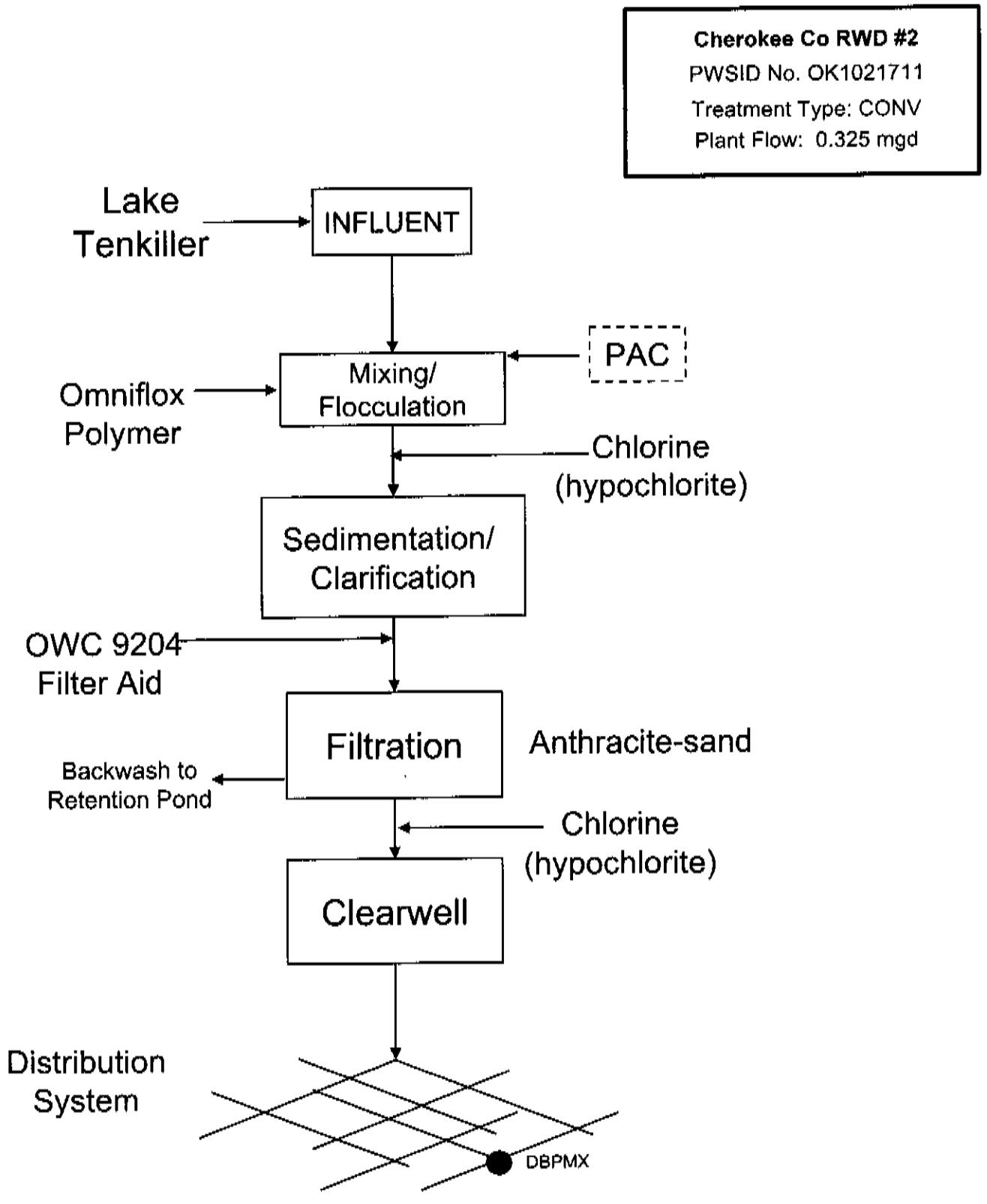
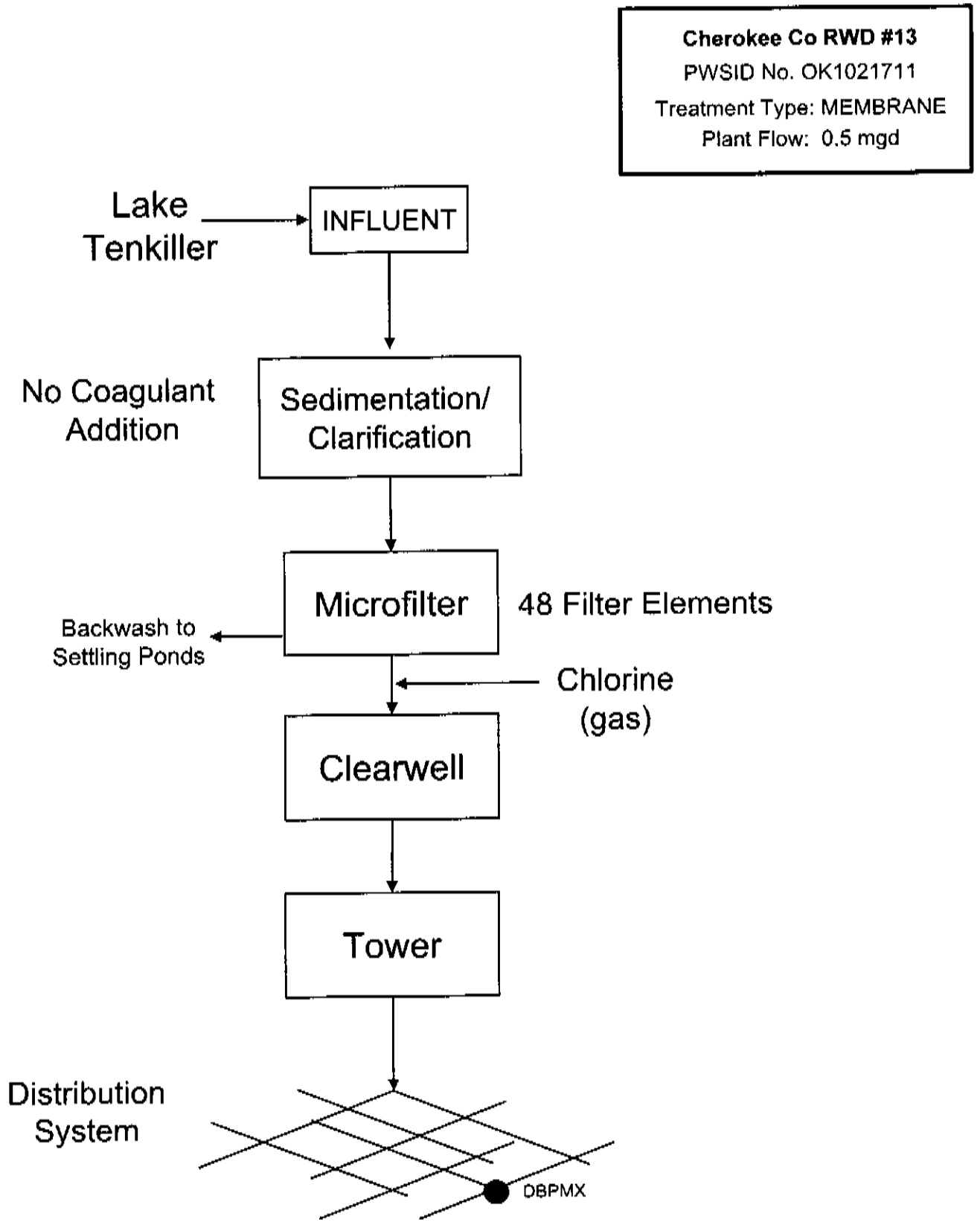
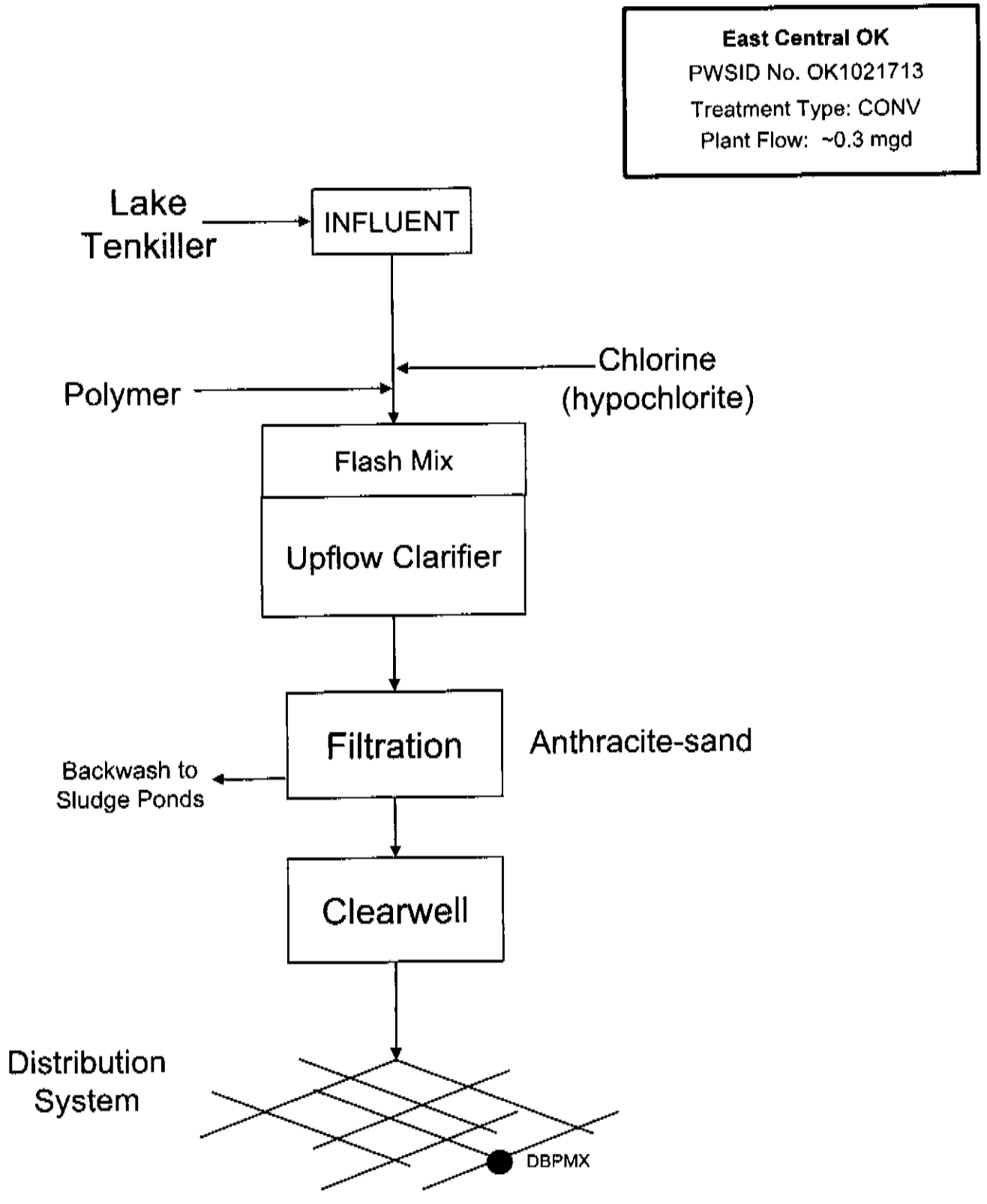
Appendix B— Schematics and Narrative Descriptions of IRW WTPs



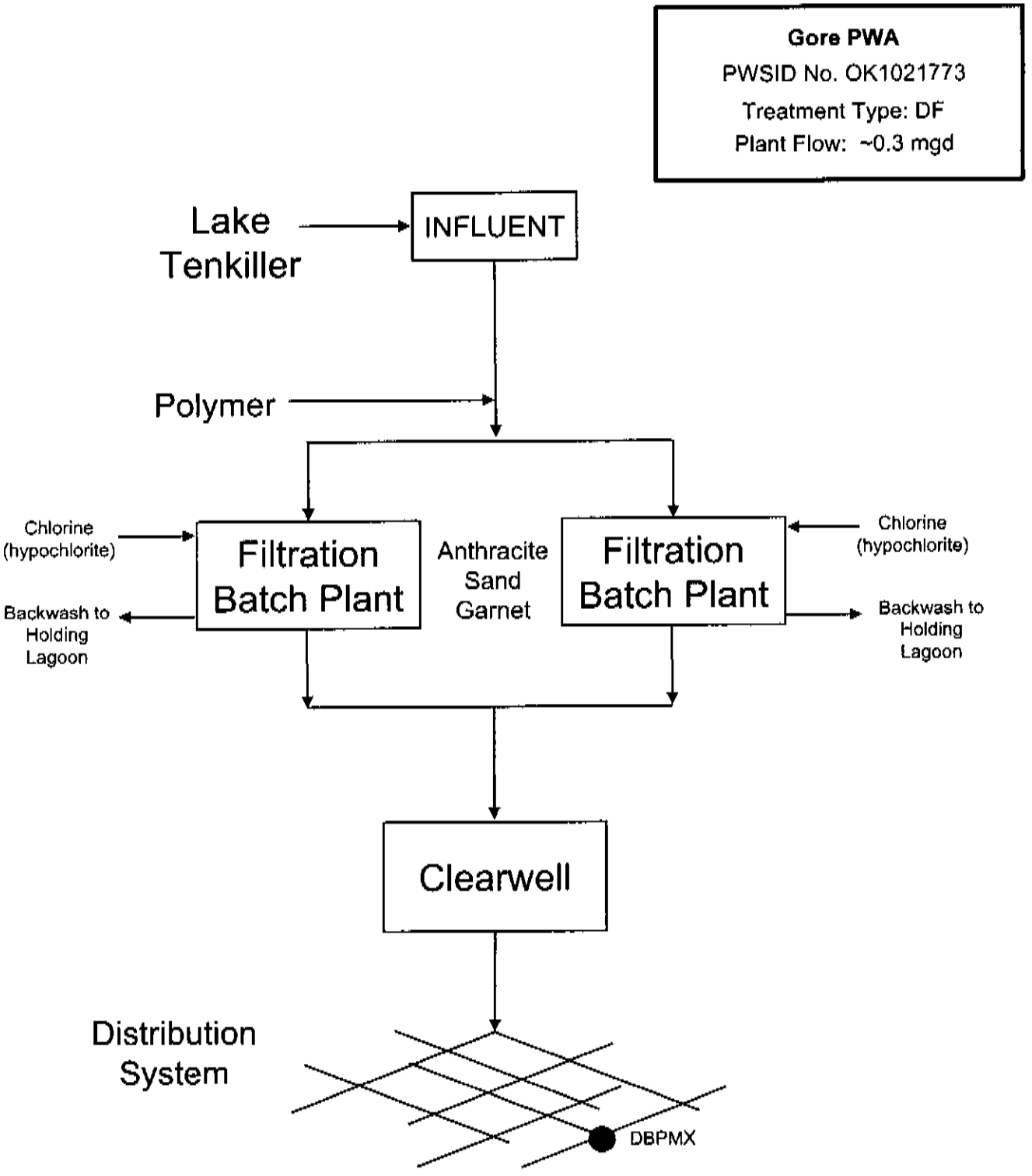
Source: (Gassaway 2008)



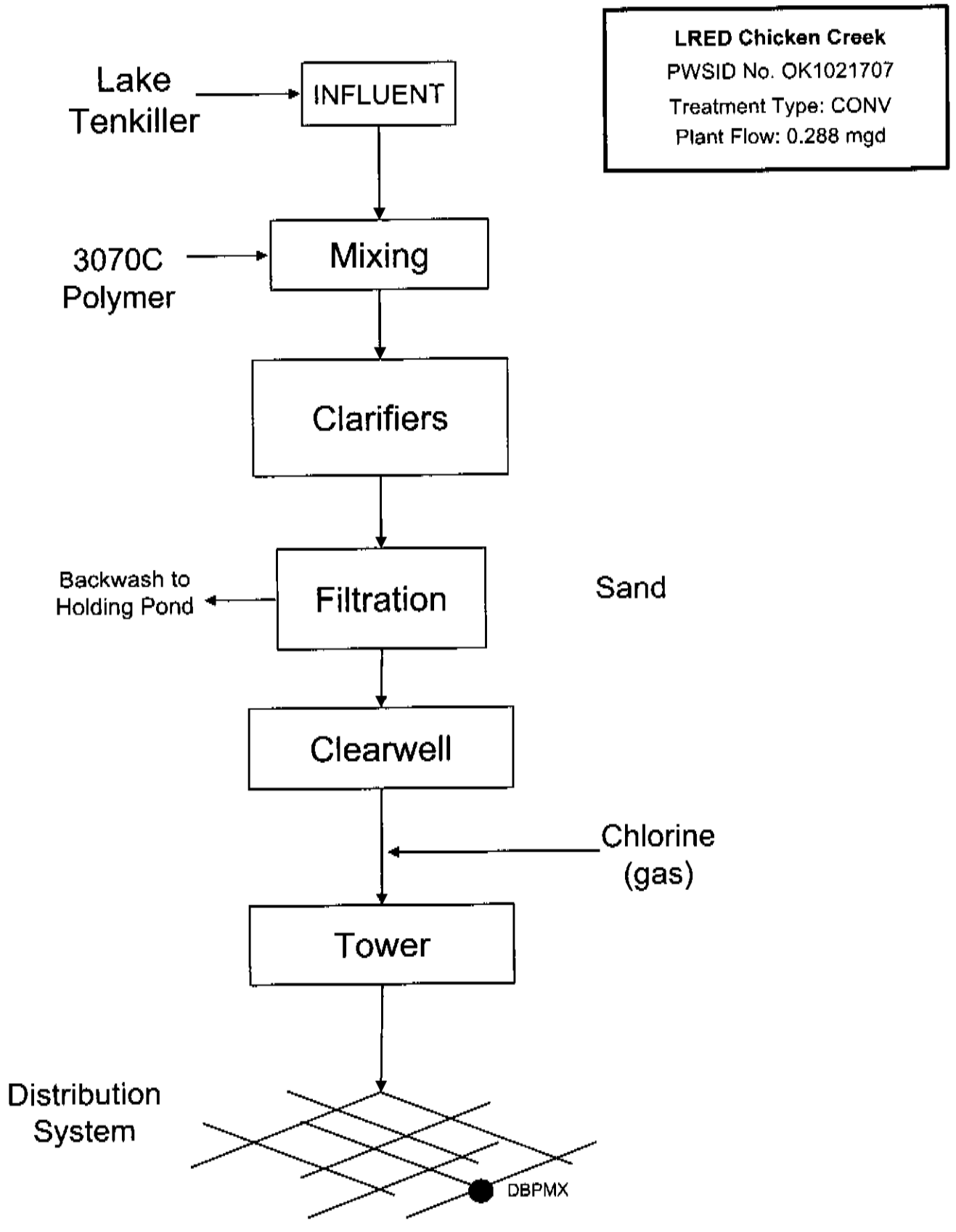
Source: (Warner 2008)



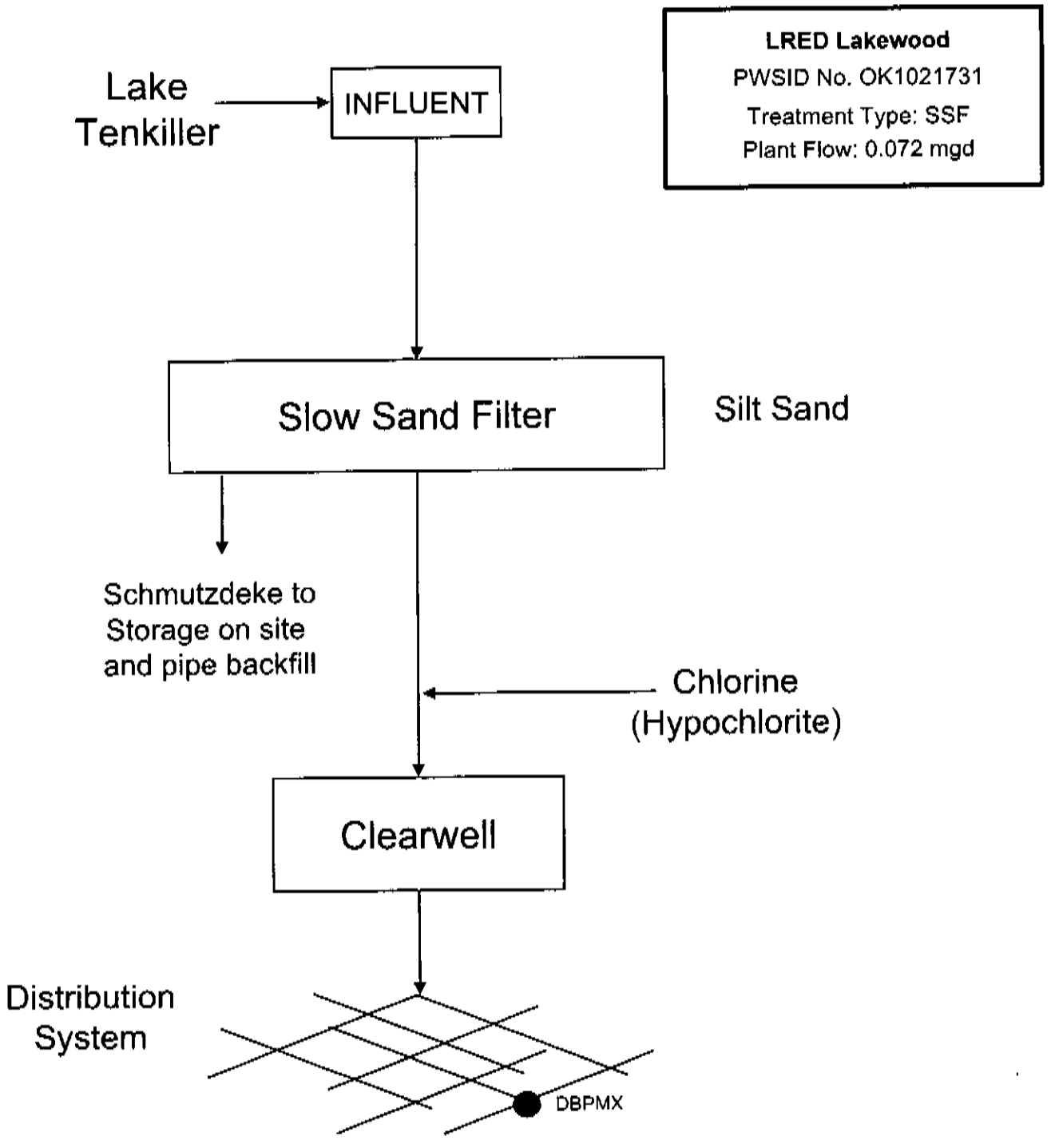
Source: (Wright 2008)



