

Animal Feeding Operations Field Study Hydrogen Sulfide and Ammonia Results Executive Summary

Iowa DNR – Ambient Air Monitoring Group



Table of Contents

List of Tables	3
Iowa Animal Feeding Operations Field Study Executive Summary: 2002-2007	4
Introduction	4
Site Information	6
Map of Site Locations.....	6
Atlantic.....	7
Belmond Old	9
Belmond New.....	11
Clarion	13
Goldfield.....	15
Iowa Falls.....	17
Jewell.....	19
Kanawha.....	21
Malcom	23
Newkirk	25
Sac City.....	27
Sioux Center	29
Stanhope	31
Viking Lake	33
West Union	35
Woodbine.....	39
Summary of Hydrogen Sulfide CAFO Data.....	41
Summary of Ammonia CAFO Data	57
Appendix A.....	72
Additional Table Information.....	72
Appendix B.....	76
Iowa Code section 459.207.....	76
Appendix C.....	77
Milestones in the Development of Legislation and Rules Related to the Field Study.....	77
Appendix D.....	78
Iowa Administrative Code 567 Chapter 32	78
Appendix E	79
Iowa Air Sampling Manual	79
Appendix F	83
Field Study Chronology	83

List of Tables

Table 1. Annual 8th highest daily maximum sample values for daily Hydrogen Sulfide.	41
Table 2. Annual percent completeness for daily Hydrogen Sulfide.....	42
Table 3. Quarterly percent completeness for daily Hydrogen Sulfide.....	43
Table 4. Statistical summary for daily Hydrogen Sulfide	44
Table 5-a. Top ten maximum sample values for daily Hydrogen Sulfide for 2002-2004 CAFO sites.....	45
Table 5-b. Top ten maximum sample values for daily Hydrogen Sulfide for 2005-2007 CAFO sites.	46
Table 6-a. Percentiles for daily Hydrogen Sulfide for 2002-2004 CAFO sites	47
Table 6-b. Percentiles for daily Hydrogen Sulfide for 2005-2007 CAFO sites.....	48
Table 7. Number of hours with levels over the Health Effects Value (HEV)	49
Table 8. Annual percent completeness for hourly Hydrogen Sulfide	50
Table 9. Quarterly percent completeness for hourly Hydrogen Sulfide.....	51
Table 10. Statistical summary for 2002-2007 hourly Hydrogen Sulfide data	52
Table 11-a. Top ten maximum sample values for hourly Hydrogen Sulfide data for 2002-2004.....	53
Table 11-b. Top ten maximum sample values for hourly Hydrogen Sulfide data for 2005-2007.....	54
Table 12-a. Percentiles for hourly Hydrogen Sulfide data for 2002-2004 CAFO sites	55
Table 12-b. Percentiles for hourly Hydrogen Sulfide data for 2005-2007 CAFO sites.....	56
Table 13. Annual highest daily maximum for daily Ammonia	57
Table 14. Annual percent completeness for daily Ammonia.....	58
Table 15. Quarterly percent completeness for daily Ammonia.....	59
Table 16. Statistical summary for daily Ammonia data	60
Table 17-a. Top ten maximum sample values for daily Ammonia data for 2003-2004.....	61
Table 17-b. Top ten maximum sample values for daily Ammonia data for 2005-2007	62
Table 18-a. Percentiles for daily Ammonia data for 2003-2004 CAFO sites	63
Table 18-b. Percentiles for daily Ammonia data for 2005-2007 CAFO sites.....	64
Table 19. Annual percent completeness for hourly Ammonia	65
Table 20. Quarterly percent completeness for hourly Ammonia	66
Table 21. Statistical summary for hourly Ammonia.....	67
Table 22-a. Top ten maximum sample values for hourly Ammonia data for 2003-2004.....	68
Table 22-b. Top ten maximum sample values for hourly Ammonia data for 2005-2007.....	69
Table 23-a. Percentiles for hourly Ammonia data for 2003-2004	70
Table 23-b. Percentiles for hourly Ammonia data for 2005-2007	71

Iowa Animal Feeding Operations Field Study

Executive Summary: 2002-2007

Iowa Department of Natural Resources – Air Quality Bureau – Air Monitoring Group

Introduction

Background

In April 2002, in response to public concerns over air emissions from animal feeding operations¹, the Iowa legislature requested² that the department perform a field study of odor, hydrogen sulfide and ammonia levels. Under Iowa law³, an individual seeking to construct an animal feeding operation over a particular size must build at a minimum specified distance (known as the “separation distance”) away from homes, schools and other types of public areas (known as “separated locations”). The field study legislation gave the department authority to implement control measures at animal feeding operations provided the monitoring data showed that pollutant levels at separated locations exceeded health thresholds. The department agreed to use the rulemaking process to establish appropriate monitoring locations and health thresholds for the field study⁴.

In September 2004, the department passed a rule establishing the health threshold for hydrogen sulfide.⁵ A one hour average of 30 ppb was determined to be the threshold of adverse health effects for hydrogen sulfide, and the regulatory intervention threshold was determined to be an annual eighth highest daily maximum hourly average hydrogen sulfide value of 30 ppb. Monitoring locations were required to be within 100 meters of the separated location (house), and outside the required separation distance that applied at the time the animal feeding operation was constructed.

From 2002 to 2007⁶, hydrogen sulfide monitoring was conducted at sixteen locations near CAFOs, seven of these sites recorded hourly averages over the 30 ppb health threshold.

Of the sixteen monitoring locations, eleven met the criteria for siting established in the 2004 rulemaking. Five of these eleven sites recorded levels over the 30 ppb health threshold, and one site recorded values over the regulatory intervention threshold.

The single site that recorded values over the regulatory intervention threshold was established prior to the 2004 rulemaking.

¹ Two academic reports that analyze these concerns and make specific recommendations for policy development are:

Iowa Concentrated Animal Feeding Operation Air Quality Study, Iowa State University and The University of Iowa Study Group, February 2002:
<http://www.public-health.uiowa.edu/ehsr/CAFOstudy.htm> .

and: *Air Emissions from Animal Feeding Operations*, National Academy of Sciences, February 2003:
<http://www.nap.edu/openbook.php?isbn=0309087058> .

² See Iowa Code Section 459.207, reproduced in **Appendix B**.

³ See Iowa Code Section 459.202:

<http://coolice.legis.state.ia.us/Cool-ICE/default.asp?Category=billinfo&Service=iowaCode&input=459.202>.

⁴ Milestones in the development of the rule that identified health thresholds and monitoring locations for the study are contained in **Appendix C**.

⁵ See Iowa Code Section 567—32.1(455B), reproduced in **Appendix D**.

⁶ A chronology of the field study is contained in **Appendix F**.

Document Overview

Information concerning monitoring sites is contained in **Site Information**. The locations where monitoring was conducted for the field study are indicated in the **Map of Site Locations**. Following the map is the site description and aerial photos of each monitoring site in the study. These are organized by site name.

Tables summarizing the hydrogen sulfide data collected during the field study are contained in the section called **Summary of Hydrogen Sulfide CAFO Data**. Ammonia data also collected during the study is summarized in the tables contained in the section called **Summary of Ammonia CAFO Data**.

The document contains several appendices. **Appendix A** contains the information to further explain each table in the document. **Appendix B** contains the statutory requirements for the field study. **Appendix C** recounts milestones in the development of legislation and rules related to the field study. The rules establishing the thresholds for adverse health effects and regulatory action for hydrogen sulfide are reproduced in **Appendix D**. **Appendix E** contains the sampling manual for the study adopted as a component of the rulemaking. This manual contains monitor siting requirements and other requirements for monitor operation. A chronology of the field study is contained in **Appendix F**.

Site Information

Map of Site Locations

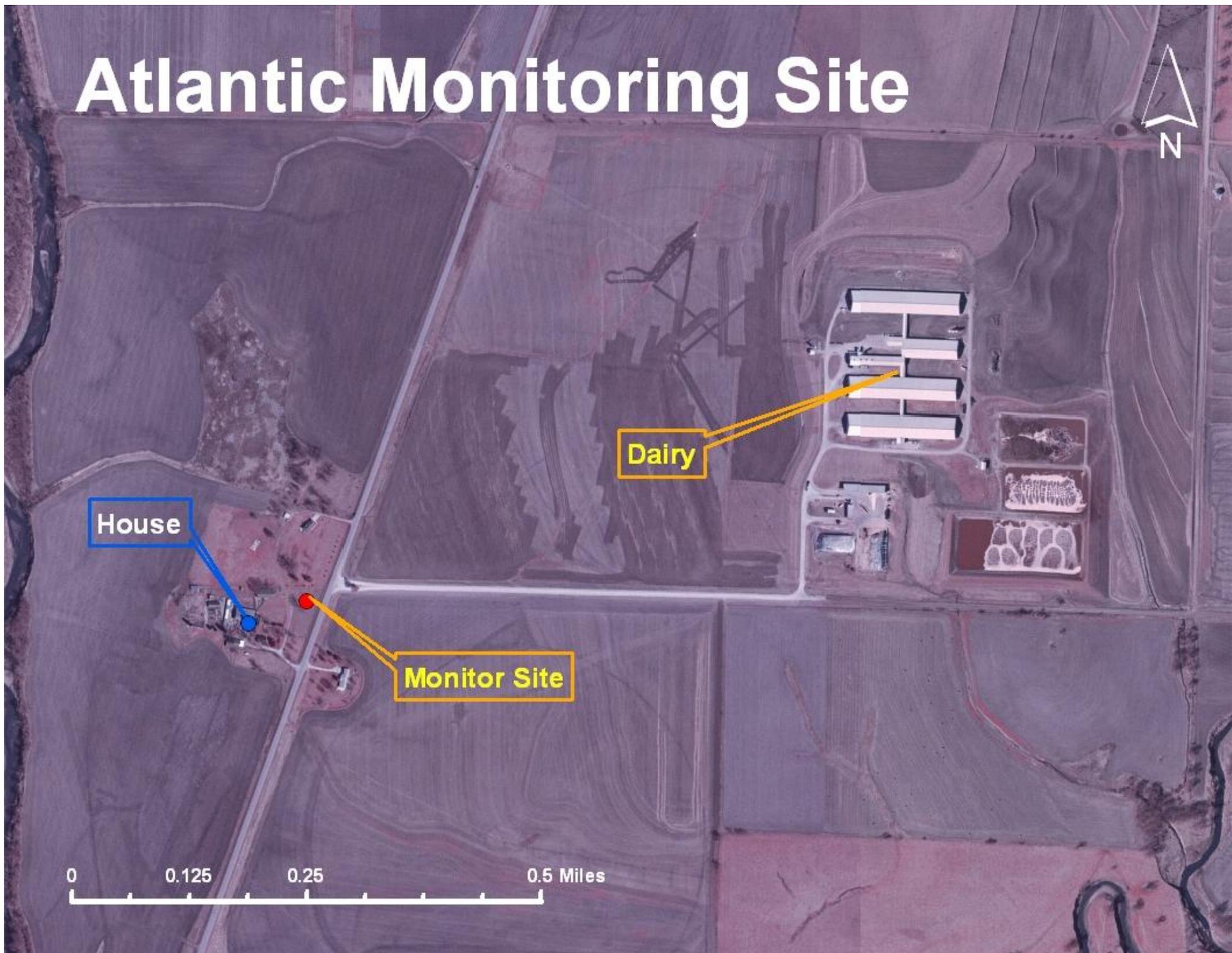


Figure 1. Locations of monitors used in the 2002-2007 Iowa Animal Feeding Operations Field Study monitoring network.

Atlantic

The Atlantic monitoring site was located in Cass County, Iowa. Monitoring for ammonia began on April 15, 2003 and for hydrogen sulfide on April 24, 2003. Monitoring for both gases ended on September 23, 2003. This monitoring site was located near the Dairy Cattle operation owned by Milk Unlimited, which was permitted for 4,320,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and within 100 meters of a house. In late 2003 the property associated with the residence was purchased by Milk Unlimited, which ended the department's ability to monitor at the site. Also, since the house was owned by the owner of the CAFO, it was no longer a separated location. Atlantic has an AQS identification number of 19-029-0003.

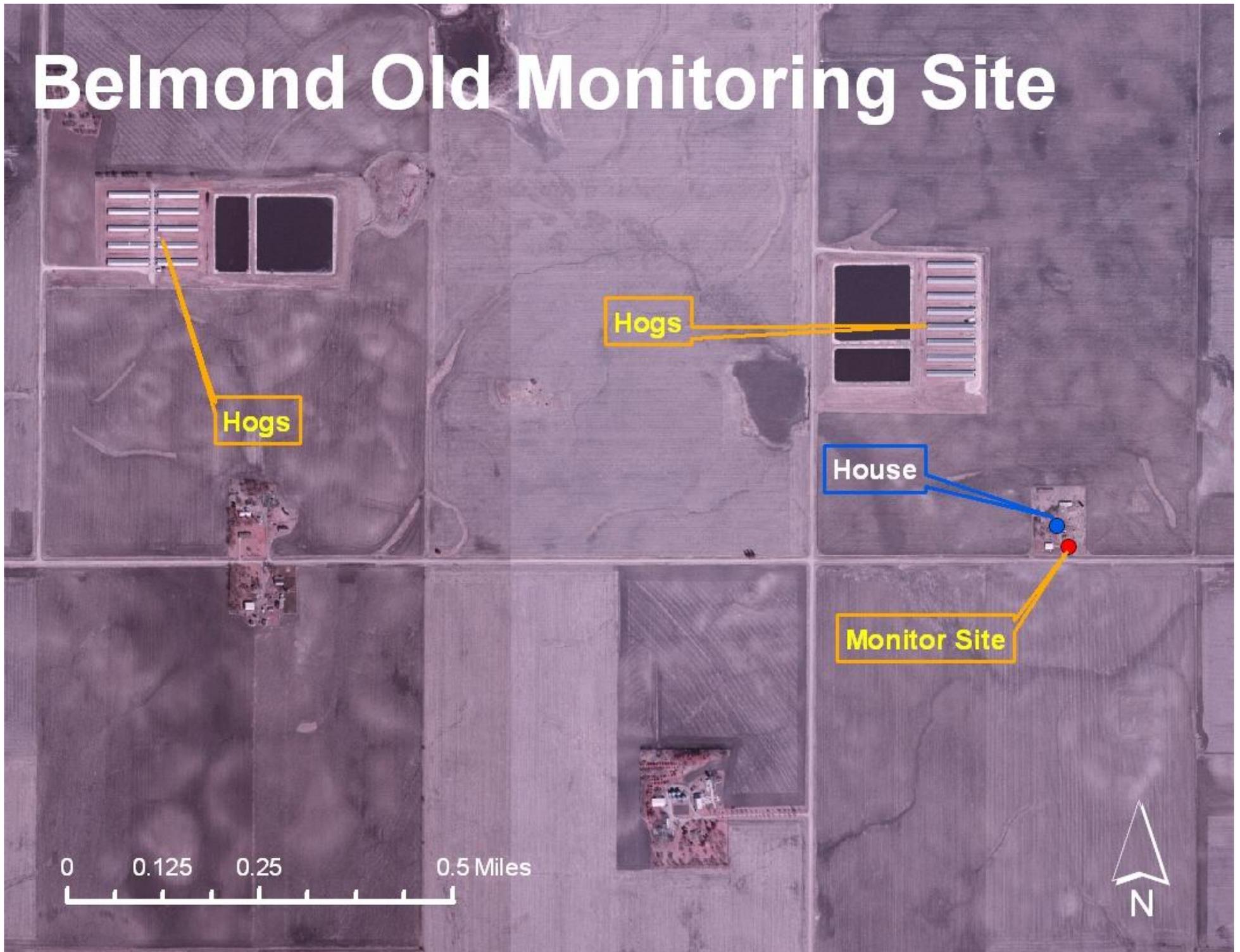
Atlantic Monitoring Site



Belmond Old

The “Belmond Old” monitoring site was located in Wright County, Iowa. Monitoring for ammonia and hydrogen sulfide at the Belmond Old site began on October 13, 2003. Monitoring for both gases ended on June 17, 2004. The Belmond Old site was located near the Iowa Select Farms - Buseman Swine Finishing operation which was permitted for 2,310,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Monitoring at the site ended because the property owner of the land housing the monitoring site had signed a waiver, allowing the CAFO to be located closer to the home than separation distances required. Because the animal feeding operation was closer than the separation requirements, the monitor was located too close based on the monitoring siting requirements adopted in 2004, and the monitoring site agreement was terminated. Belmond Old has an AQS identification number of 19-197-0005.

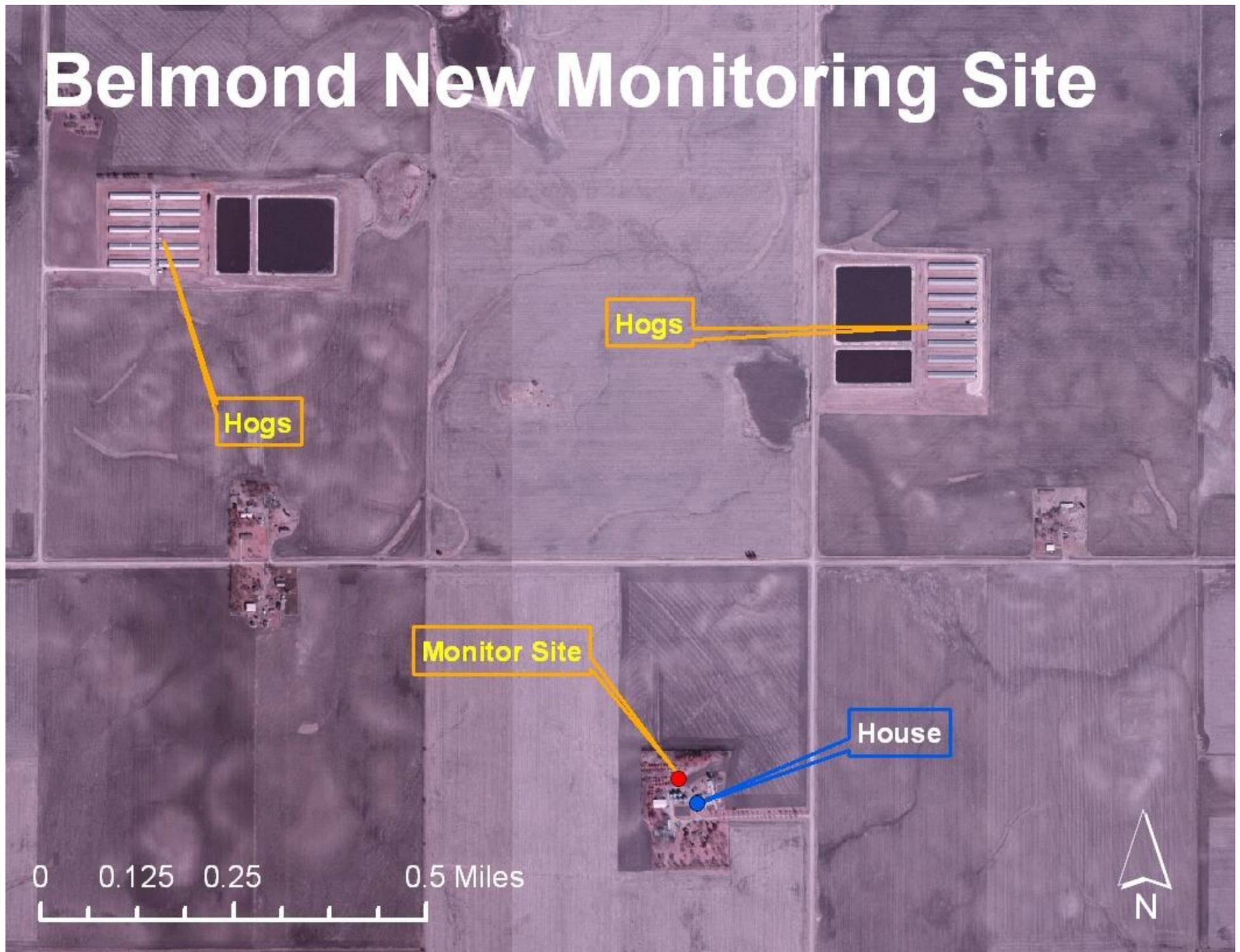
Belmond Old Monitoring Site



Belmond New

The “Belmond New” monitoring site was located in Wright County, Iowa. Monitoring for ammonia and hydrogen sulfide at the Belmond New site began on June 29, 2004. Monitoring for both gases ended on December 31, 2007. The site was located near the Iowa Select Farms - Buseman and Iowa Select Farms - Halfpop Swine Finishing operations which were permitted for 2,310,000 and 2,475,000 pounds of livestock respectively. The monitors were moved from the Belmond Old location to a property farther from the Buseman CAFO; still located in ambient air, on property associated with a residence, and near a house. Data for Belmond New was retrieved using an AQS identification number of 19-197-0007.

