HRS DOCUMENTATION RECORD
ATTEBURY GRAIN STORAGE FACILITY

CERCLIS NO. TXN000606760

HAPPY, SWISHER COUNTY, TEXAS

MARCH 2008

HRS DOCUMENTATION RECORD
HRS DOCUMENTATION RECORD--REVIEW COVER SHEET

Name of Site: Attebury Grain Storage Facility

Contact Persons:

Documentation Record: Brenda Nixon Cook
EPA Region 6 National Priorities List Coordinator
214-665-7436

Pathways, Components, or Threats Not Evaluated:

Soil Exposure Pathway
The Soil Exposure Pathway was not scored because scoring for this pathway would not alter the listing decision for the site. There is no documentation of residential contamination at this time.

Surface Water Pathway
The Surface Water Pathway was not scored because scoring for this pathway would not alter the listing decision for the site. There is no documented observed release to the Surface Water Pathway at this time.

Air Migration Pathway
The Air Migration Pathway was not scored because scoring for this pathway would not alter the listing decision for the site. There is no documented observed release to the Air Migration Pathway at this time.

FIGURES

HRS DOCUMENTATION RECORD

Name of Site: Attebury Grain Storage Facility

CERCLIS ID: TXN000606760

EPA Region: 6 **Date Prepared**: January 2008

Street Address of Site*: 201 North Gordon Street, Happy, Texas 79042 (Ref. 3, p. 1)

County and State: Swisher, Texas
General Location in the State: The Attebury Grain Storage Facility is located in the panhandle of Texas approximately 30 miles south of Amarillo, Texas. The facility is approximately 0.4 mile west of Interstate 27 in the town of Happy, Texas.

Topographic Map: United States Geological Survey (USGS) 7 _ Minute Topographical Map, Happy Quadrangle (Figure 1)(Ref. 3, p. 1).
Provide universal coordinates of the site in degrees, minutes, and seconds.

Latitude:	**Longitude**:
34º 44’ 42” N	101º 51' 12" W

Reference Point: soil gas well location. The well was drilled in the area where the grain storage facility fire was extinguished with carbon tetrachloride (CTC) (Ref. 22).

*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, placed, or 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.

PATHWAY SCORES

Air Pathway	NS
Ground Water Pathway	64.67
Soil Exposure Pathway	NS
Surface Water Pathway	NS

HRS SITE SCORE 32.33

NS= Not Scored

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	64.67	4,182.2
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	0.00	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	0.00	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	0.00	
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	0.00	
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	0.00	
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		4,182.2
6.	HRS Site Score: Divide the value on line 5 by 4 and take the square root	32.33	

GROUND WATER MIGRATION PATHWAY SCORESHEET

Factor categories and factors	Maximum Value	Value Assigned	
Likelihood of Release to an Aquifer: Shallow Aquifer			
1. Observed Release	550	550	
2. Potential to Release:			
2a. Containment	10	0	
2b. Net Precipitation	10	0	
2c. Depth to Aquifer	5	0	
2d. Travel Time	35	0	
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	0	
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	(b)	50	
8. Population:	(b)		
8a. Level I Concentrations	(b)	247.9	
8b. Level II Concentrations	(b)	0	
8c. Potential Contamination	(b)	0.28	
8d. Population (lines 8a + 8b + 8c)	(b)	248.18	
9. Resources	5	5	
10. Wellhead Protection Area	20	0	
11. Targets (lines 7 + 8d + 9 + 10)	(b)	303.18	
Ground Water Migration Score for an Aquifer: Shallow Aquifer			
12. Aquifer Score [(lines 3 x 6 x 11)/82,500][c]	100		64.67
Ground Water Migration Pathway Score:			
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]			64.67

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

NOTES TO THE READER

The following rules were applied when citing references in this Documentation Record:

1. The original page number is cited for all references.

2. If the reference cited had no original page number, then the designated tracking number is cited. Tracking numbers are assigned by EPA Region 6 to every page of every reference. The tracking number consists of the reference number followed by the page number within that reference. A tracking number will have a two-digit number followed by the sequential number (for example, 05 001; 05 002, etc.).

3. Analytical data will be referenced by tracking numbers only.

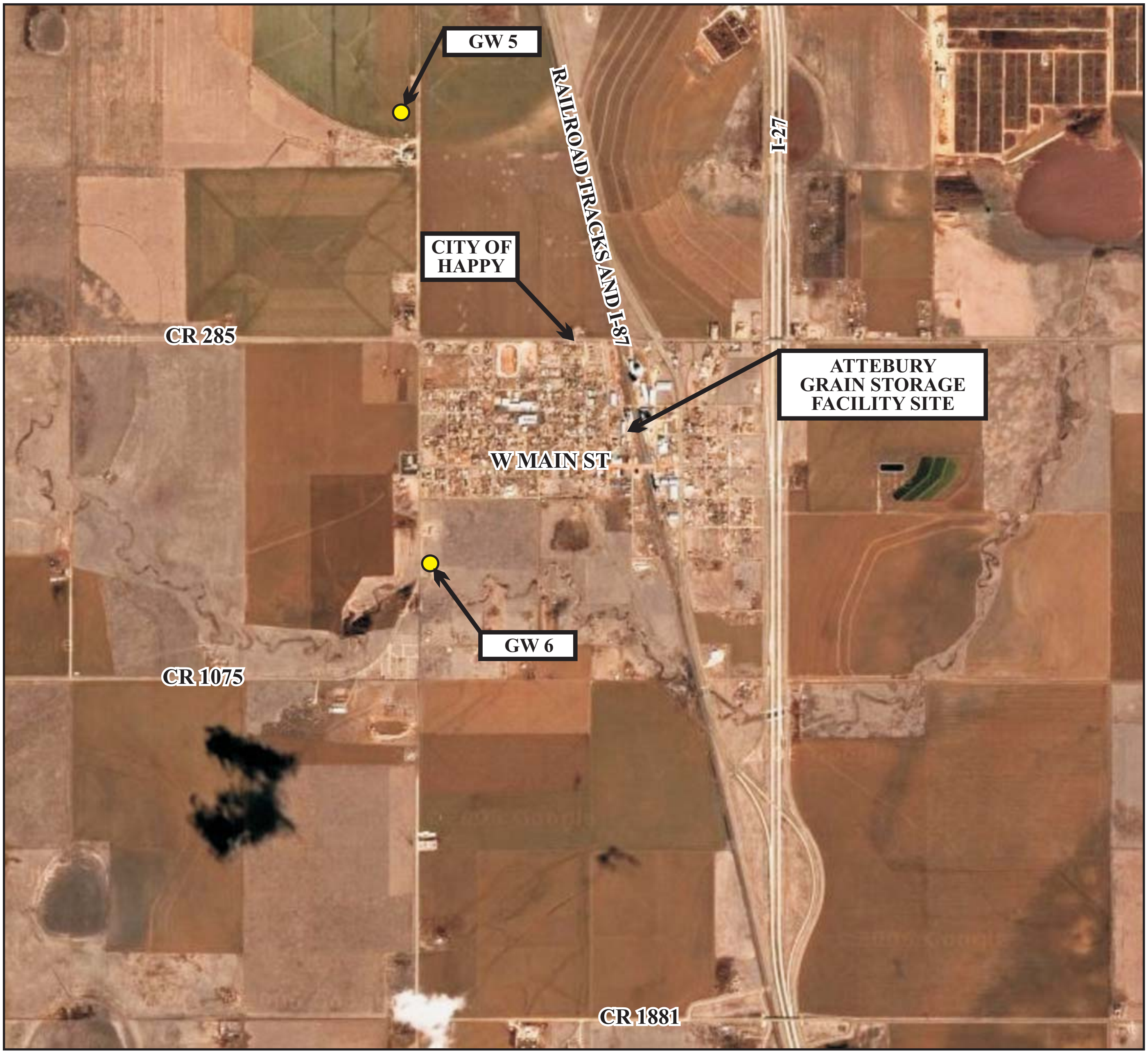
4. Hazardous substances are listed by how they appear in the Superfund Chemical Data Matrix (SCDM). Synonyms are in parentheses.

5. Abbreviations/Conventions used to identify references and citations:

   Reference...................Ref.
   Section ....Sec.
   Single Page ....p.
   Multiple Pages............pp.
   A;@.............................Next Reference.
   ( ) ....Selected acronyms.

6. The Texas Water Quality Board (TWQB), Texas Department of Water Resources (TDWR), Texas Water Commission (TWC), Texas Air Control Board (TACB), Texas Natural Resource and Conservation Commission (TNRCC) are the precursor agencies of the Texas Commission on Environmental Quality (TCEQ).