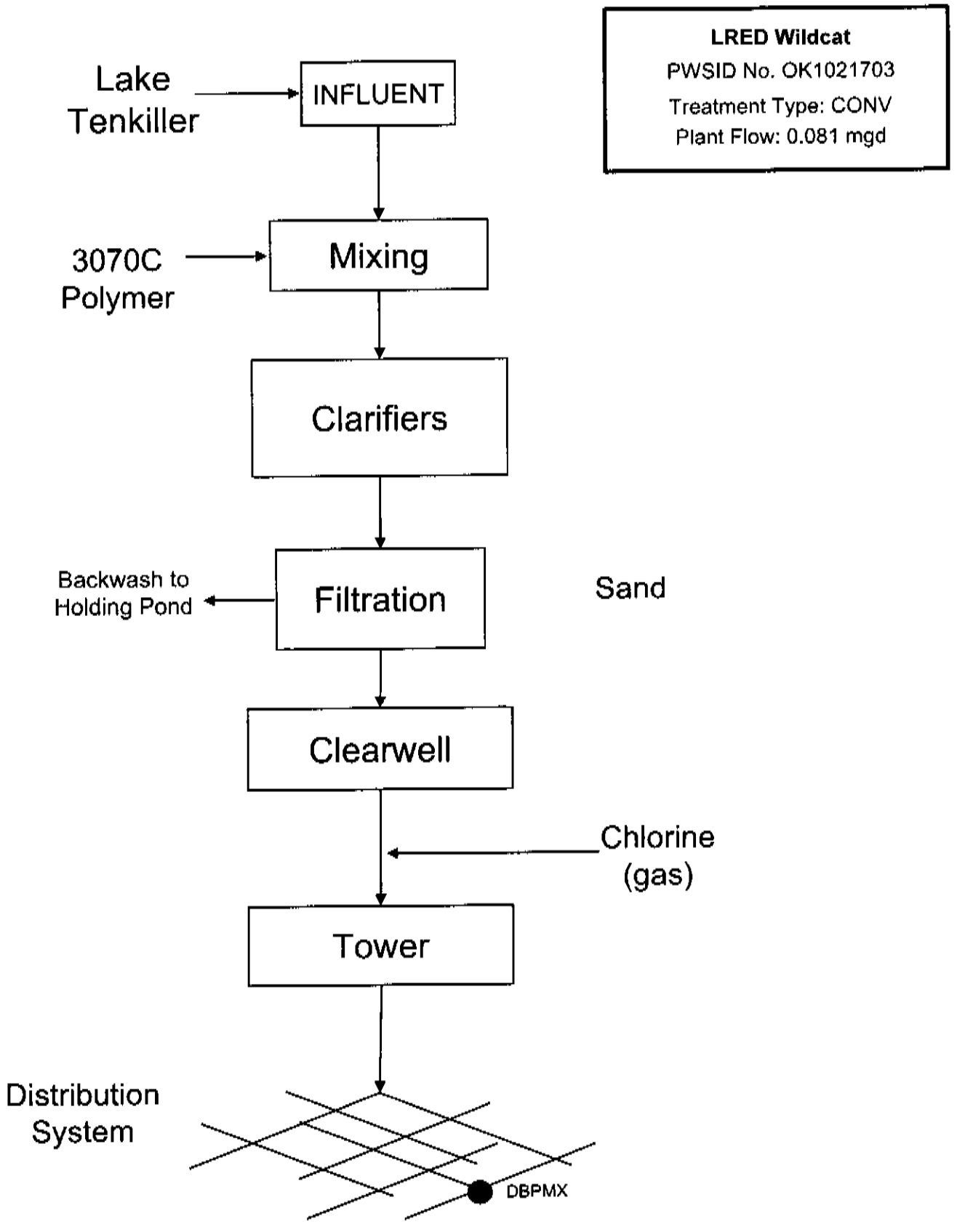
Source: (Lindley 2008)



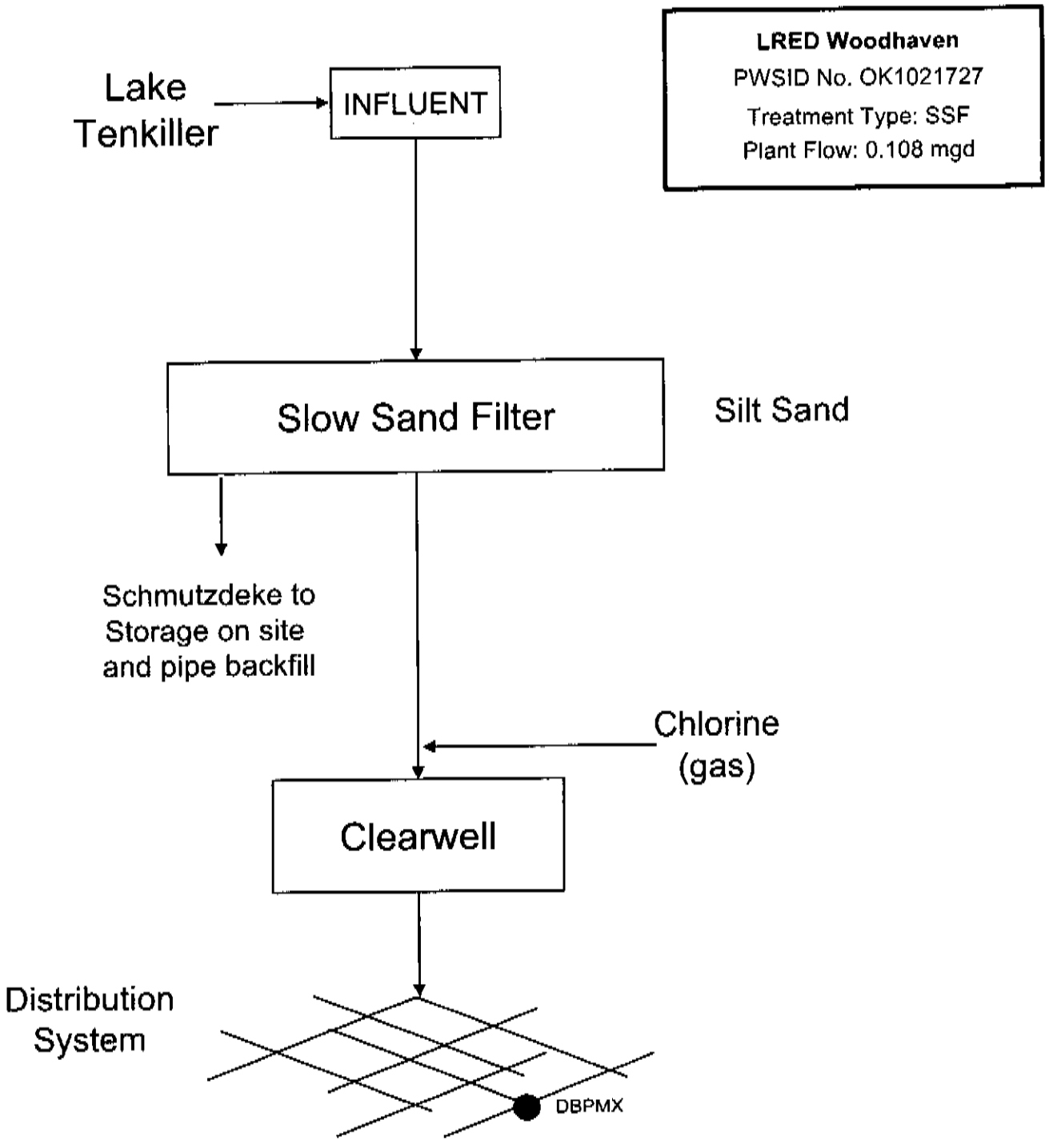
Source: (Ryals 2008)



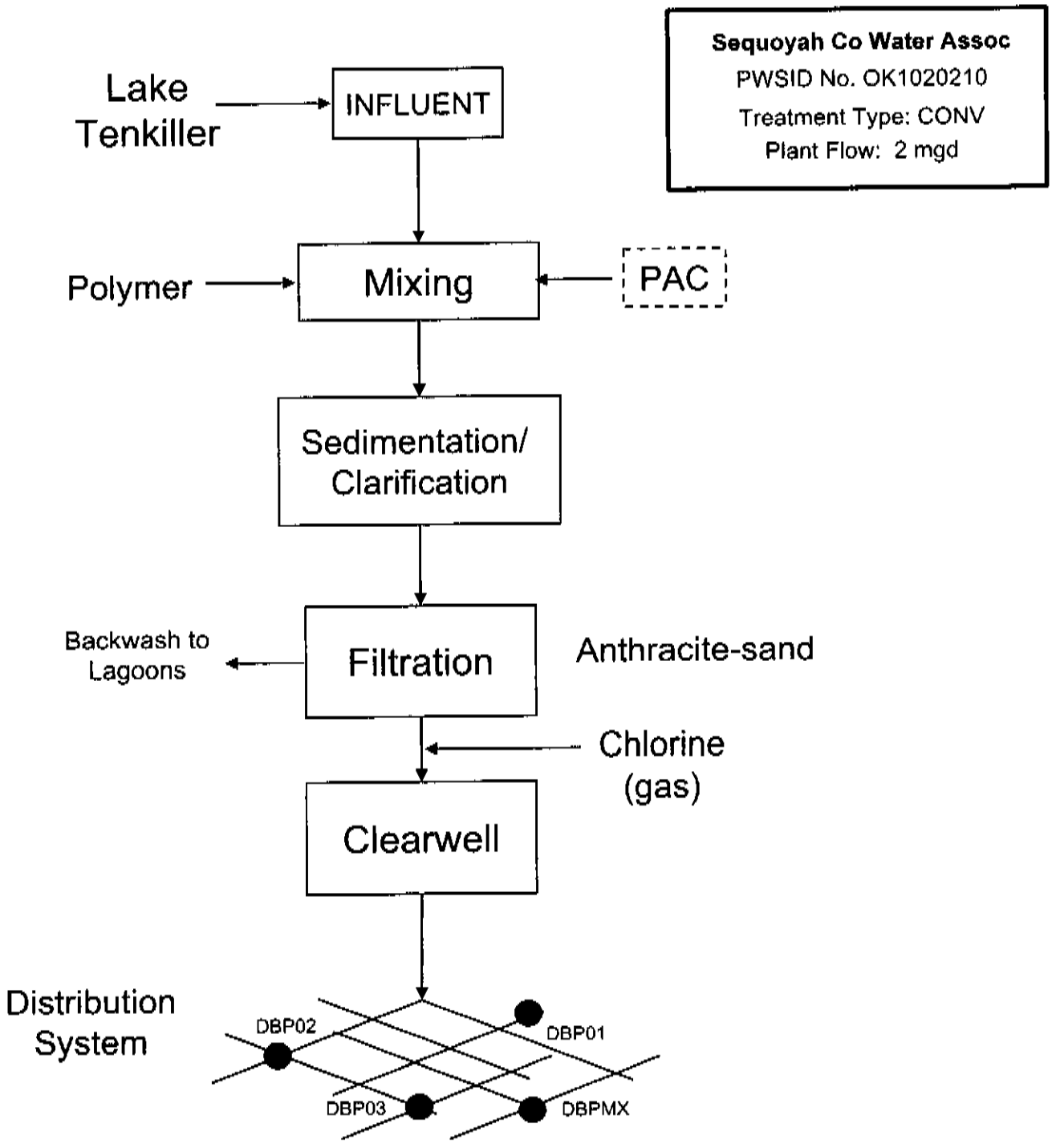
Source: (Ryals 2008)



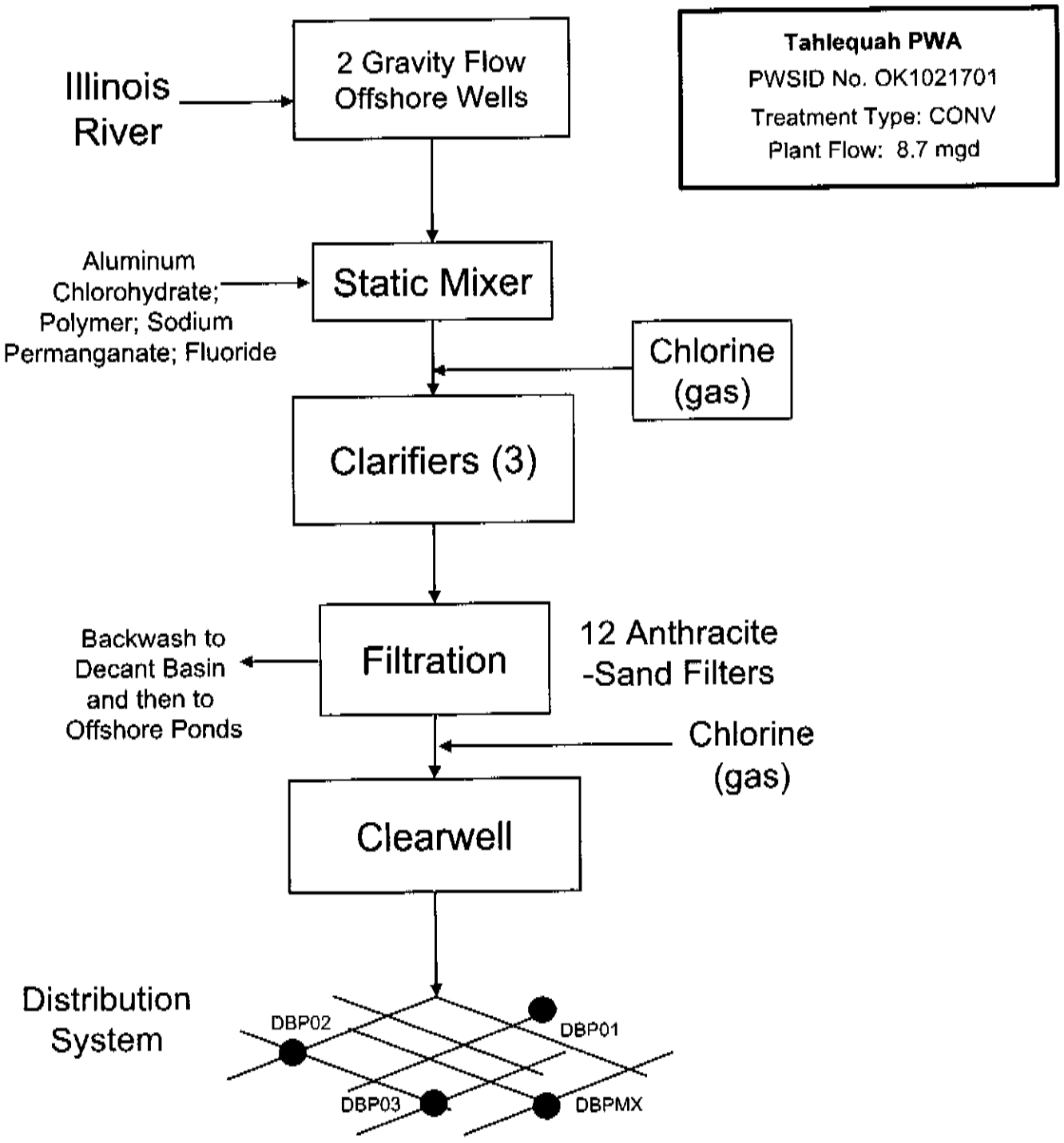
Source: (Ryals 2008)



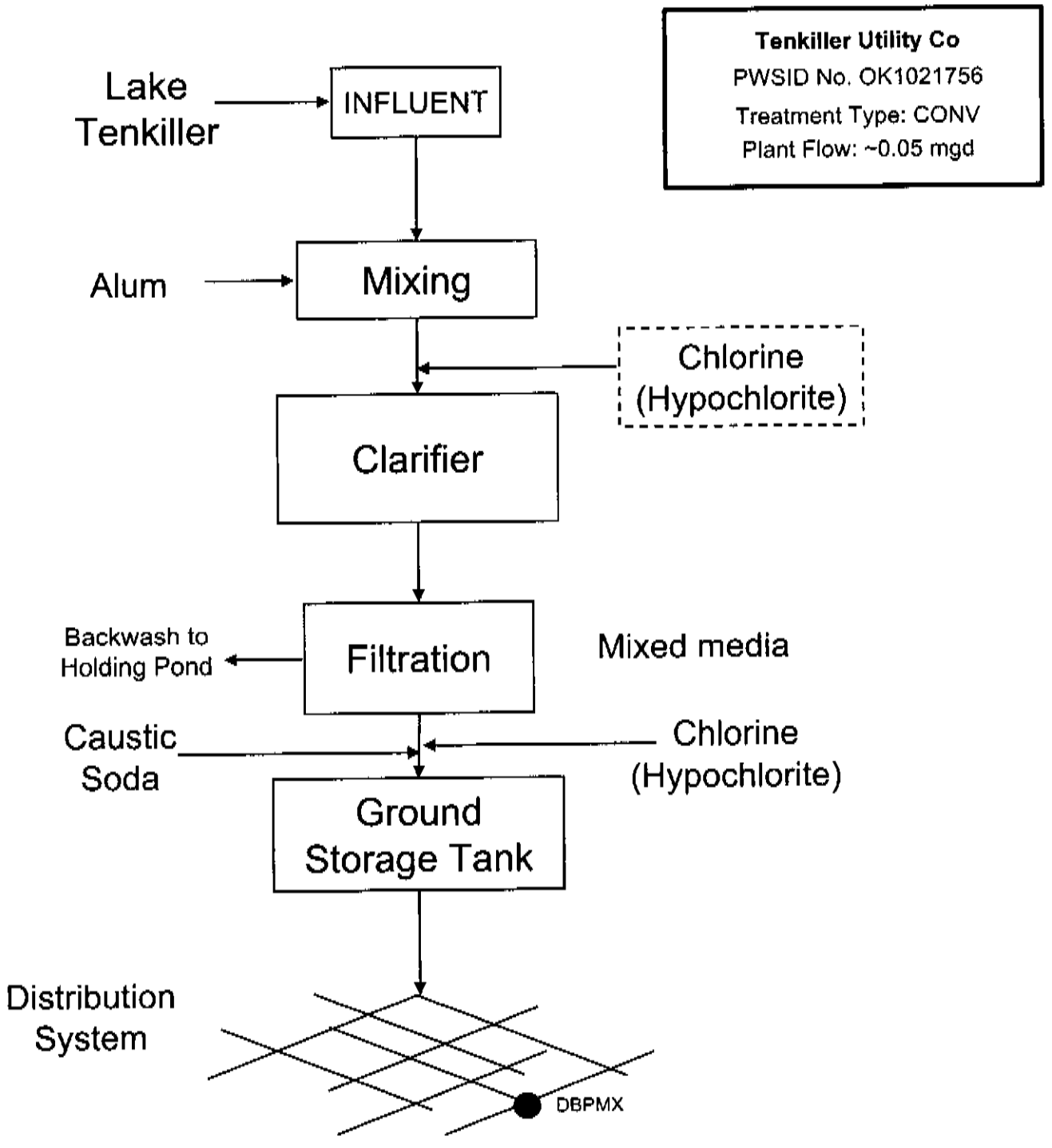
Source: (Ryals 2008)



Source: (Richards 2008)



Sources: (Day 2008; Johnson 2008; Updike 2008)



Source: (Connor 2008)

Cherokee County RWD #2	
Water System Number	OK1021711
Population Served	1,239 retail
Sources of Supply	Lake Tenkiller (100%)
Wholesale Customers	None
Treatment	Chemical addition (polymer at about 9 mg/L, alum at about 10 mg/L; prechlorination (2-3 mg/L); clarification; filtration (anthracite-sand); chlorination (1-2 mg/L); clearwell storage; phosphate added
TTHM & HAA5 Control	No DBP MCL violations; TOC removal after 2004 was typically 0-40% which is fair performance for their polymer
Water Safety	(Gassaway Deposition) State of Oklahoma has not said that the water from Cherokee Co 2 "...presents a danger to the public." (2004-2008 CCR)"Our constant goal is to provide you with a safe and dependable supply of drinking water."
Taste and Odor	(Survey) "He [David Puliam] has noticed problems with taste and odor over the last 6 years. ." ; PAC treatment in summer and early fall months, no example dosages could be found in MORs provided

Source: (Gassaway 2008; MORs; CCRs, HSWMR 2006)

Cherokee County RWD #13	
Water System Number	OK1021721
Population Served	1,640 retail; 480 wholesale
Sources of Supply	Lake Tenkiller (100%)
Wholesale Customers	Unknown
Treatment	No chemical addition; clarification; microfiltration (48 filter elements); chlorination (post about 3 mg/L); clearwell storage;
TTHM & HAA5 Control	DBP MCL violations when first started sampling in 2004; No significant TOC removal through microfilters
Water Safety	Bruce Warner Deposition) State of Oklahoma has not said that the water from Cherokee Co 13 "...presents a danger to the public." (2008 CCR)"Our goal is and always has been to provide you with a safe and dependable supply of drinking water."
Taste and Odor	(Bruce Warner from Survey) "In early October-late September when the lake turns over is when he receives complaints about a musky odor of the water. It happens every year for the last 11 years. It last for about two weeks or 10-12 days. He gets about 7-8 complaints a year. They just do it verbally when they see him. They do not do anything to deal with the taste/ odor issue it just goes away."

Source: (Warner 2008; MORs; CCRs, HSWMR 2006)

East Central OK	
Water System Number	OK1021713
Population Served	1,200 retail
Sources of Supply	Lake Tenkiller (100%)
Wholesale Customers	None
Treatment	Chemical addition (polymer at about 2 mg/L; prechlorination 3 mg/L; flash mix; clarification; filtration (anthracite-sand); clearwell storage; (chlorine residual leaving the plant is 1.5-2 mg/L)
TTHM & HAA5 Control	Utility has had a number of DBP MCL violations; TOC removal is poor; prechlorination only!; only tools to reduce DBPs are to reduce chlorine and flush system
Water Safety	(Wright Deposition) State of Oklahoma has not said that the water from East Central OK "...presents a danger to the public." (2007 CCR) "Our goal is and always has been to provide you with a safe and dependable supply of drinking water."
Taste and Odor	(Wright Depo) "Q Do you see increased problems with taste and odor when algae blooms occur? A Yeah, that -- you know, like I say, I get very few complaints on it, but that's when you get your taste and odor -- or taste and odor complaints."; (Survey) "He [Steve Wright] says he's never noticed any taste and odor problems with the water but a couple of weeks ago one of the secretaries said she could taste something. He has not received any other complaints by phone from customers."