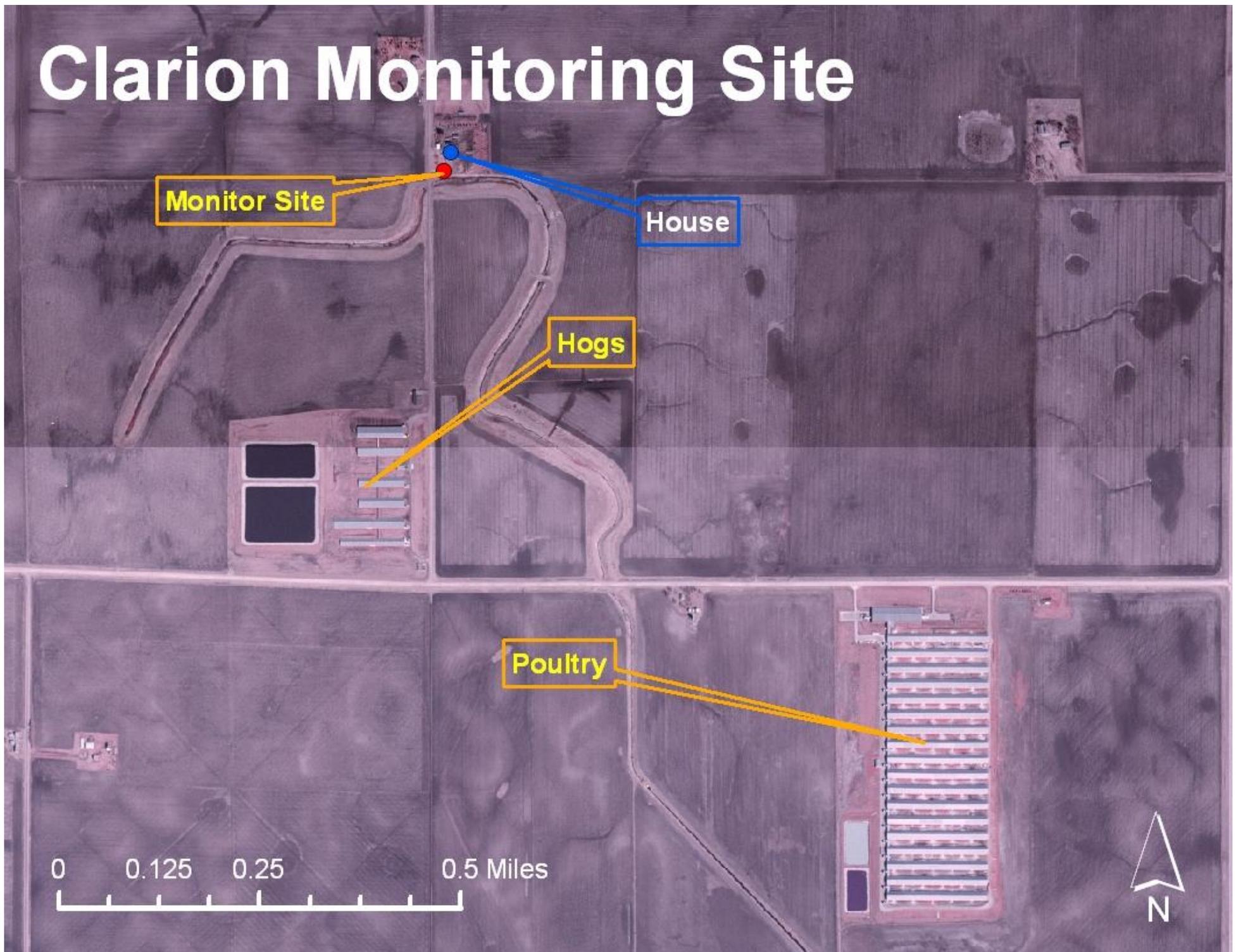
Belmond New Monitoring Site



Clarion

The Clarion monitoring site was located in Wright County, Iowa. Monitoring for ammonia started on March 18, 2003 and for hydrogen sulfide on April 1, 2002. Monitoring for both gases ended on December 31, 2007. This monitoring site was located near the DeCoster #15 Sow Site which was permitted for 1,827,265 pounds of livestock. Eighteen long barns housing layer hens are visible in the lower right portion of the aerial photograph seen below. High levels of ammonia at this location may have been a result of winds blowing from the poultry barns. The monitors were located in ambient air, on property associated with a residence, and near a house. Clarion has an AQS identification number of 19-197-0004.

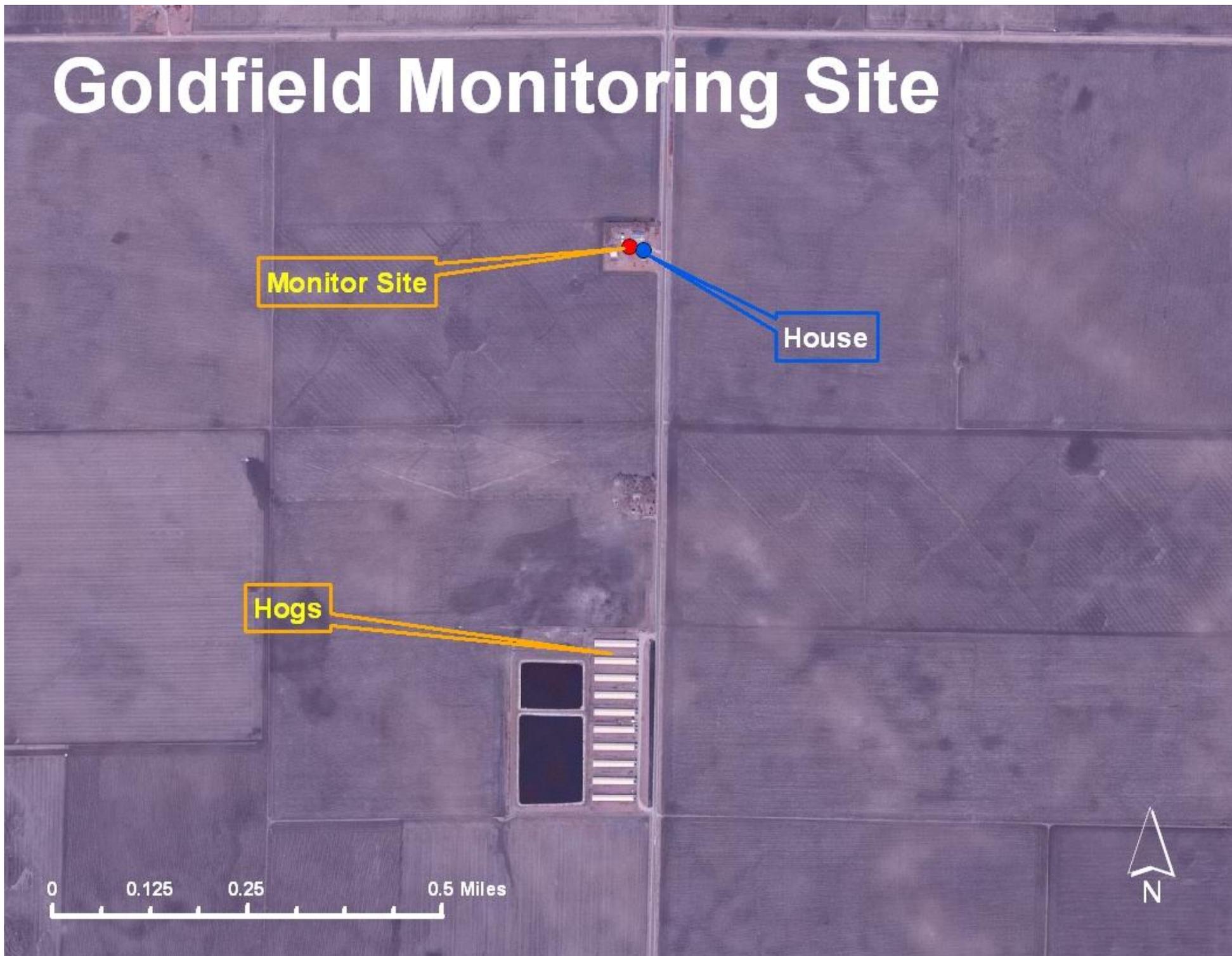
Clarion Monitoring Site



Goldfield

The Goldfield monitoring site was located in Wright County, Iowa. Monitoring at the site began on December 5, 2003 for ammonia and hydrogen sulfide. Monitoring for both gases ended on December 31, 2007. This monitoring site was located near the Iowa Select Farms - McCutcheon Finishing Swine operation which was permitted for 2,475,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Goldfield has an AQS identification number of 19-197-0006.

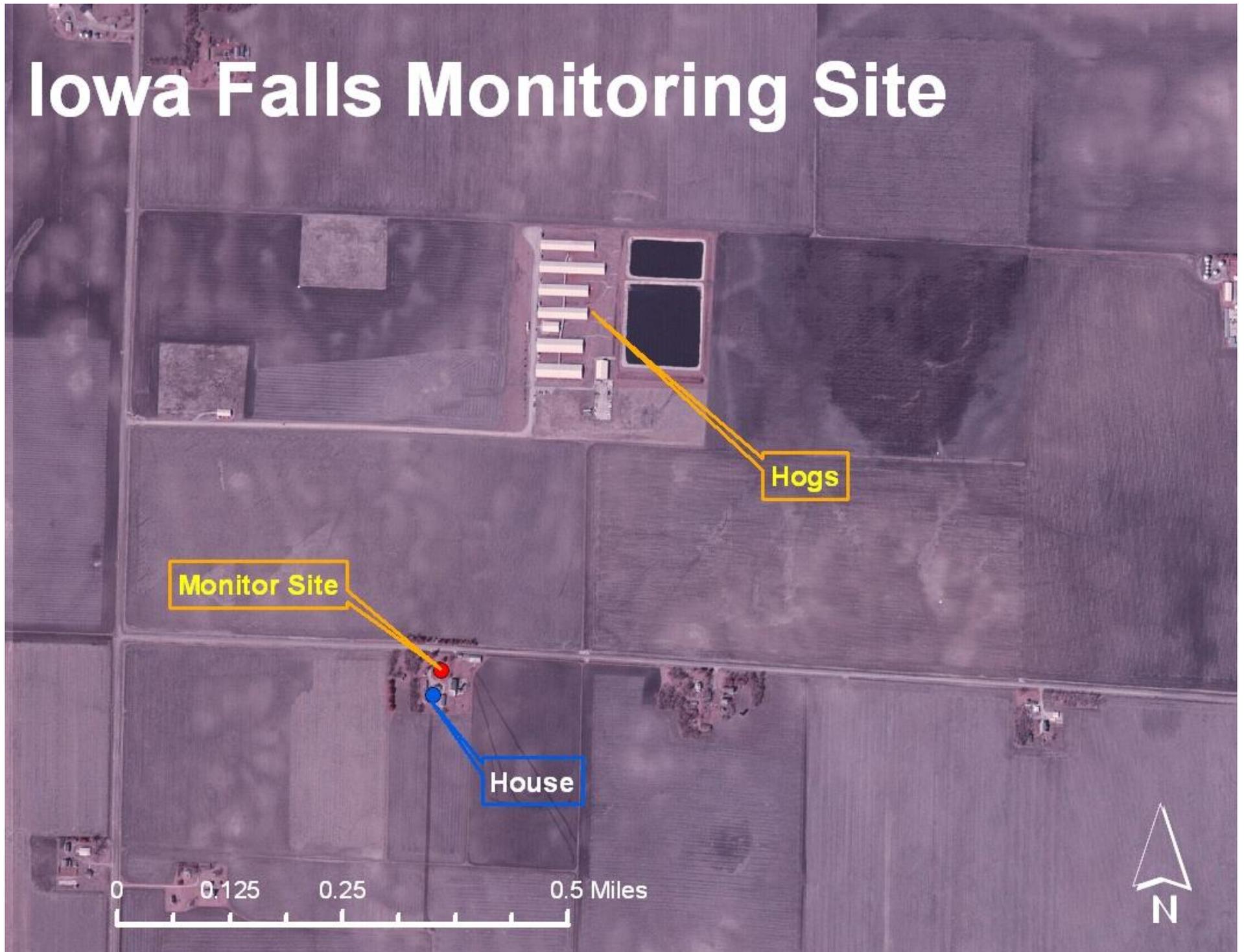
Goldfield Monitoring Site



Iowa Falls

The Iowa Falls monitoring site was located in Hardin County, Iowa. Monitoring at the site began on May 28, 2004 for ammonia and on April 30, 2004 for hydrogen sulfide. Monitoring for both gases ended on December 31, 2007. This monitoring site was located near the Iowa Select Farms - Stockdale Sow Site which was permitted for 1,502,500 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Iowa Falls has an AQS identification number of 19-083-0004.

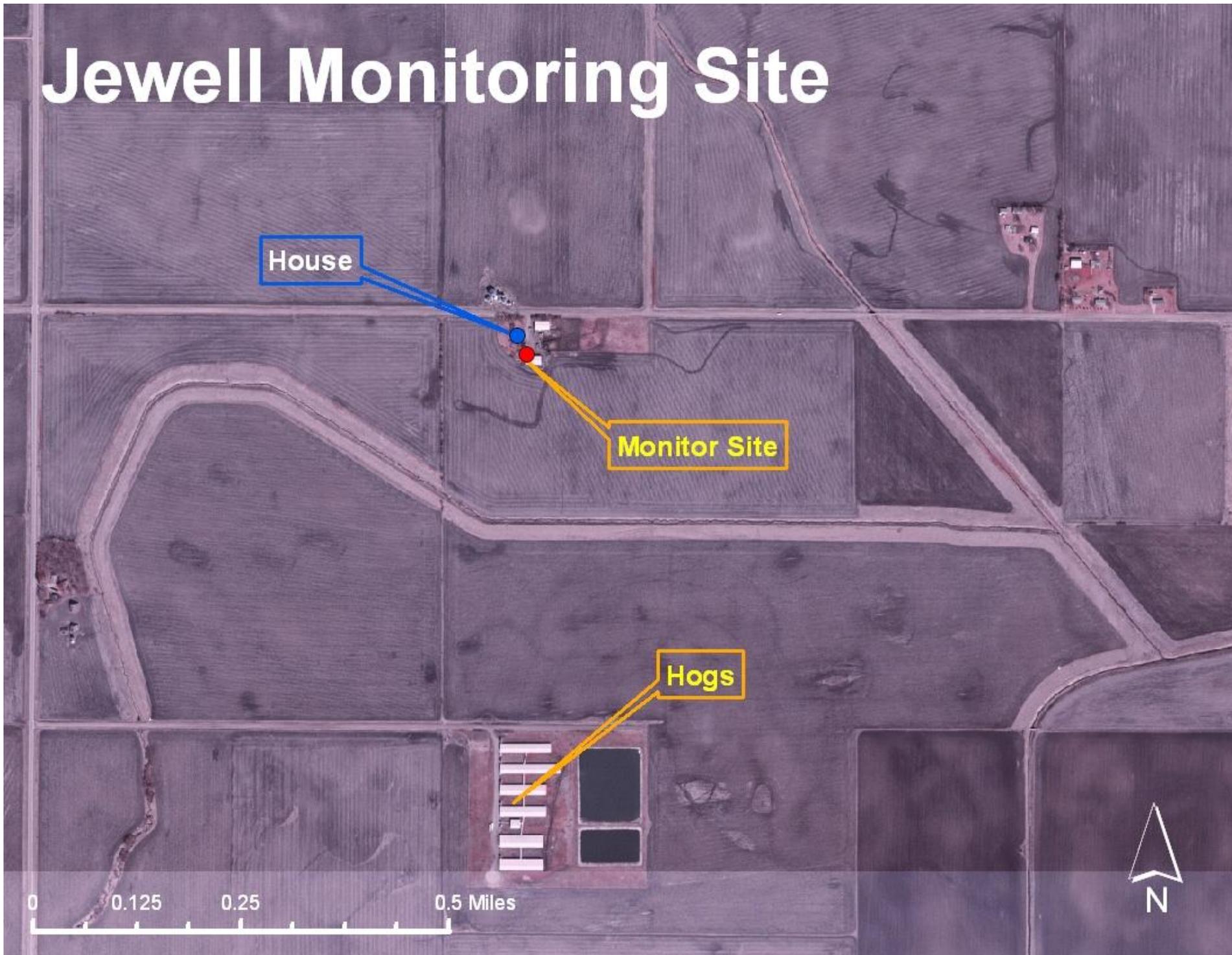
Iowa Falls Monitoring Site



Jewell

The Jewell monitoring site was located in Hamilton County, Iowa. Monitoring at the site began on July 27, 2004 for both ammonia and hydrogen sulfide. Monitoring for both gases ended on December 31, 2007. This monitoring site was located near the Iowa Select Farms - Miller Sow operation which was permitted for 1,462,500 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Jewell has an AQS identification number of 19-079-0009.

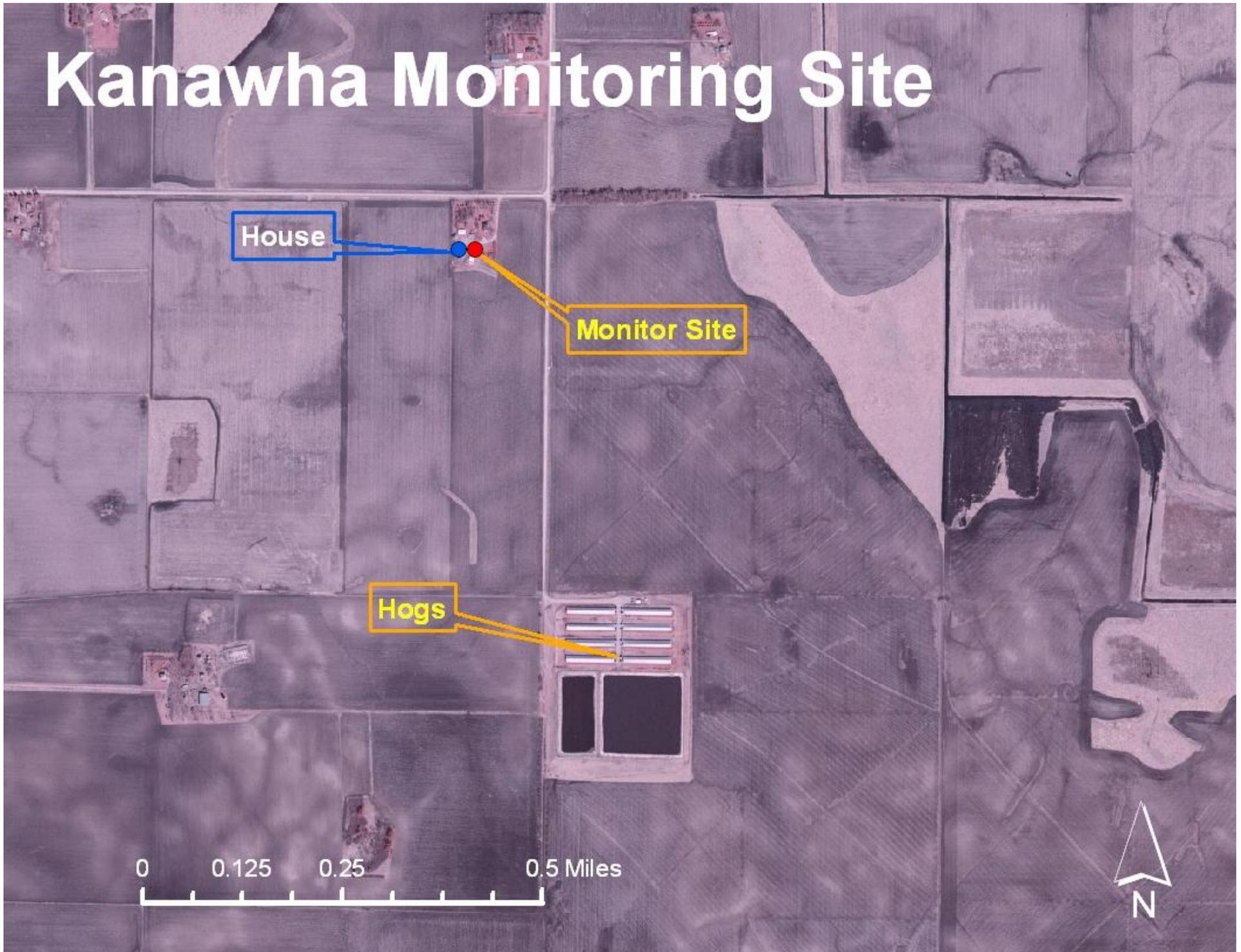
Jewell Monitoring Site



Kanawha

The Kanawha monitoring site was located in Hancock County, Iowa. Monitoring at the site began on June 30, 2004 for ammonia and hydrogen sulfide. Monitoring for both gases ended on December 31, 2007. This monitoring site was located near the Iowa Select Farms - Fishjohn Swine Finishing operation which was permitted for 2,310,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Kanawha has an AQS identification number of 19-081-0008.