NS = Not Scored
Ref. = Reference



N

APPROXIMATE SCALE

0 2000 4000 FEET

LEGEND

CITY OF HAPPY MUNICIPAL WELL (SANTA ROSA AQUIFER)

SOURCE:
1. ORTHOIMAGERY (NAIP) - 2006, 2M CIR, SWISHER COUNTY, TEXAS, UNITED STATES

2. REF. 3; REF. 8, FIGURE 1

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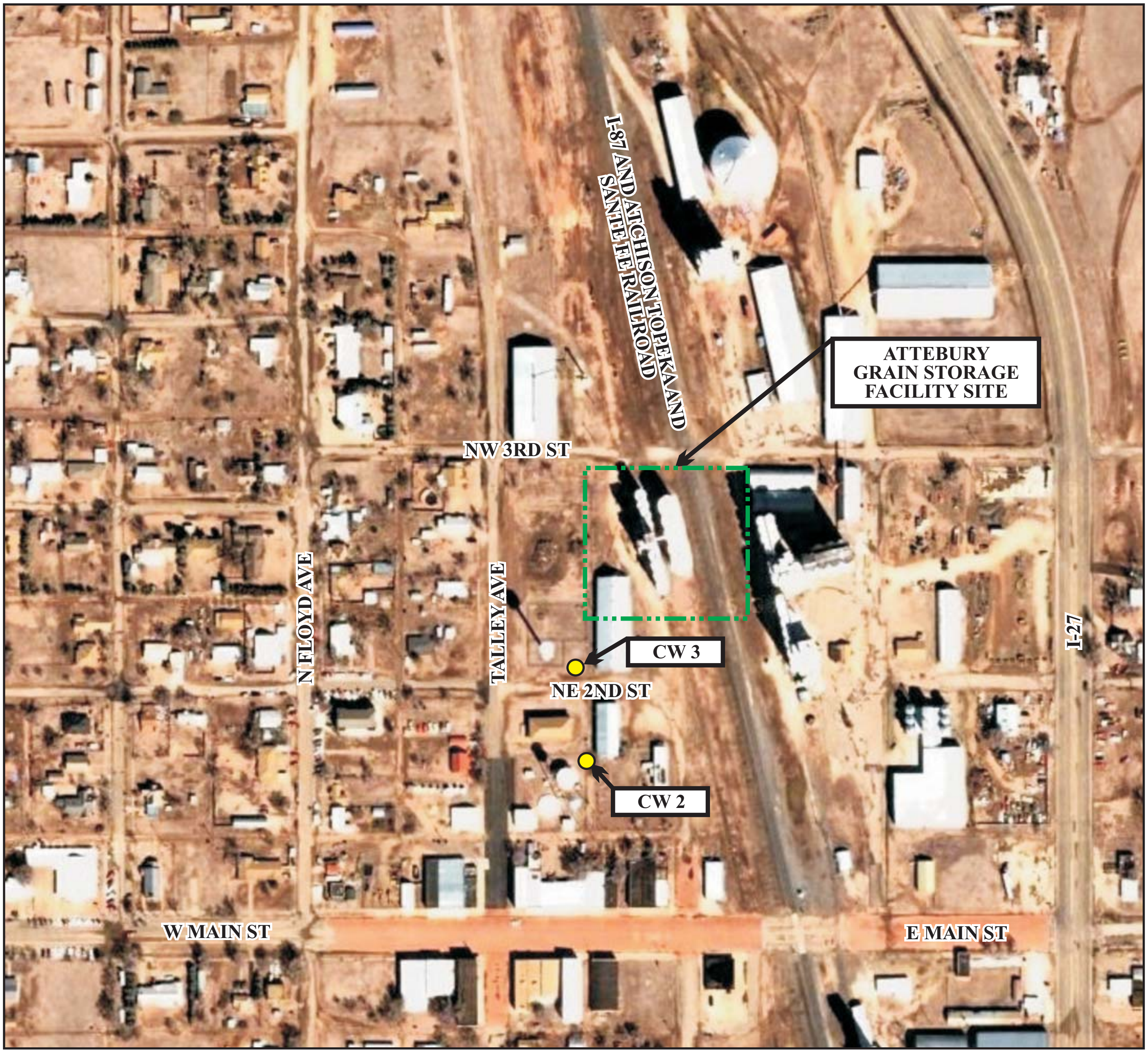
International Specialists in the Environment

JOB No. 001562.CU08.05.03 JANUARY 2008

FIGURE 1
SITE LOCATION MAP
ATTEBURY GRAIN STORAGE FACILITY SITE
HAPPY, SWISHER COUNTY, TEXAS



N

APPROXIMATE SCALE

0 200 400 FEET

LEGEND

CITY OF HAPPY (CLOSED) WELL (OGALLALA AQUIFER)

SOURCE:
1. ORTHOIMAGERY (NAIP) - 2006, 2M CIR, SWISHER COUNTY, TEXAS, UNITED STATES

2. REF. 3; REF. 8, FIGURE 2

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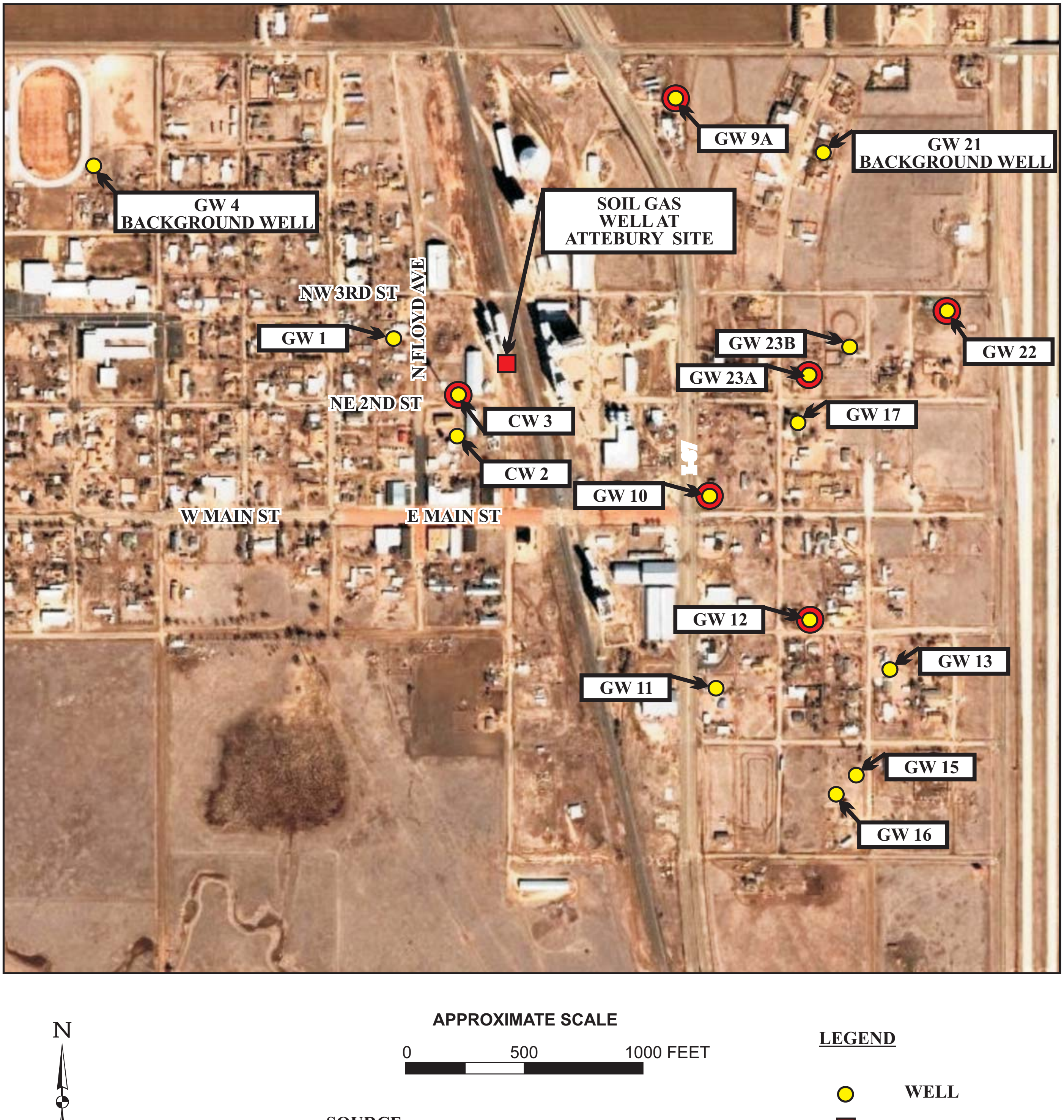
JANUARY 2008

