HAZARD RANKING SYSTEM (HRS) DOCUMENTATION RECORD- REVIEW COVER SHEET

Name of Site:	Riverside Ground Water Contamination
U.S. EPA ID No.:	INN000510936
Date Prepared:	April 2016

<u>Contact Persons</u>

Site Investigation	Mark Jaworski, Site Investigation Program, Federal Programs Section Indiana Department of Environmental Management, (317) 233-2407
Documentation Record:	Nuria Munĩz, United States Environmental Protection Agency (EPA), Region V, (312) 886-4439
	Mark Jaworski, Indiana Department of Environmental Management (IDEM), Site Investigation Program, (317) 233-2407

<u>Pathways, Components, or Threats Not Scored</u>

Surface Water Migration Pathway, Soil Exposure Pathway, and Air Migration Pathway:

The Surface Water Migration Pathway, Soil Exposure Pathway, and Air Migration Pathway were not scored as part of this Hazard Ranking System (HRS) evaluation. These pathways were not included because a release to these media does not significantly affect the overall score and because the ground water pathway produces an overall score above the minimum requirement for the Riverside Ground Water Contamination site to qualify for inclusion on the National Priorities List (NPL).

HRS DOCUMENTATION RECORD

Name of Site:	Riverside Ground Water Contamination
EPA Region:	5
Street Address*:	Lloyd Peterson Lane (Figure 1-2 of this HRS Documentation Record)
Date Prepared:	April 2016
City, County, State, Zip Code:	Indianapolis, Marion County, Indiana, 46202
General Location in the State:	Central Indiana (Figure 1-1 of this HRS Documentation Record)
Topographic Map:	Indianapolis, Indiana Quad (7.5’) (Ref. 3)
Latitude:	39^{o} 46' 54.838" North
Longitude:	86^{o} 11' 8.97" West
Reference Point:	The reference point corresponds to the location of well RS 29 at the southwestern tip of the ground water plume (Source 1) (see Figure 1-1; Refs. 3, 106, 107).
Congressional District:	7

*The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

<u>Scores</u>

Air Pathway	Not Scored
Ground Water Pathway	100.00
Soil Exposure Pathway	Not Scored
Surface Water Pathway	Not Scored
HRS SITE SCORE	**50.00**

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	100.00	10,000.00
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	NS*	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	NS	
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	NS	
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	NS	
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10,000.00
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root		50.00

Notes: *NS = Not Scored

HRS Table 3-1 –Ground Water Migration Pathway Scoresheet

Factor Categories and Factors	Maximum Value	Value Assigned
Likelihood of Release to an Aquifer:		
1. Observed Release	550	550
2. Potential to Release:		
2a. Containment	10	NS
2b. Net Precipitation	10	NS
2c. Depth to Aquifer	5	NS
2d. Travel Time	35	NS
2e. Potential to Release [lines 2a x (2b + 2c + 2d)]	500	NS
3. Likelihood of Release (higher of lines 1 and 2e)	550	550
Waste Characteristics:		
4. Toxicity/Mobility	(a)	10,000
5. Hazardous Waste Quantity	(a)	100
6. Waste Characteristics	100	32
Targets:		
7. Nearest Well	50	50
8. Population:		
8a. Level I Concentrations	(b)	102,986.5
8b. Level II Concentrations	(b)	17,865.009
8c. Potential Contamination	(b)	NS
8d. Population (lines 8a + 8b + 8c)	(b)	120,851.509
9. Resources	5	NS
10. Wellhead Protection Area	20	20
11. Targets (lines 7 + 8d + 9 + 10)	(b)	120,921.509
Ground Water Migration Score For An Aquifer:		
12. Aquifer Score [(lines 3 x 6 x 11)/82,500][c] 550 x 32 x 120,921.509/82,500 = 25,796.588	100	100.00
Ground Water Migration Pathway Score:		
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100	100.00

(a) Maximum value applies to waste characteristics category
(b) Maximum value not applicable
[c] Do not round to nearest integer
NS - Not Scored

Riverside Ground Water Contamination
Indianapolis, Marion County, Indiana

Non Orthophotography
Data - Obtained from the State of Indiana Geographical Information Office Library
Document
- RS 29 Reference 4, pages 71-74
Orthophotography - Obtained from Indiana Map Framework Data (www.indianamap.org)
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

Riverside Well RS 29

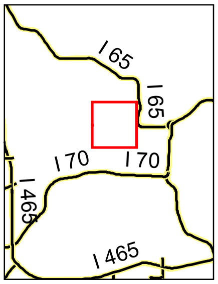
0 0.4 Kilometers

0 0.35 Miles

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: 05/26/2015

Site Vicinity



Marion County, IN

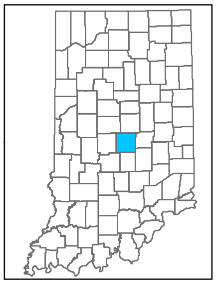
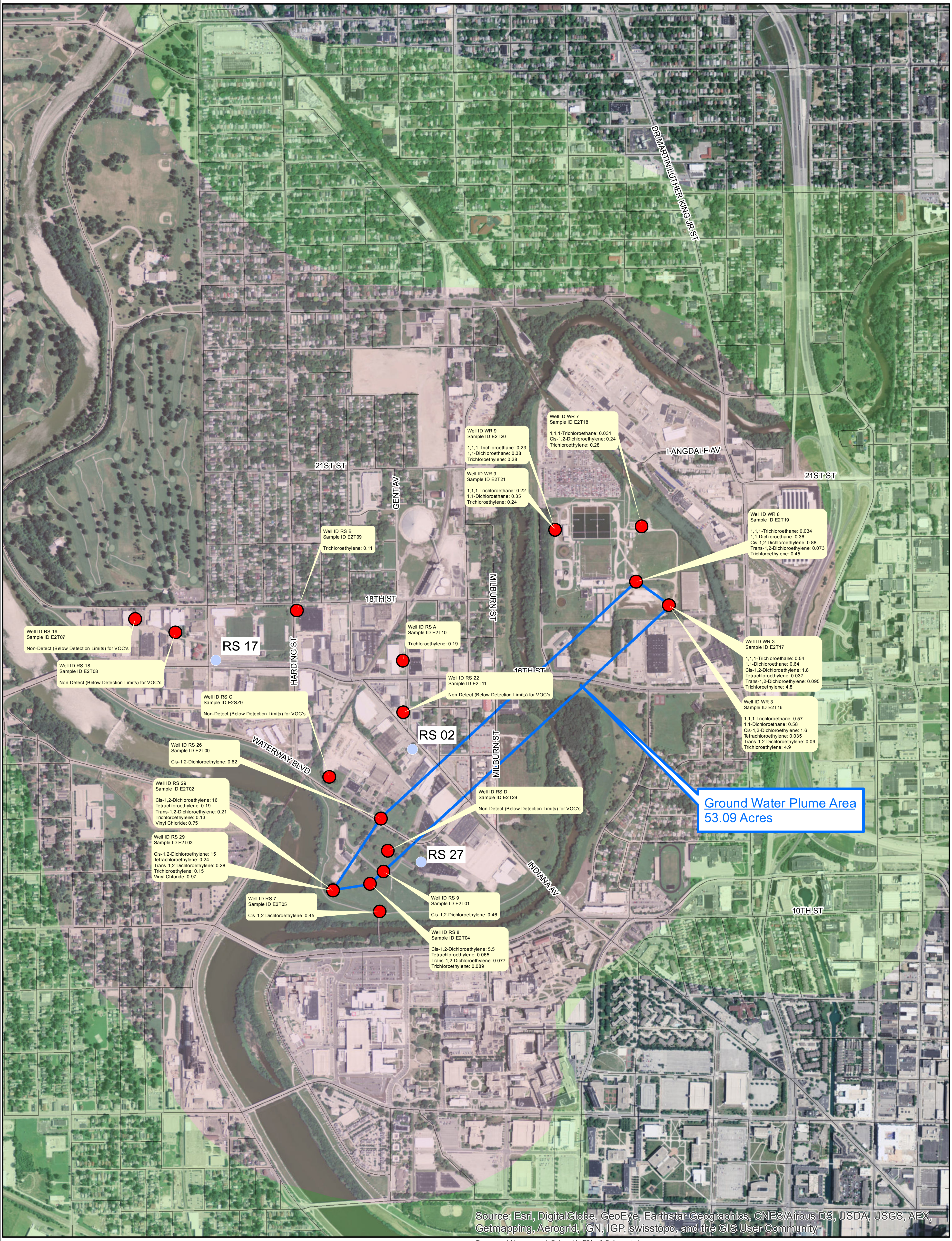


Fig. 1-1

Riverside Ground Water Plume Boundary Map
Indianapolis, Marion County, Indiana
Fig. 1-2



The source of this map image is Esri, used by EPA with Esri's permission.

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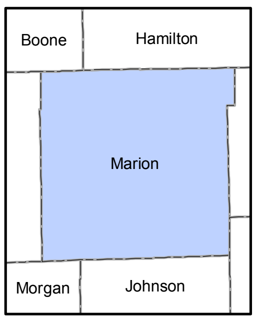
Mapped By:
Shane Moore, Office of Land Quality
Date:09/30/2015

Sources:
Non Orthophotography Data - Obtained from the State of Indiana Geographical Information Office Library
Document
- Sampling Locations Results Reference 4, Tables 3-5, pgs 562, 565, 568
- Sampling Locations Reference 107
- Well Head Protection Area Reference 60
- 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

0 0.2 0.4 0.8 Kilometers
0 0.075 0.15 0.3 Miles



- Municipal Wells Not Sampled
- 2014 Sampling Results (µg/L)
- Approximate Ground Water Plume Boundary
- Wellhead 1 Year Delineation
- Wellhead 5 Year Delineation

Wellhead Protection Areas, Riverside Ground Water Contamination
Indianapolis, Marion County, Indiana

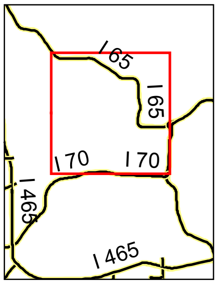
0 1 Kilometers

0 1 Miles

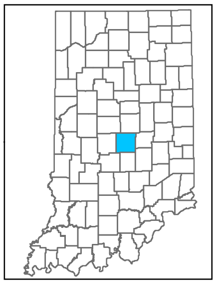
N W E S

Riverside Well RS 29
Wellhead 1 Year Delineation
Wellhead 5 Year Delineation

Site Vicinity



Marion County, IN



Sources:
Non Orthophotography Data - Obtained from the State of Indiana Geographical Information Office Library
Document
- Well Head Protection Area Reference 60
- RS 29 Reference 4, pages 71-74
Orthophotography - Obtained from Indiana Map Framework Data (www.indianamap.org)
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

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: 05/26/2015

Fig. 1-3

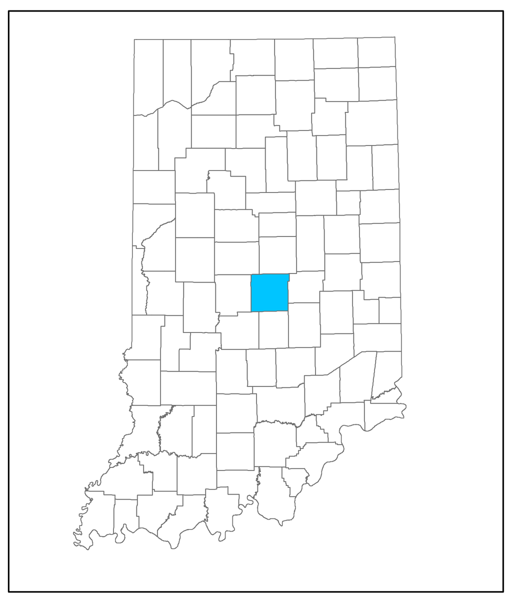
Possible Contamination Sources
Within the 5 Year Time of Travel Wellhead Protection Area
Riverside Groundwater Contamination