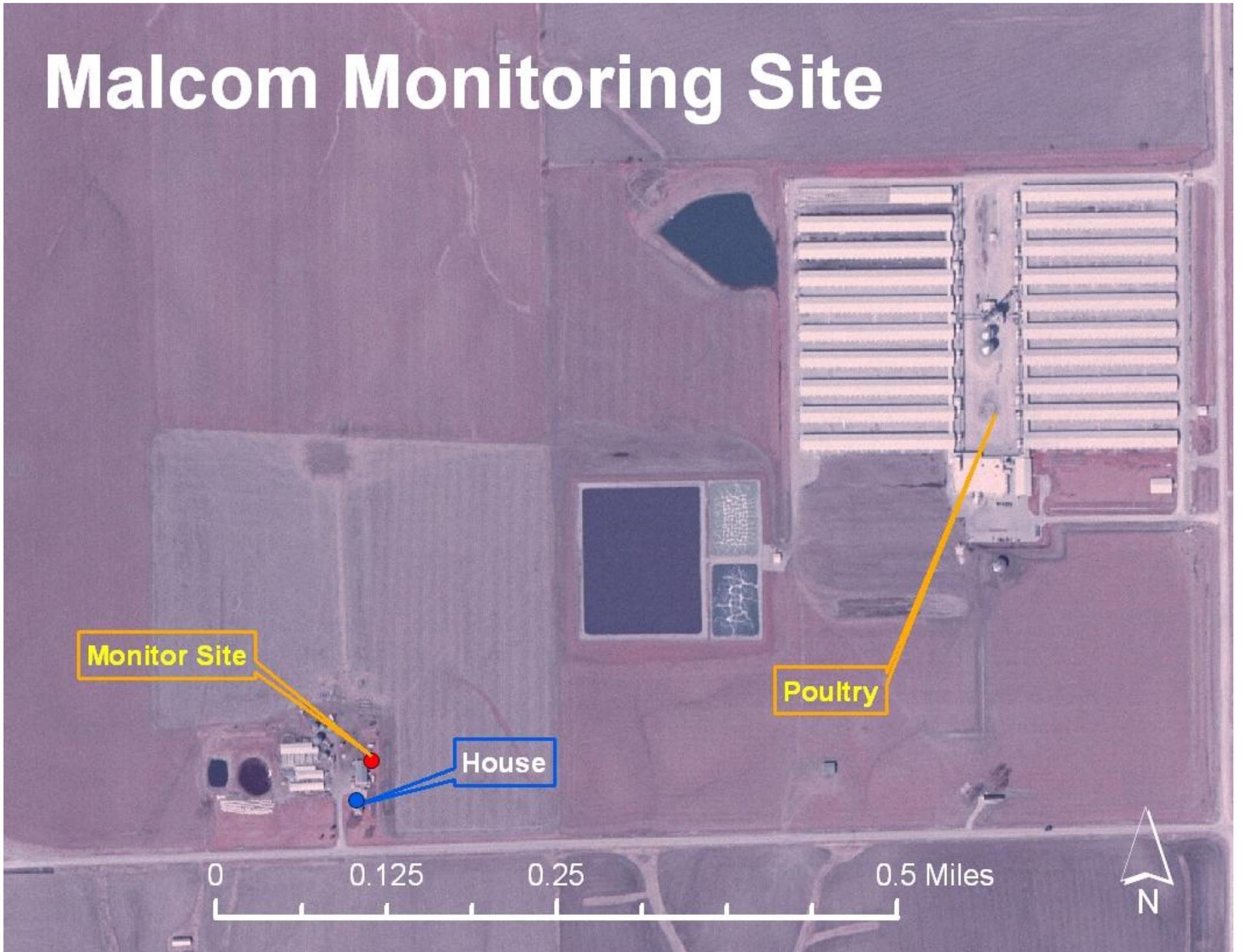
Kanawha Monitoring Site



Malcom

The Malcom monitoring site was located in Poweshiek County, Iowa. Monitoring at the site began on August 21, 2003 and May 1, 2003 for ammonia and hydrogen sulfide respectively. Monitoring for both gases ended on June 16, 2004. This monitoring site was located near a Poultry operation owned by Fremont Farms and permitted for 15,600,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Fremont Farms had an original construction permit issued on June 19, 1998. Since the permit was issued before April 1, 2002, the facility stored manure in dry form and had an egg-break water storage structure there was no separation distance requirement and the storage structure was not subject to AFO rules. This removed the site from the network and monitoring was stopped. Malcom has an AQS identification number of 19-157-0005.

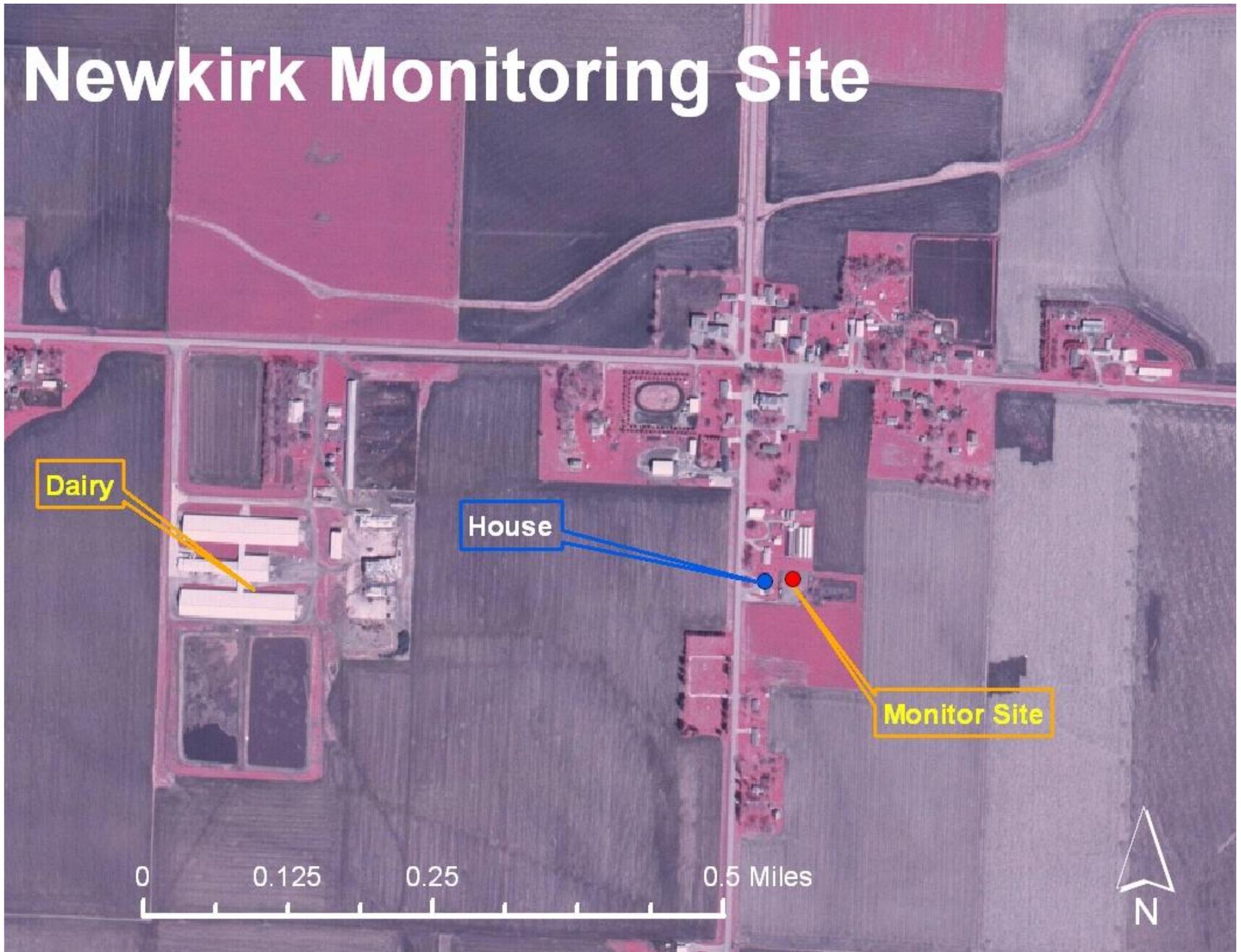
Malcom Monitoring Site



Newkirk

The Newkirk monitoring site was located in Sioux County, Iowa. Monitoring for ammonia began on July 13, 2004 and for hydrogen sulfide on July 12, 2004. Monitoring at Newkirk ended on December 31, 2007. This monitoring site was located near a Dairy Cattle operation operated by Hickory Hills Dairy and permitted for 2,390,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Newkirk has an AQS identification number of 19-167-0004.

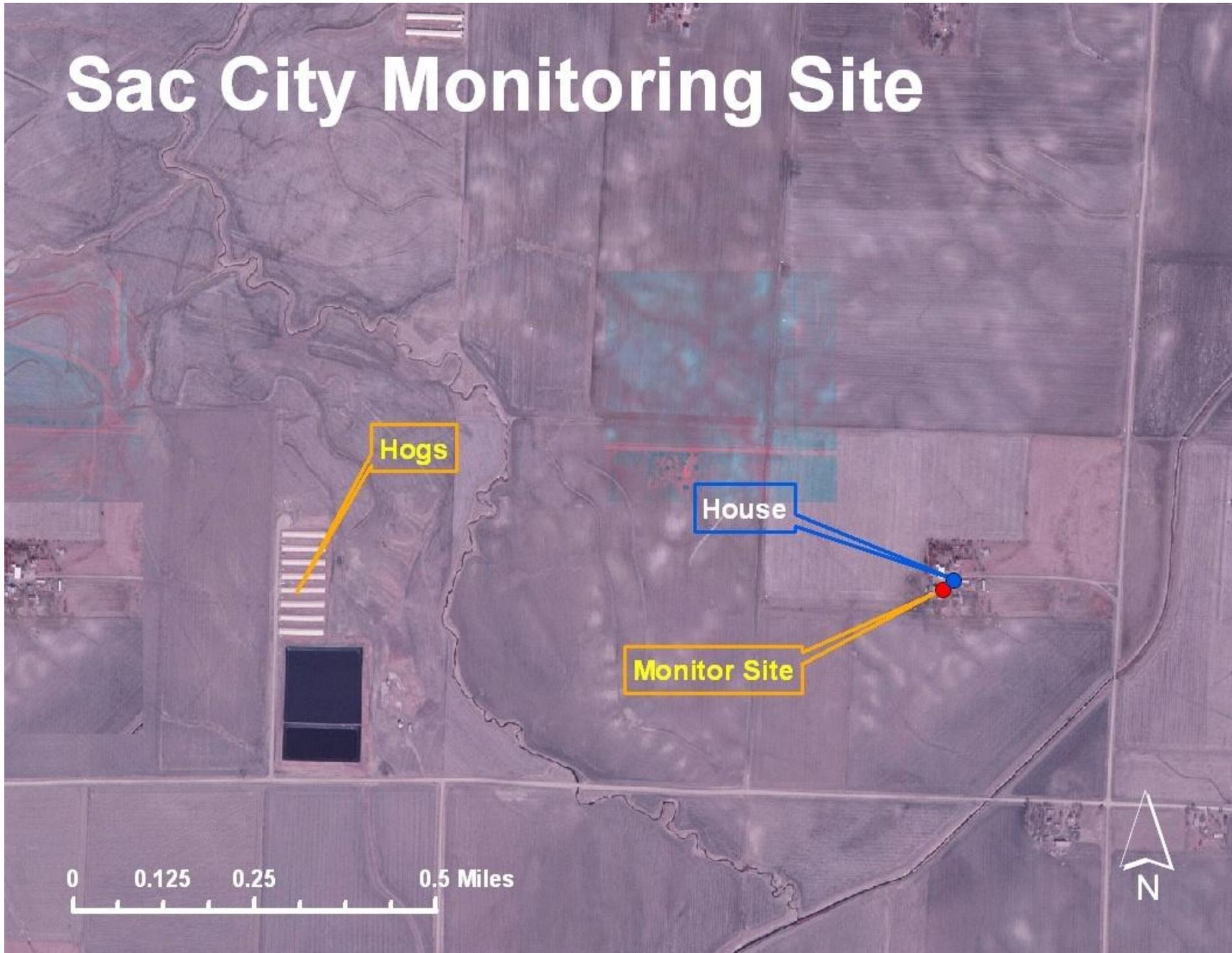
Newkirk Monitoring Site



Sac City

The Sac City monitoring site was located in Sac County, Iowa. Monitoring for ammonia began on June 1, 2004 and monitoring for hydrogen sulfide on July 7, 2004. Monitoring for both gases ended on December 31, 2007. This monitoring site was located near the Iowa Select Farms - Withum Swine Finishing operation which was permitted for 1,890,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. Sac City has an AQS identification number of 19-161-0005.

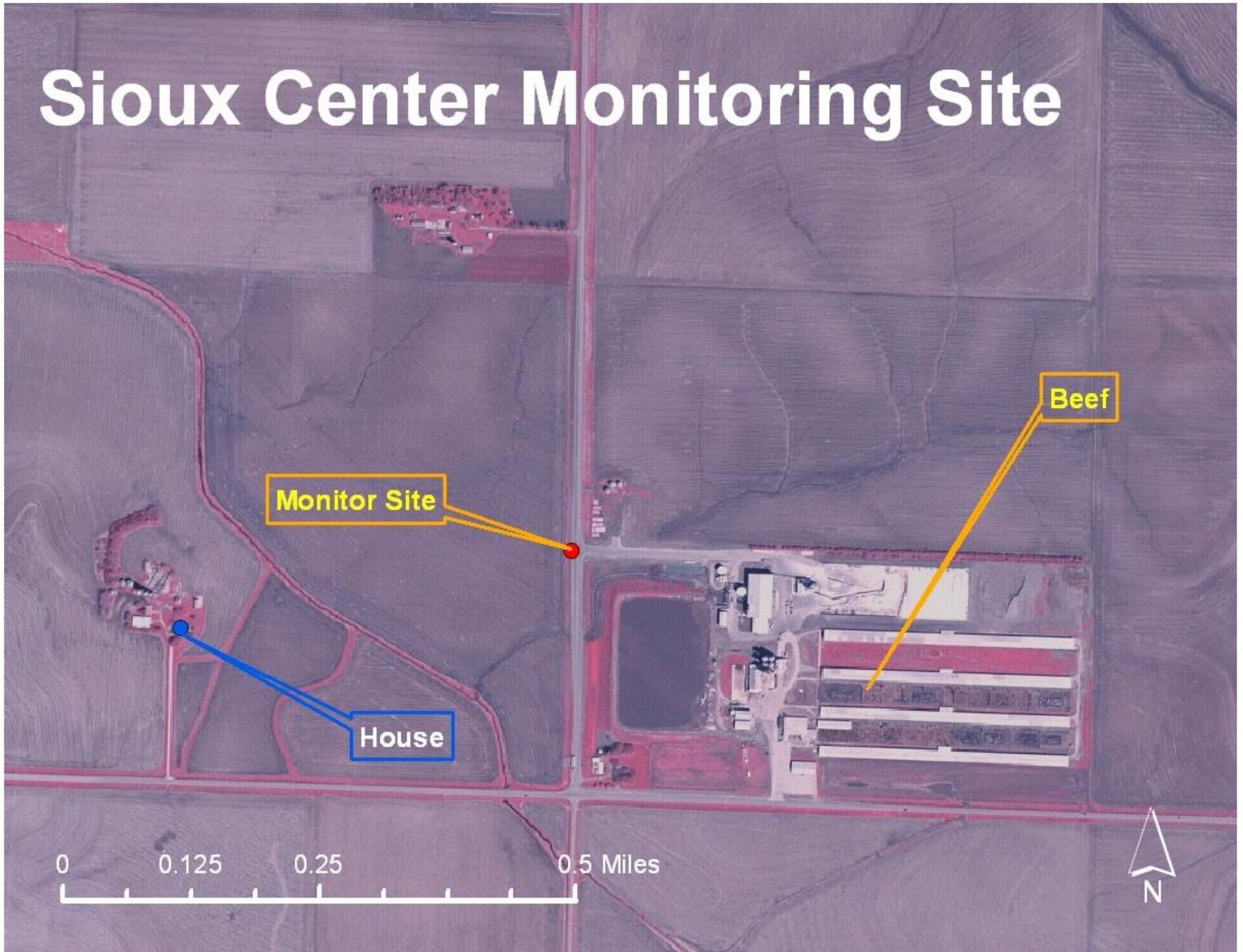
Sac City Monitoring Site



Sioux Center

The Sioux Center monitoring site was located in Sioux County, Iowa. Monitoring at the Sioux Center site for ammonia began on May 18, 2003 and for hydrogen sulfide on May 5, 2003. Monitoring for ammonia ended on April 19, 2004 and monitoring for hydrogen sulfide ended on April 22, 2004. This monitoring site was located near a Beef Cattle operation owned by Sioux Co-op and permitted for 13,000,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence. The new monitoring siting criteria, adopted in 2004, were not met because the monitor was too far away from any house. Sioux Center has an AQS identification number of 19-167-0003.

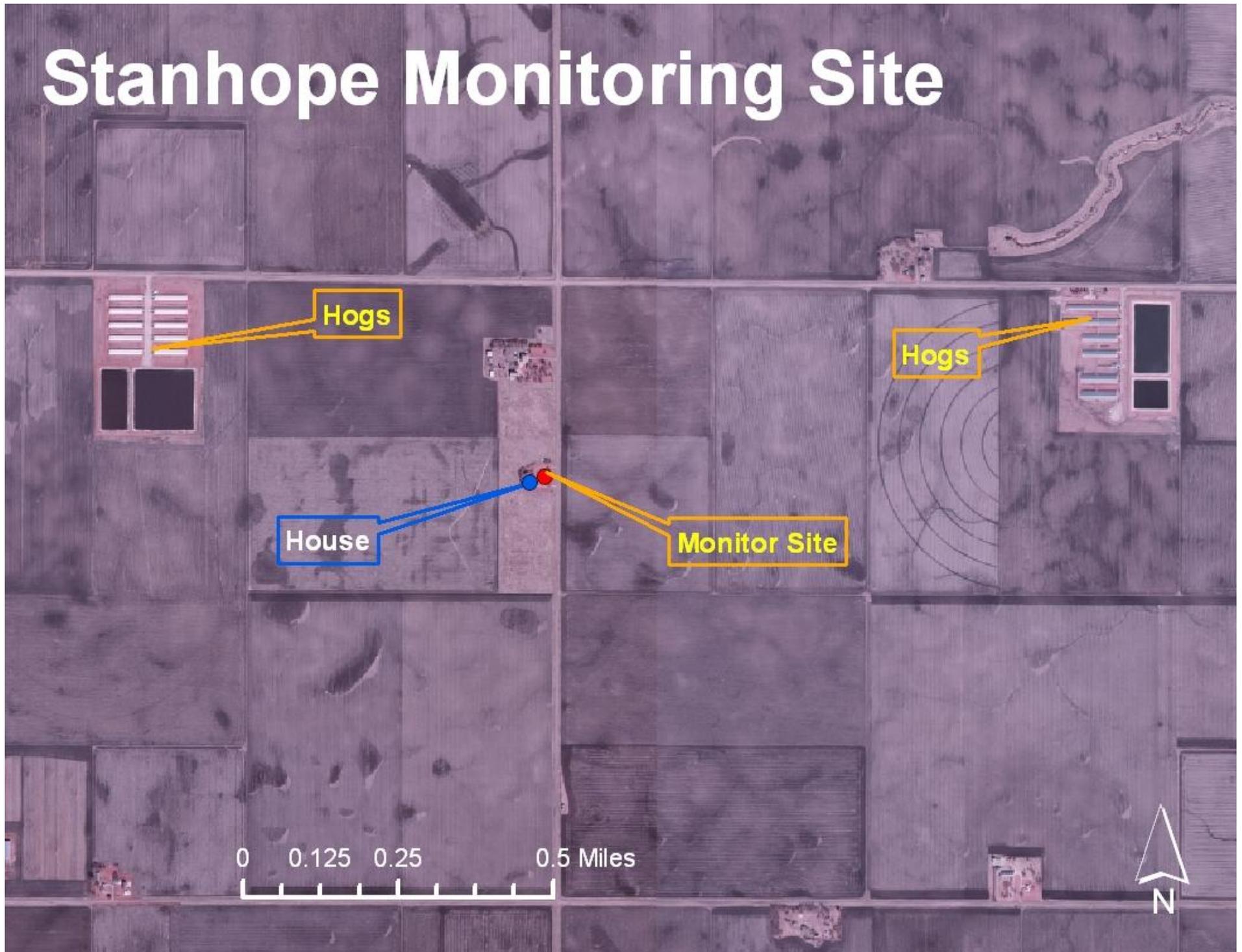
Sioux Center Monitoring Site



Stanhope

The Stanhope monitoring site was located in Hamilton County, Iowa. Monitoring for ammonia and hydrogen sulfide began on May 15, 2004. Monitoring for both gases ended on December 31, 2007. The CAFO that is closest to, and northwest, of the monitoring site is the Iowa Select Farms - Winniger Swine Finishing operation which was permitted for 2,475,000 pounds of livestock. The DeCoster Sow Unit Number 12 is east of the monitor, with a permitted weight of 1,370,145 pounds. The monitors were located in ambient air, on property associated with a residence, and near a house. Stanhope has an AQS identification number of 19-079-0008.