FIGURE 2
SITE SKETCH AND CLOSED CITY WELL MAP
ATTEBURY GRAIN STORAGE FACILITY SITE
HAPPY, SWISHER COUNTY, TEXAS



SOURCE:
1. ORTHOIMAGERY (NAIP) - 2006, 2M CIR, SWISHER COUNTY, TEXAS, UNITED STATES

2. REF. 3; REF. 8, FIGURE 5, PP 21-25

LEGEND

- WELL
- SOIL GAS WELL
- LEVEL I TARGETS

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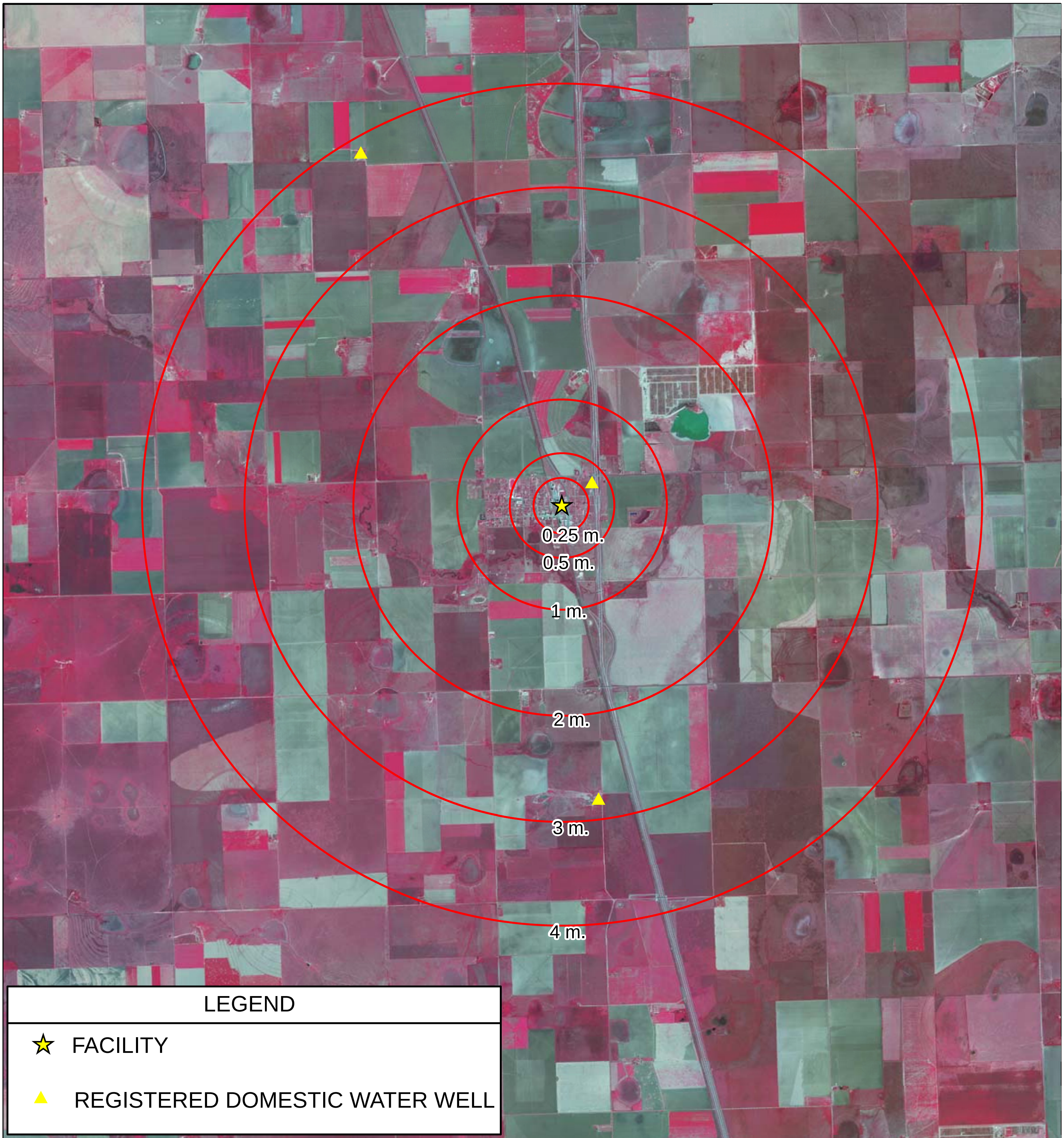
JANUARY 2008

FIGURE 3
GROUNDWATER WELLS SAMPLED AND LEVEL I TARGETS
ATTEBURY GRAIN STORAGE FACILITY SITE
HAPPY, SWISHER COUNTY, TEXAS



N

0 | 0.45 | 0.9 | 1.8 | 2.7 | 3.6 | 4.5 Miles

0 | 3,550 | 7,100 | 14,200 | 21,300 | 28,400 | 35,500 Feet

SOURCE: DIGITALLY ORTHORECTIFIED AERIAL PHOTOGRAPH OF U.S.G.S 7.5 MINUTE QUADRANGLE - HAPPY, TULSA NW, CANYON SE, OGG; TEXAS

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FIGURE 4
WELL LOCATION MAP - POTENTIAL TARGETS
ATTEBURY GRAIN STORAGE FACILITY
SWISHER COUNTY; HAPPY, TEXAS

File Name: attebury_dom.mxd

Date: 10/29/07

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7. Simpson, M. M. Science Policy Research Division. Ethylene Dibromide: History, Health Effects, and Policy Questions. May 3, 1984. 19 pages.

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9. TWC Interoffice Memorandum. Groundwater Contamination. Complaint #EF910515. City of Happy – Municipal Water Well #3. To: Screening Committee, Enforcement Section, TWC. From: Eddy Vance, District 1 Field Investigator. Date: July 31, 1991. 2 pages.

10. Letter. To: Anne C. Dobbs, Chief, Texas Water Commission. From: Bill Andrews, Water Superintendent, City of Happy. September 20, 1991. 2 pages.

11. Letter. To: Texas Water Commission. From: Gary Barrett, Manager, Farmers Elevator. Farmers Elevator, October 3, 1991. 3 pages.

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17. Laboratory Data Package for Soil Vapor Samples. Laboratory Name: DHL Analytical, Inc. Date; 9/8/06 Job Number 0608196. 21 pages.

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19. TCEQ. Superfund Site Discovery and Assessment Program. Water Well Summary Data Release Tables. August 7-8, 2006. 2 pages.

20 TCEQ. Water Supply Division, Public Drinking Water Section Sample Results for Happy Municipal Water System. September 26, 2006. 25 pages.

21. Ultrapure & Industrial Services. Field Activity Checklist for 507 North Tallmadge, Happy, Texas. September 2, 2006. 1 page.

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23. TCEQ. Superfund Site Discovery and Assessment Program. Soil Gas Data Results. August 24, 2004. 2 pages.

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25. EPA Fact Sheet. Establishing Background Levels. Directive 9287.5-19FS. PB94-963313. September 1995. 8 pages.

26. Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological FAQ^{TM}, per chemical compound: **http://www.atsdr.cdc.gov/toxpro2.html.** Updated May 25, 2004 and March 2006. Accessed October 2007.

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32. TWC. Report 89-01. Ground-Water Quality of Texas. March 1989. 16 pages.

33. TCEQ. Water System Data Sheet Report. November 27, 2006. 3 pages.

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40. TCEQ. Attebury Grain Storage Facility Site Field Notes (Diane Poteet). March 19, 2007 to March 21, 2007. 11 pages

41. TCEQ. Attebury Grain Storage Facility Site Field Notes (Sugam Shrestra). March 19, 2007 to March 21, 2007. 5 pages

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45. TCEQ. Attebury Grain Storage Facility Site. PA/SI Work Plan. March 2007**.** 42 pages (attachments, appendices, and references are not included).

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SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

2.2.1 Source Identification

Number of the source: 1

Name and HRS Source Type: Carbon Tetrachloride (CTC) Release (other)

Description of the source:

CTC was reportedly used on one of the grain elevators located on the grain storage facility to extinguish a fire in 1962 (Ref. 9, p. 1; Ref. 10, p. 2). In December 1962, an explosion and fire occurred in Elevator 2 at the Attebury Grain Storage Facility site (Ref. 9, p. 1, Ref. 10, p. 2; Ref. 50, p. 1). The incident was responded to by the Happy Volunteer Fire Department, who brought the situation under control. However, in order to completely extinguish the fire, the facility owner applied three drums of CTC and/or CTC containing material available at the facility onto the smoldering grain (Ref. 9, p. 1; Ref. 53, p. 1).

The source consists of a release of CTC or CTC mixture as a result of its use on the fire, which occurred on a portion of what is currently the Attebury Grain, Inc. property in Happy, Swisher County, Texas, where a grain storage facility (elevator and bins) burnt down in 1962. Attebury Grain, Inc. purchased the property in 1986 from Happy Elevator Company (Ref. 12, p. 1; Ref. 37, pp. 1- 28). Happy Elevator Company was the owner of the elevator when the fire occurred (Ref. 37, p. 4, 16-18).

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The site was first investigated in 1991 when a letter dated May 6, 1991 (Ref. 6, p. 4) was sent to the Mayor of Happy, Mary Sue Eakes, by the Texas Department of Health (TDH). The letter stated that the levels of CTC were 14 parts per billion (ppb) (Ref. 6, pp. 4-5) in City Well No. 3 and that the well should be closed because the concentration of CTC was above the United States Environmental Protection Agency (EPA) Federal Maximum Contaminant Level (MCL) of 5 ppb (Ref. 6, p. 4; Ref. 9, p. 1; Ref. 26, p. 3).

In August 2006, the Texas Commission of Environmental Quality (TCEQ) Superfund Site Discovery and Assessment Program staff sampled 13 private wells and City Well Nos. 2 and 3, located down gradient and in the vicinity of the location of the 1962 fire. Of the 13 private wells, 5 were found to contain contaminants above the MCL for CTC. In addition to CTC, the contaminants included 1,2-dichloroethane (1,2-DCA) and 1,2-dibromoethane (EDB) (Ref. 16, pp. 120-139; Ref. 39, pp. 11, 49, 57, 73, 97, 121, 129). City Well Nos. 2 and 3 did not have any detectible concentrations of CTC, 1,2-DCA or EDB (Ref. 4, p. 5; Ref. 5; Ref. 20, pp. 1-25).
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In addition to sampling the ground water, a soil gas well was installed on the Attebury site and soil vapor samples were collected during the August 2006 sampling event. The boring was drilled approximately twenty feet southeast of the existing metal grain storage facility on the Attebury Grain property (see Figure 3). The TCEQ installed a nested soil gas well which was screened in three different intervals (see Figure 3). It was constructed so that samples could be collected above a fractured caliche/limestone layer in the surficial wind-blown sands (7 to 10 feet below ground surface [bgs]), one below the caliche/limestone layer (47 to 52 feet bgs), and one right above the water table (95 to 100 feet bgs) (Ref. 4, p. 11; Ref. 22, pp. 1-2).