Source: (Wright 2008; MORs; CCRs, HSWMR 2006)

Gore PWA	
Water System Number	OK1021773
Population Served	1,688 retail
Sources of Supply	Lake Tenkiller (100%)
Wholesale Customers	None
Treatment	Chemical addition (polymer at about 10-14 mg/L; chlorination at the filters 3-6 mg/L; filtration (anthracite-sand-garnet); two parallel "batch" or "package" filter systems; clearwell storage; (chlorine residual leaving the plant is about 1-1.5 mg/L); pre and post chlorine addition in 2007 and 2008
TTHM & HAA5 Control	Utility has had a number of DBP MCL violations; TOC removal is fair to poor; No sedimentation;
Water Safety	(Lindley Deposition) State of Oklahoma has not said that the water from Gore PWA "...presents a danger to the public." (2007 CCR) "Our constant goal is to provide you with a safe and dependable supply of drinking water." and "MCLs are set at very stringent levels."
Taste and Odor	(Lindley Depo) "I haven't had any formal written complaints, but there've been times that I've had informal conversations with some of the citizens."; [some complaints caused by chlorine]; No survey responses provided by this utility

Source: (Lindley 2008; MORs; CCRs)

LRED Chicken Creek, Lakewood, Wildcat & Woodhaven	
Water System Number	OK1021707, OK1021731, OK1021703, OK1021727
Population Served	about 200 to 300 retail
Sources of Supply	Lake Tenkiller (100%)
Wholesale Customers	None
Treatment	2 slow sand filter plants, 2 conventional treatment plants; chlorine after filters but no reliable dosage data; Residual leaving all of the plants = 2-3 mg/L; no reliable polymer dosage data
TTHM & HAA5 Control	A few DBP MCL high values; 10-20% TOC removal--poor to fair performance for LRED Wildcat and LRED Chicken Creek
Water Safety	(Ryals Deposition) "Has anyone from the State of Oklahoma, including Department of Environmental Quality, ever claimed that water produced by the Authority presents a danger to the public? A Not to my knowledge." (2008 CCR) "Our goal is and always has been, to provide you with a safe and dependable supply of drinking water." and "MCLs are set at very stringent levels."
Taste and Odor	(Survey of Hallum) "No taste and odor complaints." at any of the four systems

Sources: (Ryals 2008; MORs; CCRs, HSWMR 2006)

Sequoyah County Water Association	
Water System Number	OK1020210
Population Served	13,460 retail; 2,259 wholesale
Sources of Supply	Lake Tenkiller (66-75%); purchased water from Van Buren (25-33%) (from City of Fort Smith, water comes from Lee Creek Reservoir)
Wholesale Customers	Sequoyah RWD #5, Town of Vian
Treatment	Chemical addition (polymer at 6-12 mg/L and PAC at 0.4 mg/L); clarification; filtration (anthracite-sand); chlorination (2-3 mg/L dose); clearwell storage
TTHM & HAA5 Control	Four early HAA5 MCL violations; moved the point of chlorination from prechlorination to addition of chlorine after the filters; "...but since then we've had no problems." TOC removal after 2004 was typically 20-40% which is good performance for their polymer
Water Safety	(Richards Deposition) State of Oklahoma has not said that the water from Sequoyah "...presents a danger to the public." (2007 CCR)"The water was safe..."
Taste and Odor	(Survey) "He [Vance Mooney] has not observed any problems with taste and odor." [26 years of experience]; PAC treatment in summer and early fall months, but 0.4 mg/L is far below an effective dose to control a problem

Source: (Richards 2008; MORs; CCRs, HSWMR 2006)

Tahlequah PWA	
Water System Number	OK1021701
Population Served	14,458 retail; 3,973 wholesale
Sources of Supply	Illinois River (100%)
Wholesale Customers	RWDs: Briggs, Welling, Lost City, Grandview, and Stick Ross Mountain Water Company
Treatment	Chemical addition (aluminum chlorohydrate at about 20 40 mg/L, polymer at about 0.1 mg/L, fluoride and sodium permanganate {started in spring of 2005}); prechlorination; clarification; chlorination at the filters; total chlorine dose 5-6 mg/L; filtration (anthracite-sand); clearwell storage; (chlorine residual leaving the plant is about 2-3 mg/L);
TTHM & HAA5 Control	Utility has never exceeded DBP MCLs;15-20% TOC removal--fair to good performance
Water Safety	(Johnson Deposition) "Has anyone from the State of Oklahoma, including Department of Environmental Quality, ever claimed that water produced by the Authority presents a danger to the public? A Not to my knowledge." (2007 CCR) "Our constant goal is to provide you with a safe and dependable supply of drinking water." and "MCLs are set at very stringent levels."
Taste and Odor	(Survey of Johnson) "He has not observed any taste and/ or odor problems himself. He did say that over the years the complaints have been sporadic. ...A few have said that the water tastes like chlorine."; no information on taste and odor complaints from three Tahlequah depositions

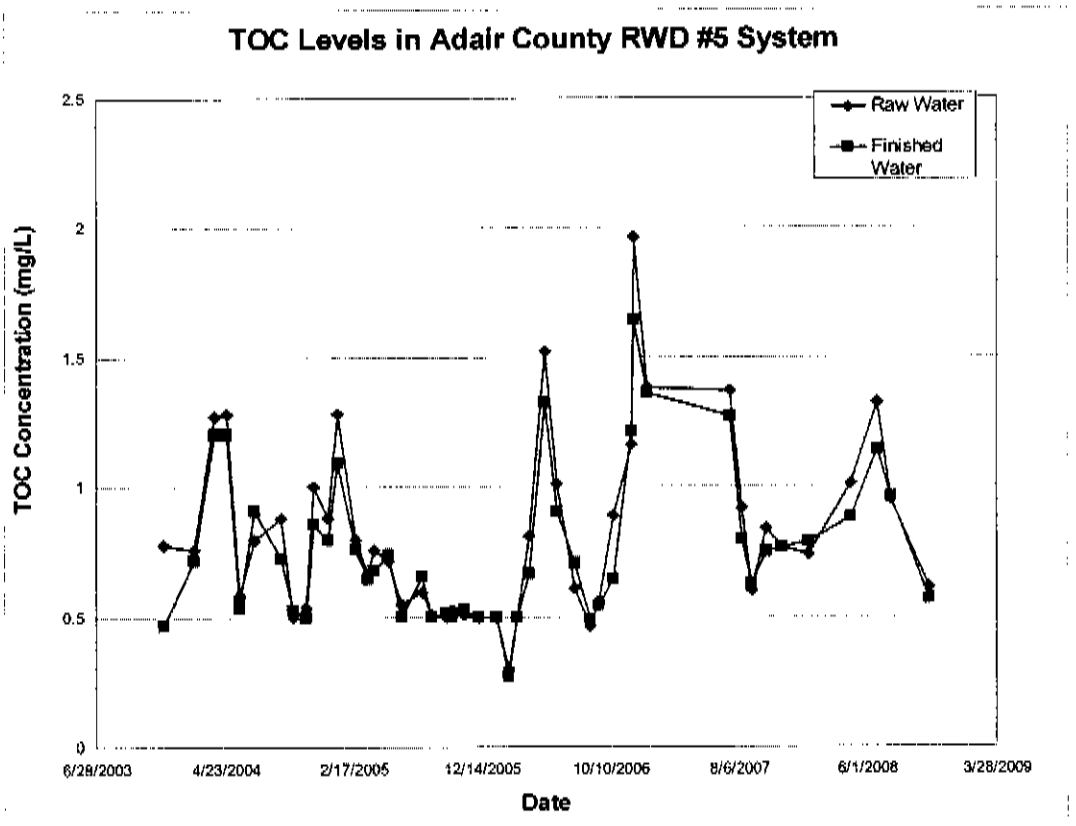
Sources: (Day 2008; Johnson 2008; Updike 2008; MORs; CCRs, HSWMR 2006)

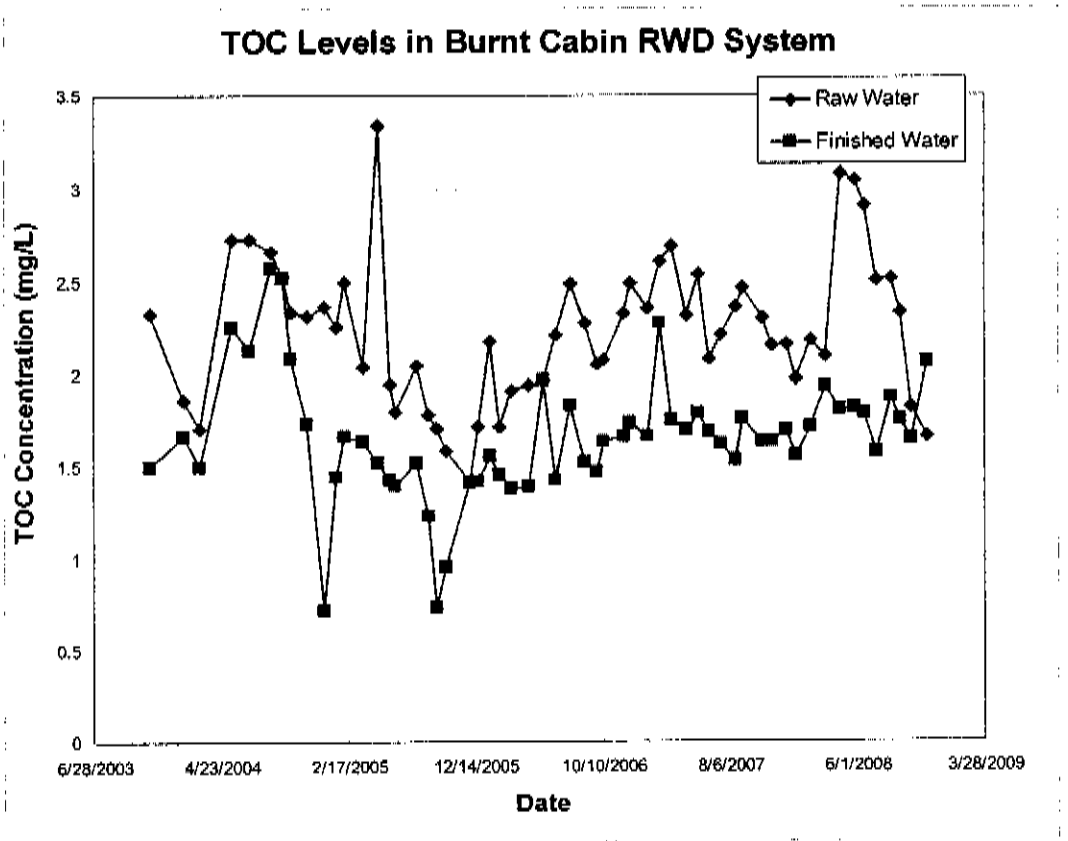
Tenkiller Utility Company	
Water System Number	OK1021756
Population Served	500 retail
Sources of Supply	Lake Tenkiller (100%)
Wholesale Customers	None
Treatment	Chemical addition (alum at 12-20 mg/L with a max of 100 mg/L 2/20/08); clarification; filtration (mixed media); chlorination (2.5-4 mg/L dose); pH adjustment with caustic soda; clearwell storage
TTHM & HAA5 Control	Early DBP MCL violations; moved the point of chlorination from prechlorination to addition of chlorine after the filters; reduced chlorine dose; TOC removal after 2004 was typically 30-50% which is very good performance for alum; rare prechlorination when lake turns over
Water Safety	(2005 CCR) "Our constant goal is to provide you with a safe and dependable supply of drinking water." and "MCLs are set at very stringent levels."
Taste and Odor	(Survey--Gary Keys) "No taste and odor complaints." (Connor Depo) "Q Has Tenkiller ever had issues with taste and odor? A No." one event in the past

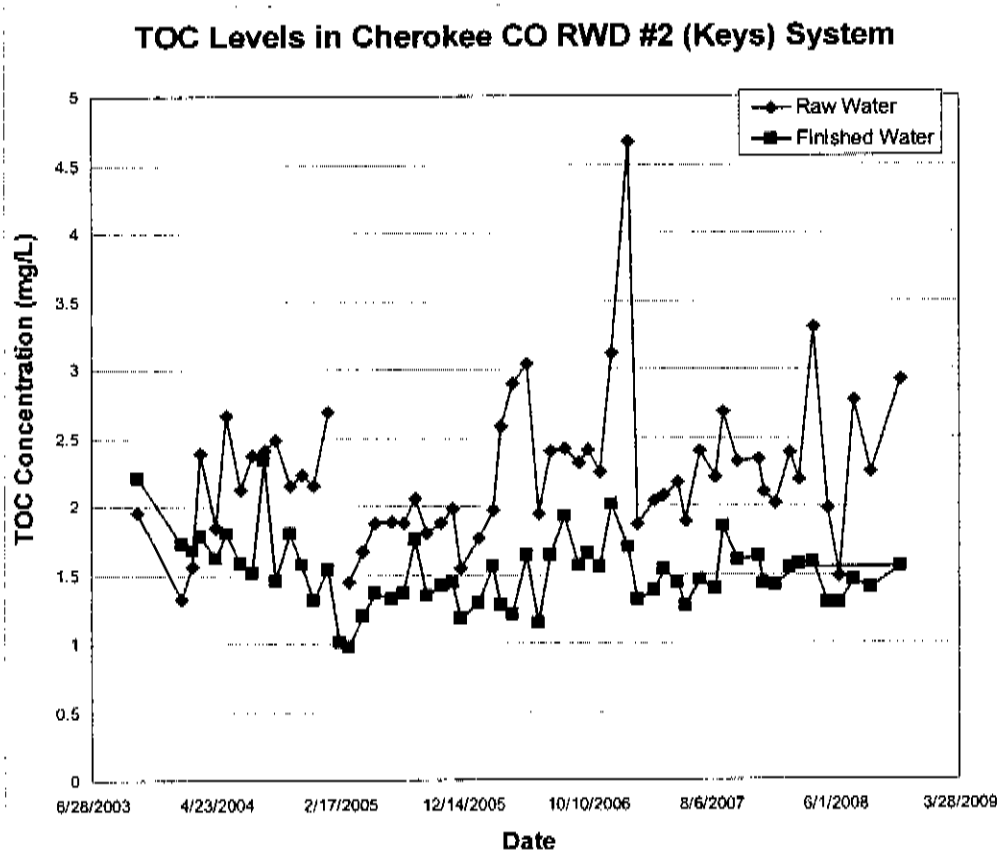
Source: (Connor 2008; MORs; CCRs, HSWMR 2006)

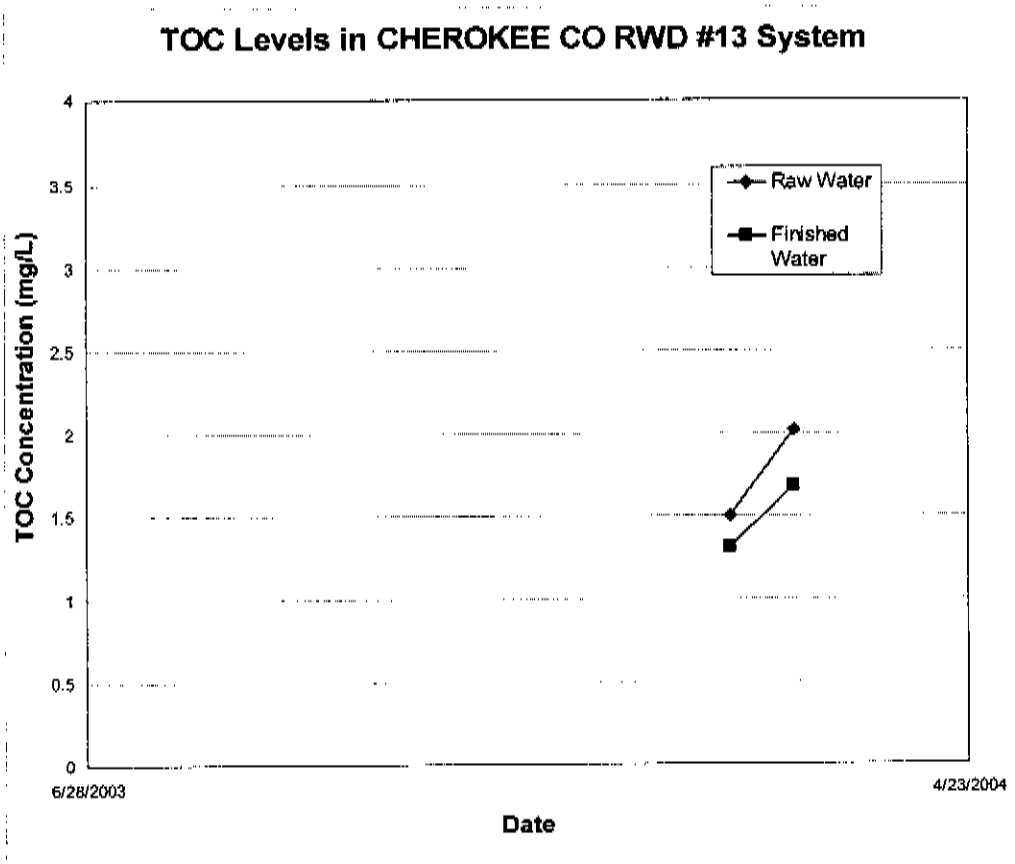
Appendix C—
TOC Data for IRW Utilities

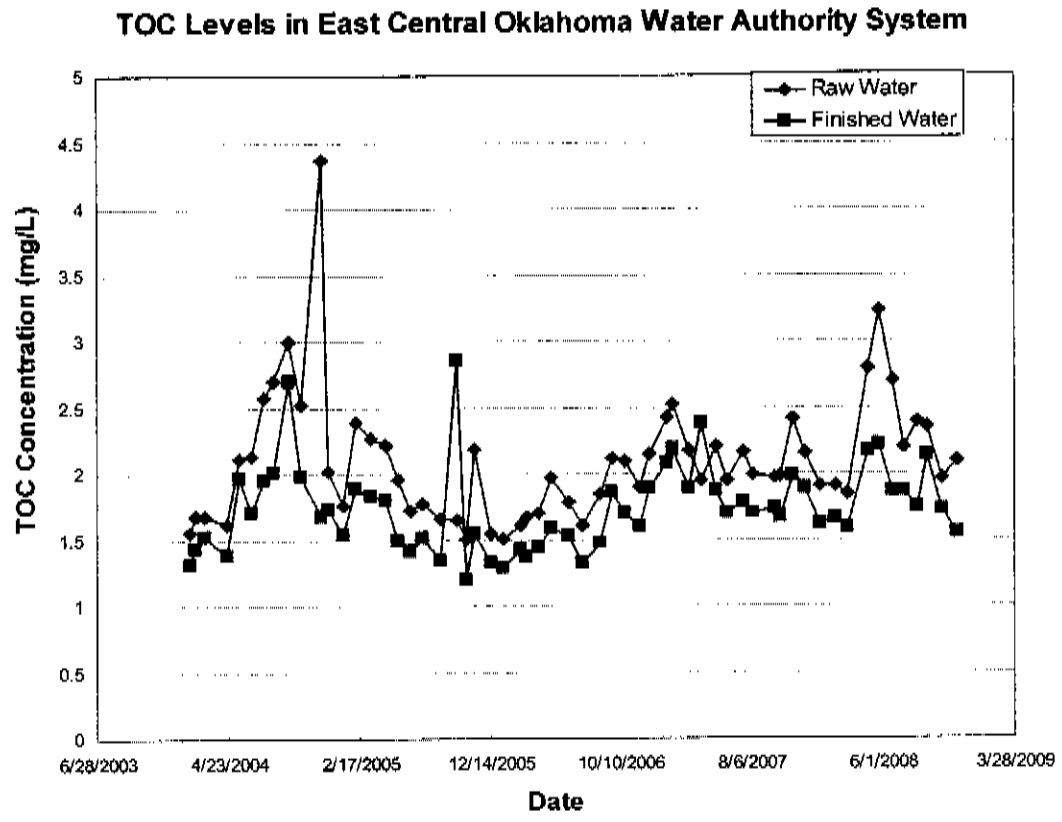
Raw Water TOC Data for IRW Water Utilities


TOC Levels in Adair County RWD #5 System
Raw Water
Finished Water
TOC Concentration (mg/L)
2.5
2
1.5
1
0.5
0
6/28/2003
4/23/2004
2/17/2005
12/14/2005
10/10/2006
8/6/2007
6/1/2008
3/28/2009
Date

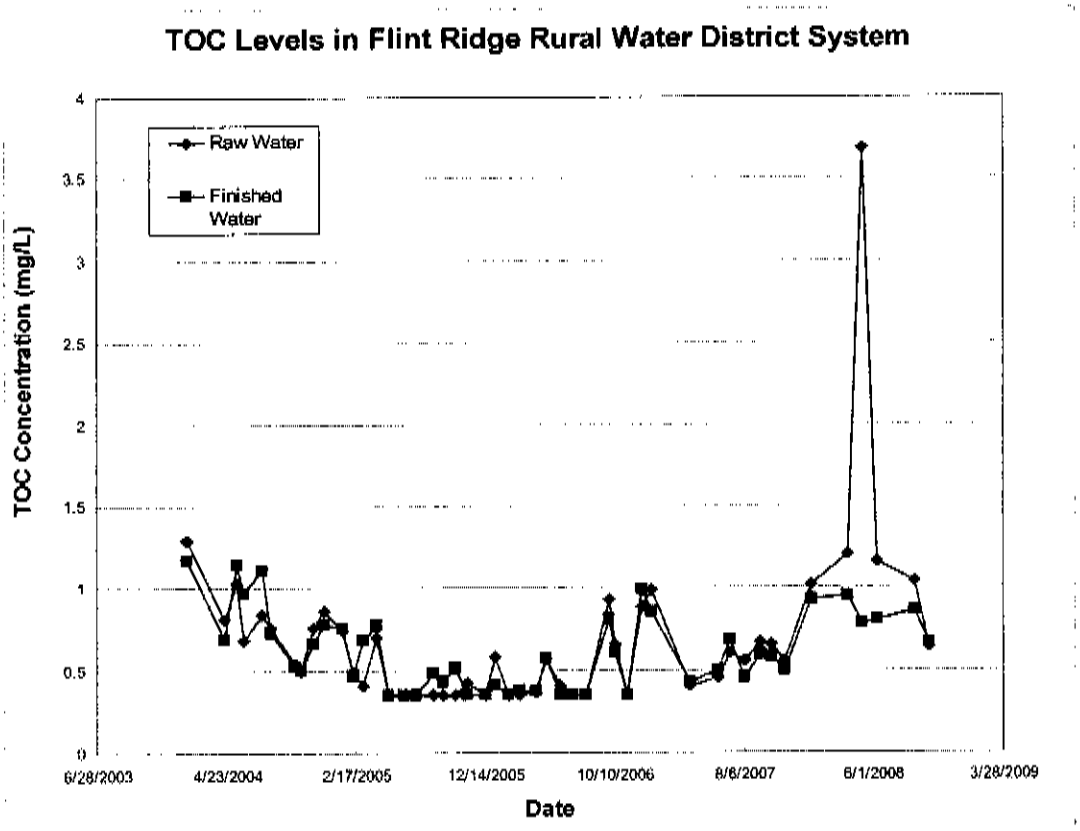

TOC Levels in Burnt Cabin RWD System
Raw Water
Finished Water
TOC Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
6/28/2003
4/23/2004
2/17/2005
12/14/2005
10/10/2006
8/6/2007
6/1/2008
3/28/2009
Date