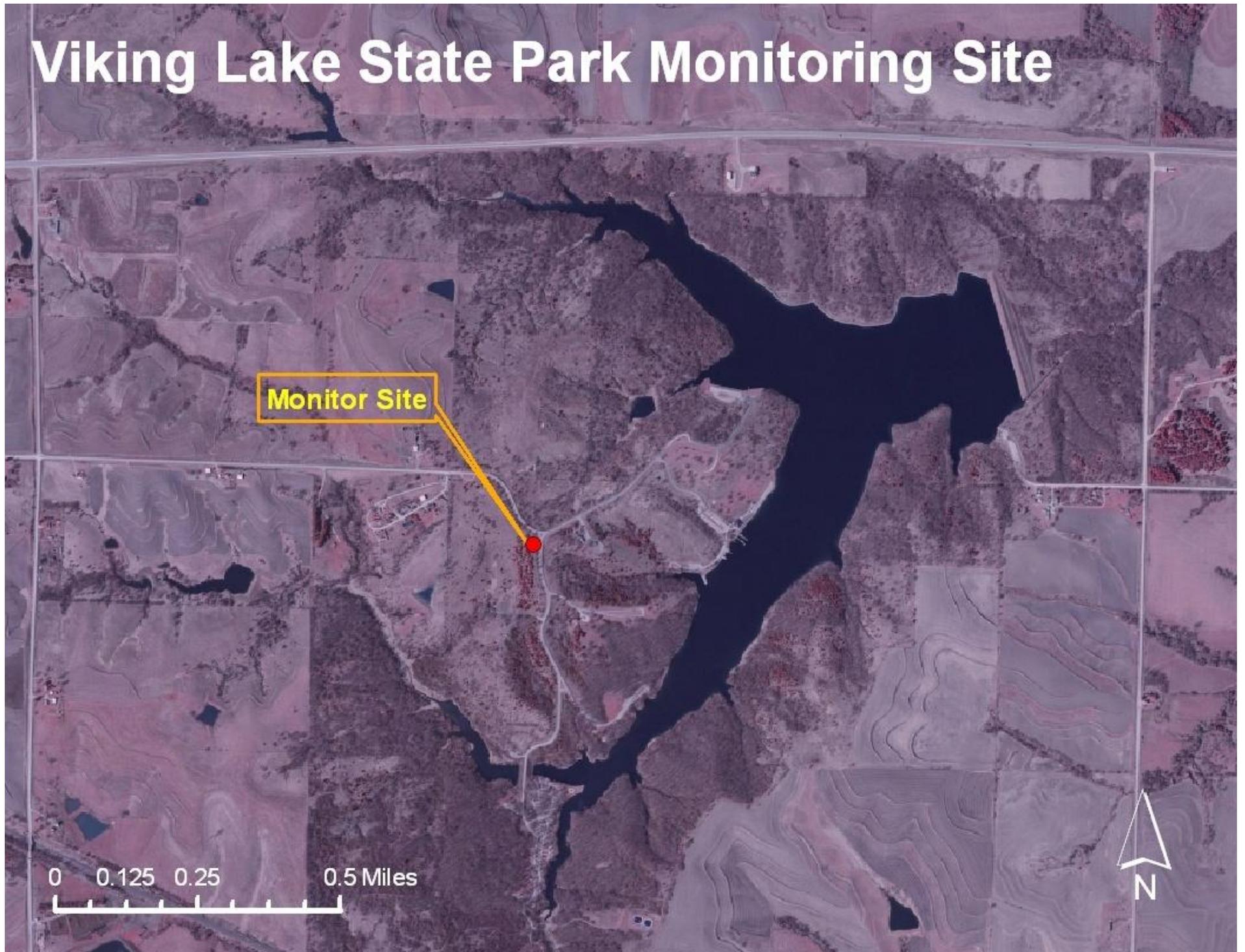
Stanhope Monitoring Site



Viking Lake

The Viking Lake monitoring site is located in Montgomery County, Iowa near Viking Lake State Park. The site began monitoring for ammonia on April 16, 2003 and continues through December 31, 2007. This monitoring site has been used as a background site for comparison to other sites. The monitor is located in ambient air, on property not associated with a residence, and away from animal feeding operations. Viking Lake has an AQS identification number of 19-137-0002.

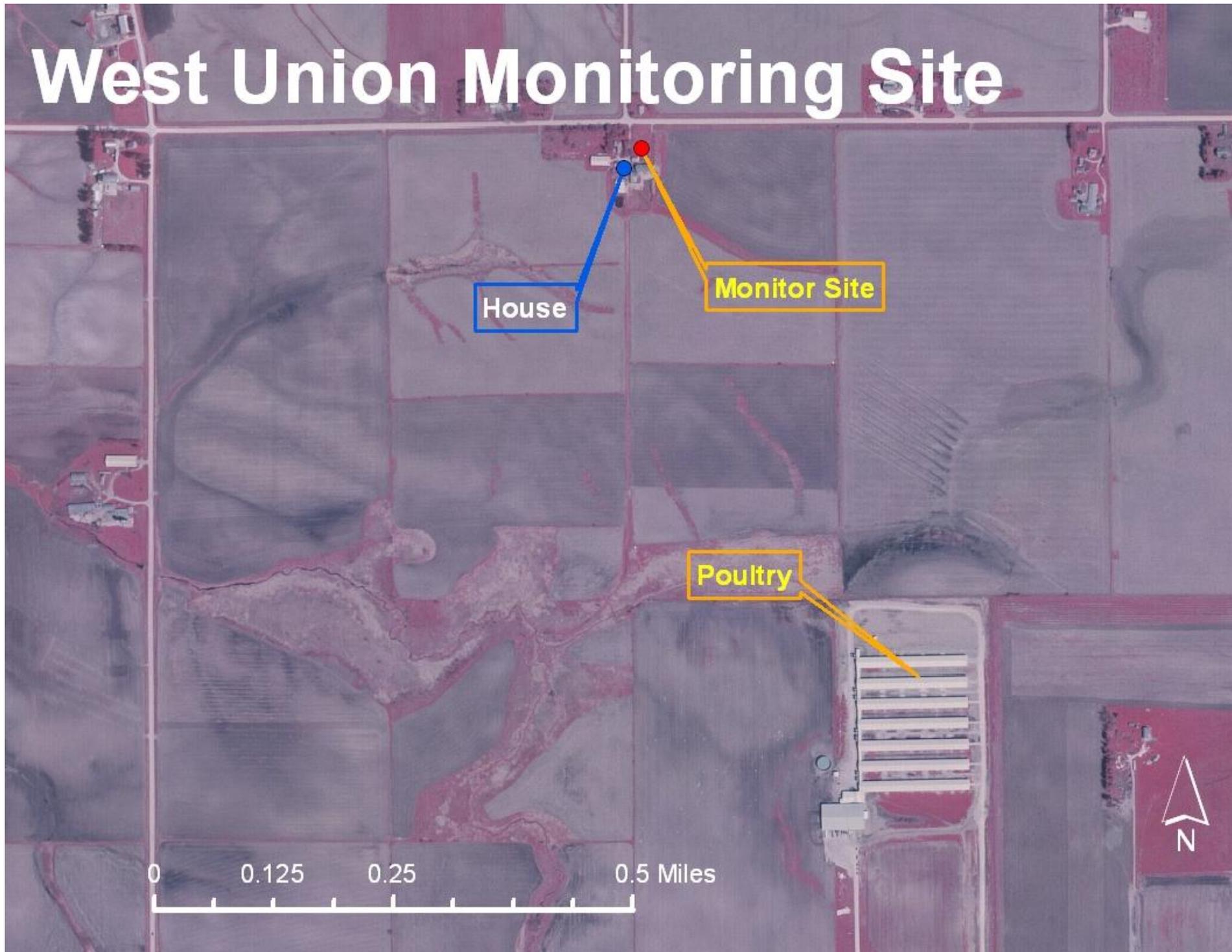
Viking Lake State Park Monitoring Site



West Union

The West Union monitoring site was located in Fayette County, Iowa. Monitoring for ammonia and hydrogen sulfide started on July 1, 2004. Monitoring for both gases ended on December 31, 2007. This monitoring site was located near a Poultry operation operated by IVA Inc. Eggs which was permitted for 3,030,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, and near a house. West Union has an AQS identification number of 19-065-0003.

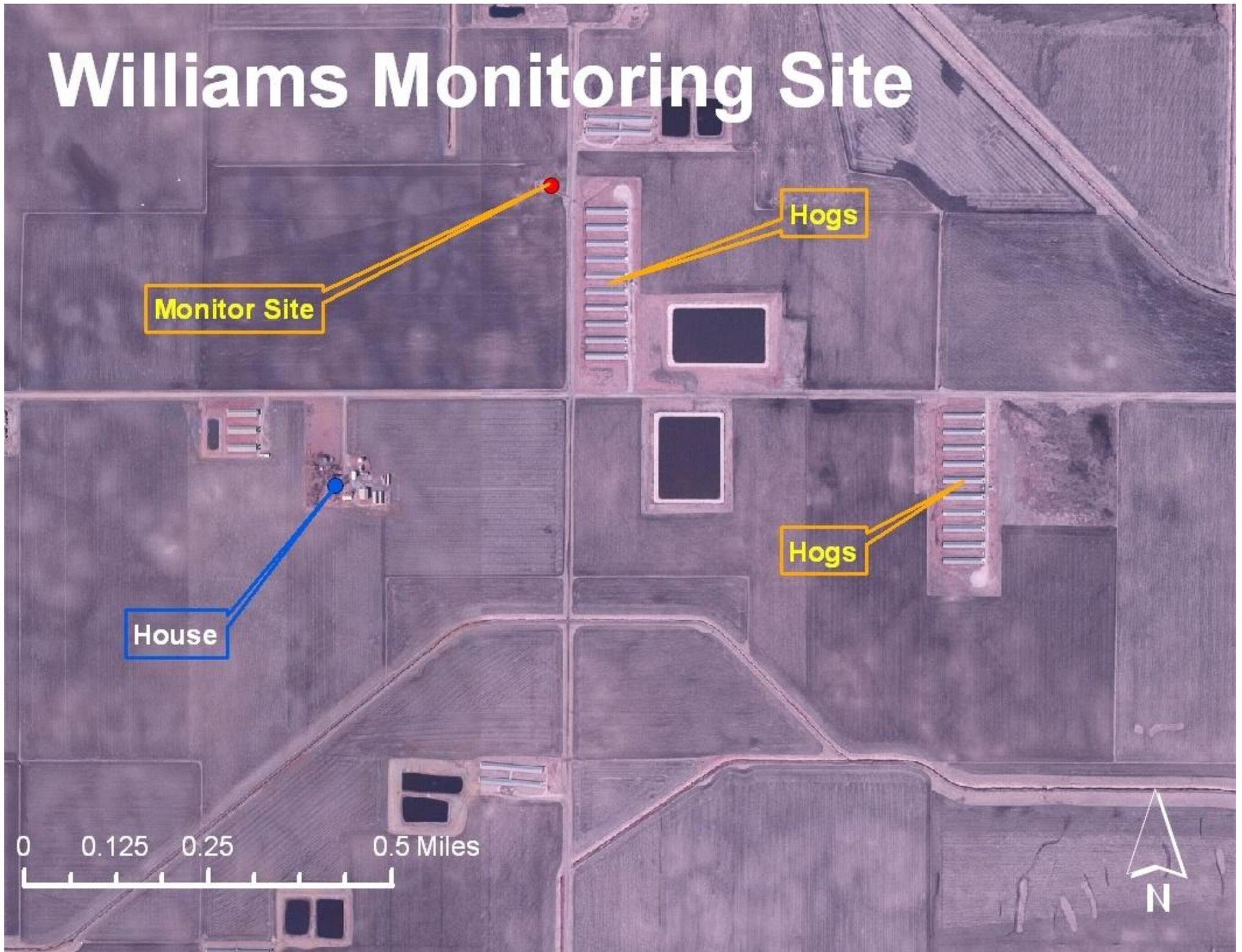
West Union Monitoring Site



Williams

The Williams monitoring site was located in Hamilton County, Iowa. Monitoring at the site for ammonia started on March 14, 2003 and for hydrogen sulfide on May 1, 2002. Monitoring for both gases ended on June 16, 2004. The two largest CAFO's located near the monitors (seen in photo below) are both DeCoster Swine Finishing Units. The monitor is directly west and right across the road from the buildings of Unit #7. Also, the monitor is about 0.4 miles, and northwest, of the lagoons of Units #6 and 7. Both swine finishing operations were permitted for 2,100,000 pounds of livestock. The monitors were located in ambient air, on property not associated with a residence. Since the monitors were not located within 100 meters of a house, the site did not meet siting criteria established in 2004 for the new network and monitoring was stopped. Williams has an AQS identification number of 19-079-0007.

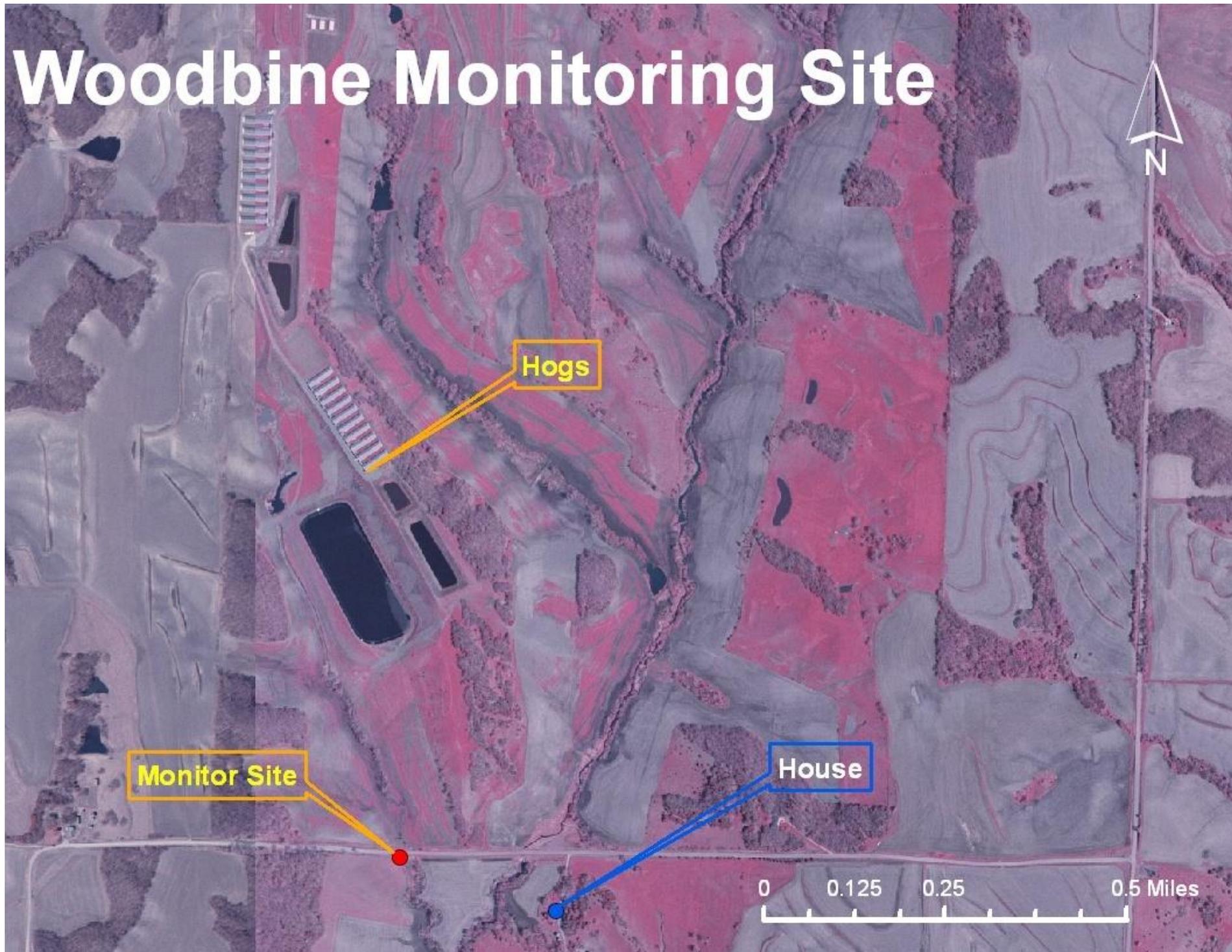
Williams Monitoring Site



Woodbine

The Woodbine monitoring site was located in Harrison County, Iowa. Monitoring at the site began on April 29, 2003 for ammonia and hydrogen sulfide. Monitoring for both gases ended on May 6, 2004. This monitoring site was located near the Swine operation of Gieman/Woodbine Finishers which was permitted for 3,012,000 pounds of livestock. The monitors were located in ambient air, on property associated with a residence, but too far from a house to meet the monitor siting criteria for the new network so monitoring was stopped. Woodbine has an AQS identification number of 19-085-0006.

Woodbine Monitoring Site



Summary of Hydrogen Sulfide CAFO Data

Table 1. Annual 8th highest daily maximum sample values for daily Hydrogen Sulfide for 2002-2007 CAFO sites.
Data is displayed in parts per billion (ppb).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002				5.2											16.2	
2003	44.1		2.5	9.6	1.0				1.1			199			14.7	21.9
2004		5.8	4.2	7.0	4.6	4.8	3.3	6.5	1.0	10.5	6.4	22.4	7.0	0.6	6.0	12.8
2005		5.0		7.1	6.5	5.4	18.8	6.1		19.3	10.6		14.4	0.8		
2006		4.1		6.0	5.1	6.9	11.4	6.3		23.4	12.5		9.4	1.9		
2007		4.2		6.4	5.1	6.9	8.5	6.7		23.1	11.6		14.3	1.4		

 Location MEETS siting criteria
 Location does NOT MEET siting criteria

 Over the standard
 Under the standard and MEETS completeness criteria
 Under the standard and does NOT MEET completeness criteria
 No Data

Table 2. Annual percent completeness for daily Hydrogen Sulfide data (2002-2007).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002				75%											67%	
2003	41%		21%	99%	7%				67%			66%			97%	58%
2004		51%	44%	100%	73%	67%	40%	48%	45%	47%	48%	31%	60%	50%	46%	31%
2005		90%		86%	93%	100%	99%	94%		95%	96%		100%	100%		
2006		99%		100%	96%	97%	92%	100%		96%	96%		99%	100%		
2007		99%		90%	100%	100%	96%	99%		100%	100%		99%	95%		

	MEETS 90% annual completeness criteria
	Does NOT MEET 90% annual completeness criteria
	No Data

Table 3. Quarterly percent completeness for daily Hydrogen Sulfide data (2002-2007).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
1																
2				99%											67%	
3				100%											99%	
4				100%											100%	
2003																
1				98%											100%	
2	74%			100%					67%			62%			100%	68%
3	90%			100%					100%			100%			88%	75%
4			85%	100%	28%				100%			100%			100%	87%
2004																
1			93%	100%	74%				98%			100%			100%	87%
2		1%	85%	100%	56%	67%			84%			23%	41%		84%	38%
3		100%		100%	62%	100%	67%	100%		87%	92%		99%	99%		
4		100%		100%	100%	100%	92%	90%		100%	100%		100%	100%		
2005																
1		100%		100%	100%	100%	100%	100%		100%	99%		100%	100%		
2		76%		100%	100%	100%	100%	100%		100%	100%		100%	100%		
3		100%		92%	86%	100%	99%	87%		100%	100%		100%	100%		
4		85%		53%	88%	100%	99%	88%		82%	84%		100%	100%		
2006																
1		100%		100%	100%	100%	100%	100%		89%	100%		98%	100%		
2		100%		100%	90%	100%	90%	100%		100%	100%		100%	100%		
3		98%		100%	96%	87%	78%	100%		95%	100%		99%	100%		
4		100%		100%	100%	100%	99%	100%		100%	85%		100%	100%		
2007																
1		99%		83%	99%	100%	93%	97%		100%	99%		96%	99%		
2		99%		100%	100%	100%	89%	100%		100%	100%		100%	100%		
3		100%		77%	100%	99%	100%	100%		100%	100%		100%	100%		
4		100%		100%	100%	100%	100%	100%		100%	100%		100%	83%		

MEETS 75% quarterly completeness criteria
 Does NOT MEET 75% quarterly completeness criteria
 No Data