The results indicated CTC concentrations at 7 to 10 feet (29.3 parts per billion by volume or ppbv), 47 to 52 feet (1,030 ppbv), and 95 to 100 feet (4,270 ppbv). The results indicate that CTC is still present in concentrations in the soil gas under the Attebury property where the wooden facility burned down and was extinguished with CTC (Ref. 17, pp. 13 - 16; Ref. 23, pp. 1, 2).

Sampling conducted by the TCEQ Public Water Supply staff in September 2006 indicated no detections of CTC, 1,2-DCA or EDB in water samples from the active Santa Rosa wells and water supply system (Ref. 20, pp. 1-25).

On September 2, 2006, the TCEQ installed a filtration system on one private well (Ref. 21, p.1) that contained both CTC and EDB concentrations above their respective MCLs (Ref. 16, pp. 130, 131). The remaining private wells with concentrations found above MCLs were not being used for drinking water by the well owner because their house was connected to the city water system (Ref. 4, pp. 8, 9 and Ref. 34, p. 1).

Due to the newly discovered ground water contamination, the TCEQ sent out ground water notification letters in October 2006 to well owners, the Swisher County Judge, and the Water Well Drillers and Pump Installers Program (Ref. 24, pp. 1-28).

On March 6, 2007, the Preliminary Assessment/Site Inspection (PA/SI) Work Plan for the Screening Site Inspection (SSI) March 2007 Sampling Event was approved by the TCEQ PA/SI Program Manager and Grant Manager (Ref. 45, p. 2).

The SSI March 2007 Sampling Event was conducted from March 19, 2007 to March 21, 2007 (Ref. 5, pp. 1- 16; Ref. 40, pp. 1 - 11; Ref. 41, pp. 1 - 5; and Ref. 42, pp. 1-8). The site inspection consisted of collecting residential and public supply water well samples. The site inspection report was completed in May 2007 (Ref. 8). TCEQ also conducted additional sampling in November 2007 (Ref. 13, pp. 1 - 78). These sampling events confirmed the presence of CTC in soil vapor and ground water in the vicinity of the location of the 1962 fire (Ref. 13, pp. 14-26, 29-71 and 91).

CTC is a toxic, carcinogenic compound that is also a highly volatile liquid. When released to the environment it evaporates quickly from surface waters and soil or moves into ground water (Ref. 26, pp.1-4). The biodegradation products of CTC are chloroform and dichloromethane (Ref. 38, pp. 1-2).

Other hazardous substances detected in the soil vapor samples include 1,2DCA and EDB (Ref. 17, pp. 13 -16; Ref. 23, pp. 1-2); these substances were also detected in the ground water (Ref. 13, pp. 15, 17, 18, 20, 21, 23, 33, 37; Ref. 16, pp. 120-139; Ref. 39, pp. 11, 49, 57, 73, 87, 95, 97, 121, 129). When released into the soil, it will either evaporate into the air or travel down through the soil and enter the ground water where it breaks down very slowly. The EPA has determined that 1,2-DCA is a probable human carcinogen (Ref. 26, pp. 5-8). EDB has been used as a pesticide in soil, and on citrus, vegetable, and grain crops. When released into the soil, it will either evaporate into the air or travel down through the soil and enter the ground water where it breaks down very slowly (Ref. 7, p. 6; Ref. 26, pp. 9-12). EDB was also used in fire extinguishers (Ref. 7, p. 6).

Prior to the 1970s, CTC was widely used as a fire extinguishant, fumigant and solvent (Ref. 26, p. 1). As a grain fumigant, CTC was used alone or mixed with other substances more toxic to insects, such as 1,2-DCA and EDB (Ref. 52, p. 1). Numerous mixtures containing CTC, EDB and 1,2-DCA used in the post harvest storage industry were manufactured under a variety of trade names (Ref. 18, pp. 1-9). In mixtures, CTC is useful as an aid to distribution and fire suppressant to other fumigants (Ref. 52, p. 1).

Location of the source, with reference to a map of the facility: (see Figure 2) The CTC release, defined by the area where the fire was extinguished, is approximately 100 feet by 200 feet in size and is located on a portion of the Attebury property (Ref. 10, p. 2) that is west and adjacent to the Atchison Topeka and Santa Fe Railway tracks, south of Northwest 3rd Street, north of Northwest 2nd Street, and east of Talley Avenue (see Figures 1 and 2; Ref. 12, p. 3). The railroad bisects the Attebury property: west of the tracks lies the grain storage facility area and east of the tracks lies the grain facility office (see Figure 2).

2.2.2 Hazardous Substances Associated With a Source

The hazardous substances associated with the source are CTC, EDB and 1,2-DCA (Ref. 13, pp. 14-37; Ref. 17, pp. 13 -16; Ref. 19, p. 1; Ref. 23, p. 2; Ref. 39, pp. 11, 49, 57, 73, 97, 121, and 129).

2.2.3 Hazardous Substance Available to a Pathway

<u>Containment</u>

Gas release to air: The air migration pathway was not scored; therefore, gas containment was not evaluated.

Particulate release to air: The air migration pathway was not scored; therefore particulate containment was not evaluated.

Release to ground water: There is no evidence to indicate that a liner was present in the location where the fire occurred and was extinguished with CTC. The analytical data shows that ground water contains levels of CTC that are above background levels (Ref. 39, pp. 11, 49, 73, 97, 121, and 129). Table 3-2 of the HRS specifies that evidence of hazardous substance migration from the source area or a source with no liner receives a containment value of 10 (Reference 1, Table 3-2).

Release via overland migration and/or flood: The Surface Water Migration Pathway was not scored; therefore, surface water containment was not evaluated.

Because containment for this source is greater than zero, the following substances associated with the source can migrate via the ground water pathway (Ref. 1, Sec. 3.1.2.1):

Source Characterization for Source No. 1							
	Hazardous Substances Available to a Pathway						
	Air Pathway		**Ground Water (GW)**	**Surface Water (SW)**		**Soil Exposure**	
Hazard Substances	**Gas**	**Parti-culate**		**Overland/Flood**	**GW to SW**	**Resident**	**Nearby**
Carbon tetrachloride	NS	NS	Y	NS	NS	NS	NS
1, 2-Dibromoethane	NS	NS	Y	NS	NS	NS	NS
1, 2-Dichloroethane	NS	NS	Y	NS	NS	NS	NS

Notes and Qualifiers:

NS = Not Scored
Y = Yes

The hazardous substances associated with Source 1 are CTC; EDB; and 1, 2-DCA (See Section 2.2.2 of this documentation record).

2.3 LIKELIHOOD OF RELEASE

Refer to Section 3.1.1 of this document for specific information related to ground water samples that meet the criteria for observed release.

2.4 WASTE CHARACTERISTICS

Specific factors related to waste characteristics associated with Source 1 are presented below.

2.4.1 Selection of Substances Potentially Posing Greatest Threat

Refer to Section 3.2.1 of this document for specific information related to the toxicity/mobility values assigned to hazardous substances associated with this source.

2.4.2 Hazardous Waste Quantity

2.4.2.1 Hazardous Constituent Quantity (Tier A) - Not Scored (NS)

There is insufficient information to evaluate Tier A, as required in Section 2.4.2.1.1 of the HRS (Reference 1, Sec. 2.4.2.1.1). As a result, the evaluation of Hazardous Waste Quantity proceeds to the evaluation of Tier B, Hazardous Wastestream Quantity (Reference 1, Sec. 2.4.2.1.1).

Hazardous Constituent Quantity Value (S): NS

2.4.2.2 Hazardous Wastestream Quantity (Tier B)

CTC, 1, 2-DCA and EDB are present in the ground water in Happy, Texas. The origin of these substances is likely the application of CTC and compounds in extinguishing the fire in the grain elevators in 1962. The amount of CTC applied is not known, therefore, the hazardous waste stream quantity is greater than zero, but is unknown (Ref. 1, Sec. 2.4.2.1.2).

Hazardous Substance	Quantity (pounds)	Reference
Carbon tetrachloride	>0	1, 23, 39
1, 2-Dichloroethane	>0	1, 23, 39
1,2-Dibromoethane	>0	1, 23, 39

<u>Notes and Qualifiers:</u>

>0 = greater than zero

Hazardous Waste stream Quantity Value (W): <u>>0</u>

2.4.2.3 Volume (Tier C)

Insufficient data is available to estimate the volume of waste for this source (Ref. 1, Section 2.4.2.1.2).

Volume Assigned Value (V): 0

2.4.2.4 Area (Tier D)

Insufficient data is available to estimate the area of waste for this source (Ref. 1, Section 2.4.2.1.3).

Area Assigned Value: 0

2.4.2.1.5 Source Hazardous Waste Quantity Value

As described in the HRS, the highest value assigned to a source from among the four tiers of hazardous constituent quantity (Tier A), hazardous wastestream quantity (Tier B), volume (Tier C), and area (Tier D) shall be selected as the source hazardous waste quantity value (Ref. 1, pp. 51590 and 51591).