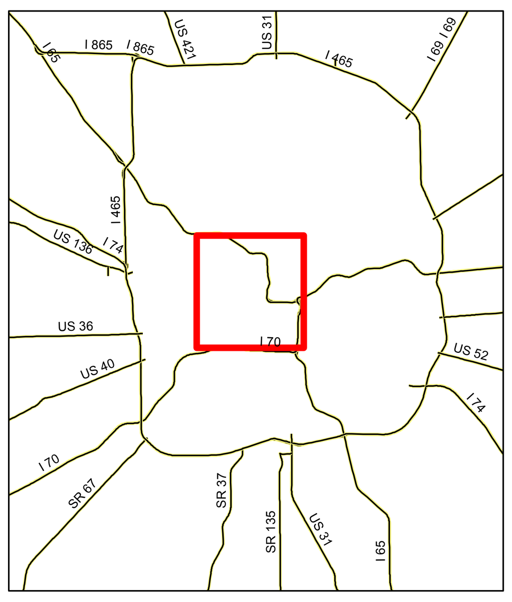
Fig. 1-4

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:10/13/2015
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

0 275 550 1,100 Meters
0 900 1,800 3,600 Feet

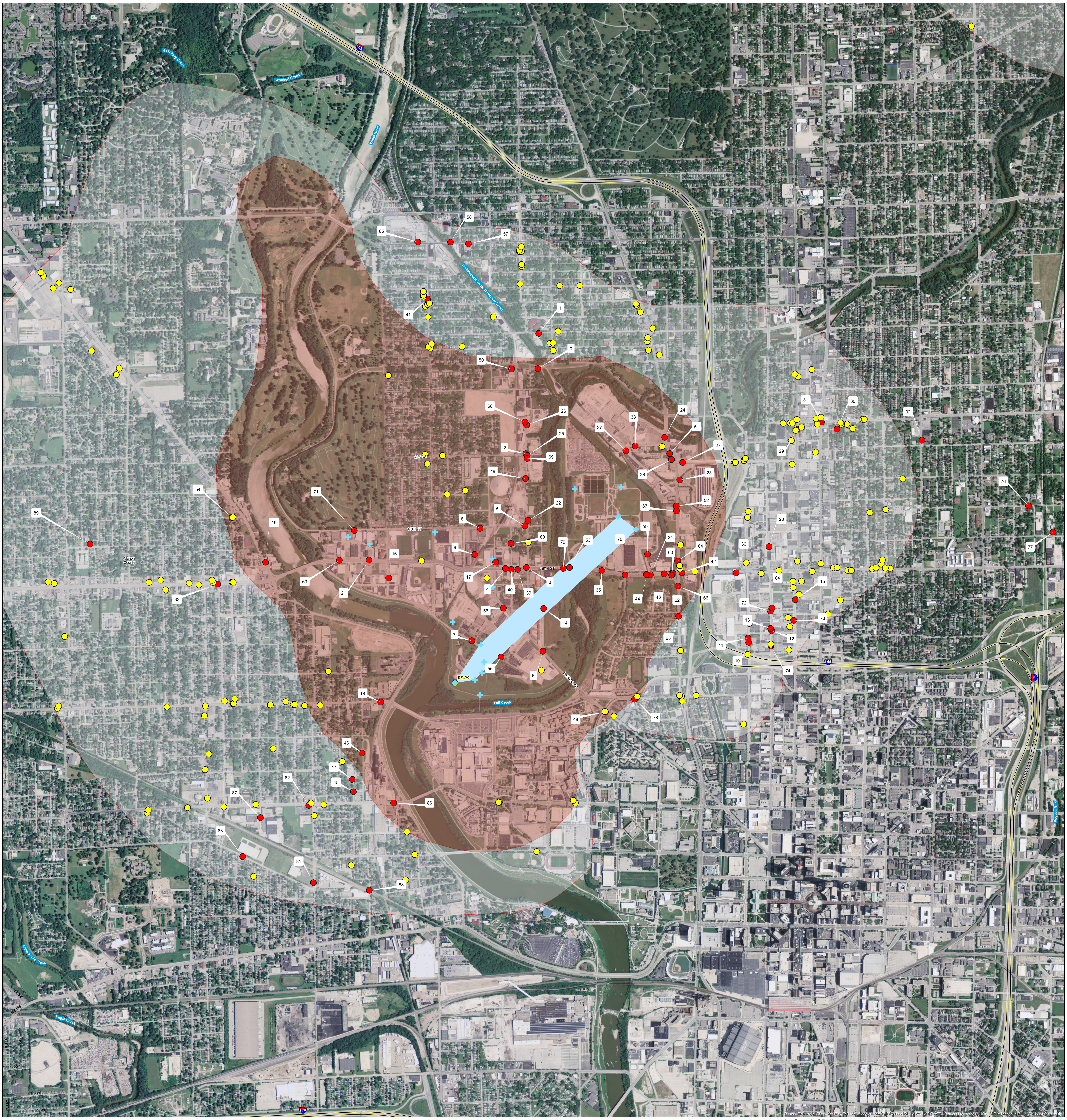




- Possible GW Contamination Sources
- PWS Well RS 29
- GroundWater Plume Boundary
- Wellhead 5 Year Delineation
- Wellhead 1 Year Delineation

Possible Contamination Sources including former Dry Cleaners
Within the 5 Year Time of Travel Wellhead Protection Area
Riverside Groundwater Contamination

Fig. 1-5



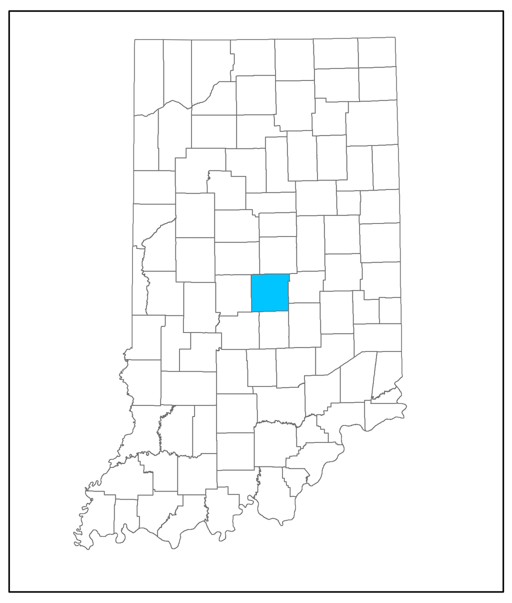
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
Shane Moore, Office of Land Quality
Date:10/13/2015
Sources:
Non Orthophotography
Data - Obtained from the State of Indiana Geographical Information Office Library
Document - Potential GW Contamination Sources
-Dry Cleaner- from Reference 34 (aggregation method) and Reference 4 (Table 1, pages 54-63)
- Potential Sources of Chlorinated Solvents Reference 4 (table on pages 381-385)
-Sampling Locations Reference 107
- 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

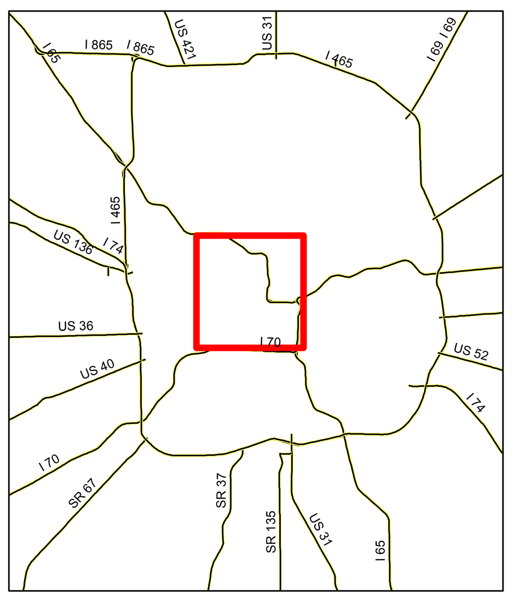
N
W E
S

IDEM

Marion County



Indianapolis



Current and Historical Dry Cleaning Sites
Possible GW Contamination Sources
Sampled Municipal Wells
PWS Well RS 29
GroundWater Plume Boundary
Wellhead 5 Year Delineation
Wellhead 1 Year Delineation

0 275 550 1,100 Meters
0 900 1,800 3,600 Feet

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107. IDEM, Email from Shane Moore to Mark Jaworski with Attachment Regarding GPS Coordinates for Sample Locations, March 9, 2016. 2 pages.

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Site Summary

Riverside Ground Water Contamination

The Riverside Ground Water Contamination site consists of a ground water plume with no identified source. Chlorinated solvents have been detected in the ground water within several of the city of Indianapolis municipal wells (see Table 5, Level I Contaminated Ground Water from Public Well Samples and Table 6, Level II Contaminated Ground Water from Public Well Samples of this HRS documentation record). The city water utility is operated by the Citizens Energy Company (Citizens) and serves approximately 876,728 people (Ref. 68, p. 1; 83, p. 2).

The Riverside Ground Water Plume encompasses two municipal well fields, the Riverside Well Field and the White River Well Field. The well fields lie adjacent to each other (see Figures 1-2). Five (5) of the wells have been contaminated by a ground water plume of chlorinated solvents, principally cis-1,2-dichloroethylene (cis-1,2-DCE) and vinyl chloride (VC) (see Table 2, Contaminated Ground Water from Public Wells Sample Table of this HRS Documentation Record; Figure 1-2 of this HRS documentation record). Facilities that have been identified and/or investigated as possible contributors to the ground water plume are shown in Figure 1-3 and Reference 105. The Riverside Ground Water Contamination site is depicted aerially by ground water sample locations obtained from municipal wells in the surrounding area, with detections of the above mentioned chlorinated solvents meeting observed release criteria (see Figure 1-2; Section 3.1.1; and Table 2, Contaminated Ground Water from Public Wells Sample Table of this HRS documentation record). The depicted plume encompasses approximately 53.09 acres and is composed of trichloroethylene (TCE), dichloroethylene (cis-1.2-DCE), and VC (see Table 2, Contaminated Ground Water from Public Wells Sample Table and Figure 1-2 of this HRS documentation record). Although the site is scored as a co-mingled plume, Attachments 1 and 2 to this HRS documentation record demonstrate that the documented ground water contamination in each well field would qualify for NPL listing independently.

The site is being scored as a ground plume with no identified source because there are too many possible sources (i.e., users of VOCs) in the vicinity of this plume to reasonably attribute the ground water contamination to any specific source or sources. A Geologic and database review conducted by IDEM to identify the actual Riverside Well Field ground water contamination sources(s) concluded that this is problematic due to municipal well depths, contaminant distribution, land uses, various facilities in the surrounding area, co-mingled plumes, limited equipment sampling depths, the number of possible sources (89+), series of sampling depths at various locations, and the complex contaminate migration pathways (Ref. 4, pp. 53-63, 375, 376, 377). IDEM staff has also identified 167 former/current dry cleaners that may also be source(s) to the impacted municipal wells (see Figure 1-5 of this HRS documentation record; 34, p.1).

HISTORY

The Riverside Ground Water Contamination site is located in Indianapolis, Marion County, Indiana (see Figure 1-1 of this HRS documentation record). On February 20, 2013, IDEM staff received notice from Citizens Energy Group that elevated levels of VC and cis-1,2-DCE are being detected in their Riverside municipal well field (Ref. 71, pp.6).

Citizens Energy was concerned that the increasing levels of VC in Well RS 29 was approaching the Maximum Contaminant Levels (MCL) for VC which may adversely impact the use of that well to supply drinking water to residents in Indianapolis (Ref. 71, pp.6, 7). The MCL for VC is 2.0 ug/l (Ref. 2, p. 10). The Riverside/White River Well Field supplies drinking water to 526,036.8 people in Indianapolis (Ref. 68, p.1; 83, p. 2).

As a result of the elevated levels of chlorinated solvents detected in the ground water in the municipal wells, the IDEM Site Investigation Program conducted a Pre-CERCLIS Screening and recommended that the Riverside Ground Water Contamination be entered into CERCLIS (Ref. 5, p. 2).

A Preliminary Assessment (PA) was conducted by IDEM for the plume. The PA was finalized February 13, 2014 (Ref. 71, p.1). A Site Inspection (SI) was conducted on May 20 and 21, 2014. A total of 25 water samples were obtained for the SI. The samples consisted of 19 ground water samples, 4 duplicate samples, and 2 trip blanks (Ref. 4, p. 19). The ground water samples were collected from 19 municipal wells located in the Riverside and White River Well Fields (Ref. 4, p. 19). All samples were analyzed for VOCs only (Ref. 4, p. 19).