Table 4. Statistical summary for daily Hydrogen Sulfide for 2002-2007 CAFO sites. Data is displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
Minimum				0.0											0.0	
Maximum				15.1											24.9	
Average				1.6											3.8	
2003																
Minimum	0.0		0.1	0.0	0.2			0.0				0.0			0.0	0.0
Maximum	101.8		4.8	20.1	2.3			3.6				330.3			29.9	36.8
Average	8.3		1.1	1.7	0.9			0.2				44.1			2.8	5.3
2004																
Minimum		0.1	0.1	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1
Maximum		11.7	12.9	17.9	9.3	8.4	5.1	15.3	2.0	25.1	11.2	81.6	20.4	2.4	10.4	18.7
Average		1.8	1.4	2.2	1.4	1.0	0.7	2.1	0.3	2.5	1.7	6.4	1.9	0.1	2.1	3.6
2005																
Minimum		0.0		0.0	0.2	0.0	0.0	0.0		0.0	0.0		0.0	0.0		
Maximum		8.0		18.6	9.1	16.2	32.4	11.2		143.7	19.5		24.6	2.3		
Average		1.4		2.1	1.7	1.3	2.9	1.9		2.8	2.2		2.6	0.1		
2006																
Minimum		0.2		0.0	0.0	0.1	0.0	0.0		0.0	0.2		0.2	0.0		
Maximum		6.1		25.2	7.6	13.5	28.8	7.5		40.7	51.9		33.0	3.9		
Average		1.3		1.8	0.9	1.3	2.1	1.3		3.3	2.7		2.2	0.5		
2007																
Minimum		0.1		0.0	0.0	0.1	0.0	0.0		0.0	0.0		0.0	0.0		
Maximum		7.0		18.6	12.3	13.6	22.0	11.6		54.2	15.1		44.5	2.2		
Average		1.2		1.7	1.1	1.4	1.9	1.6		3.6	2.4		2.6	0.4		

	Over the standard
	Under the standard and MEETS completeness criteria
	Under the standard and does NOT MEET completeness criteria
	No Data

Table 5-a. Top ten maximum sample values for daily Hydrogen Sulfide for 2002-2004 CAFO sites, displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
1				15.1											24.9	
2				10.6											22.4	
3				6.5											21.7	
4				6.5											17.9	
5				6.4											17.0	
6				6.4											16.3	
7				5.4											16.2	
8				5.2											16.2	
9				5.1											16.2	
10				5.0											15.9	
2003																
1	101.8		4.8	20.1	2.3				3.6			330.3			29.9	36.8
2	81.4		3.8	12.0	2.2				1.9			296.2			28.9	34.2
3	69.6		3.2	11.9	1.7				1.7			277.9			27.3	31.4
4	64.5		2.8	11.6	1.5				1.5			255.3			23.2	27.9
5	57.8		2.8	11.1	1.4				1.5			249.2			16.5	23.7
6	46.7		2.7	10.5	1.3				1.1			238.0			16.4	23.1
7	46.0		2.6	10.4	1.2				1.1			200.0			15.3	22.2
8	44.1		2.5	9.6	1.0				1.1			199.0			14.7	21.9
9	40.6		2.5	7.9	1.0				1.0			197.0			14.0	21.9
10	38.4		2.4	7.8	0.9				1.0			195.0			12.6	21.6
2004																
1		11.7	12.9	17.9	9.3	8.4	5.1	15.3	2.0	25.1	11.2	81.6	20.4	2.4	10.4	18.7
2		9.4	11.5	12.0	8.2	7.5	4.5	7.7	1.6	25.1	9.2	34.2	16.5	1.2	9.1	16.7
3		7.4	7.9	10.6	6.9	6.4	4.4	7.7	1.3	25.0	9.0	27.8	12.7	1.1	9.0	16.2
4		6.5	7.7	9.6	5.9	5.5	4.2	7.6	1.3	18.1	8.6	23.6	8.6	0.7	8.9	15.6
5		6.4	6.0	8.7	5.7	5.5	3.9	7.4	1.3	16.3	8.5	23.5	8.1	0.7	8.7	14.8
6		6.0	5.4	7.9	5.3	5.1	3.8	7.0	1.2	13.4	8.2	23.5	7.6	0.6	8.6	14.3
7		6.0	5.1	7.2	4.7	5.0	3.4	6.9	1.2	11.8	7.2	22.4	7.6	0.6	7.9	13.3
8		5.8	4.2	7.0	4.6	4.8	3.3	6.5	1.0	10.5	6.4	22.4	7.0	0.6	6.0	12.8
9		5.7	4.2	6.9	4.5	4.6	3.3	6.4	0.9	10.4	6.2	20.2	6.8	0.5	5.0	11.9
10		4.9	4.2	6.6	4.1	4.6	2.6	6.0	0.9	9.9	5.1	19.8	6.0	0.5	4.8	11.7

Table 5-b. Top ten maximum sample values for daily Hydrogen Sulfide for 2005-2007 CAFO sites, displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2005																
1		8.0		18.6	9.1	16.2	32.4	11.2		143.7	19.5		24.6	2.3		
2		7.7		14.7	8.9	12.9	31.2	7.2		47.8	15.9		23.8	2.2		
3		7.5		13.4	8.9	12.6	31.0	7.0		36.6	14.0		23.4	1.7		
4		6.5		10.2	7.8	10.2	24.8	6.6		27.5	13.2		19.1	1.4		
5		6.3		7.9	7.4	8.1	21.8	6.5		25.1	13.1		19.0	1.1		
6		6.0		7.3	7.1	7.0	20.0	6.4		23.7	11.5		15.5	0.9		
7		5.5		7.1	6.7	5.7	19.9	6.3		23.2	11.1		14.7	0.9		
8		5.0		7.1	6.5	5.4	18.8	6.1		19.3	10.6		14.4	0.8		
9		4.9		6.5	6.4	5.3	18.7	6.0		17.8	10.2		12.7	0.8		
10		4.7		6.5	6.1	5.3	18.1	5.9		17.5	10.2		12.7	0.7		
2006																
1		6.1		25.2	7.6	13.5	28.8	7.5		40.7	51.9		33.0	3.9		
2		5.2		16.2	6.4	12.9	24.5	7.1		29.4	23.9		25.0	2.8		
3		5.2		6.9	6.3	12.2	20.0	7.0		28.7	17.7		13.9	2.6		
4		5.0		6.8	5.5	11.4	19.4	6.8		28.5	16.7		12.3	2.5		
5		4.8		6.8	5.4	8.3	12.7	6.6		28.0	16.1		11.6	2.5		
6		4.5		6.3	5.4	8.1	12.4	6.5		26.1	16.0		10.2	2.1		
7		4.3		6.2	5.2	8.0	11.9	6.3		25.7	13.5		9.4	1.9		
8		4.1		6.0	5.1	6.9	11.4	6.3		23.4	12.5		9.4	1.9		
9		4.1		5.9	5.1	6.8	10.5	6.0		22.3	12.5		9.2	1.8		
10		4.0		5.3	4.9	5.8	9.0	6.0		21.7	12.5		8.6	1.7		
2007																
1		7.0		18.6	12.3	13.6	22.0	11.6		54.2	15.1		44.5	2.2		
2		5.6		15.2	8.3	10.1	15.4	8.3		35.7	12.8		27.3	1.8		
3		5.4		13.7	7.3	9.0	11.6	8.2		32.8	12.4		23.4	1.8		
4		4.8		9.4	7.1	8.7	11.4	8.2		29.5	12.3		22.9	1.7		
5		4.8		7.3	6.9	7.4	11.0	8.0		26.3	12.2		20.0	1.7		
6		4.6		7.1	5.9	7.3	9.9	7.1		24.5	12.0		17.6	1.6		
7		4.3		6.5	5.4	7.3	8.6	6.7		23.2	11.9		15.8	1.5		
8		4.2		6.4	5.1	6.9	8.5	6.7		23.1	11.6		14.3	1.4		
9		4.1		6.4	4.9	6.3	8.4	6.4		21.4	11.4		14.0	1.4		
10		4.1		6.3	4.7	5.4	7.7	6.3		20.6	9.5		13.1	1.3		

Table 6-a. Percentiles for daily Hydrogen Sulfide for 2002-2004 CAFO sites, displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
100%				15.1											24.9	
90%				3.5											11.5	
80%				2.4											6.5	
70%				1.8											4.1	
60%				1.5											2.6	
50%				1.1											1.6	
40%				0.9											1.1	
30%				0.6											0.7	
20%				0.4											0.5	
10%				0.2											0.0	
2003																
100%	101.8		4.8	20.1	2.3				3.6			330.3			29.9	36.8
90%	22.3		2.5	3.8	1.6				0.7			116.1			6.0	12.8
80%	9.6		1.9	2.2	1.3				0.4			74.2			4.2	8.2
70%	5.8		1.4	1.6	1.0				0.2			49.0			2.9	6.4
60%	3.2		1.0	1.2	0.8				0.0			32.7			2.1	4.1
50%	2.1		0.7	1.0	0.6				0.0			18.3			1.5	2.7
40%	1.4		0.6	0.8	0.6				0.0			10.8			1.1	2.1
30%	0.8		0.4	0.7	0.5				0.0			6.5			0.7	1.5
20%	0.4		0.3	0.6	0.5				0.0			3.4			0.5	0.8
10%	0.1		0.2	0.3	0.4				0.0			0.6			0.4	0.5
2004																
100%		11.7	12.9	17.9	9.3	8.4	5.1	15.3	2.0	25.1	11.2	81.6	20.4	2.4	10.4	18.7
90%		3.8	3.3	4.5	3.0	2.3	1.9	4.9	0.8	5.6	3.8	19.3	3.7	0.4	4.1	10.1
80%		2.7	2.0	3.0	2.0	1.5	1.2	3.7	0.6	3.0	2.7	9.4	2.6	0.2	2.7	6.8
70%		2.0	1.2	2.5	1.5	1.1	0.7	2.7	0.4	2.2	2.0	7.9	1.9	0.1	2.0	4.5
60%		1.6	0.9	2.0	1.1	0.7	0.5	1.8	0.3	1.5	1.5	4.7	1.5	0.0	1.8	2.6
50%		1.1	0.7	1.6	0.9	0.6	0.2	1.4	0.1	1.0	0.9	2.4	1.1	0.0	1.5	1.2
40%		0.9	0.5	1.3	0.8	0.4	0.1	1.0	0.0	0.8	0.6	1.7	1.0	0.0	1.3	0.7
30%		0.7	0.5	1.0	0.7	0.3	0.0	0.7	0.0	0.7	0.4	0.9	0.7	0.0	1.2	0.5
20%		0.6	0.4	0.9	0.6	0.2	0.0	0.5	0.0	0.5	0.3	0.5	0.6	0.0	1.0	0.4
10%		0.5	0.3	0.7	0.4	0.1	0.0	0.3	0.0	0.3	0.1	0.2	0.4	0.0	0.7	0.3

Table 6-b. Percentiles for daily Hydrogen Sulfide for 2005-2007 CAFO sites, displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2005																
100%		8.0		18.6	9.1	16.2	32.4	11.2		143.7	19.5		24.6	2.3		
90%		3.2		4.0	4.0	3.6	5.7	4.2		5.2	5.8		6.0	0.4		
80%		1.9		2.8	2.5	1.6	3.9	2.8		2.7	3.6		3.9	0.2		
70%		1.5		2.2	1.8	1.2	2.9	2.1		1.7	2.3		2.7	0.1		
60%		1.2		2.0	1.4	0.8	1.9	1.7		1.2	1.6		1.8	0.0		
50%		0.9		1.6	1.2	0.7	1.5	1.5		1.0	1.1		1.4	0.0		
40%		0.7		1.4	0.9	0.5	1.2	1.1		0.8	0.8		1.0	0.0		
30%		0.6		1.1	0.8	0.4	0.8	0.9		0.6	0.5		0.8	0.0		
20%		0.5		0.9	0.7	0.3	0.5	0.7		0.4	0.4		0.6	0.0		
10%		0.4		0.6	0.6	0.1	0.2	0.5		0.3	0.2		0.4	0.0		
2006																
100%		6.1		25.2	7.6	13.5	28.8	7.5		40.7	51.9		33.0	3.9		
90%		2.7		3.6	2.3	2.8	4.7	3.1		7.6	6.1		4.3	1.0		
80%		1.9		2.6	1.3	1.7	2.8	2.0		3.5	3.9		2.8	0.7		
70%		1.3		2.1	0.9	1.3	1.9	1.4		2.2	2.9		2.2	0.6		
60%		1.1		1.7	0.7	0.9	1.4	1.2		1.8	2.0		1.7	0.5		
50%		0.9		1.4	0.5	0.7	1.1	1.0		1.6	1.4		1.4	0.4		
40%		0.8		1.1	0.4	0.6	0.9	0.8		1.3	1.1		1.1	0.3		
30%		0.7		0.8	0.3	0.5	0.8	0.6		1.1	0.7		0.9	0.3		
20%		0.6		0.6	0.2	0.4	0.6	0.3		0.9	0.6		0.7	0.2		
10%		0.4		0.4	0.2	0.3	0.4	0.0		0.6	0.4		0.5	0.0		
2007																
100%		7.0		18.6	12.3	13.6	22.0	11.6		54.2	15.1		44.5	2.2		
90%		2.4		3.3	2.9	3.0	4.6	3.8		8.2	5.9		5.6	1.0		
80%		1.7		2.2	2.1	2.0	2.7	2.1		4.5	3.8		3.0	0.7		
70%		1.3		1.8	1.1	1.4	1.9	1.6		2.8	2.7		2.2	0.5		
60%		1.0		1.5	0.8	1.1	1.4	1.4		2.2	2.0		1.7	0.4		
50%		0.8		1.2	0.6	0.8	1.1	1.1		1.8	1.5		1.3	0.3		
40%		0.6		0.9	0.3	0.6	0.8	0.9		1.5	1.2		1.0	0.3		
30%		0.6		0.8	0.2	0.5	0.6	0.7		1.3	0.8		0.8	0.2		
20%		0.4		0.6	0.1	0.4	0.5	0.4		1.1	0.5		0.6	0.1		
10%		0.3		0.3	0.0	0.3	0.3	0.3		0.8	0.2		0.4	0.0		

Table 7. Number of hours with levels over the Health Effects Value (HEV) for 2002-2007 CAFO sites.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002				0											0	
2003	23		0	0	0				0			470			0	3
2004		0	0	0	0	0	0	0	0	0	0	9	0	0	0	0
2005		0		0	0	0	3	0		4	0		0	0		
2006		0		0	0	0	0	0		2	1		1	0		
2007		0		0	0	0	0	0		4	0		1	0		

	MEETS completeness
	Does NOT MEET completeness
	No Data

Table 8. Annual percent completeness for hourly Hydrogen Sulfide data for 2002-2007 CAFO sites.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002				74%											66%	
2003	41%		21%	99%	7%				66%			65%			96%	62%
2004		50%	44%	99%	73%	66%	40%	48%	45%	47%	48%	30%	60%	50%	45%	32%
2005		90%		86%	93%	99%	99%	94%		95%	95%		99%	99%		
2006		99%		99%	96%	96%	92%	99%		96%	96%		99%	99%		
2007		99%		93%	99%	99%	97%	99%		99%	99%		98%	95%		

	MEETS 90% annual completeness
	Does NOT MEET 90% annual completeness
	No Data

Table 9. Quarterly percent completeness for hourly Hydrogen Sulfide data for 2002-2007 CAFO sites.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
1																
2				98%											66%	
3				99%											99%	
4				99%											99%	
2003																
1				99%											99%	
2	73%			99%					66%			61%			99%	68%
3	91%			99%					99%			99%			88%	86%
4			85%	99%	28%				99%			99%			99%	92%
2004																
1			94%	99%	73%				98%			99%			99%	91%
2		2%	84%	99%	57%	67%		1%	83%			23%	43%		83%	38%
3		99%		99%	62%	99%	67%	99%		86%	92%		99%	99%		
4		99%		99%	99%	99%	92%	90%		99%	99%		99%	99%		
2005																
1		99%		99%	99%	99%	99%	99%		99%	98%		99%	99%		
2		76%		99%	99%	99%	99%	99%		99%	99%		99%	99%		
3		99%		92%	86%	99%	99%	88%		99%	99%		99%	99%		
4		85%		55%	89%	99%	99%	89%		82%	84%		99%	99%		
2006																
1		99%		99%	99%	99%	99%	99%		88%	99%		98%	99%		
2		99%		99%	91%	99%	90%	99%		99%	99%		99%	99%		
3		98%		99%	97%	87%	82%	99%		96%	99%		99%	99%		
4		99%		99%	99%	99%	99%	99%		99%	85%		99%	99%		
2007																
1		98%		84%	99%	99%	95%	97%		99%	99%		96%	99%		
2		98%		99%	99%	99%	94%	99%		99%	99%		99%	99%		
3		99%		88%	99%	98%	99%	99%		99%	99%		99%	99%		
4		99%		99%	99%	99%	99%	99%		99%	99%		99%	83%		

MEETS 75% quarterly completeness
 Does NOT MEET 75% quarterly completeness
 No Data

Table 10. Statistical summary for 2002-2007 hourly Hydrogen Sulfide data, displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
Minimum				0.0											0.0	
Maximum				15.1											24.9	
Average				0.4											1.0	
2003																
Minimum	0.0		0.0	0.0	0.0			0.0			0.0			0.0	0.0	
Maximum	101.8		4.8	20.1	2.3			3.6			330.3			29.9	36.8	
Average	1.0		0.3	0.4	0.3			0.1			8.9			0.6	1.1	
2004																
Minimum		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum		11.7	12.9	17.9	9.3	8.4	5.1	15.3	2.0	25.1	11.2	81.6	20.4	2.4	10.4	18.7
Average		0.5	0.4	0.8	0.6	0.2	0.1	0.6	0.1	0.5	0.3	1.6	0.5	0.0	0.9	0.7
2005																
Minimum		0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0		
Maximum		8.0		18.6	9.1	16.2	32.4	11.2		143.7	19.5		24.6	2.3		
Average		0.4		0.7	0.7	0.3	0.7	0.7		0.6	0.4		0.6	0.0		
2006																
Minimum		0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0		
Maximum		6.1		25.2	7.6	13.5	28.8	7.5		40.7	51.9		33.0	3.9		
Average		0.5		0.6	0.3	0.4	0.6	0.4		0.9	0.5		0.6	0.2		
2007																
Minimum		0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0		
Maximum		7.0		18.6	12.3	13.6	22.0	11.6		54.2	15.1		44.5	2.2		
Average		0.4		0.5	0.2	0.4	0.5	0.5		1.1	0.6		0.6	0.1		

	MEETS completeness
	Does NOT MEET completeness
	No Data

Table 11-a. Top ten maximum sample values for hourly Hydrogen Sulfide data for 2002-2004 CAFO sites.
 Data is displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
1				15.1											24.9	
2				10.6											22.4	
3				9.8											21.7	
4				6.5											20.5	
5				6.5											17.9	
6				6.4											17.0	
7				6.4											16.3	
8				6.1											16.2	
9				5.4											16.2	
10				5.2											16.2	
2003																
1	101.8		4.8	20.1	2.3				3.6			330.3			29.9	36.8
2	81.4		4.7	18.5	2.2				1.9			296.2			28.9	34.2
3	71.3		3.8	16.6	1.7				1.7			277.9			27.3	31.4
4	69.6		3.2	14.8	1.6				1.5			255.3			23.2	28.4
5	64.5		3.0	12.0	1.6				1.5			249.2			18.2	27.9
6	57.8		3.0	11.9	1.5				1.4			238.0			16.5	27.4
7	46.7		2.9	11.6	1.4				1.4			227.0			16.4	23.7
8	46.0		2.8	11.1	1.3				1.3			200.0			16.4	23.6
9	45.8		2.8	10.8	1.3				1.1			199.0			15.3	23.1
10	44.1		2.8	10.5	1.2				1.1			197.0			15.0	22.2
2004																
1		11.7	12.9	17.9	9.3	8.4	5.1	15.3	2.0	25.1	11.2	81.6	20.4	2.4	10.4	18.7
2		9.4	12.6	14.6	9.2	7.5	4.5	7.7	1.8	25.1	9.2	79.9	16.5	1.2	9.1	16.7
3		9.3	11.5	14.2	8.5	6.4	4.4	7.7	1.7	25.0	9.0	70.2	13.5	1.1	9.0	16.2
4		7.4	11.5	13.5	8.2	5.7	4.2	7.6	1.6	18.1	8.6	51.3	12.7	0.7	8.9	15.6
5		6.5	10.8	12.5	7.1	5.6	3.9	7.4	1.5	16.3	8.6	49.5	11.1	0.7	8.7	15.3
6		6.4	10.6	12.0	6.9	5.6	3.9	7.0	1.5	15.7	8.5	41.2	10.4	0.6	8.6	15.3
7		6.0	7.9	10.6	5.9	5.5	3.8	6.9	1.4	13.6	8.2	38.4	8.6	0.6	7.9	14.8
8		6.0	7.7	10.4	5.7	5.5	3.4	6.5	1.4	13.4	7.5	35.7	8.1	0.6	7.4	14.3
9		5.8	7.5	9.6	5.5	5.2	3.3	6.4	1.4	12.5	7.2	34.2	7.7	0.6	6.8	13.9
10		5.8	7.1	9.2	5.3	5.1	3.3	6.4	1.3	12.3	7.2	28.7	7.6	0.6	6.8	13.3