Source Hazardous Waste Quantity

Tier Measure	Migration Pathway (Ground Water)
Tier A, Constituent Quantity	NS
Tier B, Wastestream Quantity	Unknown, but > 0
Tier C, Volume	0
Tier D, Area	0

Source Hazardous Waste Quantity Value: >0

Site Summary of Source Descriptions

Source No.	Source Hazardous Waste Quantity Value	Containment Factor Values by Pathway			
		Ground Water	Surface Water	Air	
				Gas	Particulate
1	unknown, but >0	10	NS	NS	NS

According to Section 2.4.2.2 of the HRS, a Ground Water Pathway Hazardous Waste Quantity factor value of 100 is assigned for determining the Ground Water Pathway Waste Characteristics Value and for determining the HRS score because hazardous constituent quantity data is incomplete, and targets for the Ground Water Migration Pathway are subject to Actual Contamination (in this case Level I concentrations) (Ref. 1, Sec. 2.4.2.2; see section 3.3.2.2 of this documentation record).

3.0 GROUND WATER MIGRATION PATHWAY

The site, located in the Panhandle of Texas, is situated within the southern portion of the High Plains section of the Great Plains physiographic province (Ref. 28, p. 5; Ref. 36, p.1). The Southern High Plains of Texas occupies an area of approximately 22,000 square miles, extending from the Canadian River southward about 250 miles and from the New Mexico line eastward an average of 120 miles (Ref. 29, p. 1). The Southern High Plains is characterized by a nearly flat land surface sloping gently toward the southeast at 8 to 10 feet per mile. Shallow, undrained depressions or playas are common and stream drainage is poorly developed (Ref. 29, p. 1).

The principal source of ground water in Swisher County is the Ogallala aquifer. Underneath the City of Happy and within 4 miles of the site, the Ogallala Formation lies unconformably on top of the Dockum Group (Ref. 28, p. 9, Ref. 29, p. 42). Ground water flow in the region is generally to the east–southeast (Ref. 28, pp. 23, 24; Ref. 29, p. 3). The lithologic and water bearing properties of these formations are summarized in Table 2. Table 2 was modified from Texas Water Development Board Report 313 (Ref. 31, p. 10) to define "Strata" and remove formations not present in the area.

An observed release to the Ogallala aquifer has been documented by chemical analyses of ground water samples (see Tables 6 and 7 of this documentation record). Ground water samples collected down gradient of the facility document a significant increase in the concentrations of CTC, 1,2-DCA and EDB (see Table 4, Table 5, Table 6 and Table 7 of this documentation record).

Table 2 Geologic Formation in the Southern High Plains of the Texas Panhandle and Their Water-Bearing Characteristics (modified from Ref. 31, p. 10)

Strata	System	Series	Group	Formation	Thickness (feet)	Physical Characteristics of Rocks	Water-bearing Characteristics*
1	Quaternary	Pleistocene to Recent		Alluvium, eolian (wind-blown), and lacustrine deposits	40	Windblown sand and silt, fluvial flood plain deposits, and silt and clay playa lake deposits.	Yields small amounts of water to wells.
2 (aquifer)	Tertiary	Late Miocene to Pliocene		Ogallala	400	Tan, yellow, and reddish-brown, silty to coarse–grained sand mixed or alternating with yellow to red silty clay and variable sized gravel. Caliche layers common.	Yields moderate to large amounts of water to wells. The principal aquifer in the study area with yields of some wells in excess of 800 gallons/minute.
3 (aquifer)	Triassic	Upper	Dockum	Cooper Canyon	1,000+	Reddish-brown to orange siltstone and mudstone with lenses of sandstone, and conglomerate.	Yields small amounts of water to wells. Water quality variable with stratigraphic position and depth.
				Trujillo		Gray, brown, greenish-gray, fine to coarse-grained sandstone and sandy conglomerate with thin gray and red shale interbeds.	
				Tecovas		Variegated, sometimes sandy mudstone with interbedded to fine to medium grained sandstones.	
				Santa Rosa		Red to reddish-brown sandstone and conglomerate.	
4	Permian	Upper		Undivided	1,000+	Very fine- to fine-grained, red sandstone and shale; white to brown gypsum, anhydrite, and dolomite.	Not known to yield water to wells.

*Yields of wells: small= <50 GPM, moderate = 50-500 PGM, and large = >500 GPM.
**Dashed lines indicate uncomformity.

3.0.1 General Considerations

Stratum 1 – Quaternary System

The Quaternary System is an unconfined unit consisting of eolian or wind-blown sands, alluvium, playa, and caliche deposits. The eolian sands are highly permeable. The caliche, or "Caprock," can be locally impermeable or does not contain water. Recharge occurs when precipitation falls on the land surface and migrates downward through the permeable eolian sands, through the caliche via fractures, cracks, or well boreholes, until it reaches the Ogallala (Ref. 29, pp. 38-42).

Stratum 2 – Tertiary System- Unconfined Ogallala Aquifer

The Ogallala formation of Pliocene age principally consists of sand, gravel, silt and clay-material eroded from the Rocky Mountains and deposited in a fluvial environment (Ref. 30, p. 3). In Swisher County, the principal source of fresh ground water is the Ogallala aquifer. Over the last 30 years, however, withdraw of ground water has greatly exceeded recharge to the aquifer (Ref. 30, p. 1).

Ground water occurs in the Ogallala generally under water-table conditions: that is, the upper surface of the saturated material, or water table, is unconfined and the water will not rise in the wells above the level at which it is found in the strata. Relatively impermeable clay and shale layers of Triassic age generally form the lower boundary of the aquifer (Ref. 29, p. 42). In 1980, the saturated thickness of the Ogallala was estimated to rarely exceed 60 feet in Swisher County (Ref. 31, p. 7).

Water quality of the Ogallala aquifer in Swisher County is fresh and generally contains less than 500 milligrams per liter (mg/L) total dissolved solids (TDS), is slightly basic, and is very hard (Ref. 28, pp. 9, 34; Ref. 31, p. 19). Flow is generally to the east-southeast (Ref. 28, p. 23, 24; Ref. 29, p. 3).

Stratum 3 - Upper Triassic Confining Layers and Dockum Aquifer

The Triassic sediments of the Dockum Group, that form the Dockum aquifer, consists of alternating sequences of sand, gravel, silt and clay material deposited in fluvial, deltaic, or lacustrine environments within a closed continental basin (Ref. 28, p. 8, 20-22). The Dockum Aquifer is classified as a minor aquifer and underlies much of the Ogallala formation in the Texas Panhandle (Ref. 28, p. 1). Flow is generally toward the east – southeast (Ref. 28, pp. 1, 23, 24).

Recoverable ground water in the Dockum aquifer occurs within the many sandstone and conglomerate beds that are present throughout the 2,000-foot-thick sedimentary sequence, but mainly in the lower sections of the sequence (Best Sandstone unit) (Ref. 28, p. 52). The coarse-grained deposits form the more porous and permeable water-bearing units of the Dockum Group, whereas the fine-grained sediments form impermeable aquitards (confining layers) in the group. The more prolific parts of the aquifer are consequently developed in the lower and middle sections where the coarse-grained sediments predominate. Locally, any water-bearing sandstone within the Dockum Group is typically referred to as the Santa Rosa aquifer (Ref. 28, p. 8).

Where overlain by younger formations, the Dockum aquifer is typically under confined conditions (Ref. 28, p. 28). In the confined area of the aquifer, recharge to the Dockum aquifer occurs from upward leakage from underlying Permian rocks and downward leakage from the overlying Ogallala aquifer due to the hydraulic-head differences between the aquifers (Ref. 28, p. 28), and thus, the two aquifers are hydrogeologically in communication.

The Dockum aquifer is of poor chemical quality (Ref. 28, p. 1, 34, 52-53). In Swisher County, the water quality of the Dockum aquifer is less than 5,000 milligrams per liter (mg/L) for total dissolved solids (TDS) (Ref. 28, p. 37). In 1989, the TDS for the Dockum aquifer under the City of Happy was between 1,000 to 3,000 mg/L (Ref. 32, p. 73).

Stratum 4 - Permian Confining Strata

The upper Permian strata act as a confining layer to the Dockum aquifer (Ref. 28, p. 5). The basal unit, Santa Rosa Formation, rests unconformably on Upper Permian red clay beds, which can be as much as 130 feet thick (Ref. 28, p. 6; Ref. 29, pp. 14-15). In some places under the High Plains, however, briny, deeper Permian aquifers will leak water upward to the Dockum aquifer due to the hydraulic heads in the Dockum aquifer being 1,800 feet higher than the hydraulic heads in the Permian. It is unknown if this occurs under the City of Happy.

The general ground water flow in the region is east-southeast (Ref. 28, pp. 23, 24; Ref. 29, p. 3).

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

An observed release has been documented to the ground water pathway for the site by chemical analysis (see Table 6). Establishing an observed release by chemical analysis requires analytical evidence of a hazardous substance in the media significantly above the background level. 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 and that of the background sample (Ref. 1, Section 2.3, Table 2-3).

An observed release to the Ground Water Migration Pathway is based upon chemical analysis of ground water samples collected from monitor wells and drinking water wells completed in the Ogallala aquifer.

