-}26}\left(10 \text{ years}\right)}$ $ET_{res}\left(\frac{24 \text{ hours}}{\text{day}}\right) = \frac{ET_{0\text{-}2}\left(\frac{24 \text{ hours}}{\text{day}}\right) \times ED_{0\text{-}2}\left(2 \text{ years}\right) + ET_{2\text{-}6}\left(\frac{24 \text{ hours}}{\text{day}}\right) \times ED_{2\text{-}6}\left(4 \text{ years}\right) + ET_{6\text{-}16}\left(\frac{24 \text{ hours}}{\text{day}}\right) \times ED_{6\text{-}16}\left(10 \text{ years}\right) + ET_{16\text{-}26}\left(\frac{24 \text{ hours}}{\text{day}}\right) \times ED_{16\text{-}26}\left(10 \text{ years}\right)}{ED_{0\text{-}2}\left(2 \text{ years}\right) + ED_{2\text{-}6}\left(4 \text{ years}\right) + ED_{6\text{-}16}\left(10 \text{ years}\right) + ED_{16\text{-}26}\left(10 \text{ years}\right)}$

Residential Tap Water Supporting Equations (Cont.)	B (Dimensionless Ratio of Permeability Coefficient)	• B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve) $B = \frac{K_p\left(\frac{cm}{hour}\right)}{K_{p,ve}\left(\frac{cm}{hour}\right)} \approx K_p\left(\frac{cm}{hour}\right) \times \frac{\sqrt{MW\left(\frac{g}{mole}\right)}}{2.6}$ (as an approximation) where: $K_{p,ve}\left(\frac{cm}{hour}\right) = \frac{K_{ew} \times D_e\left(\frac{cm^2}{hour}\right)}{L_e\,(cm)}$ where: $K_{ew} = 1$ (assuming epidermis behaves essentially as water); $L_e = 10^{-2}$ (cm); $D_e = \frac{7.1\times10^{-6}\left(\frac{cm^2}{sec}\right)}{\sqrt{MW\left(\frac{g}{mole}\right)}}$ (assumes $D_e = 10^{-6}\left(\frac{cm^2}{sec}\right)$ when MW = 50)
	t* (Time to Reach Steady State [hours])	• t* = Time to reach steady-state (hours) = 2.4 τ_{event} If $B \le 0.6$, then $t^*\,(hours) = 2.4 \times \tau_{event}\left(\frac{hours}{event}\right)$ or, If $B > 0.6$, then $t^*\,(hours) = 6 \times \tau_{event}\left(\frac{hours}{event}\right) \times \left(b-\sqrt{b^2-c^2}\right)$ where: $b = \frac{2\times(1+B)^2}{\pi} - c$ and $c = \frac{1+3\times B+3\times B^2}{3\times(1+B)}$

Residential Tap Water Supporting Equations (Cont.)	τ_{event} (Lag time per event in hours/event)	• τ_{event} = Lag time per event (hours/event) $\tau_{event}\left(\frac{hours}{event}\right) = \frac{l_{sc}^{2}\,(cm)}{6 \times D_{sc}\left(\frac{cm^2}{hour}\right)}$ where: $\log\frac{D_{sc}\left(\frac{cm^2}{hour}\right)}{l_{sc}\,(cm)} = -2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right)$ or $\frac{D_{sc}\left(\frac{cm^2}{hr}\right)}{l_{sc}\,(cm)} = 10^{\left(-2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right)\right)}$ thus: $l_{sc}\,(cm) = \frac{10^{\left(-2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right)\right)}}{D_{sc}\left(\frac{cm^2}{hour}\right)}$ and $D_{sc}\left(\frac{cm^2}{hour}\right) = l_{sc}\,(cm) \times 10^{\left(-2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right)\right)}$
	CAF_o – oral toxicity value adjustment factor for cancer	$CAF_o\,(0.804) = \frac{CSF_o\left(\frac{3.7 \times 10^{-2}\,mg}{kg-day}\right)^{-1} \text{ NHL+Liver oral slope factor}}{CSF_o\left(\frac{4.6 \times 10^{-2}\,mg}{kg-day}\right)^{-1} \text{ Adult – based oral slope factor}}$
	MAF_o - oral toxicity value adjustment factor for mutagens	$MAF_o\,(0.202) = \frac{CSF_o\left(\frac{9.3 \times 10^{-3}\,mg}{kg-day}\right)^{-1} \text{ Kidney oral slope factor}}{CSF_o\left(\frac{4.6 \times 10^{-2}\,mg}{kg-day}\right)^{-1} \text{ Adult – based oral slope factor}}$