Table 11-b. Top ten maximum sample values for hourly Hydrogen Sulfide data for 2005-2007 CAFO sites.
Data is displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2005																
1		8.0		18.6	9.1	16.2	32.4	11.2		143.7	19.5		24.6	2.3		
2		7.7		15.2	8.9	12.9	31.2	7.2		47.8	15.9		23.8	2.2		
3		7.5		14.8	8.9	12.6	31.0	7.0		45.2	14.0		23.4	1.8		
4		7.3		14.7	7.8	11.3	24.8	6.6		36.6	13.2		21.9	1.7		
5		7.0		13.8	7.5	10.2	22.0	6.5		27.7	13.1		20.1	1.4		
6		6.8		13.4	7.4	9.0	21.8	6.4		27.5	11.7		19.8	1.3		
7		6.7		12.3	7.1	8.1	20.0	6.3		25.1	11.5		19.8	1.3		
8		6.5		11.6	7.0	7.2	19.9	6.2		23.7	11.1		19.1	1.2		
9		6.4		11.2	6.7	7.0	18.8	6.1		23.2	10.6		19.0	1.2		
10		6.4		10.8	6.6	6.8	18.8	6.0		22.0	10.4		18.9	1.2		
2006																
1		6.1		25.2	7.6	13.5	28.8	7.5		40.7	51.9		33.0	3.9		
2		5.2		16.2	6.4	12.9	24.5	7.1		38.2	23.9		25.0	3.4		
3		5.2		11.9	6.3	12.2	20.0	7.0		29.4	18.0		21.2	3.1		
4		5.0		7.0	5.5	11.4	19.4	6.8		28.7	17.7		13.9	2.8		
5		4.8		6.9	5.5	8.3	19.4	6.7		28.5	16.7		12.5	2.6		
6		4.6		6.8	5.4	8.1	19.1	6.6		28.0	16.1		12.3	2.6		
7		4.6		6.8	5.4	8.1	17.9	6.5		26.1	16.0		11.6	2.5		
8		4.5		6.3	5.2	8.0	12.7	6.4		25.7	14.4		10.2	2.5		
9		4.5		6.2	5.1	7.7	12.7	6.3		25.4	13.5		9.4	2.1		
10		4.3		6.0	5.1	7.5	12.4	6.3		23.4	12.5		9.4	2.1		
2007																
1		7.0		18.6	12.3	13.6	22.0	11.6		54.2	15.1		44.5	2.2		
2		5.6		16.6	8.3	10.1	17.6	8.3		35.7	12.8		29.0	1.8		
3		5.4		16.1	7.3	9.0	15.8	8.2		32.8	12.4		27.3	1.8		
4		4.8		15.2	7.1	8.7	15.4	8.2		31.6	12.3		23.4	1.8		
5		4.8		14.2	6.9	8.7	12.7	8.1		29.5	12.2		22.9	1.8		
6		4.6		13.9	5.9	8.0	12.3	8.0		26.3	12.0		22.3	1.7		
7		4.3		13.7	5.8	7.4	11.6	8.0		24.5	11.9		21.3	1.7		
8		4.2		13.6	5.4	7.3	11.4	7.2		24.4	11.6		20.8	1.7		
9		4.2		11.4	5.3	7.3	11.0	7.1		23.4	11.4		20.4	1.6		
10		4.1		11.2	5.1	7.3	10.2	7.1		23.2	11.4		20.0	1.6		

Table 12-a. Percentiles for hourly Hydrogen Sulfide data for 2002-2004 CAFO sites. Data is displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2002																
100%				15.1											24.9	
90%				1.2											2.6	
80%				0.7											1.1	
70%				0.4											0.6	
60%				0.2											0.4	
50%				0.0											0.2	
40%				0.0											0.1	
30%				0.0											0.0	
20%				0.0											0.0	
10%				0.0											0.0	
2003																
100%	101.8		4.8	20.1	2.3				3.6			330.3			29.9	36.8
90%	1.3		0.8	1.0	0.7				0.2			23.9			1.5	2.8
80%	0.5		0.4	0.6	0.5				0.0			7.4			0.9	1.3
70%	0.3		0.3	0.4	0.4				0.0			2.9			0.6	0.8
60%	0.2		0.2	0.3	0.3				0.0			1.2			0.3	0.5
50%	0.1		0.1	0.3	0.3				0.0			0.5			0.2	0.3
40%	0.1		0.1	0.2	0.2				0.0			0.2			0.1	0.2
30%	0.0		0.1	0.1	0.1				0.0			0.0			0.0	0.1
20%	0.0		0.0	0.0	0.1				0.0			0.0			0.0	0.0
10%	0.0		0.0	0.0	0.0				0.0			0.0			0.0	0.0
2004																
100%		11.7	12.9	17.9	9.3	8.4	5.1	15.3	2.0	25.1	11.2	81.6	20.4	2.4	10.4	18.7
90%		1.0	0.8	1.5	1.4	0.4	0.2	1.4	0.5	1.0	0.8	4.3	1.0	0.0	1.5	1.9
80%		0.6	0.5	1.1	0.8	0.2	0.0	0.9	0.3	0.5	0.3	1.5	0.6	0.0	1.1	0.6
70%		0.5	0.4	0.9	0.6	0.1	0.0	0.6	0.0	0.4	0.1	0.8	0.4	0.0	1.0	0.4
60%		0.4	0.3	0.8	0.6	0.0	0.0	0.4	0.0	0.3	0.0	0.5	0.3	0.0	0.9	0.3
50%		0.4	0.2	0.6	0.5	0.0	0.0	0.3	0.0	0.2	0.0	0.4	0.3	0.0	0.8	0.2
40%		0.3	0.2	0.5	0.4	0.0	0.0	0.2	0.0	0.2	0.0	0.1	0.2	0.0	0.7	0.1
30%		0.2	0.1	0.4	0.3	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.2	0.0	0.5	0.1
20%		0.2	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.0
10%		0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0

Table 12-b. Percentiles for hourly Hydrogen Sulfide data for 2005-2007 CAFO sites. Data is displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	West Union	Williams	Woodbine
2005																
100%		8.0		18.6	9.1	16.2	32.4	11.2		143.7	19.5		24.6	2.3		
90%		0.9		1.4	1.1	0.7	1.5	1.4		1.1	1.0		1.3	0.0		
80%		0.6		1.0	0.8	0.4	0.9	1.1		0.6	0.5		0.7	0.0		
70%		0.4		0.8	0.7	0.3	0.6	0.8		0.5	0.3		0.5	0.0		
60%		0.3		0.7	0.6	0.2	0.4	0.6		0.4	0.2		0.3	0.0		
50%		0.3		0.6	0.5	0.1	0.3	0.5		0.3	0.1		0.3	0.0		
40%		0.2		0.5	0.4	0.1	0.2	0.4		0.2	0.1		0.2	0.0		
30%		0.1		0.3	0.4	0.0	0.1	0.2		0.1	0.0		0.1	0.0		
20%		0.1		0.1	0.3	0.0	0.0	0.1		0.1	0.0		0.1	0.0		
10%		0.0		0.0	0.2	0.0	0.0	0.0		0.0	0.0		0.0	0.0		
2006																
100%		6.1		25.2	7.6	13.5	28.8	7.5		40.7	51.9		33.0	3.9		
90%		0.9		1.2	0.6	0.8	1.3	1.0		1.6	1.3		1.1	0.4		
80%		0.6		0.8	0.4	0.5	0.9	0.7		1.2	0.6		0.7	0.3		
70%		0.5		0.6	0.3	0.4	0.7	0.5		1.0	0.4		0.5	0.2		
60%		0.4		0.5	0.2	0.3	0.5	0.3		0.8	0.3		0.4	0.1		
50%		0.4		0.4	0.1	0.3	0.4	0.2		0.7	0.2		0.3	0.1		
40%		0.3		0.3	0.1	0.2	0.3	0.0		0.6	0.2		0.3	0.1		
30%		0.3		0.2	0.0	0.2	0.2	0.0		0.4	0.1		0.2	0.0		
20%		0.2		0.2	0.0	0.1	0.1	0.0		0.3	0.1		0.2	0.0		
10%		0.2		0.1	0.0	0.1	0.0	0.0		0.0	0.0		0.1	0.0		
2007																
100%		7.0		18.6	12.3	13.6	22.0	11.6		54.2	15.1		44.5	2.2		
90%		0.8		1.1	0.7	0.8	1.0	1.2		1.8	1.4		1.1	0.4		
80%		0.5		0.7	0.3	0.5	0.6	0.9		1.3	0.9		0.6	0.3		
70%		0.4		0.5	0.1	0.4	0.4	0.7		1.1	0.6		0.4	0.2		
60%		0.3		0.3	0.0	0.3	0.3	0.5		0.9	0.4		0.3	0.1		
50%		0.3		0.2	0.0	0.2	0.2	0.3		0.8	0.2		0.2	0.0		
40%		0.2		0.2	0.0	0.2	0.2	0.1		0.7	0.1		0.2	0.0		
30%		0.2		0.1	0.0	0.2	0.1	0.0		0.6	0.0		0.1	0.0		
20%		0.1		0.1	0.0	0.1	0.0	0.0		0.5	0.0		0.0	0.0		
10%		0.1		0.0	0.0	0.1	0.0	0.0		0.2	0.0		0.0	0.0		

Summary of Ammonia CAFO Data

Table 13. Annual highest daily maximum for daily Ammonia data for 2003-2007 CAFO sites. Numbers expressed in parts per billion (ppb).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003	650.6		150.7	1182.0	642.3				398.9			357.9		142.6		1104.0	696.8
2004		481.2	379.1	973.5	904.6	607.0	690.2	251.7	745.9	316.1	390.8	100.6	1751.0	198.1	588.6	199.5	135.3
2005		476.4		508.0	783.3	427.3	875.5	548.0		729.6	317.4		1045.0	109.8	453.5		
2006		181.1		550.7	538.5	285.8	995.7	314.9		278.8	395.9		1820.0	43.7	930.9		
2007		330.8		586.3	1996.0	174.9	459.6	877.4		161.0	251.2		596.3	114.6	732.8		

	MEETS 90% annual AND 75% quarterly completeness
	Does NOT MEET 90% annual or Does NOT MEET 75% quarterly completeness
	No Data

Table 14. Annual percent completeness for daily Ammonia data (2003-2007).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003	39%		21%	72%	6%				35%			48%		62%		60%	50%
2004		50%	46%	93%	85%	58%	42%	50%	40%	38%	52%	26%	49%	92%	48%	45%	31%
2005		99%		90%	95%	98%	99%	96%		100%	99%		100%	97%	99%		
2006		100%		100%	99%	100%	98%	99%		99%	99%		100%	88%	94%		
2007		99%		95%	97%	100%	98%	99%		94%	96%		95%	93%	92%		

	MEETS 90% annual completeness
	Does NOT MEET 90% completeness
	No Data

Table 15. Quarterly percent completeness for daily Ammonia data (2003-2007).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
1				7%												18%	
2	65%			89%								47%		81%		77%	68%
3	90%			96%							41%	49%		71%		43%	53%
4			85%	95%	25%				96%			93%		97%		100%	76%
2004																	
1			99%	99%	82%				79%			95%		100%		99%	87%
2		1%	85%	100%	59%	36%			82%		32%	9%	26%	80%		82%	38%
3		99%		76%	99%	99%	71%	100%		83%	76%		73%	91%	90%		
4		99%		98%	99%	98%	98%	99%		67%	99%		97%	96%	99%		
2005																	
1		100%		99%	98%	91%	99%	99%		100%	98%		100%	89%	97%		
2		100%		100%	100%	100%	99%	100%		100%	100%		100%	100%	99%		
3		98%		91%	99%	100%	100%	84%		100%	100%		99%	99%	99%		
4		100%		71%	85%	100%	99%	100%		100%	100%		100%	100%	100%		
2006																	
1		99%		100%	100%	99%	100%	100%		99%	99%		100%	88%	100%		
2		100%		100%	100%	100%	100%	100%		100%	99%		100%	87%	100%		
3		100%		100%	98%	100%	93%	100%		99%	100%		99%	79%	99%		
4		100%		100%	100%	100%	99%	98%		100%	100%		100%	100%	78%		
2007																	
1		99%		89%	93%	100%	94%	97%		77%	86%		96%	100%	72%		
2		97%		100%	100%	99%	98%	100%		100%	100%		86%	76%	97%		
3		100%		90%	96%	100%	100%	100%		100%	100%		100%	97%	99%		
4		100%		100%	100%	100%	100%	100%		100%	100%		100%	100%	100%		

MEETS 75% quarterly completeness
 Does NOT MEET 75% quarterly completeness
 No Data

Table 16. Statistical summary, displayed in parts per billion, for daily Ammonia data (2003-2007).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
Minimum	8.6		1.8	0.0	22.8				6.1			0.2		0.0		0.0	3.3
Maximum	650.6		150.7	1182.0	642.3				398.9			357.9		142.6		1104.0	696.8
Average	154.0		41.2	138.9	136.6				55.8			68.4		9.7		90.2	143.2
2004																	
Minimum		0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.8
Maximum		481.2	379.1	973.5	904.6	607.0	690.2	251.7	745.9	316.1	390.8	100.6	1751.0	198.1	588.6	199.5	135.3
Average		41.8	41.4	96.2	54.8	88.7	103.8	38.4	78.2	23.9	54.0	28.7	100.7	8.7	29.4	36.2	39.5
2005																	
Minimum		0.3		0.0	0.0	0.0	2.9	0.0		0.0	0.0		2.0	0.0	0.0		
Maximum		476.4		508.0	783.3	427.3	875.5	548.0		729.6	317.4		1045.0	109.8	453.5		
Average		31.0		71.3	38.1	51.7	52.8	40.0		31.3	29.8		64.5	7.2	45.3		
2006																	
Minimum		0.3		0.0	0.0	0.1	3.8	0.0		0.0	0.0		0.0	0.0	0.0		
Maximum		181.1		550.7	538.5	285.8	995.7	314.9		278.8	395.9		1820.0	43.7	930.9		
Average		25.2		67.1	31.2	31.5	44.6	30.2		26.1	27.0		46.7	6.6	64.7		
2007																	
Minimum		2.3		0.0	0.0	2.1	0.5	0.0		0.0	0.0		1.7	0.0	0.0		
Maximum		330.8		586.3	1996.0	174.9	459.6	877.4		161.0	251.2		596.3	114.6	732.8		
Average		25.5		59.4	27.0	26.2	41.6	33.6		21.3	26.4		37.1	8.4	54.8		

	MEETS completeness
	Does NOT MEET completeness
	No Data

Table 17-a. Top ten maximum sample values for daily Ammonia data for 2003-2004. Data displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
1	650.6		150.7	1182.0	642.3				398.9			357.9		142.6		1104.0	696.8
2	423.6		123.8	949.5	290.6				364.2			345.2		75.6		819.4	547.9
3	419.1		112.4	859.1	229.5				264.9			319.9		67.5		743.5	480.5
4	379.3		110.0	757.2	185.9				254.5			315.0		54.4		672.4	453.0
5	368.3		97.5	729.8	176.6				233.7			309.0		46.7		661.8	443.3
6	364.6		97.0	696.3	171.9				193.6			289.4		41.2		535.3	419.4
7	319.1		87.9	691.4	154.0				152.4			277.3		40.2		522.1	403.1
8	316.7		81.7	596.6	126.6				152.0			260.8		39.1		444.1	395.0
9	312.5		75.6	521.4	111.5				135.8			236.8		37.6		443.8	377.0
10	305.1		69.6	494.5	109.9				130.0			234.7		34.7		393.2	375.8
2004																	
1		481.2	379.1	973.5	904.6	607.0	690.2	251.7	745.9	316.1	390.8	100.6	1751.0	198.1	588.6	199.5	135.3
2		329.4	311.8	609.5	404.9	431.5	587.1	250.3	641.0	244.8	343.6	100.2	797.2	65.5	232.8	185.5	129.4
3		269.7	271.4	603.7	334.1	414.9	401.9	199.7	511.2	225.9	240.9	83.8	745.7	62.8	187.9	178.2	123.1
4		251.0	180.6	568.7	308.9	407.9	366.0	190.4	485.2	138.9	204.2	82.5	622.2	61.1	123.3	160.7	117.5
5		227.2	160.0	564.8	216.7	312.7	363.1	185.3	472.7	103.9	196.3	82.0	507.5	44.8	106.4	155.3	108.0
6		201.8	145.4	538.7	200.9	302.4	332.1	177.3	460.2	80.9	191.9	72.6	330.9	42.5	98.9	150.9	97.9
7		165.2	117.6	516.4	195.1	282.0	323.3	145.8	407.3	74.0	170.2	69.7	256.6	32.7	93.5	140.9	91.8
8		164.9	116.5	466.3	179.9	266.4	280.1	136.9	402.5	71.0	150.1	68.9	253.9	31.1	91.6	135.0	90.9
9		161.0	100.2	440.5	176.7	243.8	247.7	134.5	394.1	64.2	146.6	63.9	224.5	28.9	85.9	130.6	85.7
10		154.2	98.4	415.4	173.6	217.0	237.8	124.3	384.7	57.3	134.9	63.8	219.4	28.5	81.6	122.9	84.2

Table 17-b. Top ten maximum sample values for daily Ammonia data for 2005-2007. Data displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2005																	
1		476.4		508.0	783.3	427.3	875.5	548.0		729.6	317.4		1045.0	109.8	453.5		
2		352.8		478.3	702.2	385.1	721.4	383.3		721.4	202.8		859.7	48.9	366.5		
3		269.6		466.3	374.7	318.5	705.3	363.1		296.6	180.6		787.4	38.9	329.2		
4		268.1		465.9	367.7	289.0	479.7	340.1		244.0	168.6		741.9	35.2	272.5		
5		255.2		437.9	246.7	280.1	387.2	278.1		207.2	167.6		558.8	34.0	261.8		
6		206.4		388.5	209.7	279.2	346.3	260.7		202.8	145.7		522.7	31.2	240.9		
7		194.4		369.7	207.6	271.6	297.9	242.1		190.4	144.5		519.6	25.8	234.6		
8		163.0		358.0	204.6	268.2	295.6	241.2		185.9	141.1		486.6	25.0	216.6		
9		153.7		321.5	200.4	243.3	265.7	222.3		183.8	110.4		458.8	22.3	208.7		
10		151.6		303.1	164.3	241.9	243.5	221.9		169.0	102.6		452.6	21.7	206.4		
2006																	
1		181.1		550.7	538.5	285.8	995.7	314.9		278.8	395.9		1820.0	43.7	930.9		
2		144.7		444.7	355.7	283.6	397.8	257.6		263.1	262.3		649.4	39.2	805.4		
3		127.4		429.3	317.0	258.9	332.9	236.4		159.3	246.7		424.4	38.5	800.1		
4		119.8		424.1	297.9	193.6	319.2	202.9		132.3	234.8		412.0	34.4	573.1		
5		117.5		406.5	243.9	193.4	251.5	196.5		132.0	181.8		374.9	33.4	382.6		
6		101.6		374.2	222.9	168.2	243.8	188.2		127.9	142.4		331.2	29.4	357.9		
7		95.7		336.4	217.2	135.3	226.6	144.5		111.2	134.0		310.0	28.1	354.9		
8		92.3		331.8	210.1	134.7	220.5	143.3		111.0	122.0		293.9	24.4	338.1		
9		90.9		301.2	175.7	120.9	198.2	141.4		108.6	119.0		270.9	23.0	319.7		
10		79.0		300.9	167.0	118.7	183.4	138.7		103.6	118.2		250.0	21.5	309.1		
2007																	
1		330.8		586.3	1996.0	174.9	459.6	877.4		161.0	251.2		596.3	114.6	732.8		
2		244.0		432.8	1137.0	153.4	398.1	681.7		130.1	158.1		520.0	47.6	622.5		
3		175.0		338.6	207.5	99.2	340.4	410.3		120.9	119.5		420.8	43.5	495.6		
4		128.6		336.2	177.3	90.5	326.9	366.3		119.6	90.0		399.3	43.4	492.4		
5		123.4		322.5	169.0	84.9	326.4	320.3		83.0	90.0		305.8	42.2	415.6		
6		101.8		321.1	158.6	79.7	261.1	269.3		82.2	89.1		298.6	32.9	358.0		
7		100.5		314.2	157.5	77.8	250.4	244.4		78.8	83.8		258.3	32.0	319.8		
8		100.0		305.9	120.4	76.9	220.7	223.2		76.5	81.8		228.4	31.2	275.8		
9		94.2		289.6	118.8	74.4	219.7	169.4		74.1	79.8		204.2	30.6	270.7		
10		94.2		280.7	97.4	74.4	202.0	162.7		66.6	79.7		149.3	27.5	268.3		