Analysis of the ground water from the municipal wells revealed detections of chlorinated solvents in seven (7) ground water samples collected from five (5) municipal wells. The impacted wells are RS 26, RS 29, and RS 8 that were obtained from the Riverside Well Field and wells WR 3 and WR 8 that were collected from the White River Well Field (see Table 2, Contaminated Ground Water from Public Wells Sample Table, of this HRS documentation record).

2.2 SOURCE CHARACTERIZATION

2.2.1 Source Identification

Number of Source: 1

Source Type: Other: Ground Water Plume with No Identified Source

Description and Location of Source (see Figure 1-2 of this HRS documentation record))

The source consists of a contaminated ground water plume located within the Riverside and White River Municipal Well Fields. Both well fields lie near the confluence of the White River and Fall Creek in central Indianapolis (see Table 2,Contaminated Ground Water from Public Wells Sample Table of this HRS Documentation Record; Figure 1-2).

There are many known current and historical users of chlorinated solvents in the area. The specific sources of the contamination at the Riverside Ground Water Contamination site cannot reasonably be determined at this time. A description of possible sources that may have used or released solvents can be found Reference 105 (see also Figures 1-4 and 1-5 of this HRS documentation record).

No single identifiable source could be identified as the actual source(s) of the Riverside Well Field ground water contamination (Ref. 4, p. 377). Typical suspect source area investigations are limited by equipment with a maximum depth of around 40 feet bgs for ground water sampling (Ref. 4, p. 377). The investigation area is large: 89+ suspect sources range from approximately 1,000 to over 13,000 feet away from Riverside Municipal Well RS 29 (Ref. 4, p. 377). In order to link a possible source to a specific contaminated well, the installation of an extensive series of sampling points at various depths from about 30 to 290 feet over a wide area would be needed (Ref. 4, p. 377). The subsurface complexity and heterogeneity likely complicates contaminate migration pathways; therefore, "connecting the dots" from any one source to a target well would likely require a relatively high density of samples (Ref. 4, p. 377).

Ground water observed release samples were used to delineate the outline of the plume, which covers approximately 53.09 acres (see Figure 1-2 of this HRS documentation record; Sections 3.0.1 and 3.1.1 of this HRS documentation record). The area of the ground water plume is based on available samples that meet the criteria for an observed release (Ref. 1, pp. 45, 46; Section 3.1.1 of this HRS documentation record).

The contaminated ground water plume is located at and north of the White River /Fall Creek confluence in central Indianapolis (see Figure 1-2 of this HRS documentation record).

2.2.2 Hazardous Substances Associated with a Source

The following hazardous substances are associated with the source (see Section 3.1.1 of this HRS documentation record):

VC	Vinyl Chloride
Cis-1,2 DCE	Cis - 1,2 Dichloroethene
TCE	Trichloroethene

2.2.3 Hazardous Substances Available to a Pathway

Containment Description	Containment Factor Value	References
Gas release to air: The air migration pathway was not scored; therefore, gas containment was not evaluated	Not Scored	
Particulate release to air: The air migration pathway was not scored; therefore, gas containment was not evaluated.	Not Scored	
Release to ground water: The containment factor value of 10 is assigned based on analytical evidence of hazardous substances in ground water samples from municipal wells (see Tables 2, 5, and 6 of this HRS documentation record). Therefore, based on evidence of release (evidence of hazardous substance migration from a source area), the highest ground water migration pathway containment factor value of 10 was assigned to Source No. 1 as specified in Table 3-2 of the HRS Rule (Ref. 1. Section 3.1.2.1)	10	Ref. 1, Table 3-2, p.70 See Section 3.1.1 of this HRS documentation
Release via overland migration and/or flood: The surface water pathway was not scored; therefore, surface water overland/flood migration component containment was not evaluated	Not Scored	

2.4.2 Hazardous Waste Quantity

2.4.2.1 Source Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity (Tier A)

The hazardous constituent quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances in the source and releases from the sources not known and cannot be estimated with reasonable confidence [Ref. 1, pp. 64, 65 (Section 2.4.2.1.1)]. There are insufficient historical and current data (manifests, potentially responsible party (PRP) records, State records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source No. 1 with reasonable confidence. As a result, the evaluation of hazardous waste quantity proceeds to the evaluation of Tier B, hazardous wastestream quantity (Ref. 1, Section 2.4.2.1.1, pp. 64, 65).

Hazardous Constituent Quantity Assigned Value: NS

2.4.2.1.2. Hazardous Wastestream Quantity (Tier B)

The hazardous wastestream quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass of the hazardous wastestreams plus the mass of any additional CERCLA pollutants and contaminants in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, pp. 51591 (Section 2.4.2.1.2)]. There are insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, etc.) available to adequately calculate the total mass or partial mass of the hazardous wastestreams plus the mass of all CERCLA pollutants and contaminants in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous wastestream quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume (Ref. 1, Section 2.4.2.1.2, p. 65).

Hazardous Wastestream Quantity Assigned Value: NS

2.4.2.1.3. Volume (Tier C)

Horizontal and vertical extent of the plume cannot be determined based on available sampling data; a sufficient number of samples are not available to statistically represent the range of contaminant concentrations throughout the source. Therefore, the source volume is unknown, but greater than 0 (Ref. 1, Section 2.4.2.1.3, p. 65).

Source Type	Description (# drums or dimensions)	Units (yd^3/gal)	References
Other	Unknown	--	Ref. 1, Table 2-5

Sum (yd^3/gal): > 0
Equation for Assigning Value (Ref. 1, Table 2-5): >0/2.5=>0

Volume Assigned Value: Unknown, but > 0

2.4.2.1.4. Area (Tier D)

The area measure (Tier D) is not evaluated for source type “other” (Ref. 1, Table 2-5).

Area Assigned Value: 0

2.4.2.1.5. Source Hazardous Waste Quantity Value

Volume of ground water plume: Unknown, but >0
Highest assigned value assigned from Ref. 1, Table 2-5: > 0
Source Hazardous Waste Quantity Value: >0 (Ref. 1, Section 2.4.2.1.5, p. 65).

SUMMARY OF SOURCE DESCRIPTIONS

<table>
<tr><th rowspan="3">Source No.</th><th rowspan="3">Source Haz. Waste Quantity Value</th><th rowspan="3">Source Hazardous Constituent Quantity Complete? (Y/N)</th><th colspan="5">Containment Factor Value by Pathway</th></tr>
<tr><th rowspan="2">Ground Water (GW) (Ref. 1, Table 3-2)</th><th colspan="2">Surface Water (SW)</th><th colspan="2">Air</th></tr>
<tr><th>Overland/ flood (Ref. 1, Table 4-2)</th><th>GW to SW (Ref. 1, Table 3-2)</th><th>Gas (Ref. 1, Table 6-3)</th><th>Particulate (Ref. 1, Table 6-9)</th></tr>
<tr><td>1</td><td>> 0</td><td>N</td><td>10</td><td>NS*</td><td>NS*</td><td>NS*</td><td>NS*</td></tr>
</table>

*NS (Not Scored)

Other Possible Sources
No other possible sources have been identified at this site.

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 General Considerations

The soils in the project area are Genesee-Sloam (GSl) and Urban Land-Fox-Ockley (ULFO) associations. Soils are well drained to very poorly drained, nearly level soils formed in loamy alluvium. ULFO soils are urban land and well drained, nearly level to moderately sloping soils that are moderately deep to deep over sand and gravel and formed in loamy outwash and the underlying gravelly sand and sand. Urban land is so altered and obscured by public works and structures that identification is not feasible. Genesee silt loam consists of deep, nearly level, well drained soils on flood plains on loamy alluvium (Ref. 71, p. 28).

The well field areas are approximately 700 feet above mean sea level (amsl), and the topography is primarily flat with engineered levees along the White River (Ref. 3, p.1). The physiographic settings are terraces and the floodplain of the White River. Beneath the surface soils, the source area is underlain by sand and gravel-dominated sequences deposited by large-scale channelized meltwaters. These sequences extend approximately 100 feet until bedrock is encountered around 600 feet amsl. The bedrock in the project area consists of the Devonian-aged Muscatatuck Group of limestone and dolomite (Ref. 71, pp. 28, 29).

Two primary aquifers are in the project area: a shallow, unconfined sand and gravel aquifer (hereafter referred to in this HRS documentation record as the unconsolidated aquifer) located in the outwash deposits, and a deeper, karst aquifer in the carbonate rock (hereafter referred to in this HRS documentation record as the bedrock aquifer). Both aquifers are used by private and municipal wells. The surface waters are hydraulically well connected to the sand and gravel aquifer. The transmissivity of the sand and gravel aquifer is in the range of 35,000 ft^2/day. The ground water flow in the immediate area is primarily toward the White River. The aquifers extend beyond Marion County in all directions; therefore there are no aquifer boundaries within 4 miles from the site (Ref. 71, p. 29).

Although fine grained materials (e.g., silty clay, clay, etc.) are often encountered in the sand and gravel deposits, the fined-grained units are not laterally extensive over the wellhead protection area (WHPA), as shown by the WHPA cross-sections. Some well logs within the one year time of travel identify mostly sand and gravel deposits above bedrock; therefore, the fine-grained units are discontinuous (see Figure 1-3 of this HRS documentation record; Refs. 92, pp. 1-15; 84, pp. 37-48). The presence of discontinuous fine-grained units (aka aquitards) within the outwash deposit may complicate plume behavior, as aquitards have the potential to locally store, transmit, and/or deflect contaminants (Ref. 4, p. 374).

Bedrock in the Riverside wellfield is Devonian-age Muskatatuck group consisting of crystalline limestone and lesser calcareous shales (Ref. 92 p. 10). Prior to glaciation, the top of the bedrock surface was exposed to weathering and underwent karst development (Ref. 96, p. 15). Within the wellfield, the outwash (sand and gravel, or unconsolidated) aquifer is directly on the bedrock, (Ref. 95, p. 23), which is relict karst; therefore, “the limestone aquifer is hydraulically connected to the outwash sand and gravel aquifer” (Refs. 92, p. 16; 95, p. 27). The “…carbonate rocks lying…immediately beneath the outwash have undergone extensive solution-channel development…” (Ref. 93, p. 3). Possible solution cavities and/or voids were identified in the test piezometers cored near RS 29 (Refs. 69, p. 3; 94, pp. 6, 12, 18-20). Karst features are abundant in exposures of these rocks elsewhere in central Indiana (Ref. 92, p. 16)

There are no aquifer boundaries within 4 miles from the site (Ref. 92, pp. 2, 8, 9, 11). As shown by the WHPA time-of-travel areas and the geologic cross-sections, Fall Creek and the White River are relatively shallow and do not form hydrological divides. Based on the extent of the aquifers (Refs. 4, p.

374; 92, pp. 10, 11), continuity of carbonate bedrock units and lack of a mountain range, ocean, etc., there is no evidence of a potential aquifer boundary, or discontinuity, within 4 miles of the wellfield (Refs. 3; 4, p. 374; 92, pp. 8, 9, 10).

- Aquifer Interconnection within 2 miles

Within the well field, the outwash (sand and gravel, or unconsolidated) aquifer is directly on the bedrock, which is relict karst, therefore, "the limestone aquifer is hydraulically connected to the outwash sand and gravel aquifer". The "…carbonate rocks lying…immediately beneath the outwash have undergone extensive solution-channel development…" (Refs. 4, p. 375; 92, p. 16; 93, p. 3; 94, pp. 1-26). Possible solution cavities and/or voids were identified in the test piezometers cored near RS-29. Furthermore, the difference in depth-to-bedrock encountered in the cores ranged over 12 feet, which is consistent with a weathered, epikarst surface (Refs. 4, p.375; 69, p. 3; 94, pp. 1-26).