APPENDIX G

EPA RSL Calculator Outputs

Site-specific
Resident Equation Inputs for Tap Water

*** Inputted values different from Resident defaults are highlighted.**

Variable	Resident Tap Water Default Value	Form-input Value
BW_{0-2} (mutagenic body weight) kg	15	15
BW_{2-6} (mutagenic body weight) kg	15	15
BW_{6-16} (mutagenic body weight) kg	80	80
BW_{16-26} (mutagenic body weight) kg	80	80
BW_{res-a} (body weight - adult) kg	80	80
BW_{res-c} (body weight - child) kg	15	15
$DFW_{res-adj}$ (age-adjusted dermal factor) cm^2-event/kg	2610650	2610650
$DFWM_{res-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8191633	8191633
ED_{res} (exposure duration - resident) years	26	26
ED_{0-2} (mutagenic exposure duration first phase) years	2	2
ED_{2-6} (mutagenic exposure duration second phase) years	4	4
ED_{6-16} (mutagenic exposure duration third phase) years	10	10
ED_{16-26} (mutagenic exposure duration fourth phase) years	10	10
ED_{res-a} (exposure duration - adult) years	20	20
ED_{res-c} (exposure duration - child) years	6	6
EF_{res} (exposure frequency) days/year	350	350
EF_{0-2} (mutagenic exposure frequency first phase) days/year	350	350
EF_{2-6} (mutagenic exposure frequency second phase) days/year	350	350
EF_{6-16} (mutagenic exposure frequency third phase) days/year	350	350
EF_{16-26} (mutagenic exposure frequency fourth phase) days/year	350	350
EF_{res-a} (exposure frequency - adult) days/year	350	350
EF_{res-c} (exposure frequency - child) days/year	350	350
ET_{res} (exposure time) hours/day	24	24
$ET_{event-res-adj}$ (age-adjusted exposure time) hours/event	0.67077	0.67077
$ET_{event-res-madj}$ (mutagenic age-adjusted exposure time) hours/event	0.67077	0.67077
ET_{0-2} (mutagenic dermal exposure time first phase) hours/event	0.54	0.54
ET_{2-6} (mutagenic dermal exposure time second phase) hours/event	0.54	0.54
ET_{6-16} (mutagenic dermal exposure time third phase) hours/event	0.71	0.71
ET_{16-26} (mutagenic dermal exposure time fourth phase) hours/event	0.71	0.71

Output generated 06MAY2020:12:38:40

Site-specific
Resident Equation Inputs for Tap Water

*** Inputted values different from Resident defaults are highlighted.**

Variable	Resident Tap Water Default Value	Form-input Value
ET_{res-a} (dermal exposure time - adult) hours/event	0.71	0.71
ET_{res-c} (dermal exposure time - child) hours/event	0.54	0.54
ET_{0-2} (mutagenic inhalation exposure time first phase) hours/day	24	24
ET_{2-6} (mutagenic inhalation exposure time second phase) hours/day	24	24
ET_{6-16} (mutagenic inhalation exposure time third phase) hours/day	24	24
ET_{16-26} (mutagenic inhalation exposure time fourth phase) hours/day	24	24
ET_{res-a} (inhalation exposure time - adult) hours/day	24	24
ET_{res-c} (inhalation exposure time - child) hours/day	24	24
EV_{0-2} (mutagenic events) per day	1	1
EV_{2-6} (mutagenic events) per day	1	1
EV_{6-16} (mutagenic events) per day	1	1
EV_{16-26} (mutagenic events) per day	1	1
EV_{res-a} (events - adult) per day	1	1
EV_{res-c} (events - child) per day	1	1
THQ (target hazard quotient) unitless	0.1	0.1
$IFW_{res-adj}$ (adjusted intake factor) L/kg	327.95	327.95
$IFWM_{res-adj}$ (mutagenic adjusted intake factor) L/kg	1019.9	1019.9
IRW_{0-2} (mutagenic water intake rate) L/day	0.78	0.78
IRW_{2-6} (mutagenic water intake rate) L/day	0.78	0.78
IRW_{6-16} (mutagenic water intake rate) L/day	2.5	2.5
IRW_{16-26} (mutagenic water intake rate) L/day	2.5	2.5
IRW_{res-a} (water intake rate - adult) L/day	2.5	2.5
IRW_{res-c} (water intake rate - child) L/day	0.78	0.78
K (volatilization factor of Andelman) L/m^3	0.5	0.5
LT (lifetime) years	70	70
SA_{0-2} (mutagenic skin surface area) cm^2	6365	6365
SA_{2-6} (mutagenic skin surface area) cm^2	6365	6365
SA_{6-16} (mutagenic skin surface area) cm^2	19652	19652
SA_{16-26} (mutagenic skin surface area) cm^2	19652	19652