Aquifer Being Evaluated:

Ogallala Aquifer: This aquifer is the primary source of drinking water for the City of Happy and the surrounding area (Ref. 27, pp. 1-5).

Chemical Analysis:

Background Samples

Background Concentration

Two (2) background ground water samples were collected during the site sampling investigations to be used as background samples. These samples were collected in wells with depths similar to the depths of wells near the site. A site specific ground water gradient map could not be constructed because the wells in the area are closed systems, and ground water elevations could not be measured, however since the area in the vicinity of the site has very little variation in elevation, it is expected that absolute well depth measurements are comparable to those expressed as depth in above mean sea level (or relative) measurements. Because no other documented sources of CTC, EDB or 1,2-DCA were identified in upgradient areas from the location of the site based on regional ground water flow, the pumpage of the city wells and private wells located in the immediate area have influenced local ground water flow and therefore contaminant transport and distribution (Figure 3).

Table 3 provides a summary of the background sample descriptions and Table 4 provides a summary of the background sample results.

Table 3 - Ground Water Migration Pathway Background Sample Descriptions				
Sample ID/EPA Sample ID	**Date Collected**	**Well Depth (ft.)**	**Screened Interval**	**References**
GW-04	3/20/07	213 feet deep/ Ogallala Aquifer	163-203 feet bgs	Ref. 27 p. 2 Ref. 34, p.1 Figure 3
GW-21	3/21/07	150-200 feet deep/ Ogallala Aquifer	Unknown	Ref. 34, p.1 Figure 3

Table 4 - Ground Water Migration Pathway Background Sample Results				
Sample Location/Station No. [EPA ID]	**Hazardous Substances**	**Sample Concentrations (µg/L)**	**Sample Quantitation Limit (or equivalent) (µg/L)**	**References**
GW-04	1,2-Dibromoethane	U	1.0	Ref. 39, p. 6; Ref. 43, p. 5
	1,2-Dichloroethane	U	1.0	Ref. 39, p. 5; Ref. 43, p. 5
	Carbon tetrachloride	U	1.0	Ref. 39, p. 5; Ref. 43, p. 5
GW-21	1,2-Dibromoethane	U	1.0	Ref. 39, p. 66; Ref. 43, p. 5
	1,2-Dichloroethane	U	1.0	Ref. 39, p. 65; Ref. 43, p. 5
	Carbon tetrachloride	U	1.0	Ref. 39, p. 65; Ref. 43, p. 5

Notes: U = Not Detected
Sample Quantitation limit (or equivalent) (µg/L) are reporting limits, and are adjusted for sample size and matrix interference

Because some man-made hazardous substances are not found ubiquitously in the environment, they can be attributed only to a contaminant source (Ref. 25, p. 2). The presence of these substances in the release is sufficient to show contamination; a background sample is not needed (Ref. 25, p. 2). CTC, EDB and 1,2-DCA are man-made hazardous substances that are not naturally occurring and sampling data from background wells have demonstrated these substances are not ubiquitous in the vicinity of the site. Therefore, the background levels of these substances are considered to be below detection limits.

Ground Water Sample Results

The following samples meet the observed release criteria and are presented below indicating organic hazardous substances with their concentrations and sample quantitation limits (SQLs). These samples were qualified as “releases” based on the criteria in Table 2-3 (Ref. 1, Section 2.3). All Ogallala well locations can be seen in Figure 3, while City Well Nos. 5 and 6 locations are shown in Figure 1. The benchmarks for each contaminant can be found in Ref. 2.

Table 5 - Ground Water Migration Pathway

Observed Release Sample Descriptions

Sample ID/EPA Sample ID	Date Collected	Well Depth (ft.)	Screened Interval (ft. bgs)	References
GW-09A	8/9/06, 3/20/07, and 11/13/07	150-200 Ogallala Aquifer	unknown	Ref. 13, p. 105; Ref. 16, p. 8; Ref. 34, p.1 Figure 3
GW-10	3/21/07	150-200 Ogallala Aquifer	unknown	Ref. 34, p.1 Figure 3
GW-11	8/9/06 and 3/21/07	150-200 Ogallala Aquifer	unknown	Ref. 16, p. 8; Ref. 34, p.1 Figure 3
GW-12	8/9/06 and 3/21/07	205 Ogallala Aquifer	185-205 feet	Ref. 16, p. 8; Ref. 34, p.1 Ref. 46, p.6 Figure 3
GW-13	8/8/06 and 3/20/07	152-153 Ogallala Aquifer	Unknown	Ref. 16, p. 5; Ref. 34, p.1 Ref. 46, p.1 Figure 3
GW-17	8/8/06 and 3/21/07	150-200 Ogallala Aquifer	Unknown	Ref. 16, p. 5; Ref. 34, p. 1 Ref. 46, p. 3 Figure 3
GW-22	8/8/06 and 3/21/07	225 Ogallala Aquifer	Unknown	Ref. 16, p. 5; Ref. 34, p. 1 Ref. 46, p. 3 Figure 3
GW-23A	8/8/06 and 3/21/07	205 Ogallala Aquifer	195-205 feet bgs	Ref. 16, p. 5; Ref. 27, p.6 Ref. 34, p.1 Figure 3
GW-27 (CW 3)	8/8/06 and 3/20/07	215 Ogallala Aquifer	156-211 feet bgs	Ref. 16, p. 5; Ref. 27, p.1 Ref. 46, p.3 Figure 3

Table 6 - Ground Water Migration Pathway Observed Release Sample Results August 2006				
Sample Location/Station No. [EPA ID]	**Hazardous Substances**	**Sample Concentrations (µg/L)**	**Sample Quantitation Limit (or equivalent) (ug/L)**	**References**
GW-09A	1,2-Dibromoethane	0.32 J	0.04	Ref. 16, p. 131
	1,2-Dichloroethane	2.1	0.08	Ref. 16, p.130
	Carbon tetrachloride	50.62	0.05	Ref. 16, p. 130
GW-11	1,2-Dichloroethane	ND	0.08	Ref. 16, p. 126
	Carbon tetrachloride	1.57	0.05	Ref. 16, p. 126
GW-12	1,2-Dichloroethane	0.45 J	0.08	Ref. 16, p. 142
	Carbon tetrachloride	1.29	0.05	Ref. 16, p. 142
GW-13	Carbon tetrachloride	0.63	0.05	Ref. 16, p. 66
GW-17	1,2-Dichloroethane	16.97	0.08	Ref. 16, p. 70
	Carbon tetrachloride	0.78	0.05	Ref. 16, p. 70
GW-19	Carbon tetrachloride	0.98	0.06	Ref. 16, p. 134
GW-22	1,2-Dichloroethane	1.97	0.08	Ref. 16, p. 78
	Carbon tetrachloride	1.74	0.05	Ref. 16, p. 78
GW-23A	1,2-Dichloroethane	4.95	0.08	Ref. 16, p. 82
	Carbon tetrachloride	1.94	0.05	Ref. 16, p. 82
GW-27	1,2-Dichloroethane	ND	0.08	Ref. 16, p. 94
	Carbon tetrachloride	0.82	0.05	Ref. 16, p. 94
GW-36	1,2-Dichloroethane	24.45	0.08	Ref. 16, p. 74
	Carbon tetrachloride	0.37 J	0.05	Ref. 16, p. 74
GW-37	Carbon tetrachloride	0.98	0.05	Ref. 16, p. 138

Notes: J = Analyte detected below quantitation limit
ND = Not detected at the reporting limit

Table 6 - Ground Water Migration Pathway Observed Release Sample Results March 2007 Samples				
Sample Location/Station No. [EPA ID]	**Hazardous Substances**	**Sample Concentrations (µg/L)**	**Sample Quantitation Limit (or equivalent) (µg/L)**	**References**
GW-09	1,2-Dichloroethane	2.3	1.0	Ref. 39, p.11; Ref. 43, pp. 6, 8
	Carbon tetrachloride	44.2	1.0	Ref. 39, p.11; Ref. 43, pp. 6, 8
GW-10	1,2-Dichloroethane	1.7	1.0	Ref. 39, p.49; Ref. 43, pp. 6, 8
	Carbon tetrachloride	2.8	1.0	Ref. 39, p.49; Ref. 43, pp. 6, 8
GW-12	1,2-Dichloroethane	U	1.0	Ref. 39, p.97; Ref. 43, pp. 6, 8
	Carbon tetrachloride	1.0	1.0	Ref. 39, p.97; Ref. 43, pp. 6, 8
GW-17	1,2-Dichloroethane	11.6	1.0	Ref. 39, p.57; Ref. 43, pp. 6, 8
	Carbon tetrachloride	U	1.0	Ref. 39, p. 57; Ref. 43, pp. 6, 8
GW-22	1,2-Dichloroethane	1.6	1.0	Ref. 39, p. 73; Ref. 43, pp. 6, 8
	Carbon tetrachloride	1.6	1.0	Ref. 39, p. 73; Ref. 43, pp. 6, 8
GW-23A	1,2-Dichloroethane	7.0	1.0	Ref. 39, p.121; Ref. 43, pp. 6, 8
	Carbon tetrachloride	1.3	1.0	Ref. 39, p.121; Ref. 43, pp. 6, 8
GW-27	1,2-Dichloroethane	U	1.0	Ref. 39, p.37; Ref. 43, pp. 6, 8
	Carbon tetrachloride	U	1.0	Ref. 39, p.37; Ref. 43, pp. 6, 8
GW-32 (Duplicate of 23A)	1,2-Dichloroethane	6.9	1.0	Ref. 39, p.129; Ref. 43, pp. 6, 8
	Carbon tetrachloride	1.4	1.0	Ref. 39, p.129; Ref. 43, pp. 6, 8
GW-33	1,2-Dichloroethane	U	1.0	Ref. 39, p.42; Ref. 43, pp. 6, 8
	Carbon tetrachloride	U	1.0	Ref. 39, p.42; Ref. 43, pp. 6, 8