The results of the Fall Creek/White River Tunnel System, Piezometer Monitoring Summary report, dated April 2013 and prepared by Black & Veatch further demonstrate the connectivity of the aquifers (Ref. 4, p. 375; 69, pp.1-13). A series of piezometers were installed as part of a geotechnical investigation that included the WHPA. Piezometers GW-04-DC/SC and GW-05-DC/SC installed near RS-29 terminate between 124.5 and 220 feet bgs (Ref. 94, pp. 1-26). Well construction logs for all the piezometers show they vary in depth from about 47 to 269 feet bgs, so they measure both the outwash and carbonate aquifers (Refs. 69, p. 3; 97, pp. 1-106). The results of the piezometer monitoring show connectivity between the surface water, outwash aquifer, and carbonate aquifer (Refs. 4, p. 375; 69, pp. 1-13).

> "A correlation is evident between deep groundwater levels, precipitation, and stream level. In general, the water levels measured fluctuate in a similar pattern to both precipitation and stream level indicating hydraulic interconnectivity with the White River, Fall Creek, and the carbonate aquifer" (Refs. 4, p. 375; 69, p. 3).

Potential aquifer boundaries, (aka aquifer discontinuities), such as a mountain range, ocean, bedrock fault, etc., are not within a 4-mile radius of the site (Refs. 3; 4, pp. 374, 375; 92, pp. 8, 9, 10, 11)

Based on these results, the aquifers beneath the site can be considered a single, connected hydrologic unit for HRS scoring purposes (Refs. 1, Section 3.0.1.2, p. 69; 4, p. 375).

SUMMARY OF AQUIFER(S) BEING EVALUATED

Aquifer No.	Aquifer Name	Is Aquifer Interconnected with Upper Aquifer within 2 miles? (Y/N/NA)	Is Aquifer Continuous within 4-mile TDL? (Y/N)	Is Aquifer Karst? (Y/N)
1	Unconsolidated	NA	Y*	N
2	Bedrock	Y***	Y*	Y**

* There are no aquifer boundaries within 4 miles from the site (Refs. 3; 92, pp. 2, 8, 9, 10, 11). As shown by the WHPA time-of-travel areas and the geologic cross-sections, Fall Creek and the White River are relatively shallow and do not form hydrological divides (see Figure 1-3 of this HRS documentation record; Ref, 4, p. 374; pp. 1-15).

**Two primary aquifers are in the project area: a shallow, unconfined sand and gravel aquifer located in the outwash deposits, and a deeper, karst aquifer in the carbonate rock (Ref.95, pp. 25, 26, 27).

***The results of the piezometer monitoring show connectivity between the surface water, outwash aquifer, and carbonate aquifer (Ref. 69, p. 1-13).

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

Aquifer Being Evaluated: The interconnected unconsolidated and bedrock aquifers

Establishing an observed release by chemical analysis requires analytical evidence of a hazardous substance in the media significantly above background level (Ref. 1, Section 2.3, p. 63). If the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds its own Sample Quantitation Limit (SQL) and that of the background sample. If the SQL cannot be established, the U.S. EPA Contract-Required Quantitation Limit (CRQL) is used in place of the SQL (Ref. 1, Table 2-3, p. 63). Samples were analyzed VOCs using CLP SOWM01.2 (Trace Volatiles) analysis procedure (Ref. 4, pp. 127, 276).

Chemical Analysis

On May 20, 2014, IDEM Site Investigation Program staff conducted sampling for the Riverside Ground Water Contamination site (Ref. 4, p. 19). Twenty-five ground water samples were collected along with the prescribed Quality Assurance/Quality Control (QA/QC) samples and analyzed at an EPA Contract Laboratory Program lab. Analyses included CLP SOW SOM01.2 (Trace Volatiles) for Volatile Organic Compounds (VOCs) (Ref. 4, pp. 19, 126, 127, 182, 183, 275, 276).

- Background Concentrations:

IDEM Site Investigation Program staff collected 25 water samples for the Riverside Ground Water Contamination site inspection (Ref. 4, pp. 19, 20, 557, 558). Four (4) background water samples were obtained from four municipal wells (Riverside Well (RS) 18, Riverside Well 19, White River (WR) Well 7 and White River Well 9) (Ref. 4, pp. 19, 20, 557, 558).

All sample collection and analysis was conducted in accordance with the approved IDEM Quality Assurance Protection Plan (QAPP), dated April 30, 2008, IDEM Standard Operating Procedures (SOPs) and the Contract Lab Program (CLP) protocol. A field duplicate was taken one (1) per matrix for each ten (10) samples. Matrix Spike/Matrix Spike duplicates (MS/MSDs) were collected one (1) per matrix for each 20 samples. Nitrile surgical gloves were worn and discarded between the collection of each sample. All samples collected by Team #1 each day were documented, iced, and shipped overnight to the appropriate CLP laboratory by Team #2 that evening. All sample locations were photographed and recorded using the Global Positioning System (GPS) (Ref. 4, pp. 19, 20, 67 through 113).

The table below, Table 1, Background Ground Water Sample Table, shows ground water sample results that were obtained from deep municipal wells (RS 18 and RS 19) that were completed in limestone (bedrock aquifer) and two shallow municipal wells (WR7 and WR9) that were completed in sand and gravel (unconsolidated aquifer) (Refs. 62, p. 3; 84, pp. 25, 29, 30). Therefore, RS 18 and RS 19 are background wells for all wells obtaining water from limestone (Riverside Well Field) and WR 7 and WR 9 are background wells for all wells obtaining water from the sand and gravel, White River Well field (Refs. 62, p. 3; 84, pp. 39-43). The samples were obtained from wells in the same wellfields, screened in equivalent materials and near the same depths to the contaminated wells.

Table 1
Background Ground Water Sample Table Obtained from 4 Municipal Wells (two Shallow completed in Sand and Gravel; and two Deep completed in bedrock limestone)

EPA CLP#	Date	Location	Depth Below Ground Surface/ Aquifer matrix	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T07	05/20/14	RS19	392 ft./LS	Cis1,2-DCE VC	0.5 U 0.5 U	0.5	Refs. 4, pp. 182, 231, 232; 35, p. 9; 36, p.1; 62, p. 5; 61, p. 94, 143, 144
E2T08	05/20/14	RS 18	400 ft./LS	Cis1,2-DCE VC	0.5 U 0.5 U	0.5	Refs. 4, pp. 182, 240, 241; 35, p. 10; 36, p.1; 62, p. 5; 61, p. 94, 152, 153
E2T20	05/21/14	WR 9	79 ft 6 in./SG	Cis1,2-DCE TCE	0.5U 0.2 J	0.5	Refs. 4, pp. 119, 313, 350; 35, p. 22; 36, p.1; 62, p. 6; 84, p. 29; 70, p. 12; 61, pp. 192, 226, 263
E2T18	05/21/14	WR 7	77 ft/SG	Cis1,2-DCE TCE	0.24 J 0.28 J	0.5	Refs. 4, pp. 119, 313, 340; 35, p. 20; 36, p.1; 62, p. 6; 84, p. 25; 70, p. 12; 61, pp. 191, 226, 253

LS-----Limestone
SG-----Sand and Gravel
CRQL – Contract Required Quantitation Limit
U – The flag indicates the compound was analyzed for but not detected. The Contract Required Quantitation Limit (CRQL), or reporting limit, will be adjusted to reflect any dilution and, for soils, the percent moisture (Ref. 4, pp. 192, 321).
J – This flag indicates an estimated value. The flag is used as detailed below … When the mass spectral and retention time data indicate the presence of a compound that meets the volatile and semi-volatile GC/MS identification criteria, and the result is less than the adjusted CRQL (or Reporting Limit) but greater than zero (Ref. 4, pp. 192, 321). The J-flagged results required no adjustment per the procedure described in EPA 520-F-94-028, Using Qualified Data to Document an Observed Release and Observed Contamination, November 1996 (Ref. 101, pp. 1-18).
cis-1,2 - Dichloroethene---(Cis-1,2-DCE)
trichloroethene---(TCE)
vinyl chloride---(VC)

- Contaminated Samples:

On May 20 and 21, 2014, IDEM's Site Investigation Program conducted SI activities at the Riverside Ground Water Contamination site (Ref. 4, pp. 1, 19). The ground water obtained from some municipal wells within the Riverside and White River Well Fields were found to be contaminated with chlorinated VOCs (see Sections 3.1.1 and 3.3.2.2 of this HRS documentation record).

The extent of the ground water plume is depicted by samples from municipal wells meeting observed release criteria (see Figure 1-2 of this HRS documentation record). The extent of this plume has not been completely delineated at this time but has been characterized by municipal wells data (see Section 3.1.1 of this HRS documentation record and Figure 1-2 of this HRS documentation record).

The plume currently measures approximately 53.09 acres (see Figure 1-2 of this HRS documentation record). The area of the ground water plume is based on available samples that meet the criteria for an observed release (see Section 3.1.1 of this HRS documentation record). The plume boundary was digitized by connecting wells that met observed release criteria (see Figure 1-2 of this HRS documentation record). Background wells were identified outside the boundaries of the plume (see section 3.1.1 of this HRS documentation record; Figure 1-2 of this HRS documentation record).

The following set of tables depicts the samples that meet the observed release criteria (Ref. 1, Table 2-3, p. 63). These tables list the organic hazardous substances with their concentrations and CRQLs for each sample. These samples were qualified as "releases" based on the criteria in the HRS (Ref. 1, Section 2.3, Table 2-3, p. 63). The well locations are depicted on Figure 1-2 of this HRS documentation record.

Table 2
Contaminated Ground Water from Public Wells Sample Table

EPA CLP#	Date	Location	Depth Below Ground Surface/ Aquifer matrix	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T00	05/20/14	RS 26	285 ft./LS	Cis-1,2- DCE	0.62	0.5	Refs. 4, pp. 182, 207; 35, p. 2; 36, p.1; 62, p. 5; 61, pp. 94, 119
E2T02	05/20/14	RS 29	290 ft./LS	Vinyl Chloride Cis-1,2-DCE	0.75 16	0.5 0.5	Refs. 4, pp. 182, 213; 35, p. 4; 36, p.1; 62, p. 5; 61, pp. 94, 125
E2T03	05/20/14	RS 29	290 ft./LS	Vinyl Chloride	0.97	0.5	Refs. 4, p. 182, 216; 35, p. 5; 36, p.1; 62, p. 5; 61, pp. 94, 128
E2T03 DL	05/20/14	RS 29	290 ft/LS	Cis-1,2-DCE	15 D	1.3	Refs. 4, p. 182, 219; 35, p. 5; 36, p.1; 62, p. 5; 61, pp. 94, 131
E2T04	05/20/14	RS 8	268 ft./LS	Cis-1,2-DCE	5.5	0.5	Refs. 4, pp. 182, 222; 35, p. 6; 36, p.1; 62, p. 5; 61, pp. 94, 134
E2T16	05/21/14	WR 3	70 ft./SG	Cis-1,2-DCE TCE	1.6 4.9	0.5 0.5 0.5	Refs. 4, pp. 119, 313, 334; 35, p. 18; 36, p.1; 62, p. 5; 61, pp. 226, 247
E2T17	05/21/14	WR 3	70 ft./SG	Cis-1,2-DCE TCE	1.8 4.8	0.5 0.5 0.5 0.5	Refs. 4, pp. 119, 313, 337; 35, p. 19; 36, p.1; 62, p. 5; 61, pp.

EPA CLP#	Date	Location	Depth Below Ground Surface/ Aquifer matrix	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
							226, 250
E2T19	05/21/14	WR 8	77 ft./SG	Cis-1,2-DCE	0.88	0.5	Refs. 4, pp. 119, 313, 347; 35, p. 21; 36, p.1; 62, p. 6; 84, p. 27; 61, pp. 226, 260

LS-----Limestone
SG-----Sand and Gravel
CRQL – Contract Required Quantitation Limit
D- Concentration of cis-1,2-DCE in sample E2T03 exceeded the instruments calibration range. Sample E2T03 was reanalyzed using dilution factor, and the result and CRQL for cis-1,2-DCE are reported from the diluted analysis E2T03 DL (Ref. 4, p. 184).