Output generated 06MAY2020:12:38:40

Site-specific
Resident Equation Inputs for Tap Water

*** Inputted values different from Resident defaults are highlighted.**

Variable	Resident Tap Water Default Value	Form-input Value
SA_{res-a} (skin surface area - adult) cm^2	19652	19652
SA_{res-c} (skin surface area - child) cm^2	6365	6365
l_{sc} (apparent thickness of stratum corneum) cm	0.001	0.001
TR (target risk) unitless	1.0E-06	1.0E-06

Output generated 06MAY2020:12:38:40

Site-specific
Resident Regional Screening Levels (RSL) for Tap Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o (mg/kg-day)$^{-1}$	SF_o Ref	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	K_p (cm/hr)	MW
Dichloroethylene, 1,2-cis-	156-59-2	No	Yes	Organics	-		-		2.00E-03	I	-		1	1.10E-02	96.944
Trichloroethylene	79-01-6	Yes	Yes	Organics	4.60E-02	I	4.10E-06	I	5.00E-04	I	2.00E-03	I	1	1.16E-02	131.39
Vinyl Chloride	75-01-4	Yes	Yes	Organics	7.20E-01	I	4.40E-06	I	3.00E-03	I	1.00E-01	I	1	8.38E-03	62.499

B (unitless)	t* (hr)	τ_{event} (hr/event)	FA (unitless)	In EPD?	$DA_{event (ca)}$	$DA_{event (nc child)}$	$DA_{event (nc adult)}$	MCL (ug/L)	Ingestion SL TR=1E-06 (ug/L)	Dermal SL TR=1E-06 (ug/L)	Inhalation SL TR=1E-06 (ug/L)	Carcinogenic SL TR=1E-06 (ug/L)	Ingestion SL Child THQ=0.1 (ug/L)
4.17E-02	8.81E-01	3.67E-01	1	Yes	-	4.92E-04	8.49E-04	7.00E+01	-	-	-	-	4.01E+00
5.11E-02	1.37E+00	5.72E-01	1	Yes	1.48E-04	1.23E-04	2.12E-04	5.00E+00	1.18E+00	7.45E+00	9.57E-01	4.94E-01	1.00E+00
2.55E-02	5.65E-01	2.35E-01	1	Yes	2.64E-06	7.37E-04	1.27E-03	2.00E+00	2.14E-02	2.77E-01	3.35E-01	1.88E-02	6.02E+00

Dermal SL Child THQ=0.1 (ug/L)	Inhalation SL Child THQ=0.1 (ug/L)	Noncarcinogenic SL Child THI=0.1 (ug/L)	Ingestion SL Adult THQ=0.1 (ug/L)	Dermal SL Adult THQ=0.1 (ug/L)	Inhalation SL Adult THQ=0.1 (ug/L)	Noncarcinogenic SL Adult THI=0.1 (ug/L)	Screening Level (ug/L)
3.63E+01	-	3.61E+00	6.67E+00	5.47E+01	-	5.95E+00	3.61E+00 nc
6.89E+00	4.17E-01	2.83E-01	1.67E+00	1.04E+01	4.17E-01	3.23E-01	2.83E-01 nc
8.93E+01	2.09E+01	4.44E+00	1.00E+01	1.29E+02	2.09E+01	6.43E+00	1.88E-02 ca