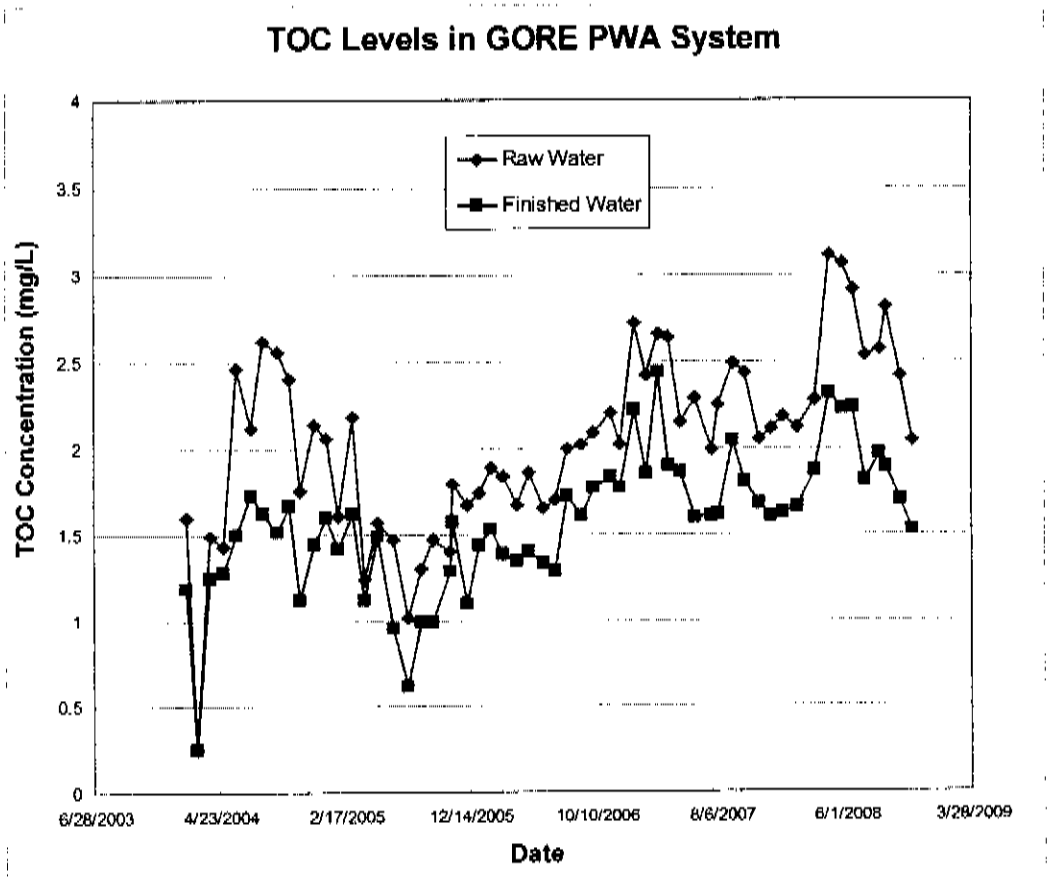

TOC Levels in Cherokee CO RWD #2 (Keys) System
Raw Water
Finished Water
TOC Concentration (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
6/28/2003
4/23/2004
2/17/2005
12/14/2005
10/10/2006
8/6/2007
6/1/2008
3/28/2009
Date

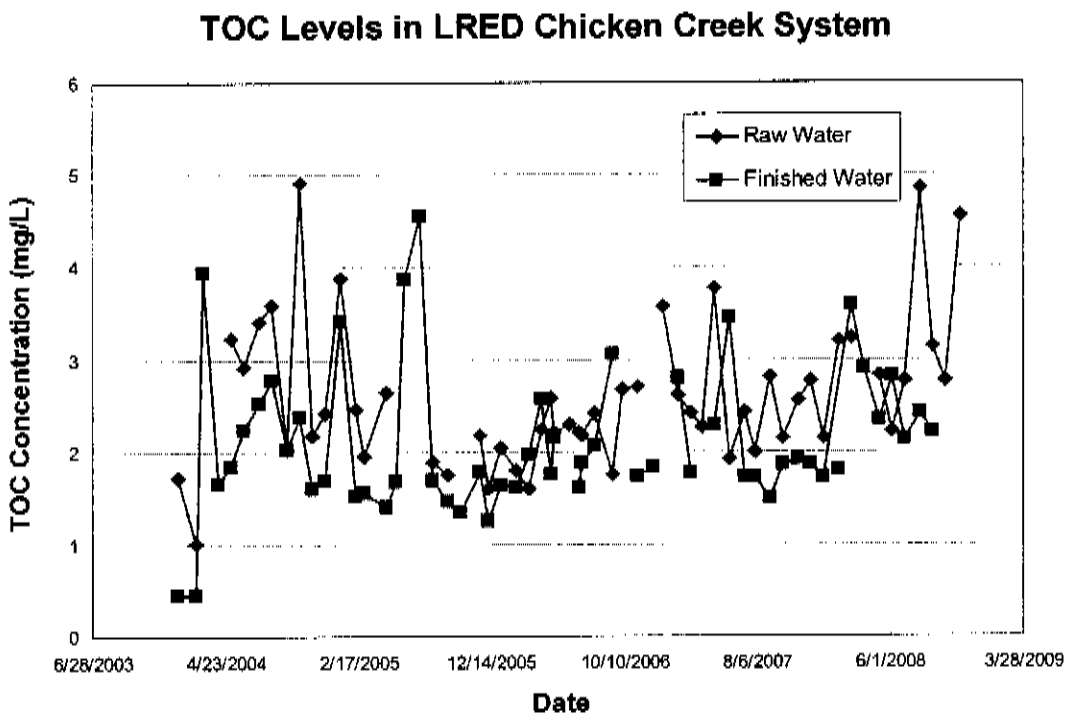

TOC Levels in CHEROKEE CO RWD #13 System
Raw Water
Finished Water
TOC Concentration (mg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
6/28/2003
4/23/2004
Date



TOC Data Not Available for Fin and Feather Resort

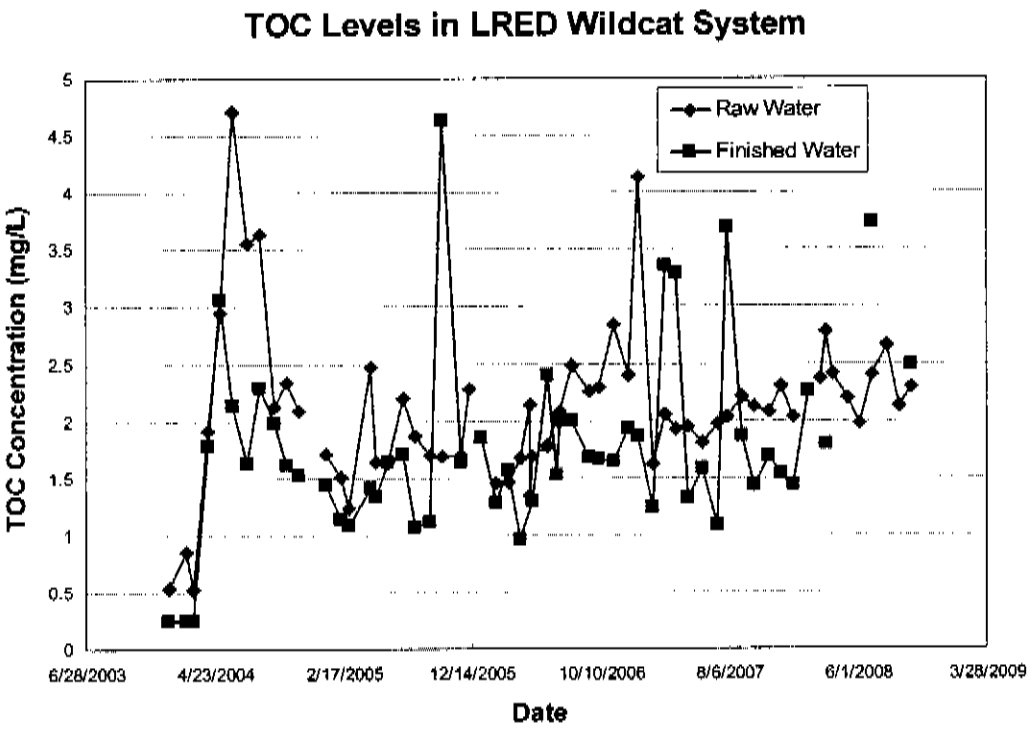

TOC Levels in Flint Ridge Rural Water District System
Raw Water
Finished Water
TOC Concentration (mg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
6/28/2003
4/23/2004
2/17/2005
12/14/2005
10/10/2006
8/6/2007
6/1/2008
3/28/2009
Date


TOC Levels in GORE PWA System
Raw Water
Finished Water
TOC Concentration (mg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
6/28/2003
4/23/2004
2/17/2005
12/14/2005
10/10/2006
8/6/2007
6/1/2008
3/28/2009
Date



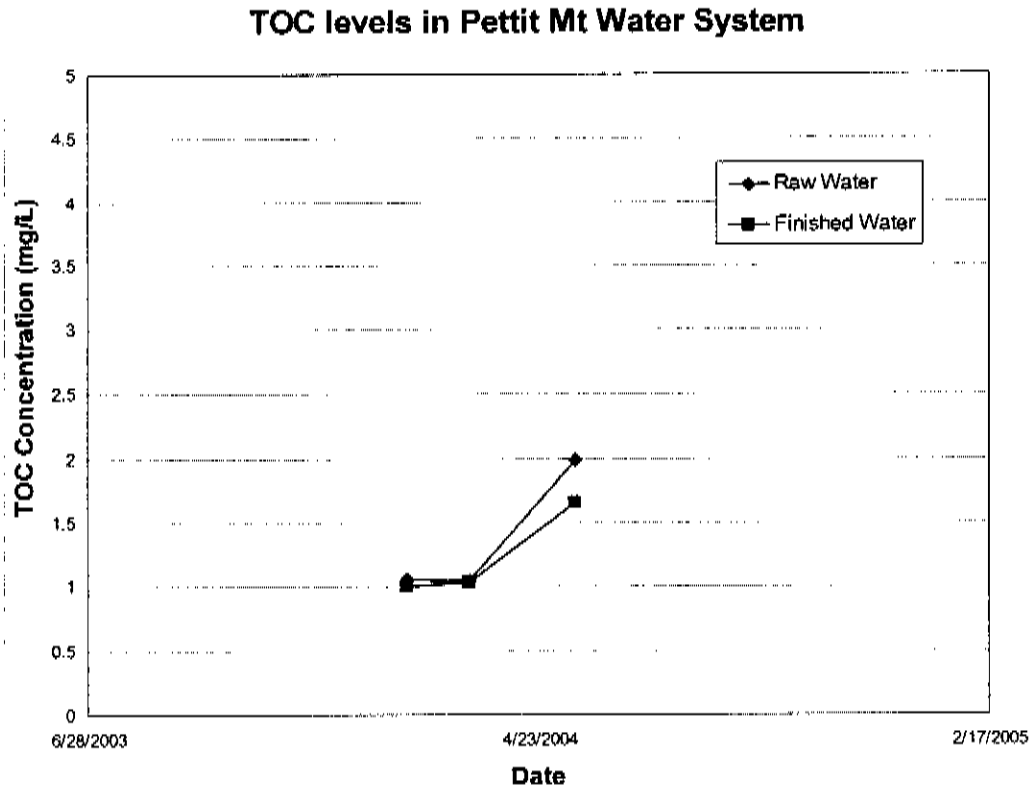
All values of Raw or Finished Water TOC >5 mg/L were excluded as outliers.

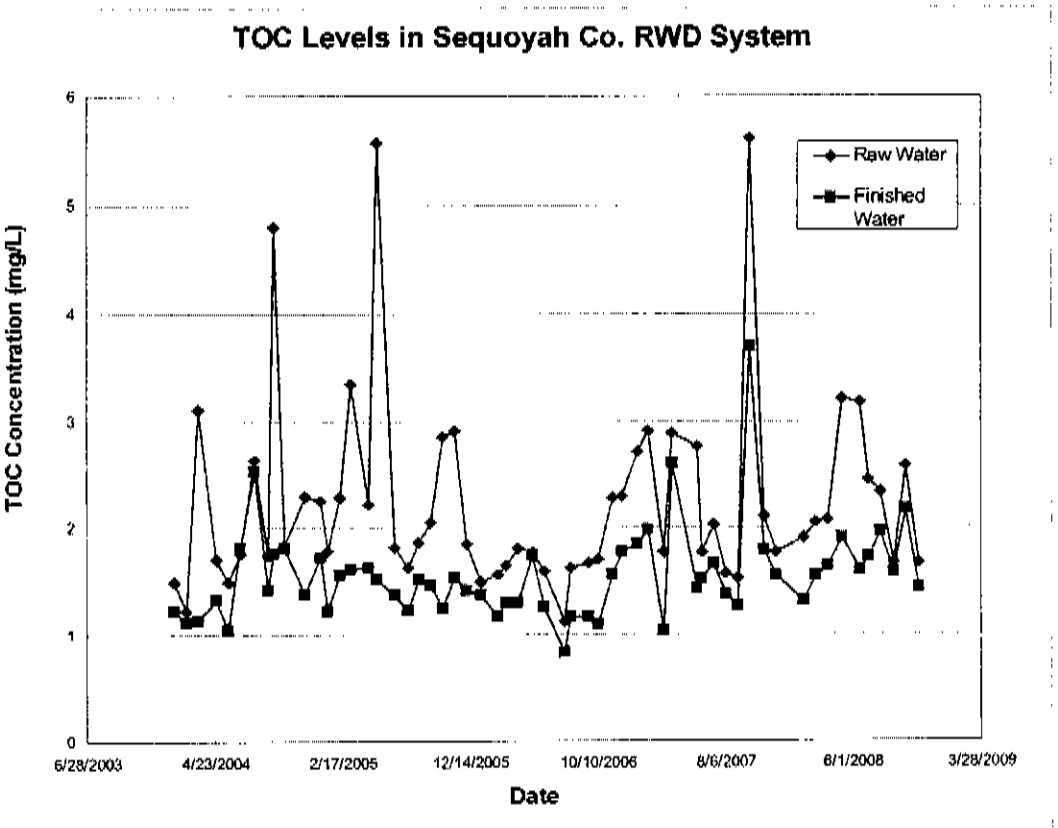
TOC Data Not Available for LRED Lakewood



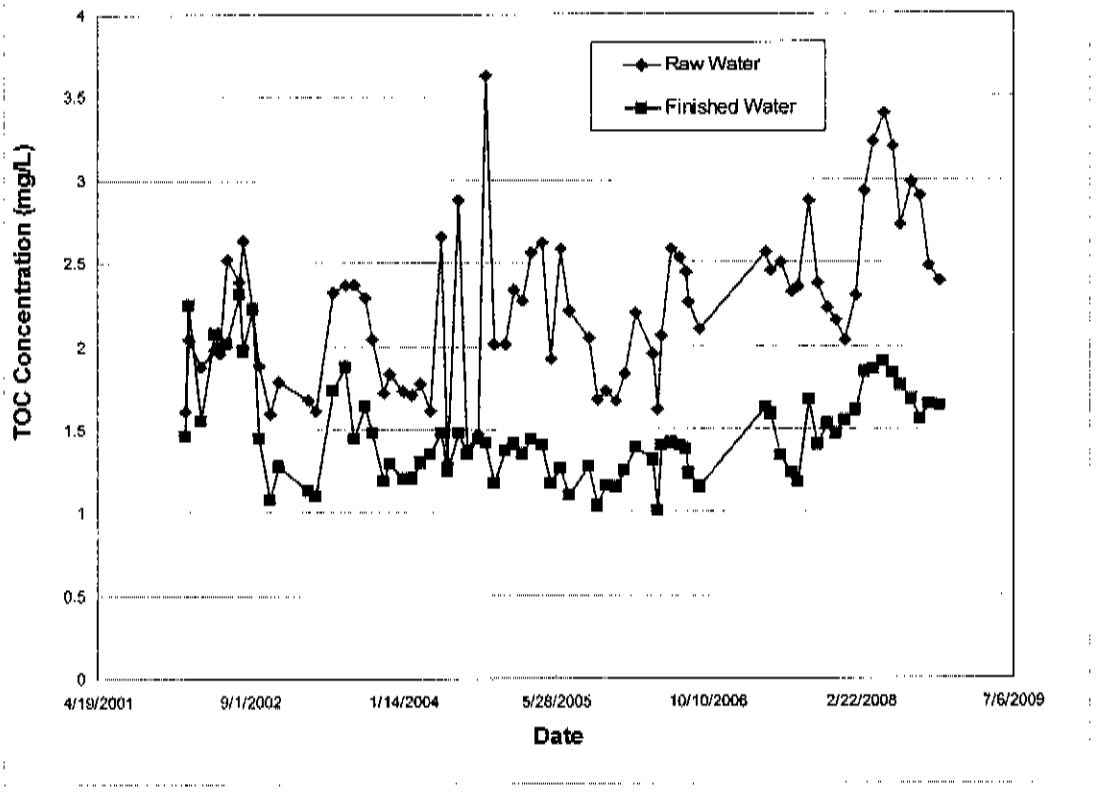
All values of Raw or Finished Water TOC >5 mg/L were excluded as outliers.

TOC Data Not Available for LRED Woodhaven

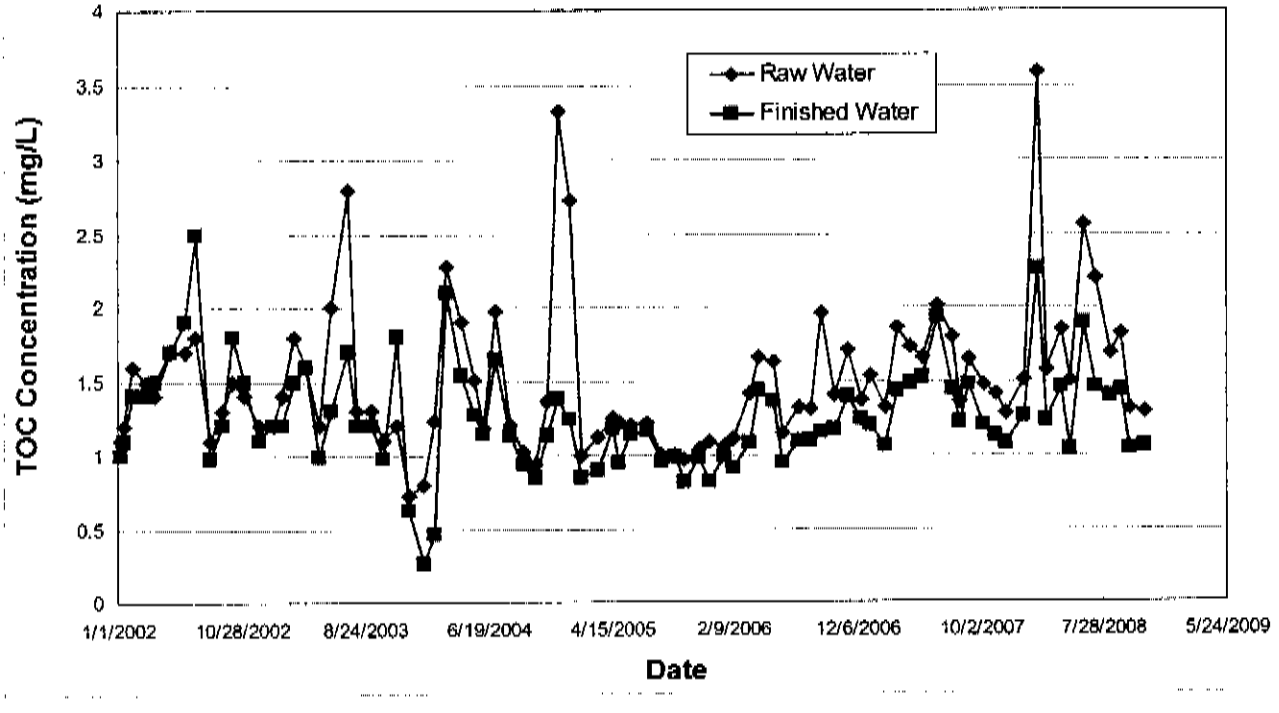

TOC levels in Pettit Mt Water System
TOC Concentration (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Raw Water
Finished Water
6/28/2003
4/23/2004
2/17/2005
Date


TOC Levels in Sequoyah Co. RWD System
TOC Concentration (mg/L)
6
5
4
3
2
1
0
Raw Water
Finished Water
6/28/2003
4/23/2004
2/17/2005
12/14/2005
10/10/2006
8/6/2007
6/1/2008
3/28/2009
Date

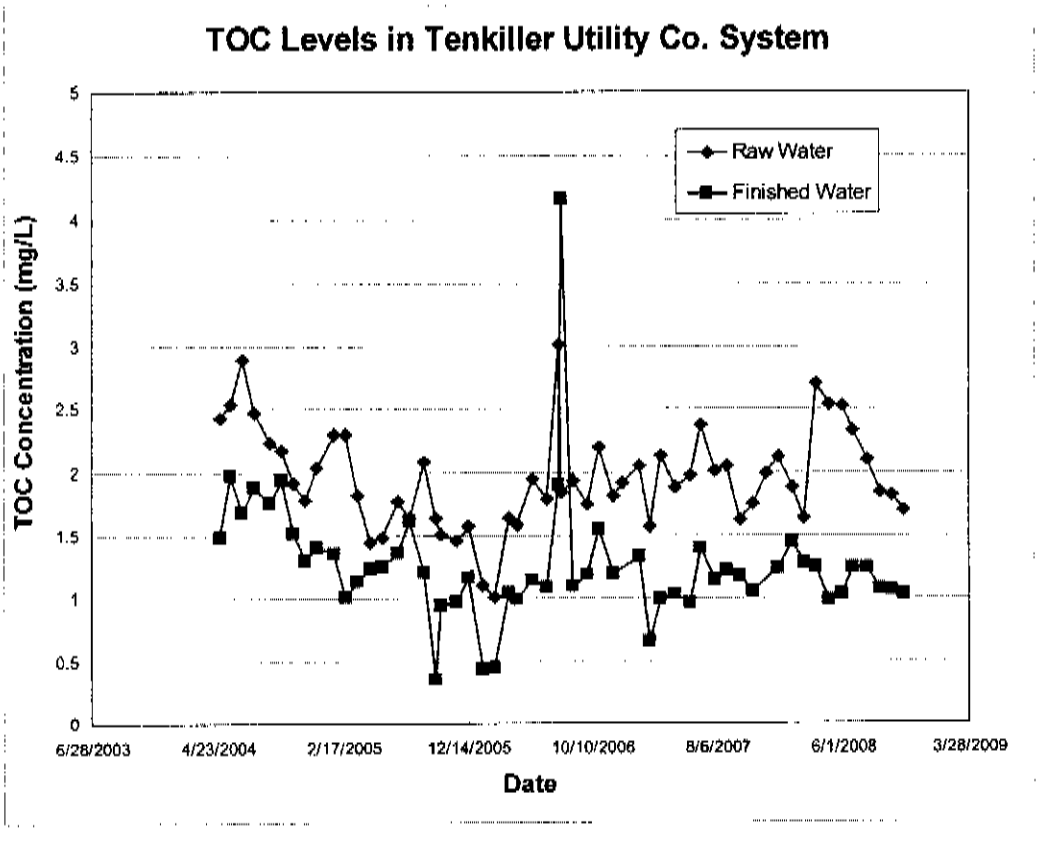
TOC levels in Sequoyah County Water Association System