Notes: U = Not Detected
Sample Quantitation limit (or equivalent) (µg/L) are reporting limits, and are adjusted for sample size and matrix interference

Table 6 - Ground Water Migration Pathway Observed Release Sample Results November 2007 Samples				
Sample Location/Station No. [EPA ID]	**Hazardous Substances**	**Sample Concentrations (µg/L)**	**Sample Quantitation Limit (or equivalent) (µg/L)**	**References**
GW-09A	1,2-Dibromoethane	0.535	0.019	Ref. 13, p. 14-26, 73-74, 83
	Carbon tetrachloride	47E	0.50	Ref. 13, p. 14-26, 29
GW-10	1,2-Dichloroethane	U	0.50	Ref. 13, p. 14-26, 37
	Carbon tetrachloride	3.0	1.0	Ref. 13, p. 14-26, 37
GW-12	1,2-Dichloroethane	U	0.50	Ref. 13, p. 14-26, 41
	Carbon tetrachloride	0.85	0.50	Ref. 13, p. 41
GW-22	1,2-Dibromoethane	0.044	0.019	Ref. 13, p. 14-26, 73-74, 79
	Carbon tetrachloride	2.1	1.0	Ref. 13, p. 14-26, 51
GW-31	1,2-Dichloroethane	U	0.50	Ref. 13, p. 14-26, 59
	Carbon tetrachloride	3.1	0.50	Ref. 13, p. 14-26, 59
GW-17	1,2-Dichloroethane	10	0.50	Ref. 13, p. 14-26, 71
	Carbon tetrachloride	1.2	0.50	Ref. 13, p. 14-26, 71

Notes: U = Not Detected
Sample Quantitation limit (or equivalent) (µg/L) are reporting limits, and are adjusted for sample size and matrix interference

Attribution:

Prior to the 1970s, CTC was widely used as a fire extinguishant, fumigant and solvent (Ref. 26, p. 1). As a grain fumigant, CTC was used alone or mixed with other substances more toxic to insects, such as 1,2-DCA and EDB (Ref. 52, p. 1). Numerous mixtures containing CTC, EDB and 1,2-DCA used in the post harvest storage industry were manufactured under a variety of trade names (Ref. 18, pp. 1-9). In mixtures, CTC is useful as an aid to distribution and fire suppressant to other fumigants (Ref. 52, p. 1).

The most common use of 1,2-DCA is in the production of vinyl chloride which is used to make a variety of plastic and vinyl products including polyvinyl chloride (PVC) pipes, furniture and automobile upholstery, wall coverings, house wares, and automobile parts (Ref. 26, p. 5). It is also used as a solvent and is added to leaded gasoline to remove lead (Ref. 26, p. 5). Twelve gas stations have been identified in the City of Happy. According to the TCEQ's Leaking Petroleum Storage Tank (LPST) database, there have not been any leaking tanks identified in the city (Ref. 14, p. 1).

There are three grain storage elevators currently in Happy: Farmers Elevator, Attebury Grain, Inc. (South Unit) and Attebury Grain LLC (North Unit) (Ref. 51, pp. 1-6). These other storage facilities in Happy declared that they did not use CTC in their facilities (Ref. 11, p. 1; Ref. 12, p. 1).

As a grain fumigant, CTC and the other components are potential source for ground water contamination. However, fumigant mixtures are designed and applied at rates to protect against infestation. Small quantities are applied when used as a fumigant (generally 4 gallons per 1,000 bushels) (Ref. 54, p. 58). After application much of the fumigant (and residue on the grain) is lost to volatilization, which is typically enhanced by high temperature and low humidity (Ref. 52, pp. 1-4; Ref. 54, p. 58). Because of climate conditions in the Panhandle of Texas, fumigants applied to grains would likely be lost to volatilization rather than migrating to the ground water (Ref. 28, p. 5; Ref. 52, pp. 1-4).

In December 1962, an explosion and fire occurred in Elevator 2 at the Attebury Grain Storage Facility (Ref. 9, p. 1, Ref. 10, p. 2; Ref. 50, p. 1). The incident was responded to by the Happy Volunteer Fire Department, who brought the situation under control. However, in order to completely extinguish the fire, the facility owner applied three drums of CTC and/or CTC containing material available at the facility onto the smoldering grain (Ref. 9, p. 1; Ref. 53, p. 1).

When CTC was used to extinguish the fire in the grain elevator in 1962, it was present at the facility as a fumigant/fumigant component and most probably was mixed with EDB, 1, 2-DCA or other pesticide (Ref. 9, p. 1; Ref. 11, p. 2; Ref. 18). Any excess liquid containing CTC, along with any other fire fighting fluids, would have a significant chance to enter the soil and migrate to the ground water. In addition, migration of the CTC was likely enhanced by the colder December temperature, which would reduce loss of CTC through volatilization. Because a large volume of CTC and/or a CTC mixture was used to extinguish the smoldering grain, and with the previous application of water to extinguish the fire, enhanced the potential for the CTC, 1,2-DCA and EDB to migrate to underlying soils and ground water at the location of the fire. As demonstrated by the soil gas samples collected in August 2006, these substances are still present in the subsurface gases at the location of the fire (Ref. 17, pp. 13-19). Ground water and soil gas contamination at the site is at least in part due to the application of the CTC and other compounds to extinguish the fire. According to the former Happy Volunteer Fire Department Chief, no other incidents involving fire at grain elevators or leaking of CTC had occurred in the city during his years of service from the 1960s through his retirement in 1998 (Ref. 53). For purposes of the HRS documentation record, the site comprises the release of CTC and other substances that occurred as a result of extinguishing the fire in 1962 and the associated ground water release.

Hazardous Substances Released:
The CERCLA hazardous substances used to establish an observed release to the Ground Water Migration Pathway are CTC, EDB, and 1,2-DCA.

3.1.2 Potential to Release

As specified in the HRS, since an observed release was established for the shallow aquifer, the potential to release was not evaluated (Ref. 1, p. 51595).

3.1.3 Likelihood of Release Factor Category Value

If an observed release is established for an aquifer, assign the observed release factor value as the likelihood of release factor category value for the aquifer (Ref. 1, p. 51601). Since an observed release has been established for the shallow aquifer, the Observed Release Factor Value of 550 is assigned as the likelihood of release factor category value.

Likelihood of Release Factor Category Value: 550

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

The following toxicity, mobility and combined toxicity/mobility factor values have been assigned to those substances associated with Source No. 1 which has a containment value greater than 0.

Table 8
Toxicity/Mobility Factor Values

Hazardous Substance	Toxicity Factor Value	Mobility Factor Value	Toxicity/ Mobility	Reference
1,2-Dibromoethane	10,000	1	10,000	Ref. 2, p. 009
1,2-Dichloroethane	100	1	100	Ref. 2, p. 009
Carbon tetrachloride	1,000	1	1,000	Ref. 2, p. 008

Documentation for Toxicity/Mobility Values:
The Mobility Factor Value for all hazardous substance in an observed release by chemical analysis to one or more aquifers underlying the sources(s) at the facility, regardless of the aquifer being evaluated, are assigned a mobility factor value of 1 (Ref. 1, p. 51601).

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

Toxicity/Mobility Factor Value: 10,000

3.2.2 Hazardous Waste Quantity

Table 9
Source Hazardous Waste Quantity Value

Source Number	Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)	Is source hazardous constituent quantity data complete? (yes/no)
1	>0.00	No

*According to Section 2.4.2.2 of the HRS (Ref. 1 p. 51592), if the Hazardous Waste Constituent Quantity is not adequately determined for the source, and if any target for a migration pathway is subject to Level I or Level I concentrations, then assign the greater of either value from Table

2-6 or a value of 100, whichever is greater, as the Hazardous Waste Quantity Factor Value for that pathway (Ref. 1, p. 51592).

A Hazardous Waste Quantity Factor Value of 100 is assigned for the ground water migration pathway.

3.2.3 Waste Characteristics Factor Category Value

As specified in the HRS (Ref. 1, p. 51602), the Hazardous Waste Quantity Factor Value of 100 was multiplied by the highest Toxicity/Mobility Value of 10,000. The resultant product of 1,000,000 (1.0E+06) was used to select a Waste Characteristics Factor Value of 32 from Table 2-7 of the HRS (Ref. 1, p. 51592).

Hazardous Waste Quantity Factor Value: 100
Waste Characteristics Factor Category Value: 32

3.3 TARGETS

The aquifer being evaluated for the ground water pathway targets are the Ogallala. The ground water pathway targets for these aquifers identified within one (1) mile radius from the location of the release include:

1. One (1) Public Water Supply (PWS) Well from the City of Happy; and

2. Thirteen (13) private drinking water wells.

Within a 1-mile radius of the source, five private wells and one PWS well out of a total of fifteen wells sampled have been impacted with contaminants above a human health-based benchmark. These wells have been documented with an observed release (see Table 6). The number of targets and levels of contamination are shown in Tables 7 and 8.