Table 18-a. Percentiles for daily Ammonia data for 2003-2004 CAFO sites. Data displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
100%	650.6		150.7	1182.0	642.3				398.9			357.9		142.6		1104.0	696.8
90%	257.4		77.4	322.4	220.8				98.8			169.1		20.4		227.6	307.0
80%	224.3		58.9	221.4	174.7				68.9			106.6		13.3		131.3	243.8
70%	191.9		46.8	159.7	137.6				57.3			75.3		10.1		88.0	197.0
60%	159.5		38.3	111.3	110.2				46.5			52.1		8.1		48.8	157.2
50%	141.5		34.1	86.1	97.0				38.7			39.2		6.3		33.9	119.0
40%	119.0		29.5	52.2	92.1				32.0			28.4		5.6		25.3	69.4
30%	100.7		23.3	31.6	76.0				25.9			21.9		3.3		18.2	40.5
20%	77.6		18.1	21.6	72.3				20.4			15.5		1.8		14.0	27.2
10%	42.4		13.9	13.4	51.2				14.2			11.8		0.0		9.1	19.8
2004																	
100%		481.2	379.1	973.5	904.6	607.0	690.2	251.7	745.9	316.1	390.8	100.6	1751.0	198.1	588.6	199.5	135.3
90%		88.9	74.3	252.2	98.5	155.6	214.2	98.7	188.4	44.6	99.8	62.6	170.0	18.0	49.5	91.0	81.8
80%		55.9	57.0	161.3	73.4	117.6	152.7	72.6	108.5	28.4	76.0	46.2	132.5	13.5	34.3	58.1	57.3
70%		40.4	43.7	108.8	59.0	96.4	117.0	44.3	48.5	20.8	64.3	37.8	94.2	10.2	25.2	33.9	46.1
60%		29.9	36.3	68.9	49.6	80.5	92.4	32.3	38.3	16.5	56.1	25.6	75.1	8.1	20.8	27.8	38.1
50%		22.6	31.1	45.9	40.9	73.0	79.4	18.6	25.0	13.9	43.9	22.5	63.2	6.1	18.6	21.7	32.9
40%		16.1	25.8	29.0	33.7	66.5	61.8	11.2	22.5	10.2	30.7	19.6	52.6	4.2	15.8	16.4	26.9
30%		11.8	18.5	20.5	27.9	55.3	51.6	6.8	18.5	7.5	24.2	14.9	43.0	2.1	14.2	13.4	22.7
20%		7.8	11.7	13.8	19.2	37.7	40.0	2.9	14.3	5.3	18.9	11.5	33.9	0.2	12.3	10.5	15.3
10%		5.1	5.9	6.5	10.4	25.6	13.3	0.9	10.1	1.5	11.9	4.0	24.7	0.0	9.1	5.6	9.1

Table 18-b. Percentiles for daily Ammonia data for 2005-2007 CAFO sites. Data displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2005																	
100%		476.4		508.0	783.3	427.3	875.5	548.0		729.6	317.4		1045.0	109.8	453.5		
90%		59.2		180.3	91.6	94.9	88.1	95.5		50.2	64.1		115.6	14.9	121.3		
80%		43.2		112.3	47.1	62.5	58.2	53.1		35.4	41.8		67.4	10.1	67.9		
70%		30.8		73.5	34.0	46.6	43.4	35.9		26.7	31.5		49.0	8.1	40.7		
60%		22.6		55.2	23.9	40.5	36.2	27.3		20.8	26.4		40.5	6.5	29.9		
50%		18.0		40.0	17.2	36.1	32.1	18.0		17.3	20.7		34.6	5.6	22.8		
40%		14.5		28.3	12.1	31.7	27.7	13.7		14.3	16.6		28.4	4.4	18.0		
30%		10.7		19.7	8.7	28.5	23.9	10.1		11.7	12.8		22.0	3.8	14.1		
20%		7.6		11.6	6.6	24.4	19.8	7.1		9.0	8.9		17.1	2.4	10.0		
10%		5.4		6.0	4.0	16.4	16.1	3.4		6.2	5.1		12.2	0.4	5.8		
2006																	
100%		181.1		550.7	538.5	285.8	995.7	314.9		278.8	395.9		1820.0	43.7	930.9		
90%		52.6		160.7	61.8	53.2	78.3	65.9		52.4	59.5		77.0	13.8	192.5		
80%		35.3		106.7	34.4	36.6	52.3	41.7		38.0	38.8		45.0	9.4	109.3		
70%		25.1		74.5	26.2	30.6	39.7	29.8		27.7	28.3		36.2	7.2	48.5		
60%		20.7		53.3	21.7	26.7	33.2	22.4		21.1	23.5		29.2	5.8	30.1		
50%		17.1		36.8	17.1	23.1	29.1	17.7		17.0	18.4		24.7	4.6	18.2		
40%		14.8		26.5	13.9	20.7	25.8	14.0		13.5	13.2		21.7	4.2	11.7		
30%		13.4		18.4	11.3	18.2	21.6	10.8		11.5	8.9		18.8	2.7	8.5		
20%		11.4		11.0	9.0	15.4	18.3	7.4		8.3	5.9		15.3	2.5	6.3		
10%		9.3		6.2	7.1	12.5	15.3	4.2		6.3	2.2		11.7	1.1	3.1		
2007																	
100%		330.8		586.3	1996.0	174.9	459.6	877.4		161.0	251.2		596.3	114.6	732.8		
90%		42.8		159.8	44.1	44.0	80.9	63.9		43.4	53.0		67.3	18.1	137.8		
80%		31.4		96.7	28.0	33.8	49.2	36.8		31.2	37.4		40.2	12.4	86.5		
70%		25.1		58.5	19.5	28.0	38.1	26.2		23.2	30.7		31.1	9.0	47.5		
60%		21.1		39.9	13.3	25.2	31.7	19.6		19.7	24.4		25.2	7.2	27.1		
50%		18.6		30.6	10.1	22.0	26.1	15.3		16.2	20.3		22.3	5.9	19.7		
40%		16.2		22.5	6.0	19.5	22.8	12.3		12.8	16.3		19.6	4.6	15.4		
30%		13.8		14.2	2.9	17.0	18.7	9.7		10.3	13.4		16.2	4.0	11.8		
20%		12.1		9.7	0.1	14.0	15.2	7.2		7.9	10.0		12.7	2.6	7.6		
10%		9.5		4.1	0.0	10.1	11.5	3.6		4.9	6.4		8.9	0.9	3.5		

Table 19. Annual percent completeness for hourly Ammonia data for 2003-2007 CAFO sites.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003	39%		21%	72%	7%				35%			48%		63%		61%	52%
2004		50%	45%	93%	86%	58%	42%	50%	40%	38%	51%	26%	50%	92%	47%	45%	32%
2005		98%		90%	95%	96%	98%	95%		98%	98%		98%	96%	98%		
2006		99%		99%	98%	98%	97%	98%		98%	98%		98%	88%	93%		
2007		98%		95%	96%	98%	97%	98%		93%	96%		94%	93%	91%		

	MEETS 90% annual completeness
	Does NOT MEET 90% annual completeness
	No Data

Table 20. Quarterly percent completeness for hourly Ammonia data for 2003-2007 CAFO sites.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
1				8%												19%	
2	67%			90%								47%		81%		79%	68%
3	91%			94%					42%			51%		71%		45%	60%
4			84%	94%	26%				98%			93%		97%		99%	79%
2004																	
1			98%	99%	83%				80%			95%		99%		99%	91%
2		1%	84%	99%	62%	36%			82%		31%	9%	29%	80%		83%	38%
3		99%		77%	98%	98%	69%	99%		84%	76%		73%	91%	90%		
4		98%		98%	98%	98%	97%	98%		69%	98%		98%	96%	98%		
2005																	
1		98%		98%	98%	90%	98%	98%		99%	97%		98%	91%	98%		
2		98%		98%	98%	98%	98%	98%		98%	99%		98%	98%	97%		
3		98%		92%	99%	98%	98%	86%		98%	98%		98%	98%	98%		
4		98%		71%	84%	98%	98%	99%		98%	98%		99%	99%	98%		
2006																	
1		98%		98%	99%	98%	98%	99%		98%	98%		98%	87%	98%		
2		98%		99%	99%	98%	98%	99%		98%	98%		98%	86%	98%		
3		99%		99%	98%	98%	95%	99%		97%	98%		98%	79%	98%		
4		98%		99%	99%	98%	98%	97%		98%	98%		98%	99%	78%		
2007																	
1		98%		90%	93%	98%	95%	97%		76%	85%		95%	99%	73%		
2		97%		99%	99%	98%	97%	99%		99%	99%		85%	78%	96%		
3		99%		94%	95%	99%	99%	99%		98%	99%		98%	97%	98%		
4		99%		99%	99%	98%	98%	99%		99%	99%		99%	99%	98%		

MEETS 75% quarterly completeness
 Does NOT MEET 75% quarterly completeness
 No Data

Table 21. Statistical summary, in parts per billion, for hourly Ammonia data (2003-2007).

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
Minimum	0.0		0.0	0.0	0.2			0.0			0.0			0.0		0.0	0.0
Maximum	650.6		150.7	1182.0	642.3			398.9			357.9			142.6		1104.0	696.8
Average	67.4		19.6	30.1	63.1			22.9			23.1			2.8		26.5	62.9
2004																	
Minimum		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum		481.2	379.1	973.5	904.6	607.0	690.2	251.7	745.9	316.1	390.8	100.6	1751.0	283.6	588.6	230.3	154.7
Average		11.1	17.0	26.0	22.0	44.9	49.8	11.8	20.5	6.7	22.3	11.2	38.7	3.0	11.5	15.2	17.1
2005																	
Minimum		0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0		
Maximum		476.4		508.0	783.3	427.3	875.5	548.0		729.6	317.4		1045.0	109.8	453.5		
Average		11.9		21.1	11.4	26.3	20.0	15.2		11.9	11.3		21.3	3.2	15.2		
2006																	
Minimum		0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0		
Maximum		181.1		550.7	538.5	285.8	995.7	314.9		278.8	395.9		1820.0	43.7	930.9		
Average		10.8		20.4	12.0	15.7	19.4	12.4		11.4	9.6		15.7	2.9	15.0		
2007																	
Minimum		0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0		
Maximum		330.8		586.3	1996.0	174.9	459.6	877.4		161.0	251.2		596.3	114.6	732.8		
Average		12.3		20.4	12.3	14.4	16.4	14.2		10.3	12.6		13.8	3.9	13.4		

MEETS completeness
 Does NOT MEET completeness
 No Data

Table 22-a. Top ten maximum sample values for hourly Ammonia data for 2003-2004 CAFO sites. Data displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
1	650.6		150.7	1182.0	642.3				398.9			357.9		142.6		1104.0	696.8
2	423.6		123.8	949.5	591.5				364.2			345.2		75.6		819.4	547.9
3	419.1		119.7	897.7	477.3				334.6			321.0		67.5		743.5	542.4
4	379.3		115.1	892.8	402.9				323.0			319.9		60.5		672.4	480.5
5	368.3		112.4	859.1	310.0				266.5			315.0		54.4		661.8	453.0
6	364.6		110.1	757.2	290.6				264.9			314.0		47.8		617.9	443.3
7	319.1		110.0	732.1	254.2				254.5			309.0		46.7		611.3	419.4
8	316.7		103.4	729.8	238.9				241.2			289.4		41.2		578.8	412.7
9	312.5		99.0	696.3	238.2				233.7			284.4		40.2		576.4	403.1
10	305.6		97.5	691.4	235.8				193.6			277.3		39.3		558.5	396.6
2004																	
1		481.2	379.1	973.5	904.6	607.0	690.2	251.7	745.9	316.1	390.8	100.6	1751.0	283.6	588.6	230.3	154.7
2		427.1	311.8	609.5	635.8	481.3	587.1	250.3	641.0	264.1	343.6	100.2	949.6	221.5	451.4	199.5	144.8
3		329.4	271.4	603.7	507.5	474.5	401.9	248.2	601.3	244.8	240.9	83.8	797.2	214.5	232.8	196.3	135.3
4		269.7	263.7	568.7	420.7	431.5	366.0	236.7	511.2	227.9	240.5	82.5	760.4	198.1	229.1	185.5	129.4
5		251.0	214.5	564.8	404.9	414.9	363.1	222.2	485.2	225.9	204.2	82.0	745.7	188.2	187.9	178.2	128.3
6		239.8	180.6	561.2	396.3	407.9	332.1	216.2	472.7	212.8	196.3	77.9	622.2	160.4	160.0	160.7	123.1
7		227.2	160.0	538.7	392.0	382.2	323.3	202.1	460.2	204.8	191.9	77.8	613.5	65.5	123.3	155.3	121.5
8		203.9	157.6	516.4	343.5	367.2	315.7	199.7	451.9	197.7	181.8	72.6	507.5	62.8	106.4	150.9	119.5
9		201.8	153.9	500.0	334.1	326.1	304.8	190.4	441.2	174.9	170.2	69.7	448.3	61.7	98.9	140.9	117.8
10		177.5	145.6	466.3	308.9	317.1	296.2	185.3	417.0	156.8	165.9	68.9	364.6	61.1	93.5	140.1	117.5

Table 22-b. Top ten maximum sample values for hourly Ammonia data for 2005-2007 CAFO sites. Data displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2005																	
1		476.4		508.0	783.3	427.3	875.5	548.0		729.6	317.4		1045.0	109.8	453.5		
2		352.8		478.3	760.6	385.1	721.4	392.9		721.4	249.5		859.7	99.7	366.5		
3		274.0		466.3	702.2	318.5	705.3	383.3		707.2	202.8		787.4	59.6	329.2		
4		269.6		465.9	374.7	289.0	479.7	363.1		681.8	201.2		763.3	48.9	321.5		
5		268.1		437.9	367.7	280.1	387.2	340.1		636.0	180.6		753.5	38.9	303.3		
6		255.2		433.6	287.9	279.2	346.3	302.2		634.2	177.6		741.9	38.0	272.5		
7		253.3		430.3	254.7	271.6	297.9	289.9		623.6	170.1		604.2	35.2	261.8		
8		252.2		408.7	246.7	268.2	295.6	278.1		511.2	168.6		560.8	34.0	241.4		
9		229.3		402.7	209.7	259.7	275.9	260.7		495.1	167.6		558.8	31.5	240.9		
10		225.3		401.5	207.6	243.3	275.5	242.1		455.5	166.2		522.7	31.2	234.6		
2006																	
1		181.1		550.7	538.5	285.8	995.7	314.9		278.8	395.9		1820.0	43.7	930.9		
2		144.7		444.7	388.5	283.6	761.8	257.6		263.1	285.0		1178.0	39.6	805.4		
3		138.2		429.3	355.7	258.9	716.1	236.4		259.4	262.3		708.2	39.2	800.1		
4		127.4		424.1	317.0	212.6	712.9	202.9		159.3	246.7		649.4	38.5	765.0		
5		119.8		406.5	297.9	196.5	694.1	196.5		156.5	246.0		424.4	37.1	761.6		
6		117.5		374.2	296.4	193.6	673.1	188.2		139.5	239.4		412.0	36.8	588.7		
7		101.6		351.5	266.6	193.4	665.5	187.5		138.2	234.8		374.9	35.2	573.1		
8		95.7		344.5	263.5	169.5	397.8	186.5		132.3	212.1		366.5	34.4	459.4		
9		93.0		337.6	251.4	168.2	344.4	176.4		132.3	202.2		331.2	33.4	455.8		
10		92.5		336.4	243.9	158.8	332.9	171.0		132.0	183.0		310.0	32.0	409.5		
2007																	
1		330.8		586.3	1996.0	174.9	459.6	877.4		161.0	251.2		596.3	114.6	732.8		
2		244.9		432.8	1993.0	153.4	398.1	695.2		150.0	158.1		520.0	52.7	622.5		
3		244.0		357.7	1993.0	123.0	340.4	681.7		130.1	132.8		461.3	47.6	495.6		
4		236.2		338.6	1993.0	99.2	326.9	610.8		125.5	121.8		420.8	46.6	492.4		
5		231.2		336.2	1982.0	91.8	326.4	610.1		120.9	119.5		399.3	46.5	415.6		
6		218.9		331.4	1953.0	90.5	312.9	428.1		119.6	111.3		345.1	43.5	358.0		
7		215.3		326.9	1873.0	90.5	287.6	426.7		116.9	108.1		305.8	43.4	333.7		
8		214.3		322.5	1758.0	84.9	286.3	410.3		116.1	97.2		298.6	42.4	325.1		
9		194.3		322.0	1742.0	79.7	261.1	409.4		115.9	95.7		270.9	42.2	319.8		
10		186.6		321.1	1684.0	77.8	256.8	396.9		113.5	94.6		258.3	42.0	314.7		

Table 23-a. Percentiles for hourly Ammonia data for 2003-2004 CAFO sites. Data is displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2003																	
100%	650.6		150.7	1182.0	642.3				398.9			357.9		142.6		1104.0	696.8
90%	137.4		40.9	67.2	127.5				46.3			51.5		8.0		58.4	142.1
80%	108.3		29.7	35.5	86.7				33.6			30.6		4.9		29.9	111.1
70%	89.4		23.7	23.2	70.5				25.7			21.1		3.5		20.7	91.9
60%	73.9		19.0	17.4	59.8				20.5			16.1		2.1		15.6	71.8
50%	59.3		15.8	13.3	49.6				16.7			12.4		0.7		11.9	41.0
40%	43.7		12.2	10.2	38.7				13.7			9.4		0.0		9.2	22.7
30%	25.8		9.2	7.6	27.6				10.5			7.0		0.0		6.4	15.2
20%	15.3		6.2	4.2	21.3				8.0			4.4		0.0		4.0	9.8
10%	8.4		2.6	1.0	11.6				4.2			1.7		0.0		0.4	4.1
2004																	
100%		481.2	379.1	973.5	904.6	607.0	690.2	251.7	745.9	316.1	390.8	100.6	1751.0	283.6	588.6	230.3	154.7
90%		26.2	36.7	58.7	46.9	81.1	97.1	30.2	34.4	15.3	51.2	27.9	76.3	8.2	20.4	32.0	38.2
80%		15.1	26.7	33.8	34.0	66.2	70.8	17.2	21.7	9.2	37.3	19.2	56.5	5.4	16.4	21.0	27.9
70%		10.3	20.7	23.7	26.1	57.5	56.6	11.6	17.1	6.1	27.8	14.3	44.7	3.8	13.4	16.0	20.9
60%		7.1	16.3	17.2	20.6	49.4	48.2	8.0	14.3	4.0	21.4	10.6	36.3	2.1	11.5	12.5	16.4
50%		4.7	12.8	12.6	16.1	40.5	40.4	4.8	12.1	2.3	16.4	7.5	29.7	0.3	9.8	9.8	12.5
40%		3.1	9.1	9.1	12.0	31.1	34.0	2.5	10.0	1.5	12.1	4.2	23.0	0.0	8.1	7.5	8.5
30%		2.0	6.4	6.2	8.4	23.1	28.3	1.3	7.7	0.0	7.9	2.0	16.4	0.0	6.0	5.6	6.1
20%		0.3	3.5	3.7	5.0	15.9	21.8	0.1	4.8	0.0	3.4	0.1	10.8	0.0	4.0	2.9	4.0
10%		0.0	0.3	1.2	1.3	7.4	6.8	0.0	2.1	0.0	0.0	0.0	6.2	0.0	0.2	0.4	1.0

Table 23-b. Percentiles for hourly Ammonia data for 2005-2007 CAFO sites. Data displayed in parts per billion.

Site Name	Atlantic	Belmond New	Belmond Old	Clarion	Goldfield	Iowa Falls	Jewell	Kanawha	Malcom	Newkirk	Sac City	Sioux Center	Stanhope	Viking Lake	West Union	Williams	Woodbine
2005																	
100%		476.4		508.0	783.3	427.3	875.5	548.0		729.6	317.4		1045.0	109.8	453.5		
90%		23.3		44.0	24.0	46.2	34.7	33.5		22.1	25.9		37.3	7.3	28.8		
80%		15.8		28.0	15.3	34.5	25.3	21.5		15.3	17.3		27.9	5.1	19.7		
70%		12.9		21.0	10.9	29.3	21.3	15.0		11.7	13.0		22.4	4.4	15.5		
60%		10.4		16.0	8.2	25.8	18.3	11.1		9.2	10.1		18.6	3.0	12.5		
50%		8.3		11.9	6.3	22.7	15.8	8.2		7.6	7.4		15.4	2.4	10.1		
40%		6.3		8.8	4.7	20.0	13.5	6.2		6.0	5.3		12.4	2.1	8.0		
30%		4.6		6.1	3.6	16.7	11.2	4.2		4.4	3.1		9.8	0.5	6.1		
20%		3.4		3.9	2.2	12.4	8.7	2.2		3.3	1.0		7.3	0.2	4.0		
10%		1.9		1.5	0.2	8.0	6.0	0.2		1.5	0.0		4.1	0.0	1.8		
2006																	
100%		181.1		550.7	538.5	285.8	995.7	314.9		278.8	395.9		1820.0	43.7	930.9		
90%		19.2		45.3	23.2	25.6	33.9	26.9		22.9	22.8		26.6	6.5	29.2		
80%		14.6		27.3	15.5	20.6	24.1	18.5		15.6	15.6		20.0	4.5	15.3		
70%		12.3		19.6	11.9	17.9	19.8	13.9		12.1	11.1		16.7	3.5	10.3		
60%		10.6		14.6	9.6	15.8	17.0	10.8		9.9	7.7		14.2	2.5	8.1		
50%		9.1		11.1	7.9	13.9	14.7	8.0		8.1	5.3		12.2	2.4	6.2		
40%		7.7		8.3	6.5	12.3	12.8	6.0		6.5	3.3		10.4	1.3	4.6		
30%		6.3		6.1	5.2	10.7	10.9	4.2		4.8	2.0		8.5	0.5	3.4		
20%		4.7		4.1	3.8	8.8	8.7	2.3		4.0	0.1		6.4	0.4	2.0		
10%		2.4		1.8	2.0	5.7	5.9	0.2		2.4	0.0		4.1	0.0	0.0		
2007																	
100%		330.8		586.3	1996.0	174.9	459.6	877.4		161.0	251.2		596.3	114.6	732.8		
90%		21.0		43.7	23.2	24.8	30.1	27.9		21.1	26.5		25.0	8.6	25.1		
80%		16.1		28.0	13.0	20.1	22.1	17.2		15.3	18.8		18.9	6.1	15.4		
70%		13.7		20.5	7.8	17.2	17.7	12.8		11.9	14.9		15.5	4.6	12.0		
60%		11.9		15.9	4.2	15.0	14.7	9.8		9.4	11.8		12.8	3.9	9.8		
50%		10.3		12.3	1.4	13.0	12.3	7.9		7.5	9.3		10.7	2.6	7.6		
40%		8.8		9.1	0.0	11.2	10.3	6.0		6.4	7.5		8.8	2.5	5.9		
30%		7.1		5.9	0.0	9.3	8.3	4.2		4.5	5.8		7.2	1.3	4.3		
20%		5.3		3.0	0.0	7.0	6.3	2.3		3.0	4.0		5.0	0.6	2.4		
10%		2.8		0.3	0.0	4.1	4.0	0.2		1.5	2.0		2.2	0.0	0.4		

Appendix A

Additional Table Information

Listed below is additional information that may be useful in interpreting the tables found in this review

Annual 8th Highest Daily Maximum for Hydrogen Sulfide

This table shows the 8th highest daily maximums for each hydrogen sulfide CAFO site for each year. The data is displayed in parts per billion. The values were determined from a list of the valid daily maximums. Days with at least 18 hours of continuous data or a max value over the standard (≥ 31 ppb) were considered valid and included in the study. Meeting completeness criteria requires both 90% annual and 75% quarterly completeness. Those monitoring sites within 100 meters of a separated location satisfy siting criteria. More information regarding siting criteria, completeness, or valid data can be seen in Appendix E.