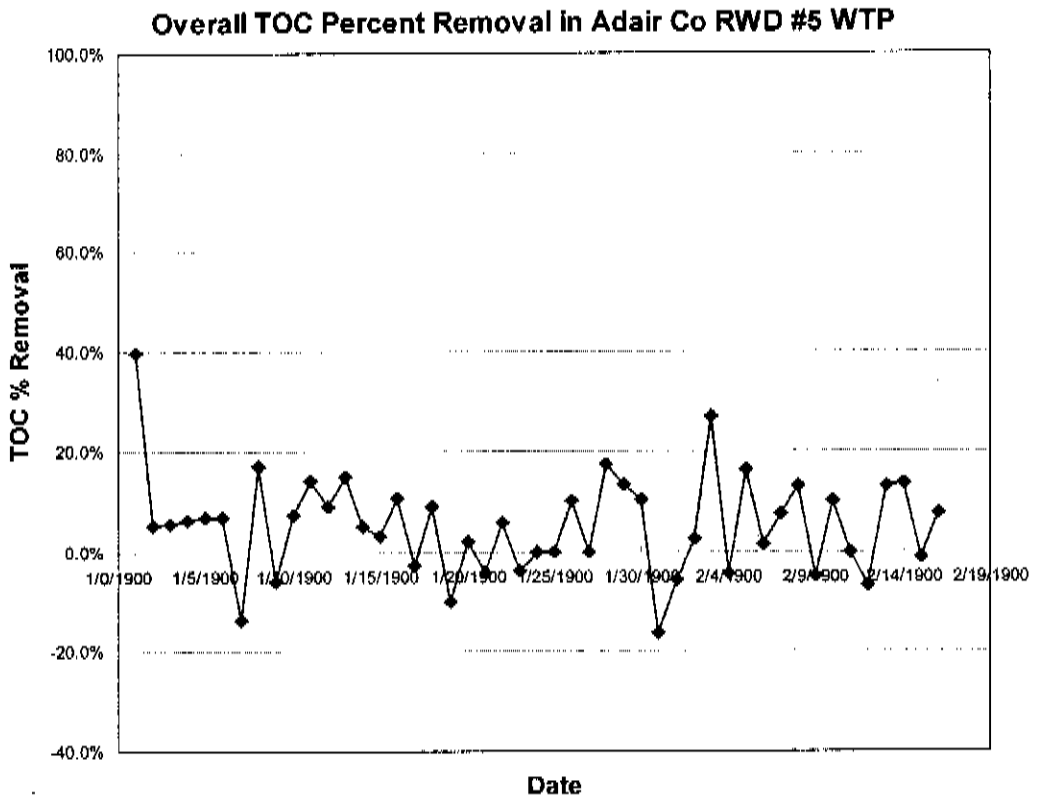
TOC Levels in Tahlequah PWA System

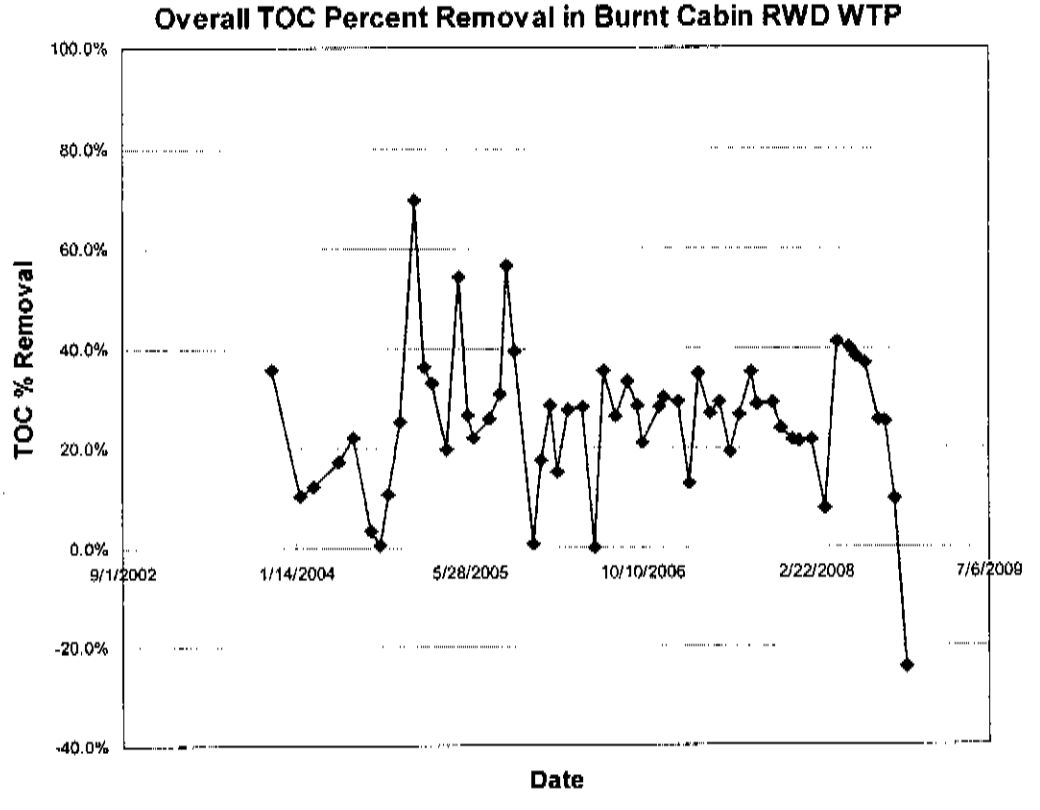


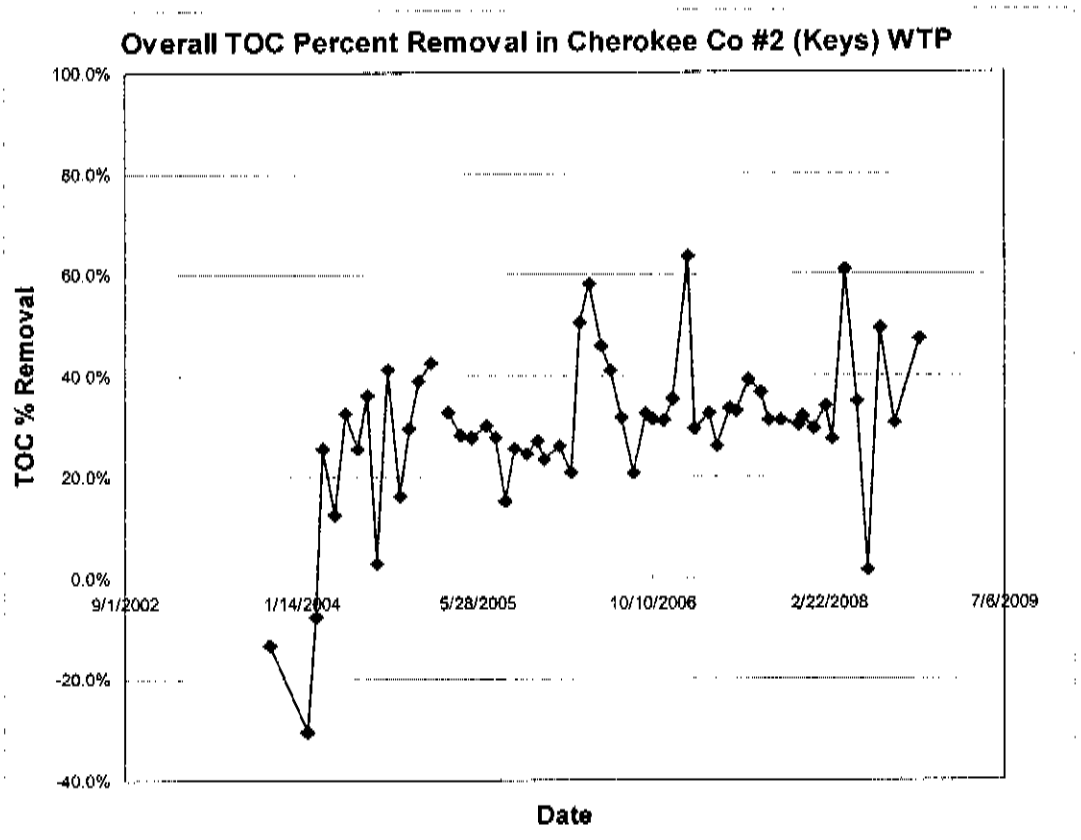
TOC Data Not Available for Tenkiller Aqua Park



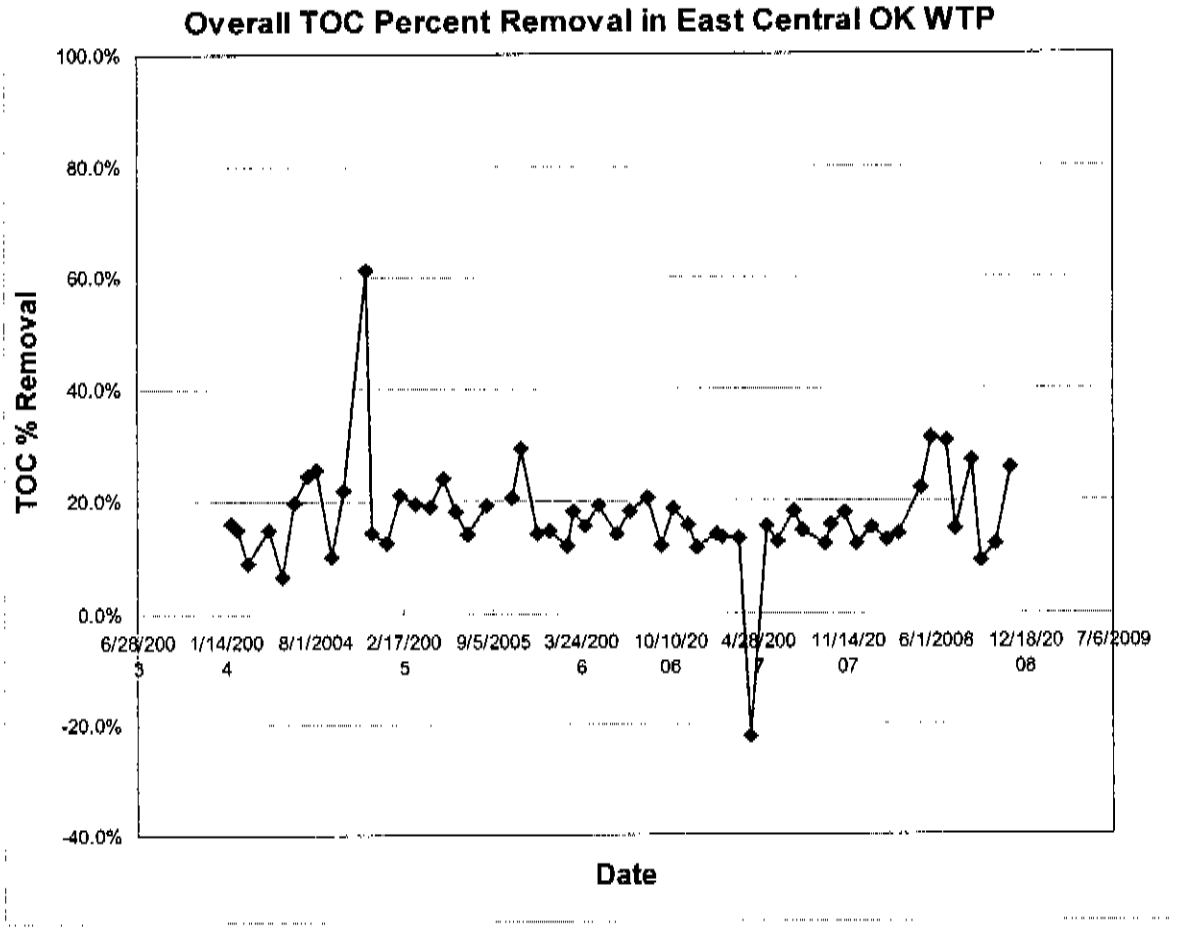
TOC Percent Removal Data for IRW Water Utilities


Overall TOC Percent Removal in Adair Co RWD #5 WTP
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
-40.0%
TOC % Removal
1/0/1900
1/5/1900
1/10/1900
1/15/1900
1/20/1900
1/25/1900
1/30/1900
2/4/1900
2/9/1900
2/14/1900
2/19/1900
Date

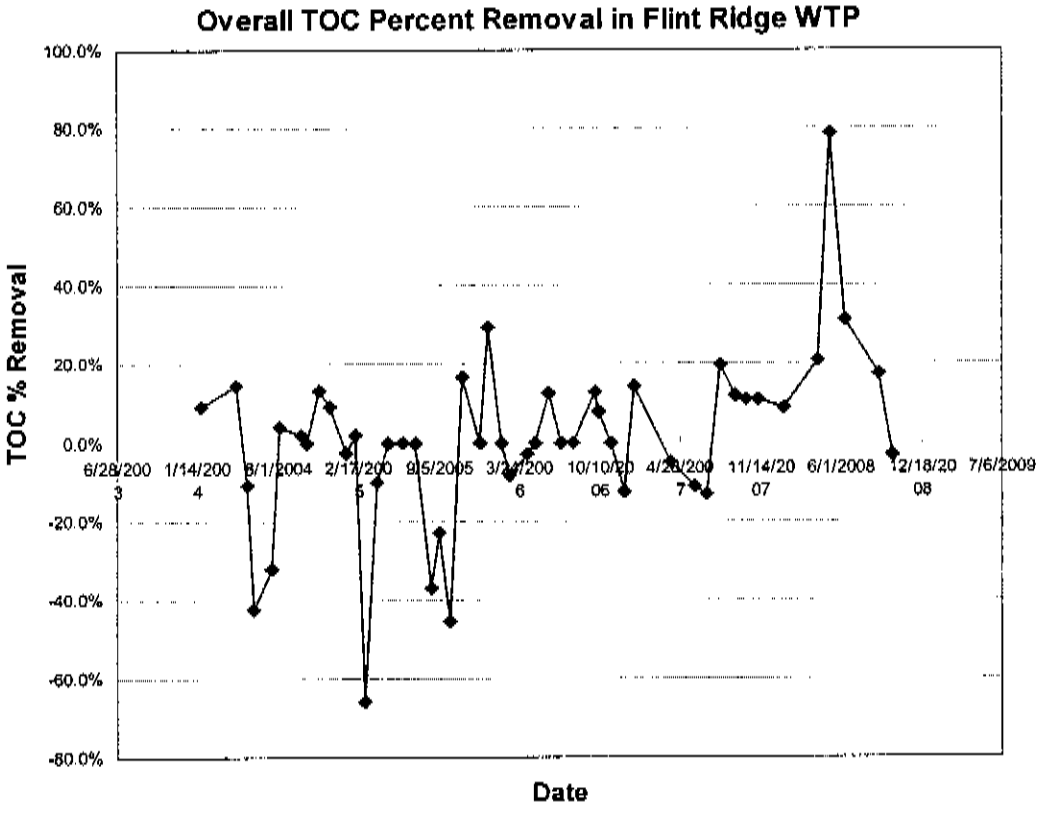

Overall TOC Percent Removal in Burnt Cabin RWD WTP
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
-40.0%
TOC % Removal
9/1/2002
1/14/2004
5/28/2005
10/10/2006
2/22/2008
7/6/2009
Date

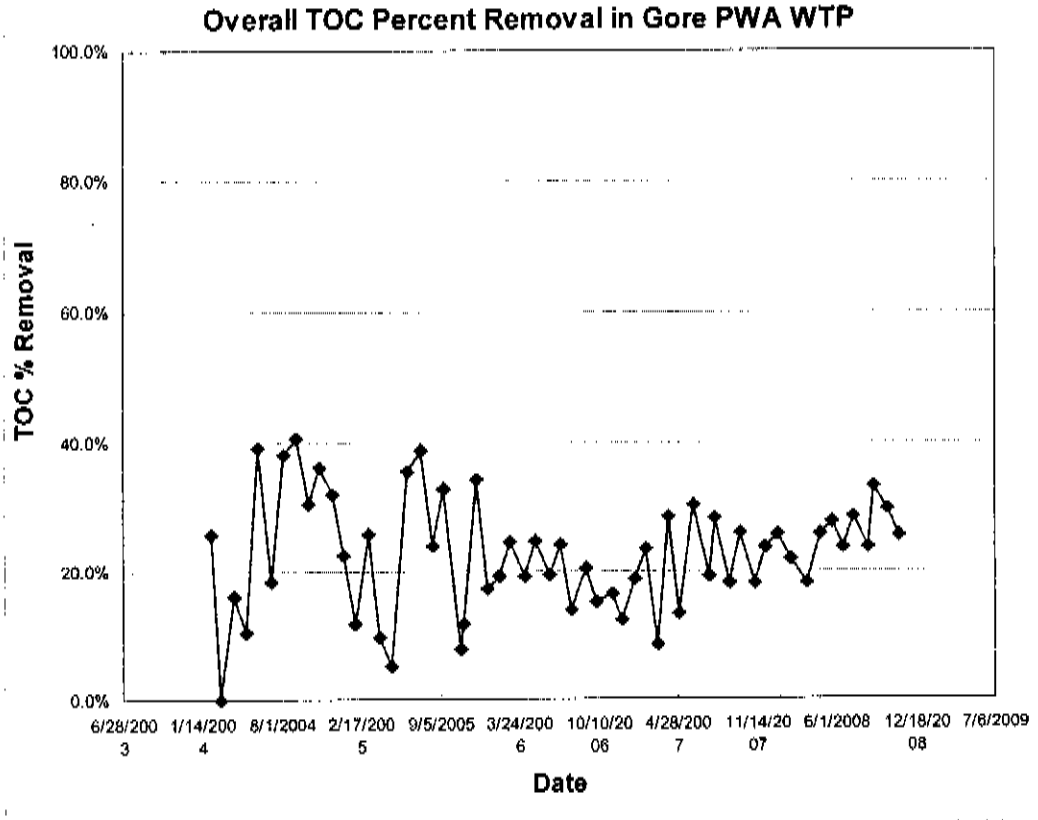


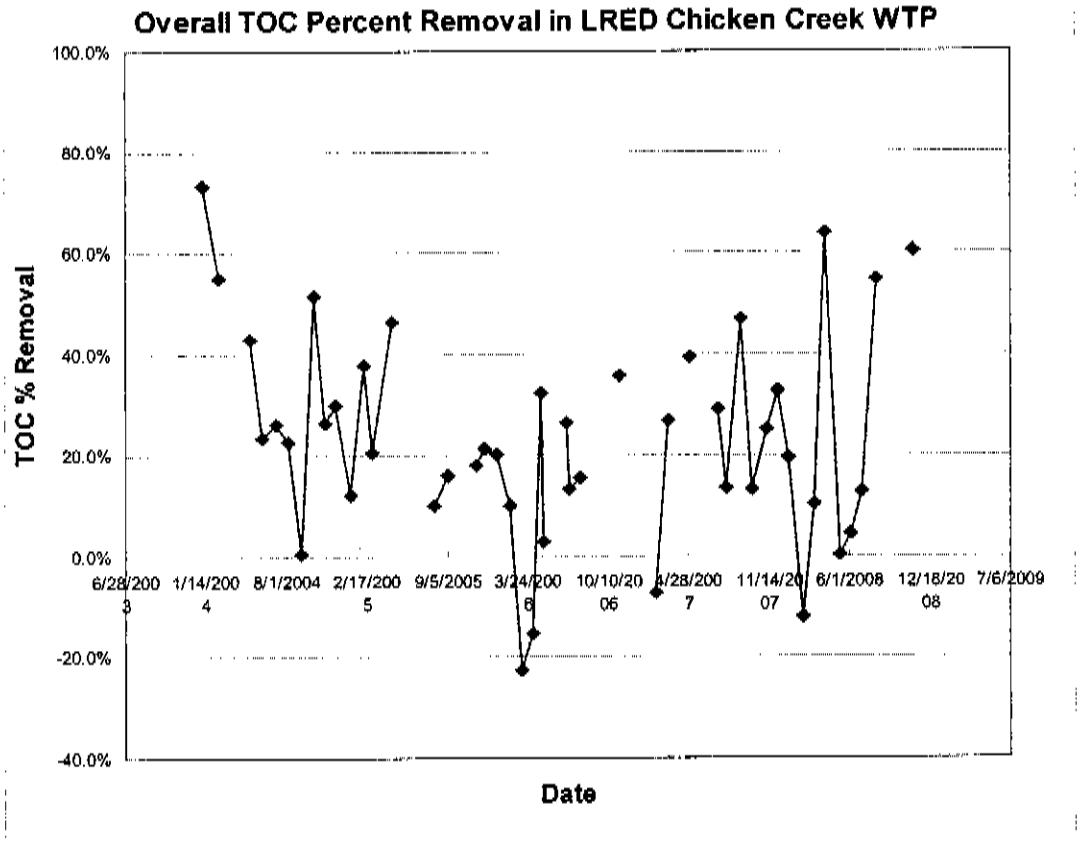
Insufficient TOC Data for Cherokee Co RWD #13 to Calculate Percent Removals



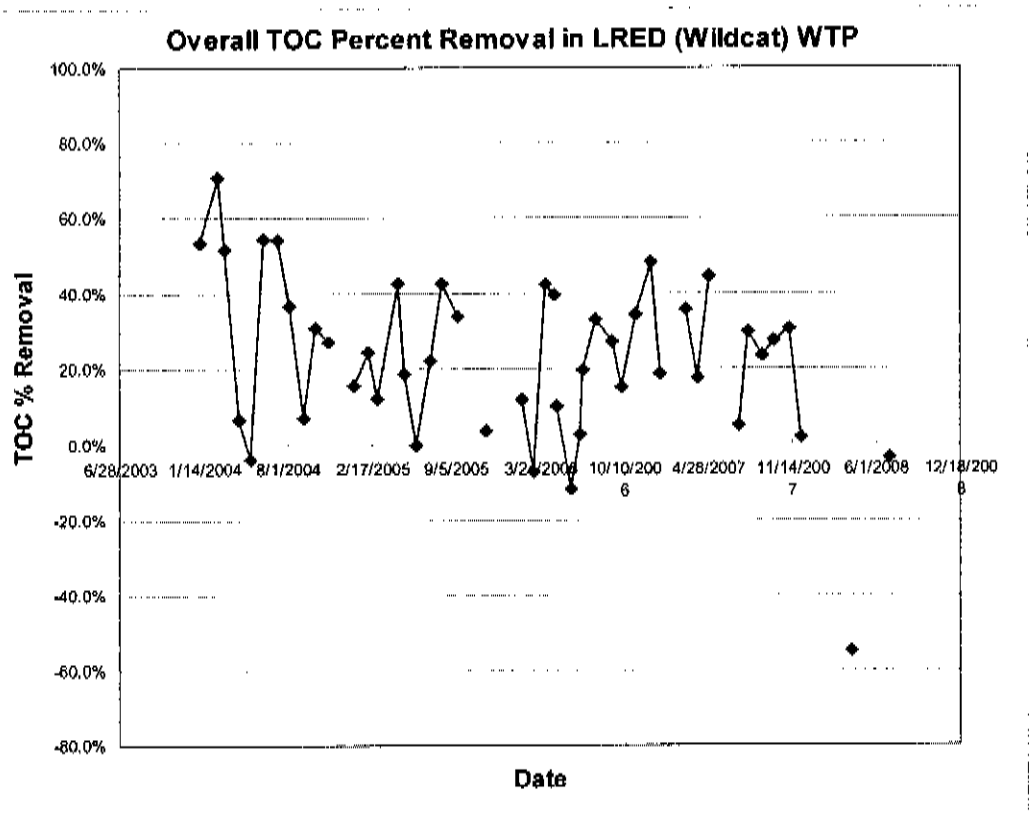
TOC Data Not Available for Fin and Feather Resort


Overall TOC Percent Removal in Flint Ridge WTP
TOC % Removal
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
-40.0%
-60.0%
-80.0%
6/28/2003
1/14/2004
8/1/2004
2/17/2005
9/5/2005
3/24/2006
10/10/2006
4/28/2007
11/14/2007
6/1/2008
12/18/2008
7/6/2009
Date


Overall TOC Percent Removal in Gore PWA WTP
TOC % Removal
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
6/28/2003
1/14/2004
8/1/2004
2/17/2005
9/5/2005
3/24/2006
10/10/2006
4/28/2007
11/14/2007
6/1/2008
12/18/2008
7/6/2009
Date