At the time of the closure of Well No. 3, approximately 588 residents in the City of Happy were supplied with water from all three wells, which were connected to a single distribution system. Well No. 5 contributed 42% (450 gallons/minute), Well No. 6 contributed 56% (600 gallons/minute) and Well No. 3 contributed 2 % (25 gallons/minute) (Ref. 35, pp. 1-3).

Table 7 - Ground Water Migration Pathway
Drinking Water Wells with Level I Concentrations of CTC in the Ogallala Aquifer

Sample Location/Station No. [EPA ID]	CTC Concentrations (µg/L) (see Table No. 6 for references)	Benchmark Concentrations (Ref. 2, p. 2)			Population Served	
		MCL/ MCLG (µg/L)	Cancer Risk Conc. (µg/L)	Non Cancer Risk Conc. (µg/L)	People	Reference
GW-09A	44.2	5.0	0.66	26.0	4	Ref. 46, p.3
GW-10	2.8				3	Ref. 47, p.1
GW-12	1.0				1	Ref. 46, p.3
GW-22	1.6				4	Ref. 46, p.2
GW-23A	1.3				1	Ref. 46, p.2
City Well No. 3*	14				11.79 (2% of 588)	Ref. 35, p.1

The approximate screened interval for the contaminated drinking water wells sampled ranges from 10 to 225 feet deep for the Ogallala (see Table 5).

These results indicated that there were 6 (six) wells with Level I concentrations for CTC that affected a population of 24.79 people for wells in the Ogallala aquifer within a one-mile radius of the site (see Tables 7 and 8).

*Municipal well No. 3 was removed from service by the City of Happy due to the CTC contamination (Ref. 9, p. 1; Ref. 23, p. 1). Contamination has been detected at concentrations exceeding health based benchmarks in this well. Currently, the population of Happy (647) is served by two wells, City Well No. 5 and City Well No. 6 (Ref. 33, pp. 1, 2).

3.3.1 Nearest Well

Nearest Well: According to Section 3.3.1 of the HRS, if one or more drinking water wells are subject to Level I concentrations, a Nearest Well Factor value of 50 is assigned (see Section 3.3.2.2 of the HRS). Level I concentrations have been documented at 6 wells within the ground water plume. GW-09A is the nearest well containing Level I concentrations of CTC.

Level of Contamination (I, II, or potential): I

Location of Well: The nearest well, GW-9 is located approximately 1,056 feet from the facility (Ref. 3)(Figure 3).

For a well with Level I concentrations, a Nearest Well Factor Value of 50 is assigned (Ref. 1, p. 51603).

Nearest Well Factor Value: 50

3.3.2 Population

3.3.2.1 Level of Contamination

3.3.2.2 Level I Concentrations

Five (5) private wells and one (1) public supply wells within a one-mile radius of the site contained Level I concentrations (see Table 7). All the private wells and the one public supply drew water from the Ogallala aquifer (see Table 7). Other wells containing CTC concentrations above health-based benchmarks, such as GW-17, are connected to the city water system and the resident does not drink their well water (Ref. 46, p. 2).

The concentrations of hazardous substance shown below include detections in drinking water wells that meet or exceed their corresponding benchmark concentrations (Ref. 2). An observed release to the Ground Water Migration Pathway has been established based on the detection of these compounds found in the drinking water wells identified in Table 7; thus, these wells are associated with Level I concentrations (Ref. 1, Section 3.3.2.1, 3.3.2.2).

As specified in the HRS (Ref. 1, Section 3.3.2.2), the number of people served by drinking water from points of withdrawal subject to Level I concentrations were summed. The total population counted from the six (6) wells is 24.79 (Ref. 46, pp. 1 – 3). The total of 24.79 was multiplied by 10, for a product of 247.9 (Ref. 1, Section 3.3.2.2).

Population Served by Level I Wells: 24.79
Level I Concentration Factor Value: 247.9

3.3.2.3 Level II Concentrations

Level II concentrations for 1,2-DCA were indicated in Well Nos. GW-10, GW-17, and GW-23A. All of these wells were used for Level I concentrations for CTC above. The concentration of 1, 2-DCA for GW-10 was 1.7 µg/L, for GW-17 was 11.6 µg/L, and for GW-23A was 7 µg/L. The owner of GW-23A has been contacted by the TCEQ for installing a filtration system since the level is above MCL for 1,2-DCA. The owners of GW-17 do not drink their well water and are connected to city water.

Drinking water wells associated with Level II concentrations were already counted under Level I Concentrations above.

Population Served by Level II Well: 0

3.3.2.4 Potential Contamination

The potential contamination factor was evaluated and scored. The Ogallala aquifer is considered a major aquifer in Texas (Ref. 48, pp. 10-12), while the Santa Rosa is considered a minor aquifer (Ref. 48, pp. 13-15).

The Texas Water Development Board (TWDB) water well database (Ref. 44, pp. 1-9) was researched to find wells within radii of _ to _, _ to 1, 1 to 2, 2 to 3, 3 to 4-miles of the facility. There are 3 domestic wells exist within 4 miles of the site (Ref. 44, pp. 1-9). Figure 4 was created from the TWDB database. Using the average population per household of 2.65 (Ref. 15, p. 1), the following potential targets were calculated based on the number of wells located within each distance category and the weighted population assigned from Table 3-12 of the HRS.

Table 12 – Potential Contamination

Distance (Miles)	No. of wells	Population	Weighted Population
0 to _	0	0	0
Greater than 1/4 to _	1	2.65	2
Greater than 1/2 to 1	0	0	0
Greater than 1 to 2	0	0	0
Greater than 2 to 3	1	2.65	0.5
Greater than 3 to 4	1	2.65	0.3
		Total:	2.8

An observed release to the Ground Water Migration Pathway has been established based on the detection of compounds found at Level I concentrations in wells within the 4-mile Target Distance Limit; thus, the above identified wells are associated with potential contamination (Ref. 1, p. 51603).

As specified in the HRS, (Ref. 1, p. 51604), the number of people served by drinking water wells was determined within in each "Other Than Karst" distance category and a distance-weighted population value for each distance category was assigned. The population subject to potential contamination is based on the number of individuals regularly served by private wells.

The distance weighted population values were summed for a total of 2.8 and was divided by 10, for a product of 0.28.

Potential Contamination Factor Value: 0.28

3.3.3 Resources

Resources, as defined in HRS Section 3.3.3, were documented for the Ogallala aquifer (Ref. 1). As demonstrated by the TWDB database, there are many wells used for irrigation and stock tank for animals (Ref. 44). Ground water is exclusively used for irrigation in Swisher County (Ref. 49, p. 2). Over 190,000 acres were irrigated in Swisher County.

Resource Factor Value: 5

3.3.4 Well Head Protection Area

There is not a wellhead protection area (WPA) for the City of Happy Water municipal water system.

Wellhead Protection Area Factor Value: 0

3.3.5 Calculation of Targets Factor Category Value

The target factor category value is calculated by determining the sum of the factor values for the nearest well (50), population (247.9 + 0.28), resources (5), and Wellhead Protection Area (0) (Ref. 1, 51604).

Calculations: 50 + 248.18 + 5 + 0 = 303.18

3.4 GROUND WATER MIGRATION SCORE FOR AN AQUIFER

The ground water migration score for an aquifer is calculated by multiplying the factor category values for likelihood of release (550), waste characteristics (32), and targets (303.18). Divided by 82,500, the resulting value (maximum value 100) is assigned as the ground water migration pathway score (Ref. 1, p. 51604). (5,335,968)

Calculations: (550 x 32 x 303.18) ÷ 82,500 = 64.67 (100 maximum)

3.5 CALCULATION OF GROUND WATER MIGRATION PATHWAY SCORE

The Ground Water Migration Pathway Score is calculated by assigning the highest ground water migration score for the Ogallala Aquifer (64.67).

3.5.1 Calculation of HRS Site Score

The HRS site score is calculated by using the root-mean-square equation which squares each pathway score then takes the sum of all pathways and divides the sum by 4 then takes the square root which is the site score (Ref. 1, Section 2.1.1).

Calculations:

<u>Pathway Scores</u>

GW Pathway [64.67]_ = 4,182.2
SW Pathway NS = 0
Soil Pathway NS = 0
Air Pathway NS = 0
(NS = not scored)

S_{gw}_ + S_{sw} _ + S_s _ +S_a _ =
4,182.2 + 0 + 0 + 0 = 4,182.2
4,182.2 ÷ 4 = 1,045.55

(square root) = 32.33

HRS Site Score: 32.33

4.0 SURFACE WATER PATHWAY

4.0.1 General Considerations

The Surface Water Pathway was not scored because scoring for this pathway would not alter the listing decision for the site. There is no documented observed release to the Surface Water Pathway at this time.

5.0 SOIL EXPOSURE PATHWAY

5.0.1 General Considerations

The Soil Exposure Pathway was not scored because scoring for this pathway would not alter the listing decision for the site. There is no documentation of residential contamination at this time.

6.0 AIR MIGRATION PATHWAY

6.0.1 Observed Release

The Air Migration Pathway was not scored because scoring for this pathway would not alter the listing decision for the site. There is no documented observed release for the Air Migration Pathway at this time.