Table 3
Level I Sample Table

EPA CLP#	Municipal Well ID	Hazardous Substance	Hazardous Substance Concentration	Benchmark Concentration µg/L	Benchmark	Reference
E2T02	RS 29	VC	0.75	$1.7x10^{-2}$	Cancer Risk	Ref. 2, p. 10; Table 2 of this documentation record
E2T03	RS 29	VC	0.97	$1.7x10^{-2}$	Cancer Risk	Ref. 2, p. 10; Table 2 of this documentation record
E2T16	WR 3	TCE	4.9	1.0	Cancer Risk	Ref. 2, p. 8; Table 2 of this documentation record
E2T17	WR 3	TCE	4.8	1.0	Cancer Risk	Ref. 2, p. 8; Table 2 of this documentation record

As specified in the HRS Rule (Ref. 1, Section 3.1.1. p. 69), an observed release factor value of 550 was assigned to the Riverside Ground Water Contamination since an observed release by chemical analysis was established to the aquifer.

Ground Water Observed Release Factor Value: 550

Attribution:

The Riverside Ground Water Contamination site is a documented release of TCE, cis-1,2-DCE, and VC to the ground water that has contaminated five active municipal wells (see section 3.1.1, Table 2, of this HRS documentation record).

The compounds found in the wells are manufactured chemicals, not thought to occur naturally, and non-detected concentrations in some background wells show that they are not ubiquitous throughout the region (Ref. 82, p. 1; 81, p. 1; see section 3.1.1, Table 1, Background Ground Water Sample Table of this HRS documentation record). Chlorinated solvents (e.g., TCE) are man-made compounds commonly used in commercial/industrial operations such as dry cleaning and metal degreasing, while other contaminants such as cis-1,2-DCE are common breakdown products of PCE and TCE (Ref. 80, pp. 1-5; 81, p. 1; 82, p. 1). The Riverside Ground Water Contamination site is located in a heavily developed area consisting of industrial, commercial, and residential land, where a variety of past industrial and commercial activities could have resulted in the ground water contamination and where some contaminated properties have been identified (Ref. 4, pp. 54-63; see Figure 1-4 of this HRS documentation record). IDEM has made significant efforts to identify the specific source(s) of ground water contamination through CERCLA SI investigation and by conducting an extensive search of IDEM records.

During the Site Inspection activities, staff conducted an extensive level of effort by searching IDEM, county, and EPA records to identify possible sources of ground water contamination. See Reference 105 for more information on this search (Refs. 4, pp. 375-385; 6-30, 32-33, 37-60, 65-67, 74-78, 86-90, 98-100, 102-104).

Figure 1-4 of this HRS documentation record shows the location of facilities identified during the search.

For several years, the State Cleanup Program of IDEM has been compiling a list of former dry cleaners and laundries in the Indianapolis and other metro areas because a release of PCE to the ground water pathway is possible from these former dry cleaning facilities. PCE is utilized in the dry cleaning process. This list is based on historical records, including Sanborn maps, Polk, Criss Cross, and other available historical resources (Ref. 34, p.1). Polk directory is a city directory. Unlike a city directory which lists residents by name, the Haines Directory (Criss Cross) lists by address or phone number because it is a mechanical reversal of the information in the phone book (Ref. 63, p. 1). Due to the volume of information required to complete this list, the list is still in a draft format and will be for the foreseeable future (Ref. 34. p. 1). Figure 1-4 of this HRS documentation record is a map that depicts the location of these former dry cleaners (along with current dry cleaners) that have been compiled at this time that lie within the wellhead protection area of the Riverside and White River municipal wells. The figure depicts 167 former and current dry cleaners. No information is currently available regarding the history and any possible releases that may have occurred from the former drycleaners. Note: The table in Reference 105 does not contain information regarding these former dry cleaner facilities.

Hazardous Substances Released (Section 3.1.1 of this HRS Documentation Record)

- TCE
- cis-1,2-DCE
- VC

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

The following table, Toxicity/Mobility Table, depicts the toxicity, mobility and combined toxicity/mobility factor values that have been assigned to those substances present in the observed release and have a containment value greater than 0.

Toxicity/Mobility Table

Hazardous Substance	Source No. (and/or Observed Release)	Toxicity Factor Value	Mobility Factor Value*	Does Hazardous Substance meet Observed Release by chemical analysis? (Y/N)	Toxicity/ Mobility (Ref. 1, Table 3-9)	References
cis-1,2-DCE	Observed Release	1,000	1	Y	1,000	Ref. 2, p. 4
TCE	Observed Release	1,000	1	Y	1,000	Ref. 2, p. 8
VC	Observed Release	10,000	1	Y	10,000	Ref. 2, p. 10

*All hazardous substances that meet the criteria for an observed release by chemical analysis to one or more aquifers, regardless of the aquifer being evaluated, are assigned a mobility factor value of 1 (Ref. 1, Section 3.2.1.2, p. 75).

The hazardous substance with the highest toxicity/mobility factor value available to the ground water migration pathway is vinyl chloride (10,000).

Toxicity/Mobility Factor Value: 10,000
(Ref. 1, Table 3-9, p. 76)

3.2.2 Hazardous Waste Quantity

Source No.	Source Type	Source Hazardous Waste Quantity
1	Other	Unknown, but >0

The Riverside Ground Water Contamination site has been scored as consisting of a ground water plume with no identified source. According to Section 2.4.2.2 in the HRS (Ref. 1, pp. 65, 66), if any target for that migration pathway is subject to Level I or Level II concentrations and the hazardous constituent quantity is not adequately determined, assign a value from Table 2-6 or a value of 100 whichever is greater, as the hazardous waste quantity factor value for that pathway. Because Level I concentrations were present in a drinking water well (see Section 3.3.2.2 of this HRS documentation record), a hazardous waste quantity factor value of 100 is assigned for the ground water pathway.

Hazardous Waste Quantity Factor Value: 100
(Ref. 1, Table 2-6, pp. 65, 66)

3.2.3 Waste Characteristics Factor Category Value

As specified in the HRS (Ref. 1, Section 3.2.3, p. 76), the Hazardous Waste Quantity Factor Value of 100 was multiplied by the highest Toxicity/Mobility Value of 10,000, resulting in a product of 1,000,000. Based on this product, a Waste Characteristics Factor Category Value of 32 was assigned from Table 2-7 of the HRS (Ref. 1, Section 2.4.3.1, p. 66).

The Toxicity/Mobility Factor Value for vinyl chloride, which has the highest Toxicity/Mobility Factor Value of the substances listed in Section 3.2.1 of this HRS documentation record, is:

Toxicity/Mobility Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 100

Hazardous Waste Quantity Factor Value: 1,000,000

Waste Characteristics Factor Category Value: 32
(Ref. 1, Table 2-7, p. 66)

3.3 GROUND WATER PATHWAY TARGETS

The Riverside and White River Well Fields provide drinking water to 526,036.8 people (Ref. 79, p. 2). Currently, Riverside Wells RS 29 and White River Well WR 3 are subject to Level I contamination. Riverside wells RS 26, RS 8 and White River Well WR 8 are subject to Level II contamination (See Tables 2, 3, and 5 of this HRS documentation record).

The following table, Table 4, Municipal Well Table, lists all active municipal wells within the Riverside and White River Well Fields. The table also lists the depth of the wells, the population apportioned to each well, the type of aquifer water is being obtained, the screen length if applicable, and the water production interval.

Table 4
Municipal Well Table

Riverside Wells	Depth	Population Apportioned	Aquifer	Screen Length (feet)	Water Production Interval/ Screen Interval	References
RS 2	297 feet	4203.531	Limestone	126	99-225 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 2; Figure 1-5
RS 7	196 feet	4045.898	Limestone	NA	?-196 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 12; Figure 1-5
RS 8	268 feet	4203.531	Limestone	198	79-277 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1;70, p. 3; Figure 1-5
RS 9	251 feet	4413.707	Limestone	166	78-244 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 4; Figure 1-5
RS 17	391 feet	3152.648	Limestone	284	86-370 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 5; Figure 1-5
RS 18	400 feet	3467.913	Limestone	314	86-400 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 6; Figure 1-5
RS 19	392 feet	3467.913	Limestone	NA	?-392 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 12; Figure 1-5
RS 22	271 feet	2627.207	Limestone	167	100-267 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 7; Figure 1-5
RS 26	285 feet	3152.648	Limestone	187	80-267 feet	Refs. 62, p.5; 64, p. 4; 79, p. 1-2; 70, p. 12; Figure 1-5
RS 27	416 feet	4466.251	Limestone	318	98-416 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 9; Figure 1-5
RS 29	290 feet	3152.648	Limestone	215	70-285 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 85, p. 1; 70, p. 11; Figure 1-5
RS A	97 feet	2364.486	Sand and Gravel	20	77-97 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 84, pp. 15,

Riverside Wells	Depth	Population Apportioned	Aquifer	Screen Length (feet)	Water Production Interval/ Screen Interval	References
						16; 85, p. 1; Figure 1-5
RS B	80 feet	5254.413	Sand and Gravel	NA	?-80	Refs. 62, p. 5; 64, p. 4; 79, p. 1-2; Figure 1-5
RS C	84 feet	7618.899	Sand and Gravel	NA	?-84	Refs. 62, p. 5; 64, p. 4; 79, p. 1-2; Figure 1-5
RS D	74 feet	5254.413	Sand and Gravel	NA	?-74	Refs. 62, p. 5; 64, p. 4; 79, p. 1-2; Figure 1-5
WR 3	70 feet	7146.002	Sand & Gravel	35	35-70 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 5; 84, p. 21; 85, p. 1; 70, p. 13; Figure 1-5
WR 7	77 feet	3678.089	Sand & Gravel	20	57-77 feet	Refs. 64, p. 4; 79, p. 1-2; 62, p. 6; 84, p. 25; 85, p. 1; 70, p. 13; Figure 1-5
WR 8	77 feet	10508.83	Sand & Gravel	20	57-77 feet	Refs. 79, p. 1-2; 62, p. 6; 84, p. 27; 85, p. 1; 70, pp. 12, 13; Figure 1-5
WR 9	79.5 feet	7356.178	Sand & Gravel	20	59.5-79-5 feet	Refs. 79, p. 1-2; 62, p. 6; 84, pp. 29, 30; 85, p. 1; 70, pp. 12, 13; Figure 1-5

NA = Not Available

3.3.1 Nearest Well

Well ID: E2T02 (Riverside Municipal Well RS 29)
Level of Contamination (I, II, or potential): I
If potential contamination, distance from source in miles: N/A

Well ID: E2T03 (Duplicate of Riverside Municipal Well RS 29)
Level of Contamination (I, II, or potential): I
If potential contamination, distance from source in miles: N/A

Well ID: E2T16 (White River Municipal WR 3)
Level of Contamination (I, II, or potential): I
If potential contamination, distance from source in miles: N/A

As specified in the HRS (Ref. 1, Section 3.3.1, Table 3-11, pp. 76, 77), if one or more drinking water wells are subject to Level I concentrations, a Nearest Well Factor Value of 50 is assigned. Level I vinyl chloride concentrations have been documented in the ground water of well RS 29, and Level I trichloroethylene concentrations have been documented in the ground water of WR 3 (see Section 3.3.2.2 of this HRS documentation record).

Nearest Well Factor Value: 50
(Ref. 1, Table 3-11)

3.3.2 Population

3.3.2.1 Level of Contamination

3.3.2.2 Level I Concentrations

The concentrations of vinyl chloride in Riverside Municipal Well RS 29 and the concentrations of TCE in White River Municipal Well WR 3 are above the cancer risk screening concentration health based benchmarks for vinyl chloride and TCE in drinking water, which are 1.7 10^{-2} µg/L and 1 µg/L, respectively. As such, populations that use wells RS 29 and WR 3 are subject to Level I hazardous substance concentrations. The table below, Table 5, depicts those municipal wells that are subject to Level I contamination. The EPA CLP #, date sample was collected, the hazardous substance detected, along with other information is presented in the table.