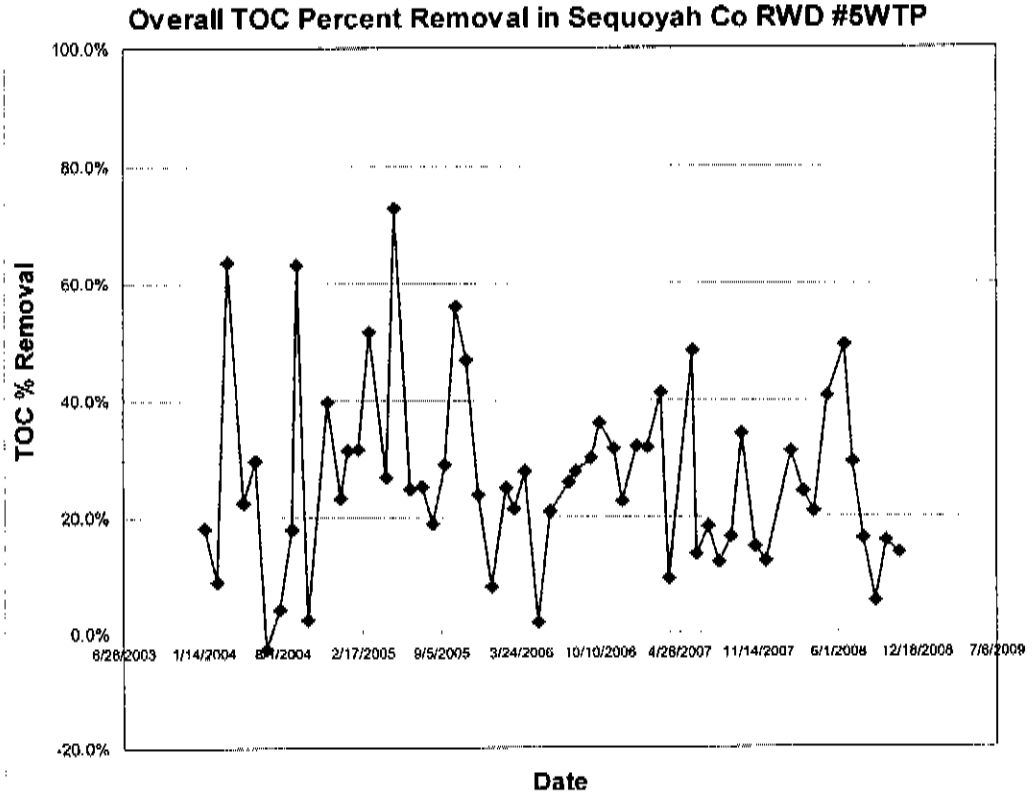


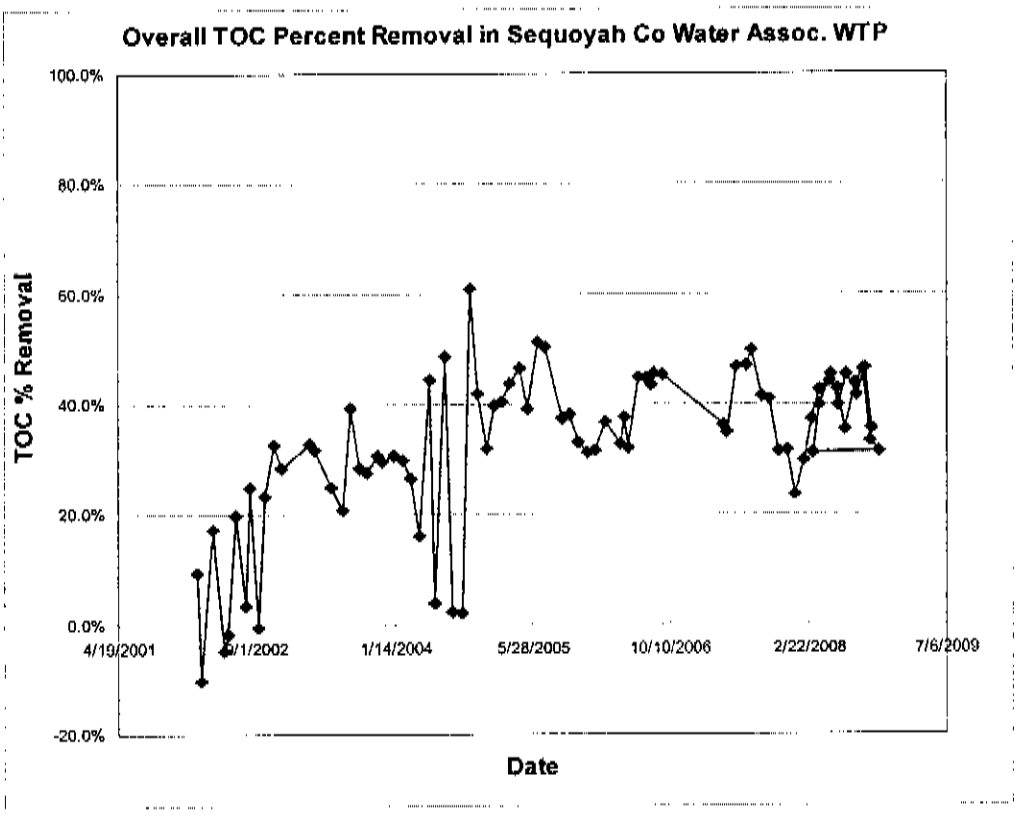
TOC Data Not Available for LRED Lakewood

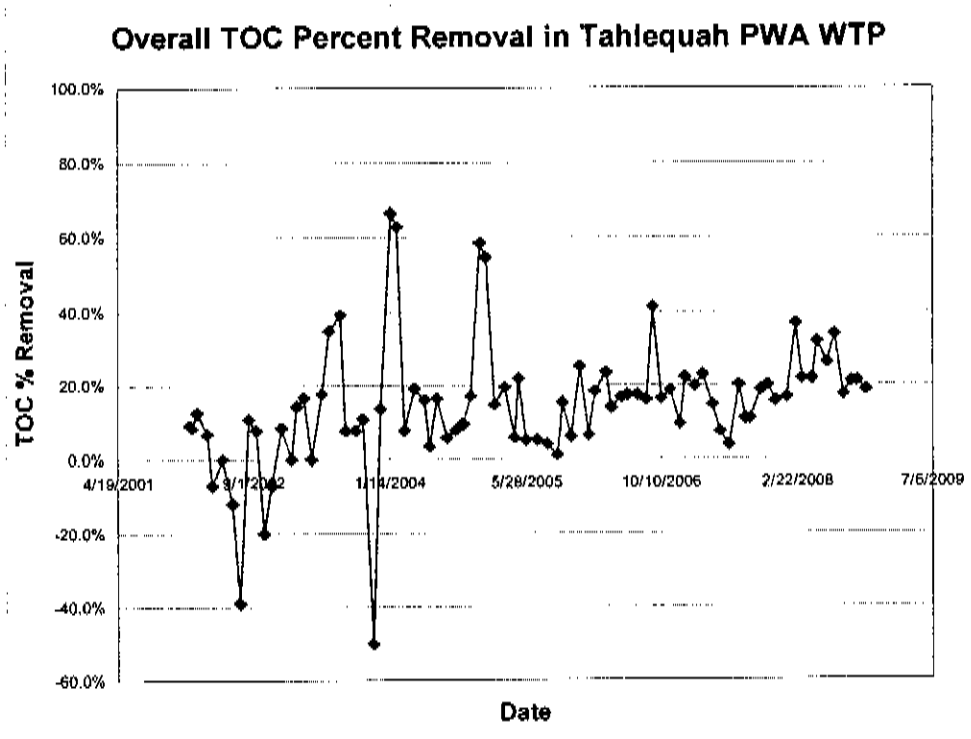


TOC Data Not Available for LRED Woodhaven

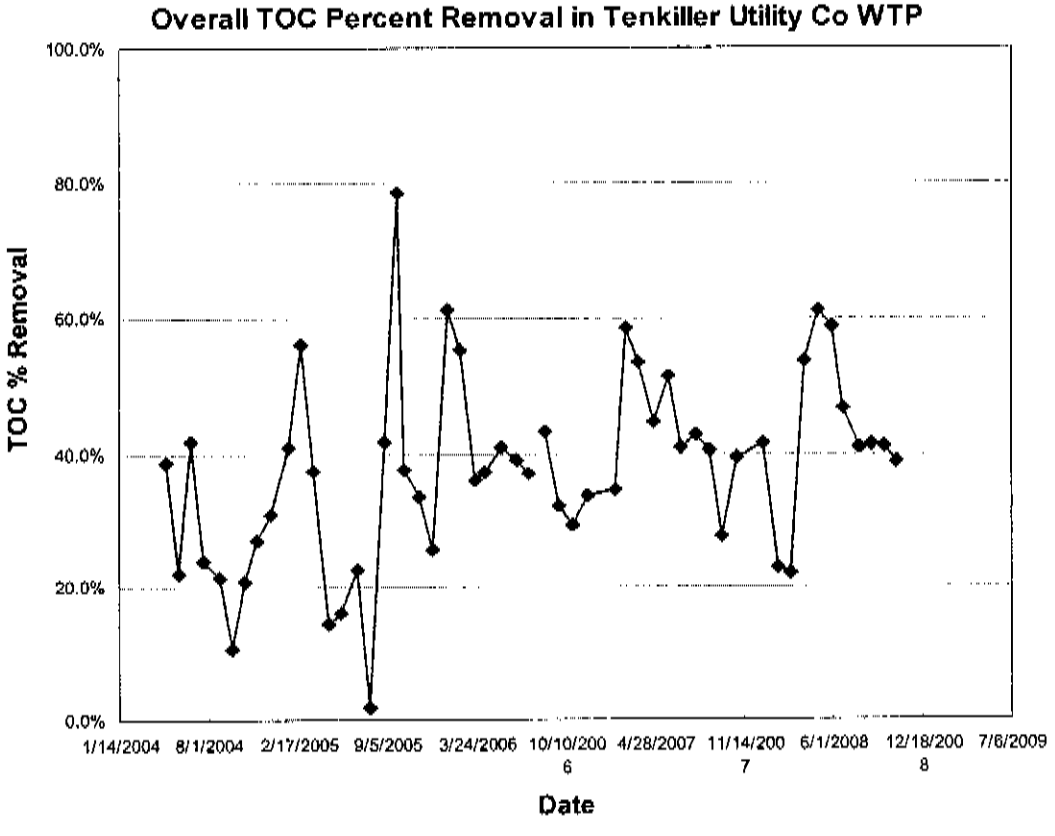
Insufficient TOC Data for Pettit MT to Calculate Percent Removals




Overall TOC Percent Removal in Sequoyah Co Water Assoc. WTP
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
TOC % Removal
4/19/2001
1/14/2004
5/28/2005
10/10/2006
2/22/2008
7/6/2009
Date


Overall TOC Percent Removal in Tahlequah PWA WTP
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
-40.0%
-60.0%
TOC % Removal
4/19/2001
1/14/2004
5/28/2005
10/10/2006
2/22/2008
7/6/2009
Date

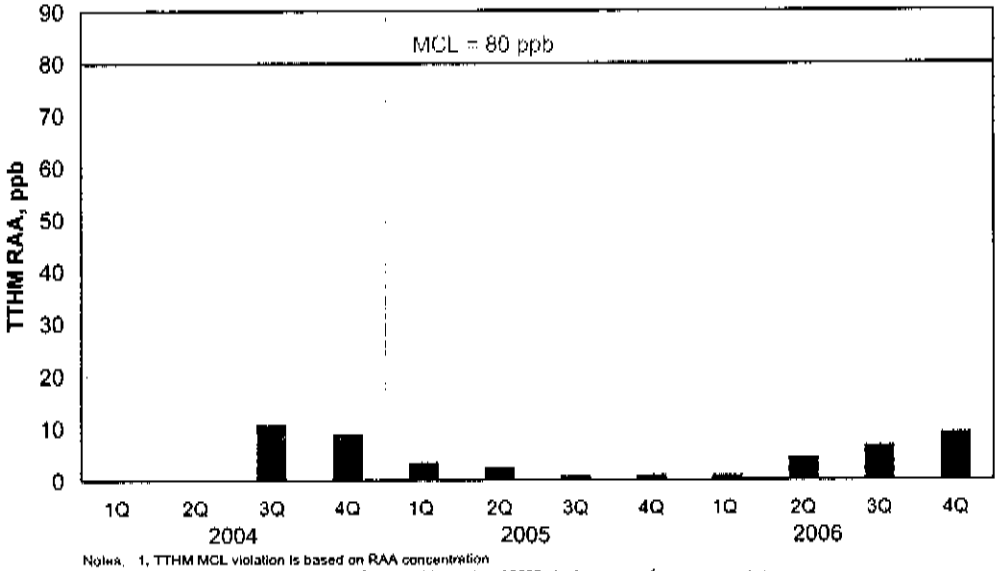
TOC Data Not Available for Tenkiller Aqua Park



Appendix D—
DBP Data for IRW Utilities

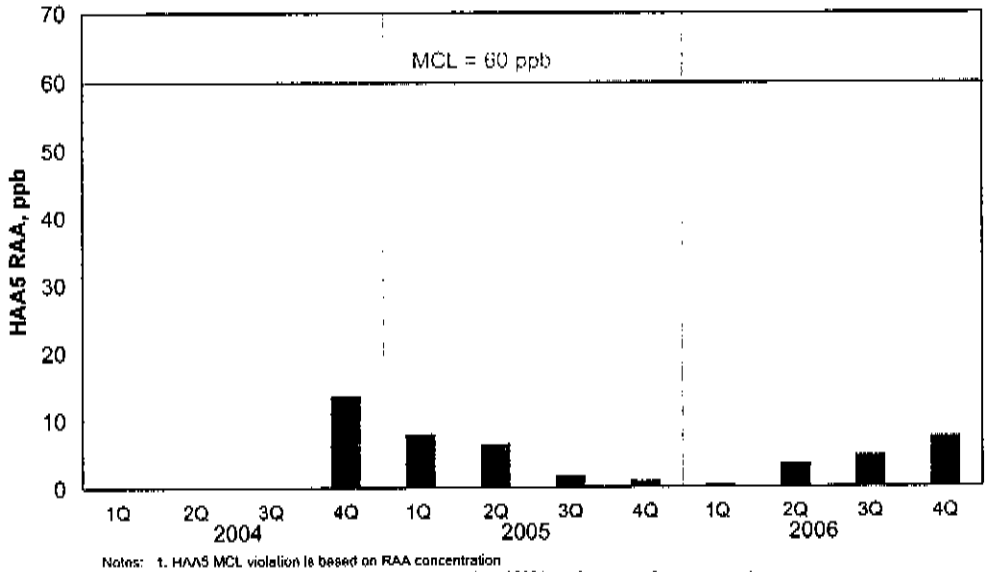
Adair County RWD #5

TTHM Running Annual Average (RAA) Concentrations in Adair County RWD #5 system, 2004 to 2006



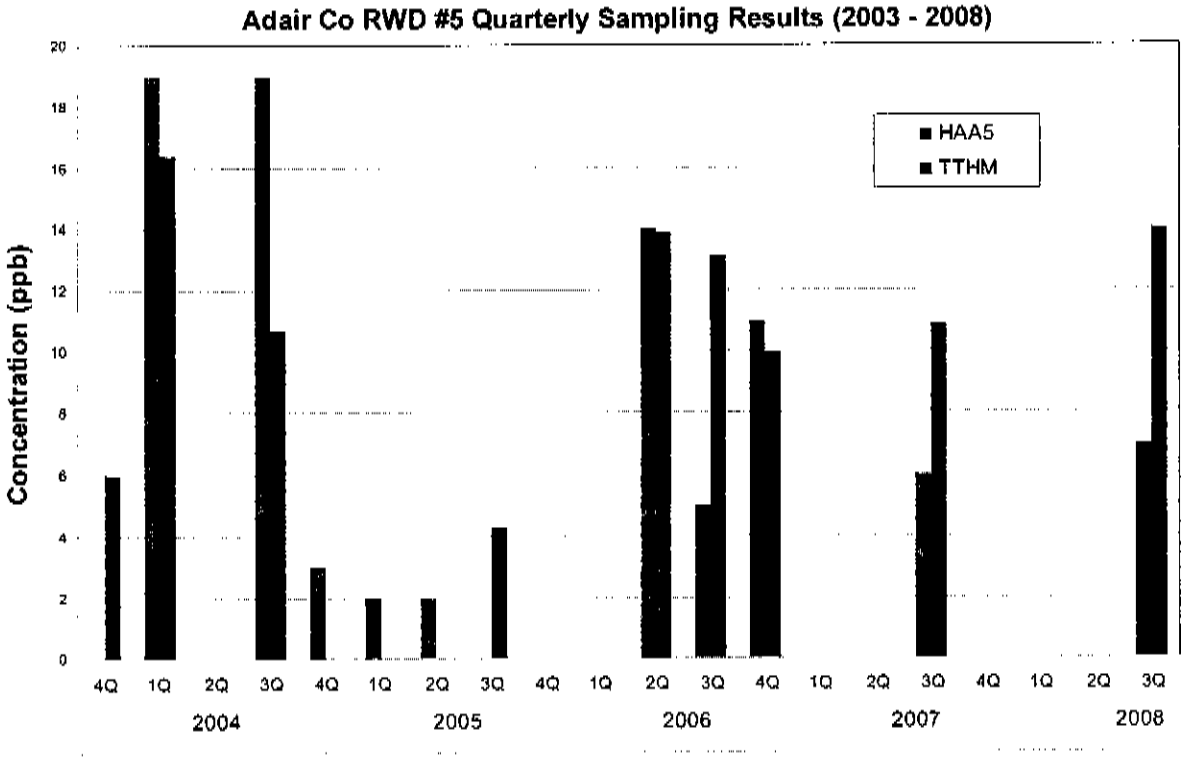
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the 4th quarter of 2003 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the 3rd quarter of 2004
4. Calculation of TTHM RAA concentrations for 2004 are slightly modified due to missing data on 2nd quarter of 2004
5. After 2006, only one sample per year taken at DBPMX

HAA5 Running Annual Average (RAA) Concentrations in Adair County RWD #5 system, 2004 to 2006

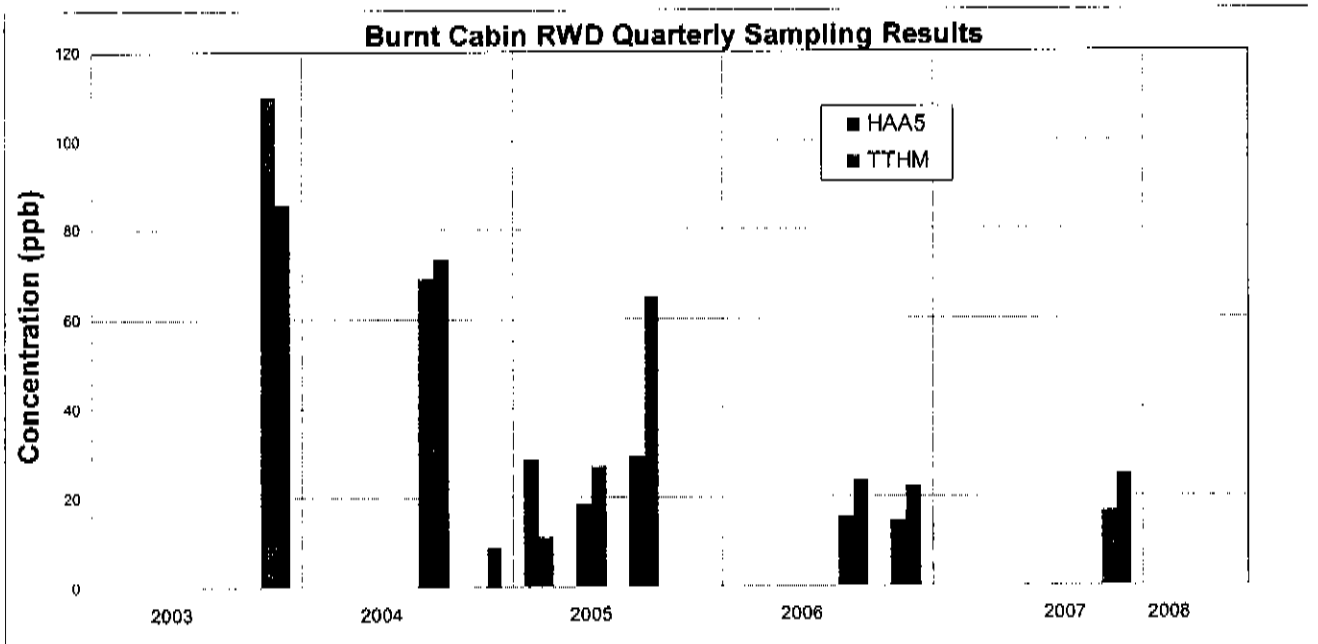


Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the fourth quarter of 2004
4. Calculation of HAA5 RAA concentrations for 2004 is slightly modified due to missing data on 2nd quarter of 2004
5. After 2006, only one sample per year taken at DBPMX

Adair County RWD #5 (cont.)



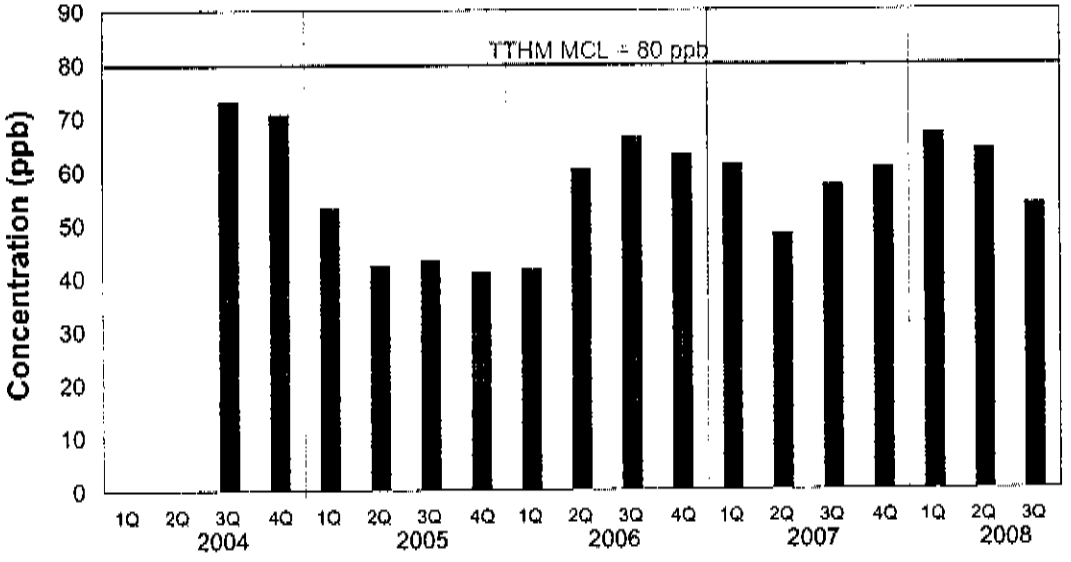
Burnt Cabin RWD



Effective Oct 1, 2005, DBP sampling frequency is yearly. Running annual average concentrations of HAA5 and TTHM cannot be calculated due to missing data.