Site-specific
Resident Risk for Tap Water

Chemical	SF_o (mg/kg-day)$^{-1}$	SF_o Ref	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	K_p (cm/hr)	MW	B (unitless)	t^* (hr)
Dichloroethylene, 1,2-cis-	-		-		2.00E-03	I	-		1	1.10E-02	96.944	4.17E-02	8.81E-01
Trichloroethylene	4.60E-02	I	4.10E-06	I	5.00E-04	I	2.00E-03	I	1	1.16E-02	131.39	5.11E-02	1.37E+00
Vinyl Chloride	7.20E-01	I	4.40E-06	I	3.00E-03	I	1.00E-01	I	1	8.38E-03	62.499	2.55E-02	5.65E-01
**Total Risk/HI*	-		-		-		-		-	-	-	-	-

Chemical	τ_{event} (hr/event)	FA (unitless)	In EPD?	$DA_{event\ (ca)}$	$DA_{event\ (nc\ child)}$	$DA_{event\ (nc\ adult)}$	MCL (ug/L)	Concentration (ug/L)	Ingestion Risk	Dermal Risk	Inhalation Risk
Dichloroethylene, 1,2-cis-	3.67E-01	1	Yes	-	4.92E-04	8.49E-04	7.00E+01	3.01E-01	-	-	-
Trichloroethylene	5.72E-01	1	Yes	1.48E-04	1.23E-04	2.12E-04	5.00E+00	5.01E-02	4.24E-08	6.73E-09	5.24E-08
Vinyl Chloride	2.35E-01	1	Yes	2.64E-06	7.37E-04	1.27E-03	2.00E+00	8.30E-02	3.87E-06	3.00E-07	2.48E-07
**Total Risk/HI*	-	-		-	-	-	-	-	*3.92E-06*	*3.07E-07*	*3.00E-07*

Chemical	Carcinogenic Risk	Ingestion Child HQ	Dermal Child HQ	Inhalation Child HQ	Noncarcinogenic Child HI	Ingestion Adult HQ	Dermal Adult HQ	Inhalation Adult HQ	Noncarcinogenic Adult HI
Dichloroethylene, 1,2-cis-	-	7.50E-03	8.29E-04	-	8.33E-03	4.51E-03	5.50E-04	-	5.06E-03
Trichloroethylene	1.01E-07	5.00E-03	7.27E-04	1.20E-02	1.77E-02	3.00E-03	4.82E-04	1.20E-02	1.55E-02
Vinyl Chloride	4.42E-06	1.38E-03	9.30E-05	3.98E-04	1.87E-03	8.29E-04	6.42E-05	3.98E-04	1.29E-03
**Total Risk/HI*	*4.52E-06*	*1.39E-02*	*1.65E-03*	*1.24E-02*	*2.79E-02*	*8.34E-03*	*1.10E-03*	*1.24E-02*	*2.18E-02*

Chemical	CASNUM	Chemical Type	Inhalation Unit Risk (µg/m ³)-1	Toxicity Source	EPA Cancer Classification	Inhalation Unit Risk Tumor Type	Inhalation Unit Risk Target Organ	Inhalation Unit Risk Species	Inhalation Unit Risk Method	Inhalation Unit Risk Route
Dichloroethylene, 1,2-cis-	156-59-2	Organics								
Trichloroethylene	79-01-6	Organics	4.10E-06	IRIS	carcinogenic to humans	Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors	Kidney, Liver	human	LEC01	NA
Vinyl Chloride	75-01-4	Organics	4.40E-06	IRIS	Known/likely human carcinogen	Liver angiosarcomas, angiomas, hepatomas, and neoplastic nodules	Liver	Rat	LED 10/ linear method	NA

Inhalation Unit Risk Treatment Duration	Inhalation Unit Risk Study Reference	Inhalation Unit Risk Notes
NA	Charbotel et al. 2006, EPA 2011, Raaschou-Nielsen et al. 2003	NA
NA	Maltoni et al. 1981, Maltoni et al. 1984	NA