Table 5
Level I Contaminated Ground Water from Public Wells Sample Table

EPA CLP#	Date	Location	Depth Below Ground Surface	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T02	05/20/14	RS 29	290 ft.	Vinyl Chloride	0.75	0.5	Refs. 4, pp. 182, 213; 35, p. 4; 36, p.1; 62, p. 5; Table 3 of this documentation record
E2T03	05/20/14	RS29	290 ft./LS	Vinyl Chloride	0.97	0.5	Refs. 4, p. 182, 216; 35, p. 5; 36, p.1; 62, p. 5; Table 3 of this documentation record
E2T16	05/21/14	WR 3	70 ft.	TCE	4.9	0.5	Refs. 4, pp. 119, 313, 334; 35, p. 18; 36, p.1; 62, p. 5; see Table 3 of this documentation record
E2T17	05/21/14	WR 3	70 ft.	TCE	4.8	0.5	Refs. 4, pp. 119, 313, 337; 35, p. 19;

EPA CLP#	Date	Location	Depth Below Ground Surface	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
							36, p.1; 62, p. 5; see Table 3 of this documentation record

Ground water from the White River and Riverside wells is pumped to the White River treatment plant where it blends with raw surface water, then passes through the entire surface water treatment process prior to distribution to customers. There is no dedicated population that is directly served by only water from these wellfields (Ref. 68, p.1).

According the municipal well company, Citizens Energy Group, there is no dedicated population that is directly served by only water from these well fields because the municipal well company does not have a ground water treatment plant at White River- the ground water from the productions wells is treated at the surface water plant. In general, the White River treatment plant provides approximately 60% of the source of supply to the customers of Citizens Water (Ref. 72, p. 1). Of the total water that goes into the White River Treatment plant, then on average, 80% is surface water and 20% is ground water (Ref. 72, p. 1).

The Riverside and White River wells draw water from the sand and gravel (unconsolidated) and bedrock aquifer systems that act as a single hydrologic unit (Ref. 4, p. 375; 62, p. 5, 6). Riverside Well RS 29 and White River Well WR 3 are subject to Level I contamination (see Table 3 and Table 5 of this documentation record).

The following information was used to determine the population served by the Riverside and White River wells:

There are 876,728 people served by Citizens Energy Group (Ref. 68, p. 1; 83, p. 2). 60% of the population (526,036.8) is served by the Riverside and White River Well Fields and the surface water intake (Ref. 68, p.1; 79, p. 1). (60% of 876,728 is 526,036.8 people). Then the well capacity (in gallons per minute) for each well in the Riverside and White River well fields and the surface water intake was obtained (Ref. 79, p. 2; 73, pp. 1, 2; 91, p. 1). The total gallons pumped per minute for all of the Riverside and White River municipal wells and the surface water intake combined was found to be 100,113.33 (Ref. 79, p. 2).

The following example depicts how the population was calculated for each well.

For Well RS 29

600 (capacity of RS 29 in GPM) divided by 100,113.33 (total gallons pumped per minute for all wells) times 526,036.8 (60% of population served) equals 3,152.64790 (rounded to 3,152.648 (Refer also to Reference 79, page 2 which shows the population served for all Riverside and White River Wells using this calculation example).

Therefore, population served by Level I concentrations is 3,152.648 people for Riverside Well for RS 29 and 7,146.002 people for White River Well WR 3 (Ref. 79, p. 2; see Table 5 of this HRS documentation record) 3152.648 + 7146.002 = 10,298.65 people

- Sum of Population Served by Level I Well x 10: 10,298.65 x 10 = 102,986.5 (Ref. 1, Section 3.3.2.2, p. 77)

Level I Concentrations Factor Value: 102,986.5

3.3.2.3 Level II Concentrations

There are three municipal wells in which observed releases are established and are subject to Level II contamination. The three municipal wells are RS 26, RS 8, and WR 8. The table below, Table 6, depicts those municipal well that are subject to Level II contamination. The EPA CLP #, date sample was collected, the hazardous substance detected, along with other information is presented in the table.

Table 6
Level II Contaminated Ground Water from Public Wells Sample Table

EPA CLP#	Date	Location	Depth Below Ground Surface	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T00	05/20/14	RS 26	285 ft.	Cis-1,2- DCE	0.62	0.5	Refs. 4, pp. 182, 207; 35, p. 2; 36, p.1; 62, p. 5
E2T04	05/20/14	RS 8	268 ft.	Cis-1,2-DCE	5.5	0.5	Refs. 4, pp. 182, 222; 35, p. 6; 36, p.1; 62, p. 5
E2T19	05/21/14	WR 8	77 ft.	Cis-1,2-DCE	0.88	0.5	Refs. 4, pp. 119, 313, 347; 35, p. 21; 36, p.1; 62, p. 6

The calculations for the number of people served for municipal wells RS 26, RS 8 and WR 8 were calculated in the exact same manner as described for the Level I wells discussed in Section 3.3.2.2 of this documentation record (Ref. 79, p. 2; see Section 3.3.2.2 of this documentation record). Note that Reference 79 depicts the population served for each Riverside/White River well using the method of calculation discussed in Section 3.3.2.2 of this documentation record.

- Population Served by Level II concentrations is 3,152.648 people for Riverside Well RS 26, 4,203.531 people for Riverside Well RS 8, and 10,508.83 people for White River Well WR 8 people (Ref. 79, p. 2).

- Sum of Population Served by Level II Well x 1:

  3,152.648 + 4,203.531 + 10,508.83 = 17,865.009
- 17,865.009 X 1 = 17,865.009 (Ref. 1, Section 3.3.2.3, p. 77).

Level II Concentrations Factor Value: 17,865.009

3.3.2.4 Potential Contamination

The potential contamination was not scored because targets subject to actual contamination at Level I and Level II concentrations are sufficient to achieve the maximum pathway score for this site.

Potential Contamination Factor Value: Not Scored

3.3.3 Resource

Resource use of the combined aquifers within the target distance limit does not include any documented Resource Factors. Therefore, a Resource Factor value of 0 is assigned (Ref. 1, Section 3.3.3, p. 78).

Resources Factor Value: 0

3.3.4 Wellhead Protection Area

The ground water plume lies within the Riverside Wellhead Protection Area (Refs. 31, p. 1; 60, p. 65; Figure 1-5). Wellhead Protection Areas are designated by the U.S. EPA in accordance with Section 1428 of the Safe Drinking Water Act (Ref. 31, p. 1; 60, p. 1). Therefore, the Wellhead Protection Area Factor Value of 20 is assigned (Ref. 1, Section 3.3.4, p. 78).

Wellhead Protection Area Factor Value: 20

Attachment 1
HRS Scoring and Target Information Showing That Riverside Wellfield Contaminated Municipal Wells RS29, RS 26 and RS 8 Will Score above 28.50 independently from Municipal Wells WR 8 and WR 3

WORKSHEET FOR COMPUTING HRS SITE SCORE
Riverside Wellfield

		S / 100	S^2 / 10000
1.	**Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)**		
2a.	**Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)**	**NS***	
2b.	**Ground Water to Surface Water Migration Component (from Table 4-25, line 28)**	**NS**	
2c.	**Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.**	**NS**	
3.	**Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)**	**NS**	
4.	**Air Migration Pathway Score (S_a) (from Table 6-1, line 12)**	**NS**	
5.	**Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$**		**10,000**
6.	**HRS Site Score Divide the value on line 5 by 4 and take the square root**	**50.00**	

Notes: *NS = Not Scored

HRS Table 3-1 –Ground Water Migration Pathway Scoresheet (For Riverside Well Field wells RS 8, RS 29 and RS 26)

Factor Categories and Factors	**Maximum Value**	**Value Assigned**
Likelihood of Release to an Aquifer:		
1. Observed Release	550	550
2. Potential to Release:		
2a. Containment	10	NS
2b. Net Precipitation	10	NS
2c. Depth to Aquifer	5	NS
2d. Travel Time	35	NS
2e. Potential to Release [lines 2a x (2b + 2c + 2d)]	500	NS
3. Likelihood of Release (higher of lines 1 and 2e)	550	550
Waste Characteristics:		
4. Toxicity/Mobility	(a)	10,000
5. Hazardous Waste Quantity	(a)	100
6. Waste Characteristics	100	32
Targets:		
7. Nearest Well	50	50
8. Population:		
8a. Level I Concentrations	(b)	31,526.48
8b. Level II Concentrations	(b)	7,356.179
8c. Potential Contamination	(b)	NS
8d. Population (lines 8a + 8b + 8c)	(b)	38,882.659
9. Resources	5	NS
10. Wellhead Protection Area	20	20
11. Targets (lines 7 + 8d + 9 + 10)	(b)	38,952.659
Ground Water Migration Score For An Aquifer:		
12. Aquifer Score [(lines 3 x 6 x 11)/82,500][c] 550 x 32 x 38,952.65 = 685,566,640 /82,500 = 8,309.89867	100	100.00
Ground Water Migration Pathway Score:		
14. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100	100.00

(a) Maximum value applies to waste characteristics category
(b) Maximum value not applicable
[c] Do not round to nearest integer
NS - Not Scored

Scores for RS 8, RS 26, and RS 29

Air Pathway	Not Scored
Ground Water Pathway	100.00
Soil Exposure Pathway	Not Scored
Surface Water Pathway	Not Scored
HRS SITE SCORE	**50.00**

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

Concentrations of vinyl chloride and cis-1,2-DCE are documented in Riverside Wells RS 26, RS 29 and RS 8 at levels significantly above background levels as documented in the table below (Ref. 1, Table 2-3, p. 63).

EPA CLP#	Date	Location	Depth Below Ground Surface/ Aquifer matrix	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
Background Samples							
E2T07	05/20/14	RS 19	392 ft./LS	Cis1,2-DCE VC	0.5 U 0.5 U	0.5	Refs. 4, pp. 182, 231, 232; 35, p. 9; 36, p.1; 62, p. 5
E2T08	05/20/14	RS 18	400 ft./LS	Cis1,2-DCE VC	0.5 U 0.5 U	0.5	Refs. 4, pp. 182, 240, 241; 35, p. 10; 36, p.1; 62, p. 5
Contaminated Samples							
E2T00	05/20/14	RS 26	285 ft./LS	Cis-1,2- DCE	0.62	0.5	Refs. 4, pp. 182, 207; 35, p. 2; 36, p.1; 62, p. 5
E2T02	05/20/14	RS 29	290 ft./LS	Vinyl Chloride Cis-1,2-DCE	0.75 16	0.5 0.5	Refs. 4, pp. 182, 213; 35, p. 4; 36, p.1; 62, p. 5
E2T03	05/20/14	RS 29	290 ft./LS	Vinyl Chloride	0.97	0.5	Refs. 4, p. 182, 216; 35, p. 5; 36, p.1; 62, p. 5
E2T03 DL	05/20/14	RS 29	290 ft/LS	Cis-1,2-DCE	15 D	1.3	Refs. 4, p. 182, 219; 35, p. 5; 36, p.1; 62, p. 5

EPA CLP#	Date	Location	Depth Below Ground Surface/ Aquifer matrix	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T04	05/20/14	RS 8	268 ft./LS	Cis-1,2-DCE	5.5	0.5	Refs. 4, pp. 182, 222; 35, p. 6; 36, p.1; 62, p. 5

LS-----Limestone
SG-----Sand and Gravel
CRQL – Contract Required Quantitation Limit
U - The flag indicates the compound was analyzed for but not detected. The Contract Required Quantitation Limit (CRQL), or reporting limit, will be adjusted to reflect any dilution, and, for soils, the percent moisture. (Ref. 4, pp. 192, 321)
D- Concentration of cis-1,2-DCE in sample E2T03 exceeded the instruments calibration range. Sample E2T03 was reanalyzed using dilution factor, and the result and CRQL for cis-1,2-DCE are reported from the diluted analysis E2T03 DL (Ref. 4, p. 184).

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

The following table, Toxicity/Mobility Table, depicts the toxicity, mobility and combined toxicity/mobility factor values that have been assigned to those substances present in the observed release and have a containment value greater than 0.

Toxicity/Mobility Table

Hazardous Substance	Source No. (and/or Observed Release)	Toxicity Factor Value	Mobility Factor Value*	Does Hazardous Substance meet Observed Release by chemical analysis? (Y/N)	Toxicity/ Mobility (Ref. 1, Table 3-9)	References
cis-1,2-DCE	Observed Release	1,000	1	Y	1,000	Ref. 2, p. 4
TCE	Observed Release	1,000	1	Y	1,000	Ref. 2, p. 8
VC	Observed Release	10,000	1	Y	10,000	Ref. 2, p. 10

*All hazardous substances that meet the criteria for an observed release by chemical analysis to one or more aquifers, regardless of the aquifer being evaluated, are assigned a mobility factor value of 1 (Ref. 1, Section 3.2.1.2, p. 75).