[Back to Table](#)

Annual Percent Completeness for Daily Hydrogen Sulfide

This table shows the annual percent completeness for the daily hydrogen sulfide. The values were calculated by dividing the number of valid days by the total number of days in each year. At least 90% of the total days must be valid to meet annual completeness criteria.

[Back to Table](#)

Quarterly Percent Completeness for Daily Hydrogen Sulfide

This table shows the daily quarterly percent completeness for hydrogen sulfide. Each year is divided into four calendar quarters. Percent completeness was found by dividing the total number of valid days by the total number of days in each calendar quarter. To meet quarterly completeness criteria, at least 75% of the days in each quarter must be valid.

[Back to Table](#)

Statistical Summary for Daily Hydrogen Sulfide

This table shows the annual minimum, annual maximum, and annual average daily sample values of the hydrogen sulfide data for each CAFO site. Completeness criteria require at least 90% annual daily completeness and 75% quarterly daily completeness. The standard is exceeded at a site where the 8th highest daily maximum is greater than 30 ppb. Sites with days that exceed the standard are valid and are not required to meet the completeness criteria for those specific days.

[Back to Table](#)

Top Ten Maximum Sample Values for Daily Hydrogen Sulfide

This table shows the top ten maximum daily sample values for hydrogen sulfide. Daily values were determined from daily maximums of the 24 hour continuous data. Days with at least 18 hours of data or values greater than the standard (30 ppb) are considered valid.

[Back to Table](#)

Percentiles for Daily Hydrogen Sulfide

This table shows ten percentile ranks for the daily hydrogen sulfide data for each CAFO site. Daily values were calculated from the daily maximums of the 24 hour continuous data.

[Back to Table](#)

Number of hours with levels over the Health Effects Value

This table shows the total number of hours, for each year, in which levels over the Health Effects Value were recorded for each CAFO site. These totals were calculated by counting the number of sample values from each site which were greater than or equal to 31 parts per billion. Hourly data utilized every hour of continuous data collected.

[Back to Table](#)

Annual Completeness for Hourly Hydrogen Sulfide

This table shows the annual completeness for the hourly hydrogen sulfide data for each CAFO site. The annual completeness was calculated by dividing the number of hours sampled by the total number of hours in each year. Annual completeness is met when 90% of the total hours are sampled. Hourly data utilized every hour of continuous data collected.

[Back to Table](#)

Quarterly Completeness for Hourly Hydrogen Sulfide

This table shows the quarterly completeness for hourly hydrogen sulfide data. These percentages were calculated by dividing the number of hours sampled in each calendar quarter by the total number of hours in each quarter. Quarterly completeness is met when at least 75% of the hours in each quarter are sampled. Hourly data utilized every hour of continuous data collected.

[Back to Table](#)

Statistical Summary for Hourly Hydrogen Sulfide

This table shows a statistical summary for the hourly hydrogen sulfide data, including the annual minimum, annual maximum and annual average for hourly values. Meeting completeness requires both 90% annual and 75% quarterly completeness. Hourly data utilized every hour of continuous data collected. Sites do not meet the standard when the 8th highest Daily maximum is greater than or equal to 31 ppb.

[Back to Table](#)

Top Ten Maximum Sample Values for Hourly Hydrogen Sulfide

This table shows the top ten annual maximum values for hourly hydrogen sulfide for each CAFO site. Hourly data refers to every hour of continuous 24 hour data collected.

[Back to Table](#)

Percentiles for Hourly Hydrogen Sulfide

This table shows ten percentile ranks for the hourly hydrogen sulfide data for each CAFO site. Hourly values include every sample value of the 24 hour continuous data.

[Back to Table](#)

Annual Highest Daily Maximum for Ammonia

This table shows the highest annual daily maximums for hydrogen sulfide for each CAFO. The data is displayed in parts per billion. The values were determined from a list of the daily maximums of the 24 hour continuous data. Days with at least 18 hours of continuous were considered valid and included in the study. Meeting completeness requires both 90% annual and 75% quarterly completeness.

[Back to Table](#)

Annual Percent Completeness for Daily Ammonia

This table shows the annual percent completeness for daily ammonia. The values were calculated by dividing the number of valid days by the total number of days in each year. At least 90% of the total days must be valid to meet completeness.

[Back to Table](#)

Quarterly Percent Completeness for Daily Ammonia

This table shows the daily quarterly percent completeness for ammonia. Each year is divided into four calendar quarters. Percent completeness was found by dividing the total number of valid days by the total number of days in each calendar quarter. To meet completeness, at least 75% of the days in each quarter must be valid.

[Back to Table](#)

Statistical Summary for Daily Ammonia

This table shows the annual minimum, annual maximum and annual average daily sample values for each CAFO site for ammonia. To meet completeness both 90% annual daily completeness and 75% quarterly daily completeness are required.

[Back to Table](#)

Top Ten Maximum Sample Values for Daily Ammonia

This table shows the top ten maximum daily sample values for ammonia. Days with at least 18 hours of data are considered valid. Daily values were determined from daily maximums of the 24 hour continuous data.

[Back to Table](#)

Percentiles for Daily Ammonia Data

This table shows ten percentile ranks for the daily ammonia data for each CAFO site. Daily values were calculated from the daily maximums of the 24 hour continuous data.

[Back to Table](#)

Annual Completeness for Hourly Ammonia

This table shows the annual completeness for the hourly ammonia data for each CAFO site. The annual completeness was calculated by dividing the number of hours sampled by the total number of hours in each year. Annual completeness is met when 90% of the total hours are sampled. Hourly data utilized every hour of continuous data collected.

[Back to Table](#)

Quarterly Completeness for Hourly Ammonia

This table shows the quarterly completeness for hourly ammonia data. These percentages were calculated by dividing the number of hours sampled in each calendar quarter by the total number of hours in each quarter. Quarterly completeness is met when at least 75% of the hours in each quarter are sampled. Hourly data utilized every hour of continuous data collected.

[Back to Table](#)

Statistical Summary for Hourly Ammonia

This table shows a statistical summary for the hourly ammonia data, including the annual minimum, annual maximum and annual average for hourly values. Meeting completeness requires both 90% annual and 75% quarterly completeness. Hourly data utilized every hour of continuous data collected.

[Back to Table](#)

Top Ten Maximum Sample Values for Hourly Ammonia

This table shows the top ten annual maximum sample values for hourly ammonia for each CAFO site. Hourly data refers to every hour of continuous 24 hour data collected.

[Back to Table](#)

Percentiles for Hourly Ammonia

This table shows ten percentile ranks for the hourly ammonia data for each CAFO site. Hourly values include every sample value of the 24 hour continuous data.

[Back to Table](#)

Appendix B

Iowa Code section 459.207

459.207 Animal Feeding Operations -- Airborne Pollutants Control.

1. As used in this section, unless the context otherwise requires:
 - a. "Airborne pollutant" means hydrogen sulfide, ammonia, or odor.
 - b. "Separated location" means a location or object from which a separation distance is required under section 459.202 or 459.204, other than a public thoroughfare.

2. The department shall conduct a comprehensive field study to monitor the level of airborne pollutants emitted from animal feeding operations in this state, including but not limited to each type of confinement feeding operation structure.

3.
 - a. After the completion of the field study, the department may develop comprehensive plans and programs for the abatement, control, and prevention of airborne pollutants originating from animal feeding operations in accordance with this section. The comprehensive plans and programs may be developed if the baseline data from the field study demonstrates to a reasonable degree of scientific certainty that airborne pollutants emitted by an animal feeding operation are present at a separated location at levels commonly known to cause a material and verifiable adverse health effect. The department may adopt any comprehensive plans or programs in accordance with chapter 17A prior to implementation or enforcement of an air quality standard but in no event shall the plans and programs provide for the enforcement of an air quality standard prior to December 1, 2004.
 - b. Any air quality standard established by the department for animal feeding operations shall be based on and enforced at distances measured from a confinement feeding operation structure to a separated location. In providing for the enforcement of the standards, the department shall take all initial measurements at the separated location. If the department determines that a violation of the standards exists, the department may conduct an investigation to trace the source of the airborne pollutant. This section does not prohibit the department from entering the premises of an animal feeding operation in compliance with section 455B.103. The department shall comply with standard bio-security requirements customarily required by the animal feeding operation which are necessary in order to control the spread of disease among an animal population.
 - c. The department shall establish recommended best management practices, mechanisms, processes, or infrastructure under the comprehensive plans and programs in order to reduce the airborne pollutants emitted from an animal feeding operation.
 - d. The department shall provide a procedure for the approval and monitoring of alternative or experimental practices, mechanisms, processes, or infrastructure to reduce the airborne pollutants emitted from an animal feeding operation, which may be incorporated as part of the comprehensive plans and programs developed under this section.

Appendix C

Milestones in the Development of Legislation and Rules Related to the Field Study

April 2002, Senate File 2293 (Iowa Code Section 459.207) requiring field study adopted.

<http://www.legis.state.ia.us/GA/79GA/Legislation/SF/02200/SF02293/Current.html>.

April 2003, Environmental Protection Commission adopts ambient standards for hydrogen sulfide and ammonia.

<http://www.iowadnr.gov/epc/archive/03apr21m.pdf>.

April 2003, the Iowa Legislature nullifies these ambient standards (SJR 5).

<http://www.legis.state.ia.us/GA/80GA/Legislation/SJR/00000/SJR00005/Current.html>.

April 2004, Governor Vilsack vetoes new ambient standards for hydrogen sulfide and ammonia proposed by Iowa legislature (HF 2523).

<http://www.legis.state.ia.us/GA/80GA/Legislation/HF/02500/HF02523/Current.html>.

September 2004, Rules (567 Iowa Administrative Code Chapter 32) establishing hydrogen sulfide health thresholds, regulatory intervention levels, and monitor siting requirements for the field study are effective.

<http://www.legis.state.ia.us/Rules/2004/Bulletin/IAB040818.pdf>.

Appendix D

Iowa Administrative Code 567 Chapter 32

ANIMAL FEEDING OPERATIONS FIELD STUDY

567—32.1(455B) Animal feeding operations field study.

The department shall conduct a field study to measure the levels of hydrogen sulfide, ammonia and odor near animal feeding operations as defined in 567—65.1(455B).

567—32.2(455B) Definitions.

For the purposes of this chapter, the following terms shall have the meaning indicated in this rule.

“Health effects standard” means the level of an airborne pollutant required to trigger plans and programs to abate emissions of airborne pollutants.

“Health effects value” means the level of an airborne pollutant commonly known to cause a material and verifiable adverse health effect.

“Separated location” means a location or object from which a separation distance is required under Iowa Code sections 455B.134, 459.202 or 459.204, other than a public thoroughfare.

567—32.3(455B) Exceedance of the health effects value (HEV) for hydrogen sulfide.

The health effects value for hydrogen sulfide is exceeded at a monitoring site when the one-hour average concentration exceeds 30 ppb.

567—32.4(455B) Exceedance of the health effects standard (HES) for hydrogen sulfide.

The health effects standard for hydrogen sulfide is exceeded at a monitoring site when the daily maximum one-hour average concentration exceeds 30 ppb more than seven times per year. The department shall develop plans and programs to abate hydrogen sulfide emissions from animal feeding operations if hydrogen sulfide levels measured at a separated location exceed the health effects standard for hydrogen sulfide.

567—32.5(455B) Iowa Air Sampling Manual.

Monitor siting requirements, data handling procedures, approved monitoring methods and equipment, quality assurance requirements, and requirements for public availability of the data for determining compliance with the HEV or HES for hydrogen sulfide shall be in accordance with the Iowa Air Sampling Manual* adopted by the commission on July 19, 2004, and adopted by reference herein.

These rules are intended to implement Iowa Code sections 459.207 and 455B.133.

*Available from the department.

[Filed 7/29/04, effective 9/22/04]

[Published 8/18/04]

Appendix E

Iowa Air Sampling Manual

(Version 7/19/04)

This manual contains monitor siting requirements, data handling procedures, approved monitoring methods and equipment, quality assurance requirements, and requirements for public availability of data required to implement the Health Effects Value (HEV) and Health Effects Standard (HES) for hydrogen sulfide (H₂S) as described in Chapter 32 of 567 (455B).

I. Monitor Siting Requirements

Monitoring Sites. For the purposes determining a violation of the HES

- 1) Monitoring sites shall not be located closer than the legally required separation distance applicable at the time of construction of an animal feeding operations structure.
- 2) Monitoring data is considered to be taken at a separated location if the monitor is located within 100 meters of the following:
 - a) A structure that constitutes the separated location.
 - b) The boundary of a public use area.

The department may conduct monitoring at locations that do not meet these requirements with objectives such as the assessment of source contributions, determination of background concentrations or assessment of community exposure.

Flow Obstructions. An object near the monitoring site is defined to be an obstruction if it protrudes above the monitoring probe. If the obstruction is higher than the probe inlet, the monitor must be sited so that the distance from the inlet to the obstruction must be at least twice the height that the obstruction protrudes above the inlet. Trees that represent an obstruction must be farther than 10 meters from the probe.

Probe Inlet Height. The probe inlet at a monitoring site must be from 3 to 15 meters above the ground.

Local Sources. Monitors should be sited to avoid the influences of local sources that may make it difficult to interpret the monitoring data.

Minimum Separation from Roadways. The minimum separation from roadways shall be determined from the following table:

Roadway average daily traffic, vehicles per day	Minimum separation distance ¹ (meters)
Less than or equal to 10,000	10
15,000	20
20,000	30
40,000	50
70,000	100
Greater than or equal to 110,000	250

¹Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count

II. Data Handling Procedures

The Hydrogen Sulfide HEV. The health effects value (HEV) for hydrogen sulfide is 30 parts per billion (ppb) for a one-hour average. An hourly average of 31 ppb is the lowest value that exceeds the hydrogen sulfide HEV. The HEV represents the level of an airborne pollutant commonly known to cause a material and verifiable adverse health effect.

The Hydrogen Sulfide HES. The health effects standard (HES) for hydrogen sulfide is met at a monitoring site when the annual eighth-highest daily maximum hourly average concentration is less than or equal to 30 ppb. An annual eighth-highest daily maximum hourly average of 31 ppb is the lowest value that exceeds the hydrogen sulfide HES. The HES represents the level of an airborne pollutant required to trigger plans and programs to abate emissions of airborne pollutants.

Computation of a Daily Maximum One-hour Average. To determine whether an exceedance of the HEV or HES for hydrogen sulfide has been measured, hourly averages must first be computed. An hourly average is considered valid if at least 45 minutes of valid averages are recorded by the data acquisition system. A sampling day consists of 24 non-overlapping hours beginning from midnight on a given day to midnight on the following day. To determine the daily maximum one-hour average, each of the valid hourly concentrations associated with a sampling day shall be truncated to 1 ppb, and the maximum hourly average value for the sampling day determined. Within this manual, years, days and hours associated with the monitoring data shall be recorded in Central Standard Time (CST), according to the United States Environmental Protection Agency (EPA) convention for continuous monitoring data. Hourly averages are associated with the start hour of the period; for example, an hourly average of the data taken from 1 A.M. to 2 A.M. CST on a given day is associated with the 1 A.M. hour of the day.

Valid Monitoring Days. At a given monitoring site, a day of continuous monitoring data is valid if:

at least 75 percent (%) (18 hours) of valid hourly averages have been recorded, or fewer than 18 valid hourly averages have been recorded, but the maximum hourly average of the available data exceeds 30 ppb. (i.e., a maximum hourly average of 31 ppb or greater)

Comparison of monitoring data with the HES. The HES is met at a monitoring site when the annual eighth-highest daily maximum concentration, expressed in parts per billion, is less than or equal to 30 ppb. The comparison shall be made using the most recent year of monitoring data meeting the data completeness requirements described below. The annual eighth-highest daily maximum 1-hour average concentration shall be expressed in parts per billion (with remaining digits to the right of the decimal point truncated.)

Data Completeness Requirements. The comparison of the monitoring data with the HES shall be based on a complete calendar year of air quality monitoring data.

1. This requirement is met at a monitoring site if daily maximum hourly average concentrations are available for at least 90% of the days of the year, with a minimum data completeness in any calendar quarter of at least 75% of the possible sampling days in the calendar quarter. When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the Director.
2. A year with concentrations greater than the level of the standard shall not be ignored on the grounds that it has less than complete data. Thus, in computing the eighth highest daily maximum concentration, data from calendar quarters with less than 75% data completeness shall be included in the computation if inclusion of the data results in an annual eighth-highest daily maximum hourly average concentration greater than 30 ppb.

III. Approved Monitoring Methods and Equipment

Hydrogen Sulfide. For comparison with the HEV or HES for hydrogen sulfide, the monitor design must incorporate a thermal oxidizer and an EPA reference method analyzer designed for sulfur dioxide. Instruments that meet this requirement are listed below:

1. Advance Pollution Instrumentation, Model 101A
2. Thermo-Environmental Instruments, Model 45C
3. Thermo-Environmental Instruments, Model 450C or 450CTL
4. Thermo-Environmental Instruments, Model 340 Thermal Converter, operated in conjunction with a Thermo-Environmental Instruments Model 43B, 43C, or 43CTL Sulfur Dioxide Analyzer

IV. Quality Assurance Requirements

Quality Assurance Project Plans and Standard Operating Procedures. Monitors shall be operated in accordance with the quality assurance project plans and standard operating procedures approved by the department.

Precision and Accuracy Assessment. Requirements for assessing the precision and accuracy for H₂S Continuous Analyzers are indicated below:

Method	Assessment	Coverage	Minimum Frequency	Parameters Reported
H ₂ S Analyzer Precision	Response check at 20-40 ppb	Each Analyzer	Once per 2 Weeks	Actual and measured Concentration
H ₂ S Analyzer Accuracy	Response checks at zero and at least 4 of the following points: 0-10 % of full scale 15-25% of full scale 35-50% of full scale 50-70% of full scale 70-90% of full Scale	1. Each Analyzer 2. 25% of analyzers (at least one)	1. Once per year 2. Each calendar Quarter	Actual and measured concentration at each level

Precision and Accuracy Goals. As a goal, the 95% probability limits for precision should be less than $\pm 15\%$. At 95% probability limits, the accuracy for hydrogen sulfide should be less than $\pm 20\%$. Calculations of precision and accuracy for hydrogen sulfide will follow the procedures for gaseous pollutants in the United States Code of Federal Regulations (40 CFR Part 58, Appendix A).

V. Public Availability of Data

Hydrogen sulfide data will be uploaded into EPA's publicly available Air Quality System (AQS) database at the same frequency required for federal ambient monitoring data. Monitoring data shall be uploaded to the AQS database within 90 days of the end of the calendar quarter in which the data was taken. Numerical values associated with invalid hourly data due to instrument malfunctions or calibrations will not be entered into AQS; explanations for each hour of missing data will be entered into the database following EPA's guidance for data coding.

Appendix F

Field Study Chronology

April 2002, hydrogen sulfide monitoring begins.

June 2002, technical advisory group meetings concerning monitoring methods and monitor siting for the field study take place.

2003-2005, study of odor near CAFO's performed by DNR field offices.

2004, monitoring sites near CAFO's relocated as necessary to conform with new monitor siting rules.

December 2007, hydrogen sulfide and ammonia component of the field study ends.