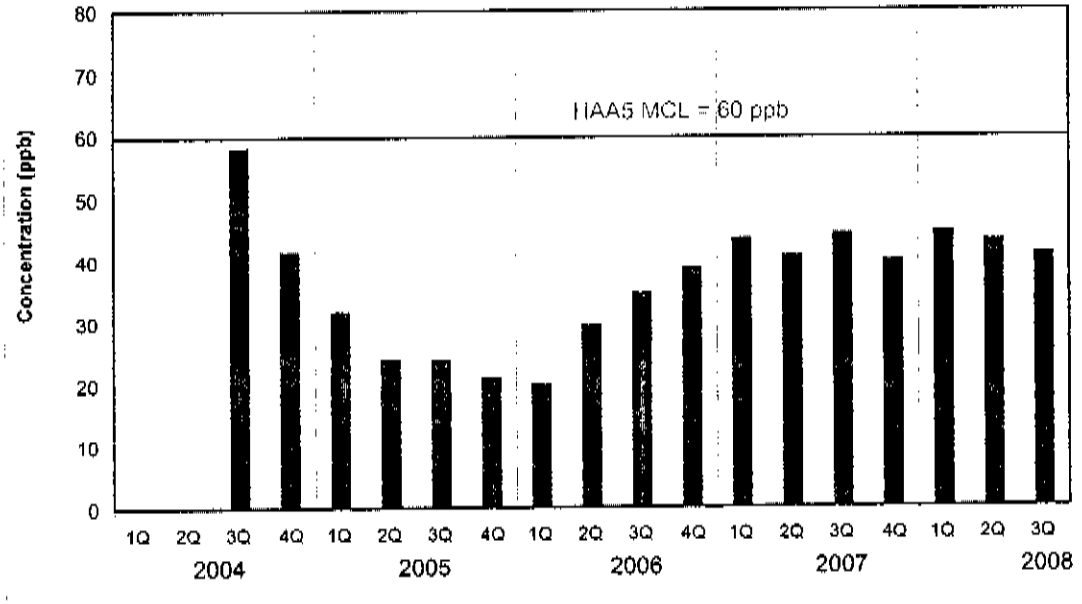
Cherokee Co #2 (Keys)

TTHM Running Annual Average (RAA) Concentrations in Cherokee County RWD #2 (Keys) System, 2004 to 2008



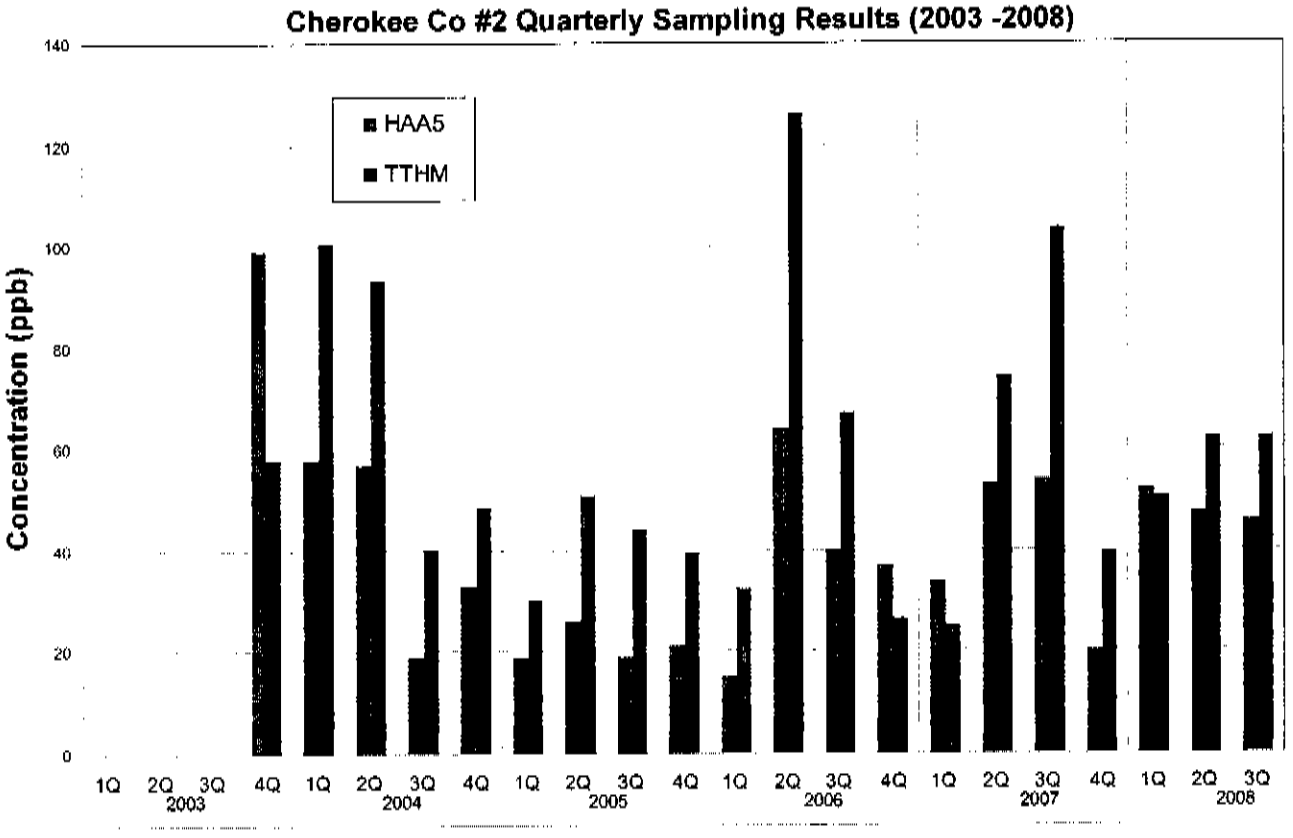
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from fourth quarter of 2004 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the third quarter of 2004

HAA5 Running Annual Average (RAA) Concentrations in Cherokee County RWD #2 (Keys) System, 2004 to 2008



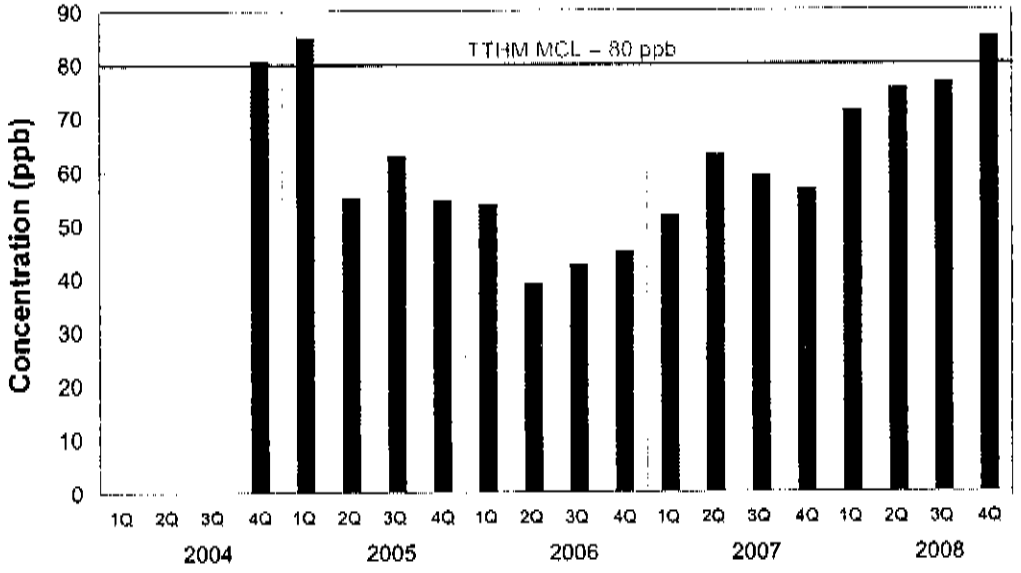
Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from fourth quarter of 2003 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the third quarter of 2004

Cherokee Co #2 (Keys) (cont.)



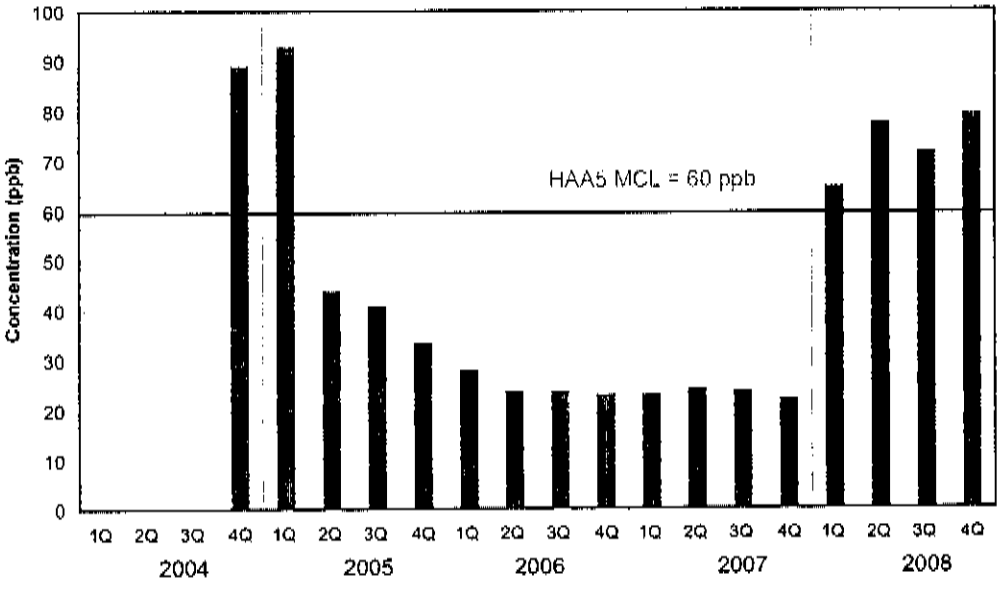
Cherokee Co #13

TTHM Running Annual Average (RAA) Concentrations in Cherokee County RWD #13 Water System, 2004 to 2008



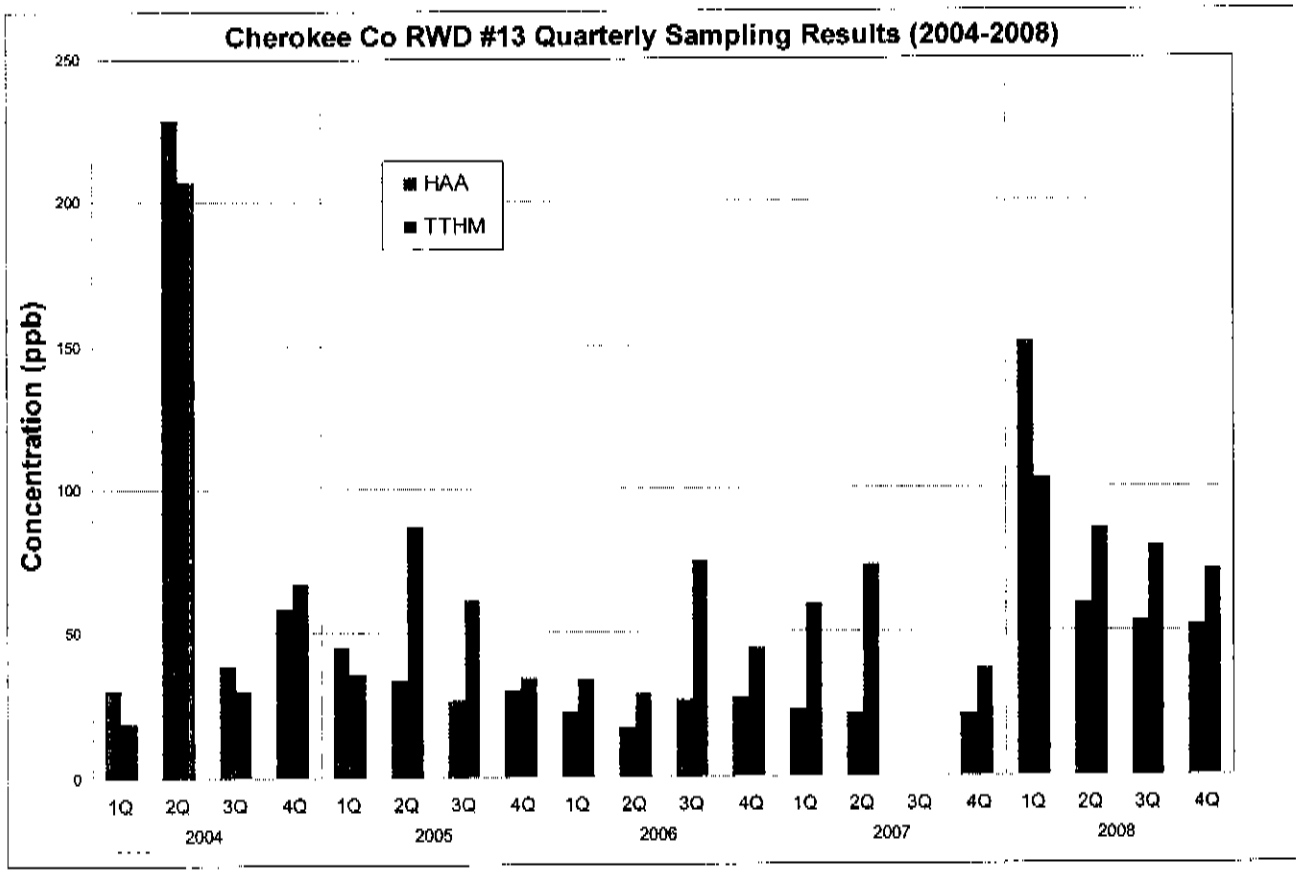
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the fourth quarter of 2004
4. Calculation of TTHM RAA concentrations for 2007 is slightly modified due to missing data

HAA5 Running Annual Average (RAA) Concentrations in Cherokee County RWD #13 Water System, 2004 to 2008



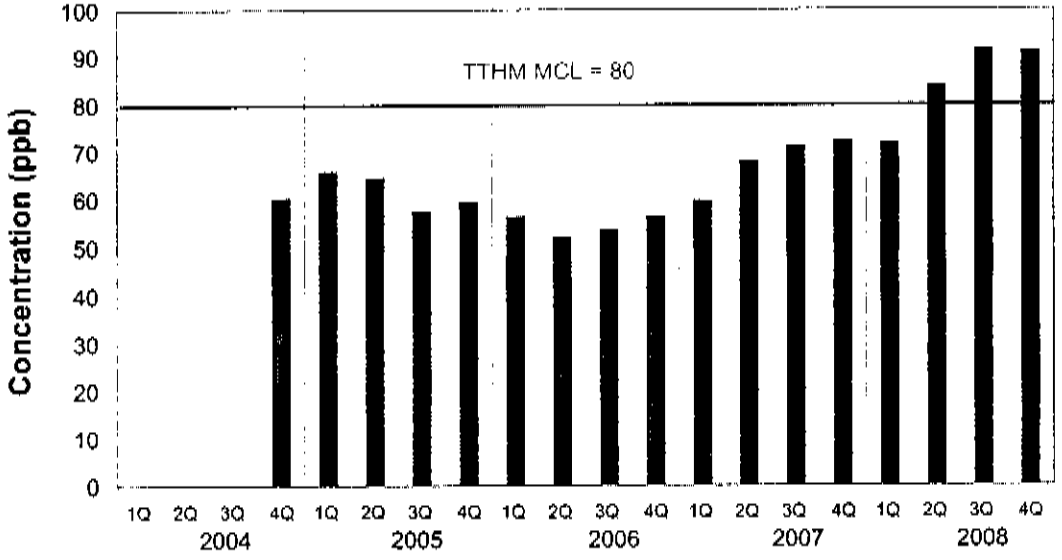
Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the fourth quarter of 2004
4. Calculation of HAA5 RAA concentrations for 2007 is slightly modified due to missing data

Cherokee Co #13 (cont.)



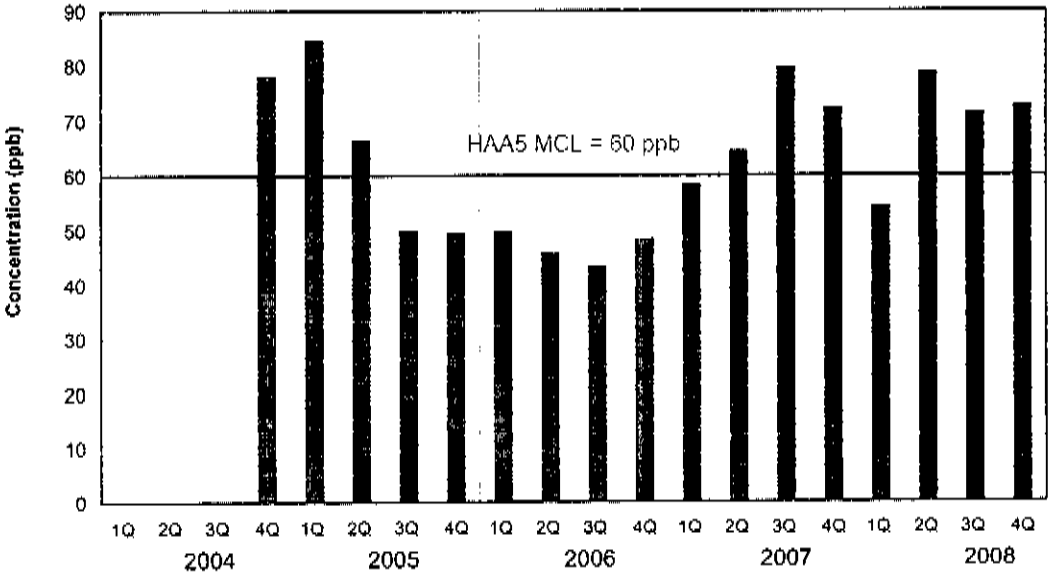
East Central OK

TTHM Running Annual Average (RAA) Concentrations in East Central Oklahoma Water Authority System, 2004 to 2008



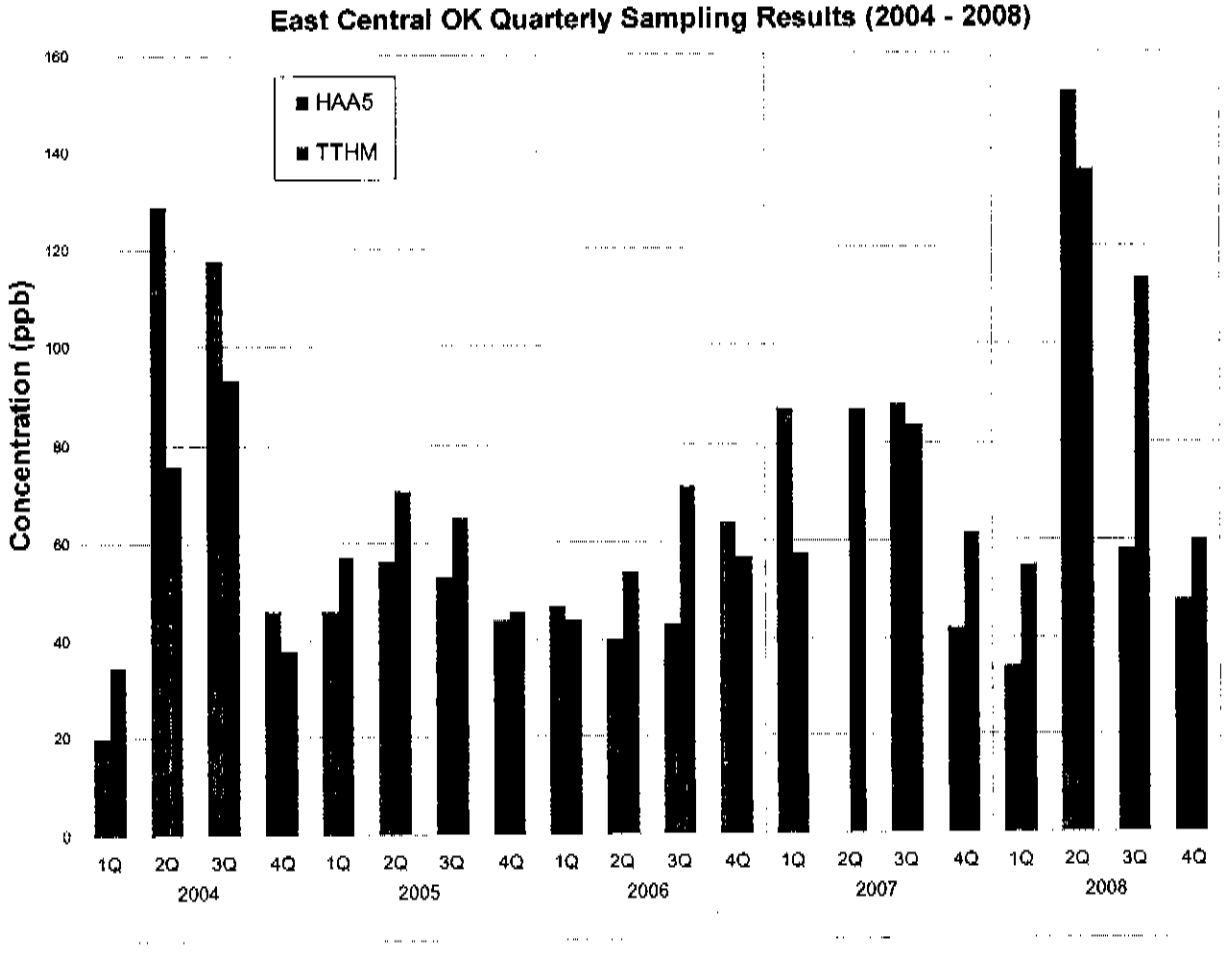
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the third quarter of 2004

HAA5 Running Annual Average (RAA) Concentrations in East Central Oklahoma Water Authority System, 2004 to 2008

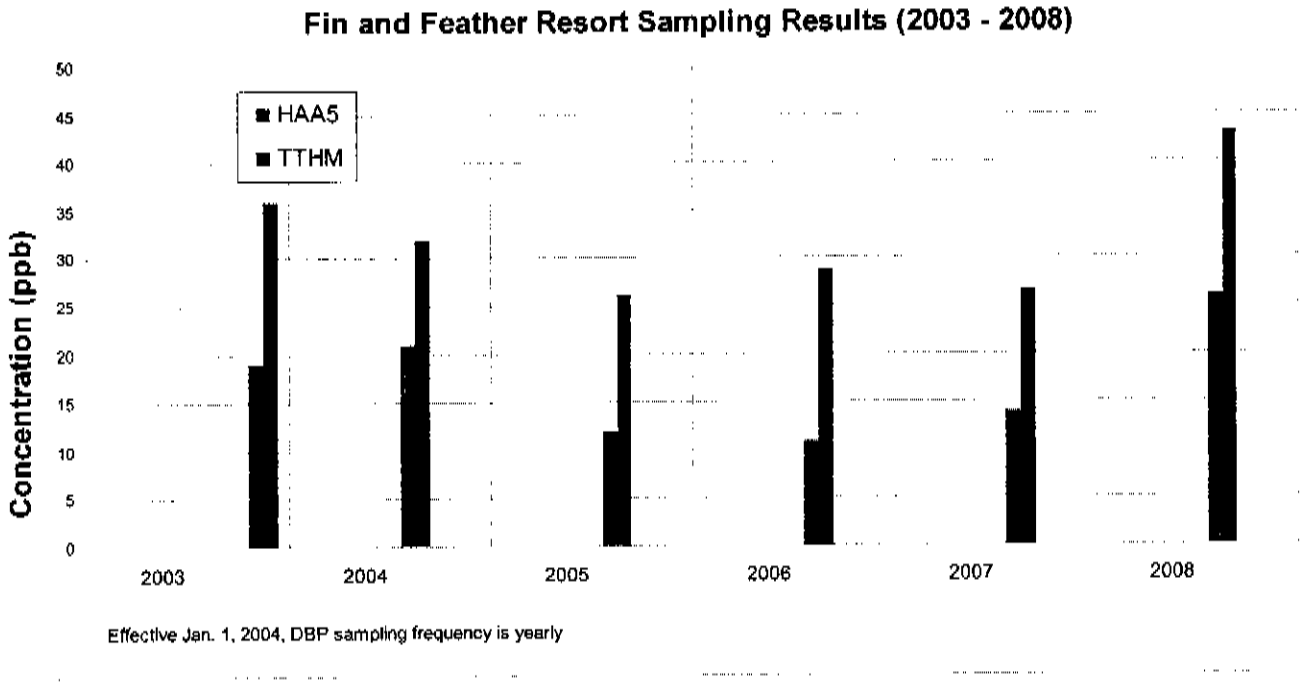


Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the fourth quarter of 2004
4. Calculation of HAA5 RAA concentration in 2007 is slightly modified due to missing data

East Central OK (cont.)