The hazardous substance with the highest toxicity/mobility factor value available to the ground water migration pathway is vinyl chloride (10,000).

Toxicity/Mobility Factor Value: 10,000
(Ref. 1, Table 3-9, p. 76)

3.2.2 Hazardous Waste Quantity

Source No.	Source Type	Source Hazardous Waste Quantity
1	Other	Unknown, but >0

The Riverside Ground Water Contamination site has been scored as consisting of a ground water plume with no identified source. According to Section 2.4.2.2 in the HRS (Ref. 1, p. 65, 66), if any target for that migration pathway is subject to Level I or Level II concentrations and the hazardous constituent quantity is not adequately determined, assign a value from Table 2-6 or a value of 100 whichever is greater, as the hazardous waste quantity factor value for that pathway. Because Level I concentrations were present in a drinking water well (see Section 3.3.2.2 of this HRS documentation record), a hazardous waste quantity factor value of 100 is assigned for the ground water pathway.

Hazardous Waste Quantity Factor Value: 100
(Ref. 1, Table 2-6, p. 66)

3.2.3 Waste Characteristics Factor Category Value

As specified in the HRS (Ref. 1, Section 3.2.3, p. 76), the Hazardous Waste Quantity Factor Value of 100 was multiplied by the highest Toxicity/Mobility Value of 10,000, resulting in a product of 1,000,000. Based on this product, a Waste Characteristics Factor Category Value of 32 was assigned from Table 2-7 of the HRS (Ref. 1, Section 2.4.3.1, p. 66).

The Toxicity/Mobility Factor Value for vinyl chloride, which has the highest Toxicity/Mobility Factor Value of the substances listed in Section 3.2.1 of this HRS documentation record, is:

Toxicity/Mobility Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 100

Hazardous Waste Quantity Factor Value: 1,000,000

Waste Characteristics Factor Category Value: 32
(Ref. 1, Table 2-7, p. 66)

3.3 GROUND WATER PATHWAY TARGETS

The Riverside and White River Well Fields provide drinking water to 526,036.8 people (Ref. 79, p. 2). Currently, Riverside Well RS 29 is subject to Level I contamination. Riverside wells RS 26 and RS 8 are subject to Level II contamination (see Tables 2 and 3 of this HRS documentation record).

See Table 4 of this HRS documentation record, Municipal Well Table, for all active municipal wells within the Riverside and White River Well Fields. The table also lists the depth of the wells, the population apportioned to each well, the type of aquifer water is being obtained, the screen length if applicable, and the water production interval.

3.3.1 Nearest Well

Well ID: E2T02 (Riverside Municipal Well RS 29)
Level of Contamination (I, II, or potential): I
If potential contamination, distance from source in miles: N/A

Well ID: E2T03 (Duplicate of Riverside Municipal Well RS 29)
Level of Contamination (I, II, or potential): I
If potential contamination, distance from source in miles: N/A

As specified in the HRS (Ref. 1, Section 3.3.1, Table 3-11, pp. 76, 77), if one or more drinking water wells are subject to Level I concentrations, a Nearest Well Factor Value of 50 is assigned. Level I vinyl chloride concentrations have been documented in the ground water of well RS 29 (see section 3.3.2.2 of this HRS documentation record).

Nearest Well Factor Value: 50
(Ref. 1, Table 3-11)

3.3.2 Population

3.3.2.1 Level of Contamination

3.3.2.2 Level I Concentrations

The concentrations of vinyl chloride in well RS 29 are above the cancer risk screening concentration health based benchmark for vinyl chloride in drinking water, which is 1.7 10^{-2} µg/L. As such, populations that use well RS 29 are subject to Level I hazardous substance concentrations. The table below depicts the municipal well that is subject to Level I contamination. The EPA CLP #, date sample was collected, the hazardous substance detected, along with other information is presented in the table.

Level I Contaminated Ground Water from Public Wells Sample Table

EPA CLP#	Date	Location	Depth Below Ground Surface	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T02	05/20/14	RS 29	290 ft.	Vinyl Chloride	0.75	0.5	Refs. 4, pp. 182, 213; 35, p. 4; 36, p.1; 62, p. 5; Table 3 of this documentation record
E2T03	05/20/14	RS 29	290 ft./LS	Vinyl Chloride	0.97	0.5	Refs. 4, p. 182, 216; 35, p. 5; 36, p.1; 62, p. 5; Table 3 of this documentation record

Ground water from the White River and Riverside wells is pumped to the White River treatment plant where it blends with raw surface water. Then it passes through the entire surface water treatment process prior to distribution to customers. There is no dedicated population that is directly served by only water from these wellfields (Ref. 68, p.1).

According the municipal well company, Citizens Energy Group, there is no dedicated population that is directly served by only water from these well fields because the municipal well company does not have a ground water treatment plant at White River- the ground water from the productions wells is treated at the surface water plant. In general, the White River treatment plant provides approximately 60% of the source of supply to the customers of Citizens Water (Ref. 72, p. 1). Of the total water that goes into the White River Treatment plant, then on average, 80% is surface water and 20% is ground water (Ref. 72, p. 1).

The Riverside wells draw water from the sand and gravel (unconsolidated) and bedrock aquifer systems that act as a single aquifer system (Ref. 4, p. 375; 62, p. 3). Riverside Well RS 29 is subject to Level I contamination (see Table 3 and Table 5 of this documentation record).

The following information was used to determine the population served by the Riverside wells:
There are 876,728 people served by Citizens Energy Group (Ref. 68, p. 1; 83, p. 2). 60% of the population (526,036.8) is served by the Riverside and White River Well Fields and the surface water intake (Ref. 68, p.1; 79, p. 1). (60% of 876,728 is 526,036.8 people). Then the well capacity (in gallons per minute) for each well in the Riverside and White River well fields and the surface water intake was obtained (Ref. 79, p. 2; 73, pp. 1, 2, 91, p. 1). The total gallons pumped per minute for all of the Riverside and White River municipal wells and the surface water intake was found to be 100,113.33 (Ref. 79, p. 2).

The following example depicts how the population was calculated for each well.

For Well RS 29
600 (capacity of RS 29 in GPM) divided by 100,113.33 (total gallons pumped per minute for all wells) times 526,036.8 (60% of population served) equals 3,152.64790 (rounded to 3,152.648) (Refer also to Reference 79, page 2 which shows the population served for all Riverside and White River Wells using this calculation example).

Therefore, population served by Level I concentrations is 3,152.648 people for Riverside Well for RS 29 (Ref. 79, p. 2; see Table 5 of this HRS documentation record).

- Sum of Population Served by Level I Well (RS 29) x 10: 3,152.648 x 10 = 31,526.48 (Ref. 1, Section 3.3.2.2., p. 77).

Level I Concentrations Factor Value: 31,526.48

3.3.2.3 Level II Concentrations

There are two municipal wells in which observed releases are established that are subject to Level II contamination. The two municipal wells are RS 26 and RS 8. The table below depicts those municipal well that are subject to Level II contamination. The EPA CLP #, date sample was collected, the hazardous substance detected, along with other information is presented in the table.

Level II Contaminated Ground Water from Public Wells Sample Table

EPA CLP#	Date	Location	Depth Below Ground Surface	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T00	05/20/14	RS 26	285 ft.	Cis-1,2- DCE	0.62	0.5	Refs. 4, pp. 182, 207; 35, p. 2; 36, p.1; 62, p. 5
E2T04	05/20/14	RS 8	268 ft.	Cis-1,2-DCE	5.5	0.5	Refs. 4, pp. 182, 222; 35, p. 6; 36, p.1; 62, p. 5

The calculations for the number of people served for municipal wells RS 26 and RS 8 were calculated in the exact same manner as described for the Level I wells discussed in Section 3.3.2.2 of this documentation record (Refs. 79, p.2; see section 3.3.2.2 of this documentation record). Note that Reference 79 depicts the population served for each Riverside/White River well using the method of calculation discussed in Section 3.3.2.2 of this documentation record.

- Population Served by Level II concentrations is 3,152.648 people for Riverside Well RS 26 and 4,203.531 people for Riverside Well RS 8 (Ref. 79, p. 2; see Table 6 of this HRS documentation record).

- Sum of Population Served by Level II Well x 1:

  3,152.648 + 4,203.531 = 7356.179 (Ref. 1, Section 3.3.2.3, p. 77).

Level II Concentrations Factor Value: 7,356.179

3.3.2.4 Potential Contamination

The potential contamination was not scored because targets subject to actual contamination at Level I and Level II concentrations are sufficient to achieve the maximum pathway score for this site

Potential Contamination Factor Value: Not Scored

3.3.3 Resource

Resource use of the combined aquifers within the target distance limit does not include any documented Resource Factors. Therefore, a Resource Factor value of 0 is assigned (Ref. 1, Section 3.3.3, p. 78).

Resources Factor Value: 0

3.3.4 Wellhead Protection Area

The ground water plume lies within the Riverside Wellhead Protection Area (Refs. 31, p. 1; 60, p. 65; Figure 1-5). Wellhead Protection Areas are designated by the U.S. EPA in accordance with Section 1428 of the Safe Drinking Water Act (Ref. 31, p. 1; 60, p. 1). Therefore, the Wellhead Protection Area Factor Value of 20 is assigned (Ref. 1, Section 3.3.4, p. 78).

Wellhead Protection Area Factor Value: 20

Attachment 2

HRS Scoring and Target Information Showing That Contaminated White River Municipal Wells WR 8 and WR 3 Will score greater than 28.50 independently from RS 29, RS 8 and RS 26

WORKSHEET FOR COMPUTING HRS SITE SCORE
White River Wellfield

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw})	100	10,000
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	NS*	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	NS	
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	NS	
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	NS	
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10,000
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root		50.00

Notes: *NS = Not Scored

HRS Table 3-1 –Ground Water Migration Pathway Scoresheet (For White River Wellfield Municipal Wells WR 3 and WR 8)

Factor Categories and Factors	Maximum Value	Value Assigned
Likelihood of Release to an Aquifer:		
1. Observed Release	550	550
2. Potential to Release:		
2a. Containment	10	NS
2b. Net Precipitation	10	NS
2c. Depth to Aquifer	5	NS
2d. Travel Time	35	NS
2e. Potential to Release [lines 2a x (2b + 2c + 2d)]	500	NS
4. Likelihood of Release (higher of lines 1 and 2e)	550	550
Waste Characteristics:		
4. Toxicity/Mobility	(a)	10,000
5. Hazardous Waste Quantity	(a)	100
6. Waste Characteristics	100	18
Targets:		
7. Nearest Well	50	50
8. Population:		
8a. Level I Concentrations	(b)	71,460.02
8b. Level II Concentrations	(b)	10,508.83
8c. Potential Contamination	(b)	NS
8d. Population (lines 8a + 8b + 8c)	(b)	81,968.85
9. Resources	5	NS
10. Wellhead Protection Area	20	20
11. Targets (lines 7 + 8d + 9 + 10)	(b)	82,038.85
Ground Water Migration Score For An Aquifer:		
12. Aquifer Score [(lines 3 x 6 x 11)/82,500][c] 550 x 18 x 82,038.85 =812,184,615/82,500 =9,844.662	100	100.00
Ground Water Migration Pathway Score:		
15. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100	100.00

(a) Maximum value applies to waste characteristics category
(b) Maximum value not applicable
[c] Do not round to nearest integer
NS - Not Scored

Scores for WR 3 and WR 8

Air Pathway	Not Scored
Ground Water Pathway	100.00
Soil Exposure Pathway	Not Scored
Surface Water Pathway	Not Scored
HRS SITE SCORE	**50.00**

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

Concentrations of cis-1,2-DCE and TCE are documented in White River wells WR 3 and WR 8 at levels significantly above background levels as documented in the table below (Ref. 1, Table 2-3, p. 63).