Oral Slope Factor Toxicity Metadata

Chemical	CASNUM	Chemical Type	Oral Slope Factor (mg/kg-day) $^{-1}$	Toxicity Source	EPA Cancer Classification	Oral Slope Factor Tumor Type	Oral Slope Factor Target Organ	Oral Slope Factor Species	Oral Slope Factor Method	Oral Slope Factor Route	Oral Slope Factor Treatment Duration	Oral Slope Factor Study Reference	Oral Slope Factor Notes
Dichloroethylene, 1,2-cis-	156-59-2	Organics											
Trichloroethylene	79-01-6	Organics	4.60E-02	IRIS	carcinogenic to humans	Derived from IUR	Derived from IUR	Derived from IUR	Derived from IUR	NA	NA	Derived from IUR	NA
Vinyl Chloride	75-01-4	Organics	7.20E-01	IRIS	Known/likely human carcinogen	Total of liver angiosarcoma, hepatocellular carcinoma, and neoplastic nodules	Liver	Rat	LMS method	NA	NA	Feron et al. 1981	NA

Chemical	CASNUM	Chemical Type	Chronic Oral Reference Dose (mg/kg-day)	Toxicity Source	Oral Chronic Reference Dose Basis	Oral Chronic Reference Dose Confidence Level	Oral Chronic Reference Dose Critical Effect	Oral Chronic Reference Dose Target Organ	Oral Chronic Reference Dose Modifying Factor	Oral Chronic Reference Dose Uncertainty Factor	Oral Chronic Reference Dose Species	Oral Chronic Reference Dose Route
Dichloroethylene, 1,2-cis-	156-59-2	Organics	2.00E-03	IRIS	BMDL10: 5.1 mg/kg-day	low	increased relative kidney weight in male rats	kidney	1	3000	rat	NA
Trichloroethylene	79-01-6	Organics	5.00E-04	IRIS	BMDL01 (HED99): 0.0051 mg/kg/day	High	Increased fetal cardiac malformations in Sprague-Dawley rats	Heart	1	10	rat	NA
Vinyl Chloride	75-01-4	Organics	3.00E-03	IRIS	NOAEL (HED): 0.09 mg/kg-day	Medium	Liver cell polymorphism	Liver	1	30	Rat	NA

Oral Chronic Reference Dose Study Duration	Oral Chronic Reference Dose Study Reference	Oral Chronic Reference Dose Notes
NA	McCauley et al. 1995, 1990	NA
NA	Johnson et al. 2003 (Supported by Keil et al. 2009 and Peden-Adams et al. 2006)	NA
NA	Til et al. 1983, Til et al. 1991	NA

Inhalation Chronic Toxicity Metadata

Chemical	CASNUM	Chemical Type	Chronic Inhalation Reference Concentration (mg/m ^{3})	Toxicity Source	Inhalation Chronic Reference Concentration Basis	Inhalation Chronic Reference Concentration Confidence Level	Inhalation Chronic Reference Concentration Critical Effect	Inhalation Chronic Reference Concentration Target Organ	Inhalation Chronic Reference Concentration Modifying Factor	Inhalation Chronic Reference Concentration Uncertainty Factor
Dichloroethylene, 1,2-cis-	156-59-2	Organics	-							
Trichloroethylene	79-01-6	Organics	0.002	IRIS	LOAEL (HEC99): 0.19 mg/m3	High	Decreased thymus weight in female B6C3F1 mice (immunotoxicity)	Thymus	1	100
Vinyl Chloride	75-01-4	Organics	0.1	IRIS	NOAEL (HEC): 2.5 mg/m3	Medium	Liver cell polymorphism	Liver	1	30

Inhalation Chronic Reference Concentration Species	Inhalation Chronic Reference Concentration Route	Inhalation Chronic Reference Concentration Study Duration	Inhalation Chronic Reference Concentration Study Reference	Inhalation Chronic Reference Concentration Notes
mice	NA	NA	Keil et al. 2009 (Supported by Johnson et al. 2003)	NA
Rat	NA	NA	Til et al. 1991, Til et al. 1983	NA