EPA CLP#	Date	Location	Depth Below Ground Surface/ Aquifer matrix	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
Background Samples							
E2T20	05/21/14	WR 9	79 ft 6 in./SG	Cis-1,2-DCE TCE	0.5U 0.2 J	0.5	Refs. 4, pp. 119, 313, 350; 35, p. 22; 36, p.1; 62, p. 6; 84, p. 29; 70, p. 12
E2T18	05/21/14	WR 7	77 ft/SG	Cis1,2-DCE TCE	0.24 J 0.28 J	0.5	Refs. 4, pp. 119, 313, 340; 35, p. 20; 36, p.1; 62, p. 6;84, p. 25; 70, p. 12
Contaminated Samples							
E2T16	05/21/14	WR 3	70 ft./SG	Cis-1,2-DCE TCE	1.6 4.9	0.5 0.5 0.5	Refs. 4, pp. 119, 313, 334; 35,

EPA CLP#	Date	Location	Depth Below Ground Surface/ Aquifer matrix	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
							p. 18; 36, p.1; 62, p. 5
E2T17	05/21/14	WR 3	70 ft./SG	Cis-1,2-DCE TCE	1.8 4.8	0.5 0.5 0.5 0.5	Refs. 4, pp. 119, 313, 337; 35, p. 19; 36, p.1; 62, p. 5;
E2T19	05/21/14	WR 8	77 ft./SG	Cis-1,2-DCE	0.88	0.5	Refs. 4, pp. 119, 313, 347; 35, p. 21; 36, p.1; 62, p. 6; 84, p. 27

LS-----Limestone
SG-----Sand and Gravel
CRQL – Contract Required Quantitation Limit
U – The flag indicates the compound was analyzed for but not detected. The Contract Required Quantitation Limit (CRQL), or reporting limit, will be adjusted to reflect any dilution and, for soils, the percent moisture (Ref. 4, pp. 192, 321).
J – This flag indicates an estimated value. The flag is used as detailed below … When the mass spectral and retention time data indicate the presence of a compound that meets the volatile and semi-volatile GC/MS identification criteria, and the result is less than the adjusted CRQL (or Reporting Limit) but greater than zero (Ref. 4, pp. 192, 321). The J-flagged results required no adjustment per the procedure described in EPA 520-F-94-028, Using Qualified Data to Document an Observed Release and Observed Contamination, November 1996 (Ref. 101, pp. 1-18).

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

The following table, Toxicity/Mobility Table, depicts the toxicity, mobility and combined toxicity/mobility factor values that have been assigned to those substances present in the observed release and have a containment value greater than 0.

Toxicity/Mobility Table

Hazardous Substance	Source No. (and/or Observed Release)	Toxicity Factor Value	Mobility Factor Value*	Does Hazardous Substance meet Observed Release by chemical analysis? (Y/N)	Toxicity/ Mobility (Ref. 1, Table 3-9)	References
cis-1,2-DCE	Observed Release	1,000	1	Y	1,000	Ref. 2, p. 4
TCE	Observed Release	1,000	1	Y	1,000	Ref. 2, p. 8
VC	Observed Release	10,000	1	Y	10,000	Ref. 2, p. 10

*All hazardous substances that meet the criteria for an observed release by chemical analysis to one or more aquifers, regardless of the aquifer being evaluated, are assigned a mobility factor value of 1 (Ref. 1, Section 3.2.1.2, p. 75).

The hazardous substance with the highest toxicity/mobility factor value available to the ground water migration pathway is vinyl chloride (10,000).

Toxicity/Mobility Factor Value: 10,000
(Ref. 1, Table 3-9, p. 76)

3.2.2 Hazardous Waste Quantity

Source No.	Source Type	Source Hazardous Waste Quantity
1	Other	Unknown, but >0

The Riverside Ground Water Contamination site has been scored as consisting of a ground water plume with no identified source. According to Section 2.4.2.2 in the HRS (Ref. 1, pp. 65, 66), if any target for that migration pathway is subject to Level I or Level II concentrations and the hazardous constituent quantity is not adequately determined, assign a value from Table 2-6 or a value of 100 whichever is greater, as the hazardous waste quantity factor value for that pathway. Because Level I concentrations were present in a drinking water well (see section 3.3.2.2 of this HRS documentation record), a hazardous waste quantity factor value of 100 is assigned for the ground water pathway.

Hazardous Waste Quantity Factor Value: 100
(Ref. 1, Table 2-6, p. 66)

3.2.3 Waste Characteristics Factor Category Value

As specified in the HRS (Ref. 1, Section 3.2.3, p. 76), the Hazardous Waste Quantity Factor Value of 100 was multiplied by the highest Toxicity/Mobility Value of 10,000, resulting in a product of 1,000,000. Based on this product, a Waste Characteristics Factor Category Value of 18 was assigned from Table 2-7 of the HRS (Ref. 1, Section 2.4.3.1, p. 66).

The Toxicity/Mobility Factor Values for trichloroethylene and cis-1,2-DCE, which both have the highest Toxicity/Mobility Factor Value of the substances listed in Section 3.2.1 of this HRS documentation record, are:

Toxicity/Mobility Factor Value: 1,000
Hazardous Waste Quantity Factor Value: 100

Hazardous Waste Quantity Factor Value: 100,000

Waste Characteristics Factor Category Value: 18
(Ref. 1, Table 2-7, pp. 65, 66)

3.3 GROUND WATER PATHWAY TARGETS

The Riverside and White River Well Fields provide drinking water to 526,036.8 people (Ref. 79, p. 2). Currently, White River Municipal Well WR 3 is subject to Level I contamination. White River Well WR 8 is subject to Level II contamination.

See Table 4, Municipal Well Table, for all active municipal wells within the Riverside, White River well fields. The table also lists the depth of the wells, the population apportioned to each well, the type of aquifer water is being obtained, the screen length if applicable, and the water production interval.

3.3.1 Nearest Well

Well ID: E2T16 (White River Municipal WR 3)
Level of Contamination (I, II, or potential): I
If potential contamination, distance from source in miles: N/A

Well ID: E2T17 (Duplicate of White River municipal WR 3)
Level of Contamination (I, II, or potential): I
If potential contamination, distance from source in miles: N/A

As specified in the HRS (Ref. 1, Section 3.3.1, Table 3-11, pp. 76, 77), if one or more drinking water wells are subject to Level I concentrations, a Nearest Well Factor Value of 50 is assigned. Level I trichloroethylene concentrations have been documented in the ground water of well WR 3 (Section 3.3.2.2 of this HRS documentation record).

Nearest Well Factor Value: 50
(Ref. 1, Table 3-11)

3.3.2 Population

3.3.2.1 Level of Contamination

3.3.2.2 Level I Concentrations

The concentrations of TCE in well WR 3 are above the cancer risk screening concentration health based benchmark for TCE in drinking water, which is 1 µg/L. As such, populations that use well WR 3 are subject to Level I hazardous substance concentrations. The table below depicts the municipal well that is subject to Level I contamination. The EPA CLP #, date sample was collected, the hazardous substance detected, along with other information is presented in the table.

Level I Contaminated Ground Water from Public Wells Sample Table

EPA CLP#	Date	Location	Depth Below Ground Surface	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T16	05/21/14	WR 3	70 ft.	TCE	4.9	0.5	Refs. 4, pp. 119, 313, 334; 35, p. 18; 36, p.1; 62, p. 5; see Table 3 of this documentation record
E2T17	05/21/14	WR 3	70 ft.	TCE	4.8	0.5	Refs. 4, pp. 119, 313, 337; 35, p. 19; 36, p.1; 62, p. 5; see Table 3 of this documentation record

Ground water from the White River and Riverside wells is pumped to the White River treatment plant where it blends with raw surface water, then passes through the entire surface water treatment process prior to distribution to customers. There is no dedicated population that is directly served by only water from these well fields (Ref. 68, p.1).

According the municipal well company, Citizens Energy Group, there is no dedicated population that is directly served by only water from these well fields because the municipal well company does not have a ground water treatment plant at White River- the ground water from the productions wells is treated at the surface water plant. In general, the White River treatment plant provides approximately 60% of the source of supply to the customers of Citizens Water (Ref. 72, p. 1). Of the total water that goes into the White River Treatment plant, then on average, 80% is surface water and 20% is ground water (Ref. 72, p. 1).

The Riverside and White River wells draw water from the sand and gravel (unconsolidated) and bedrock aquifer systems that act as a single aquifer system with the outwash aquifer (Ref. 62, p. 5, 6). White River Well WR 3 is subject to Level I contamination (see Table 3 and Table 5 of this documentation record).

The following information was used to determine the population served by the Riverside and White River wells:

There are 876,728 people served by Citizens Energy Group (Ref. 68, p. 1; 83, p. 2). 60% of the population (526,036.8) is served by the Riverside and White River Well Fields and the surface water intake (Ref. 68, p.1; 79, p. 1). (60% of 876,728 is 526,036.8 people). Then the well capacity (in gallons per minute) for each well in the Riverside and White River well fields and the surface water intake was obtained (Ref. 79, p. 2; 73, pp. 1, 2, 91, p. 1). The total gallons pumped per minute for all of the Riverside and White River municipal wells and the surface water intake combined was found to be 100,113.33 (Ref. 79, p. 2).

The following example depicts how the population was calculated for each well.

For Well WR 3
1360 (capacity of WR 3 in GPM) divided by 100,113.33 (total gallons pumped per minute for all wells) times 526,036.8 (60% of population served) equals 7,146.00192 (rounded to 7,146.002) (Refer also to Reference 79, page 2 which shows the population served for all Riverside and White River Wells using this calculation example).

Therefore, population served by Level I concentrations is 7,146.002 people for WR 3 (Ref. 79, p. 2; Table 5 of this HRS documentation record)

- Sum of Population Served by Level I Well (WR 3) x 10: 7,146.002 x 10 = 71,460.02 (Ref. 1, Section 3.3.2.2., p. 77).

Level I Concentrations Factor Value: 71,460.02

3.3.2.3 Level II Concentrations

There is one municipal well in which an observed release is established and is subject to Level II contamination. The municipal well is WR 8. The table below depicts the municipal well that is subject to Level II contamination. The EPA CLP #, date sample was collected, the hazardous substance detected, along with other information is presented in the table.

Level II Contaminated Ground Water from Public Wells Sample

EPA CLP#	Date	Location	Depth Below Ground Surface	Hazardous Substance	Hazardous Substance Concentration µg/L	CRQL µg/L	Reference
E2T19	05/21/14	WR 8	77 ft.	Cis-1,2-DCE	0.88 ug/L	0.5 ug/L	Refs. 4, pp. 119, 313, 347; 35, p. 21; 36, p.1; 62, p. 6

The calculations for the number of people served for municipal well WR 8 was calculated in the exact same manner as described for the Level I wells discussed in Section 3.3.2.2 of this documentation record (Refs. 79, p.2; Section 3.3.2.2 of this documentation record). Note that Reference 79 depicts the population served for each Riverside/White River well using the method of calculation discussed in Section 3.3.2.2 of this documentation record.

- Population Served by Level II concentrations from WR 8 is 10,508.83 (Ref. 79, p. 2; see Table 6 of this HRS documentation record).

- 10,508.83 X 1 = 10,508.83 (Ref. 1, Section 3.3.2.3, p. 77).

Level II Concentrations Factor Value: 10,508.83

3.3.2.4 Potential Contamination

The potential contamination was not scored because targets subject to actual contamination at Level I and Level II concentrations are sufficient to achieve the maximum pathway score for this site.

Potential Contamination Factor Value: Not Scored

3.3.3 Resources

Resource use of the combined aquifer within the target distance limit does not include any documented Resource Factors. Therefore, a Resource Factor value of 0 is assigned (Ref. 1, Section 3.3.3, p. 78).

Resources Factor Value: 0

3.3.4 Wellhead Protection Area

The ground water plume lies within the Riverside Wellhead Protection Area (Refs. 31, p. 1; 60, p. 65; Figure 1-5). Wellhead Protection Areas are designated by the U.S. EPA in accordance with Section 1428 of the Safe Drinking Water Act (Ref. 31, p. 1; 60, p. 1). Therefore, the Wellhead Protection Area Factor Value of 20 is assigned (Ref. 1, Section 3.3.4, p. 78).

Wellhead Protection Area Factor Value: 20