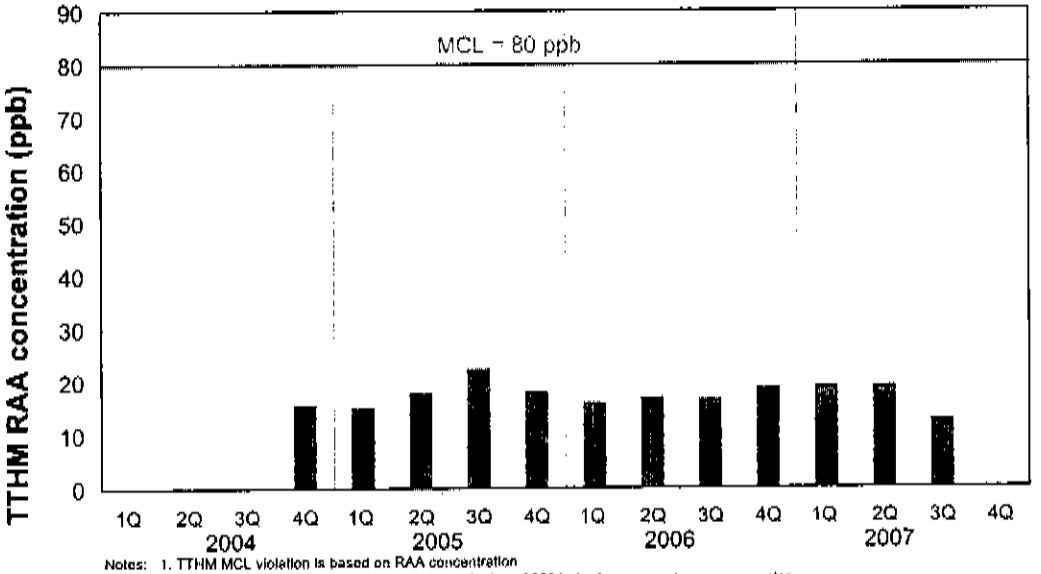


Fin and Feather Resort



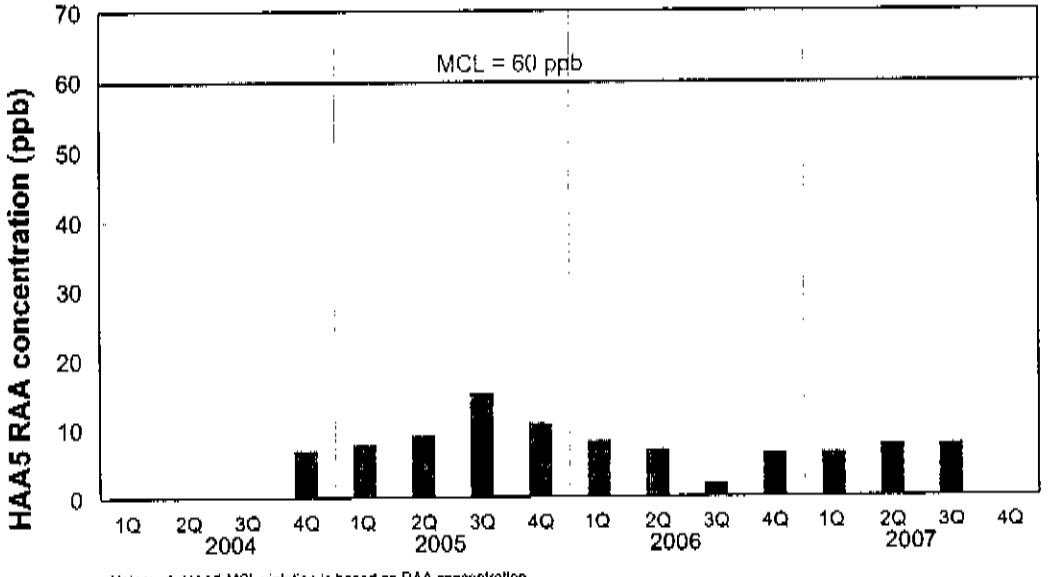
Flint Ridge RWD

TTHM Running Annual Average (RAA) Concentrations in Flint Ridge RWD system, OKlahoma from 2004 to 2007



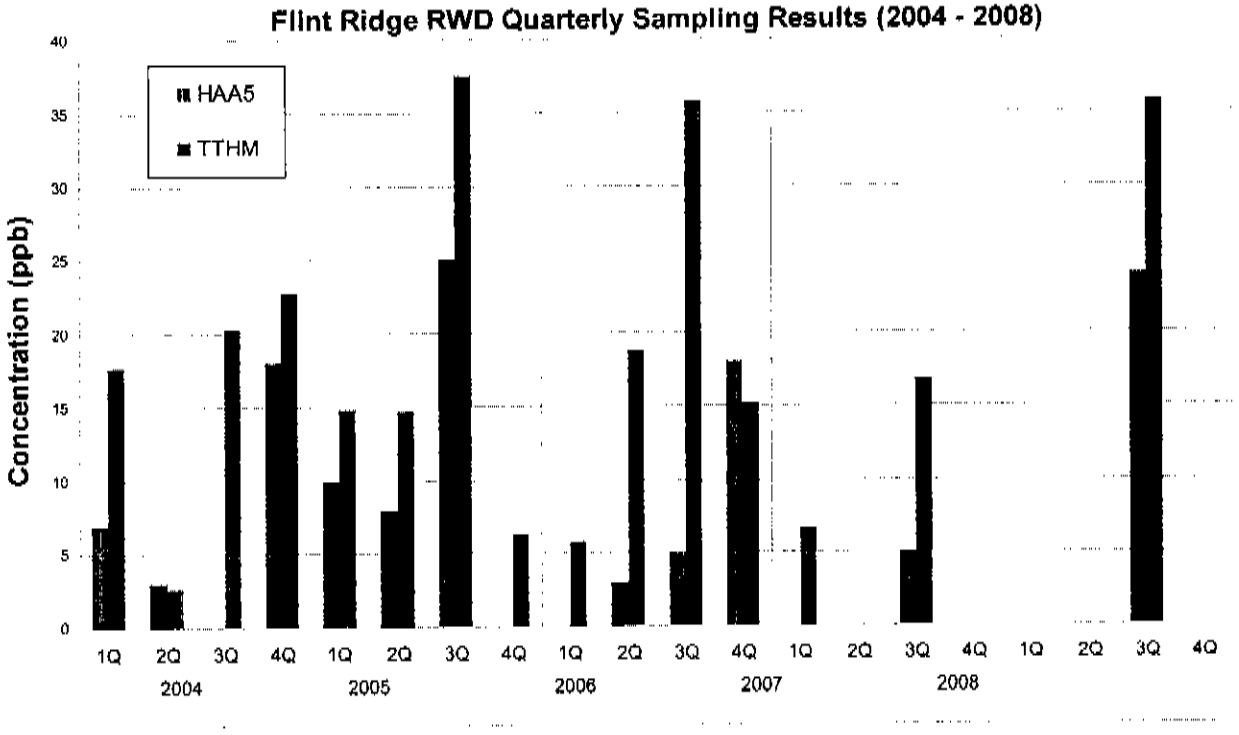
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the fourth quarter of 2004
4. Calculation of TTHM RAA concentrations for 2007 is slightly modified due to missing data on 2nd quarter of 2007
5. After 2007, only one sample per year taken at DBPMX

HAA5 Running Annual Average (RAA) Concentrations in Flint Ridge RWD system, 2004 to 2007



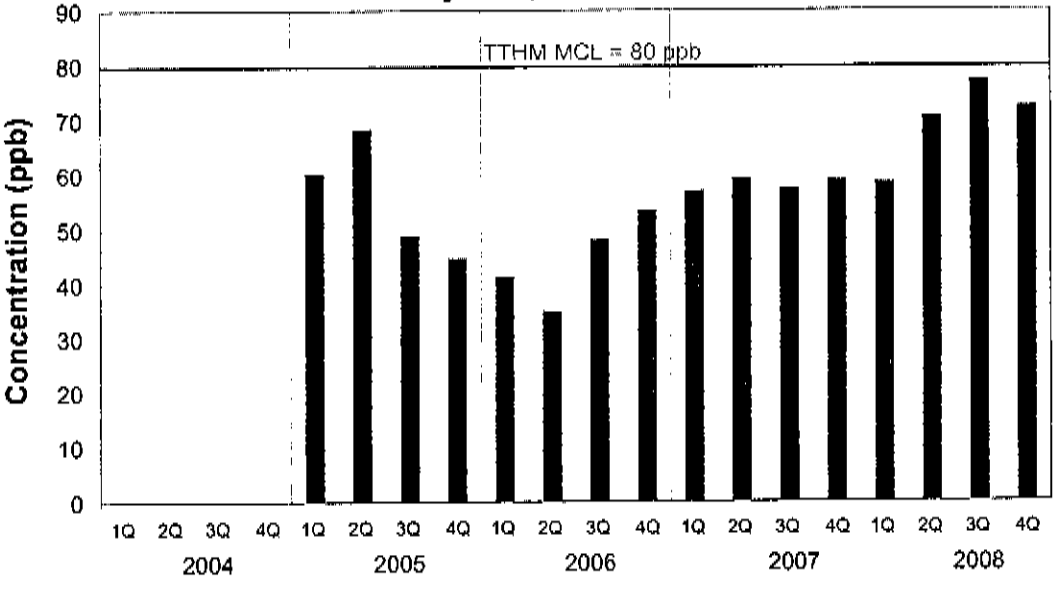
Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the fourth quarter of 2004
4. Calculation of HAA5 RAA concentrations for 2007 is slightly modified due to missing data on 2nd quarter of 2007
5. After 2007, only one sample per year taken at DBPMX

Flint Ridge RWD (cont.)



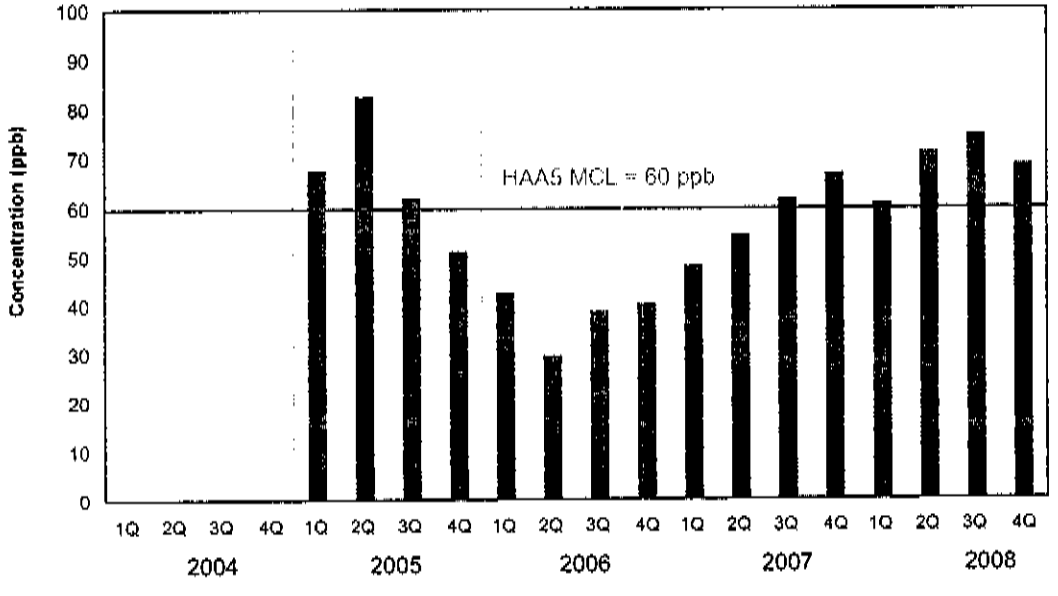
Gore PWA

TTHM Running Annual Average (RAA) Concentrations in GORE PWA Water System, Oklahoma from 2004 to 2008



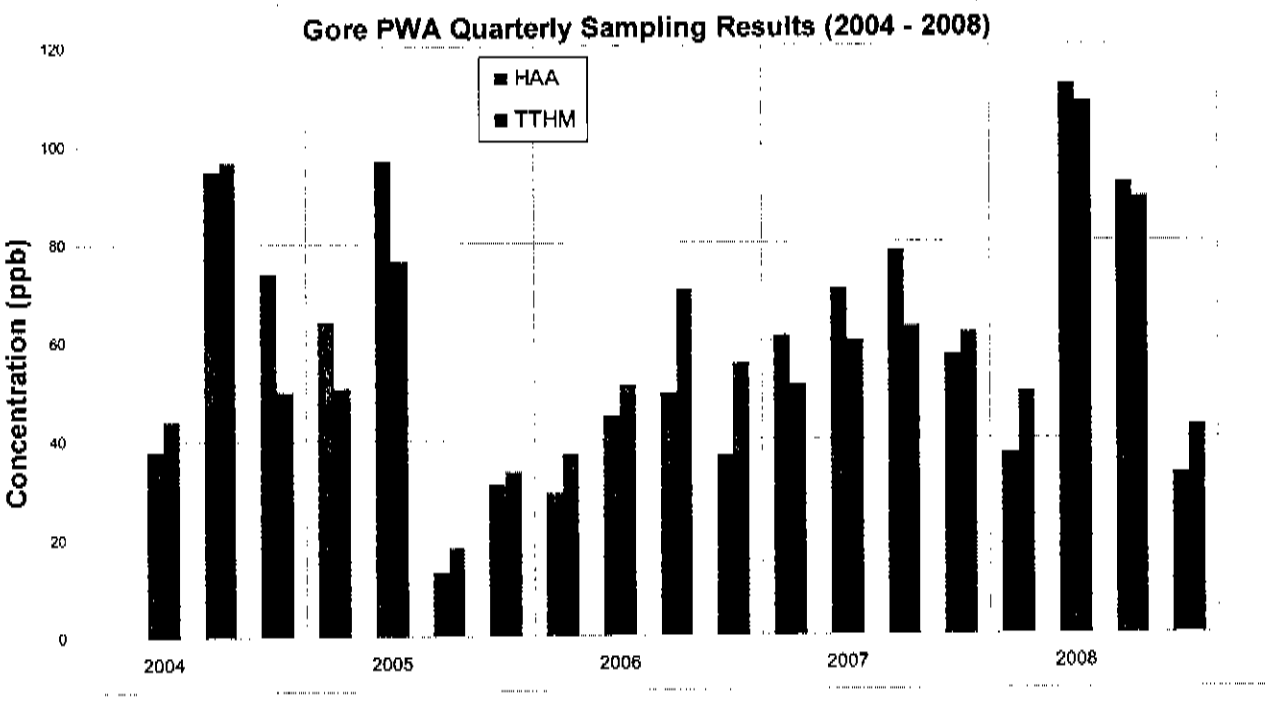
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Rountine TTHM sampling started from 2004 at a frequency of once perquarter
3. The first available TTHM RAA concentration is from the first quarter of 2005

HAA5 Running Annual Average (RAA) Concentrations in GORE PWA Water System, Oklahoma from 2004 to 2008



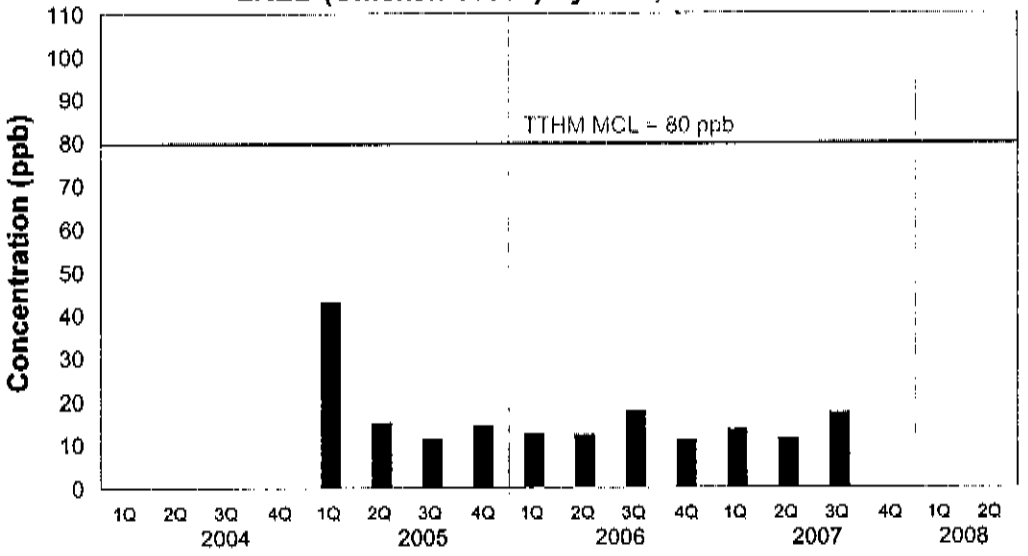
Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the first quarter of 2005

Gore PWA (cont.)



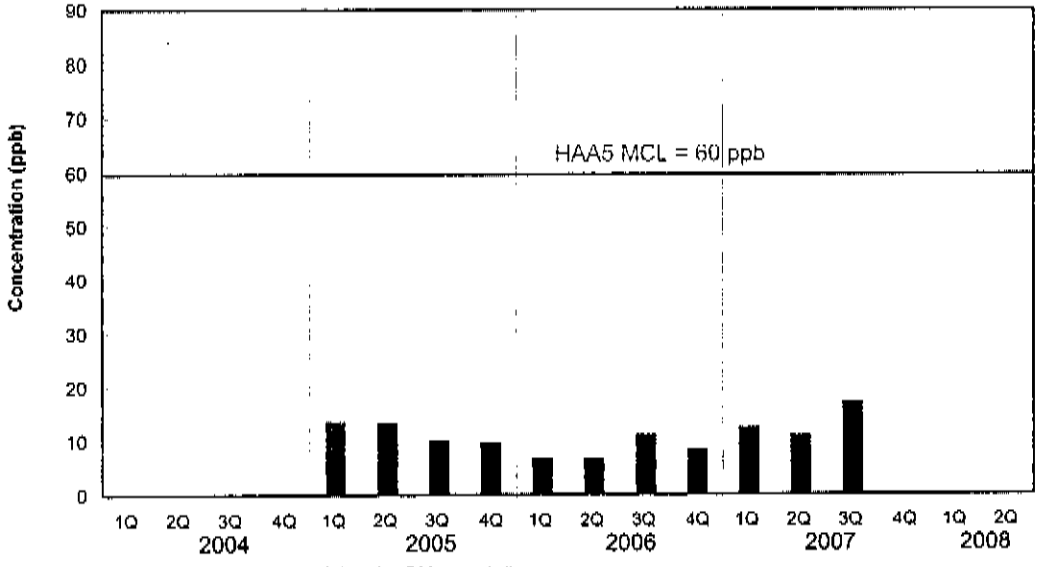
LRED Chicken Creek

TTHM Running Annual Average (RAA) Concentrations in LRED (Chicken Creek) System, 2005 to 2007



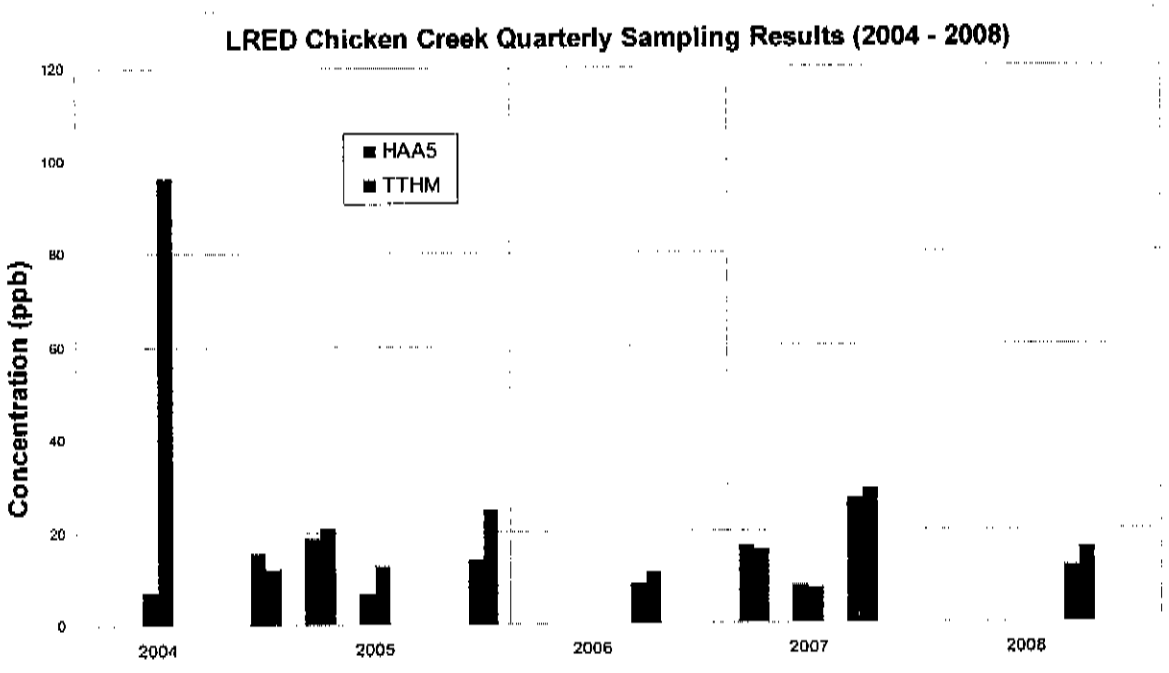
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the second quarter of 2004 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the first quarter of 2005
4. Calculation of TTHM RAA concentration is slightly modified due to missing data
5. After 2007, only one sample per year taken at DBPMX

HAA5 Running Annual Average (RAA) Concentrations in LRED (Chicken Creek) System, 2005 to 2007

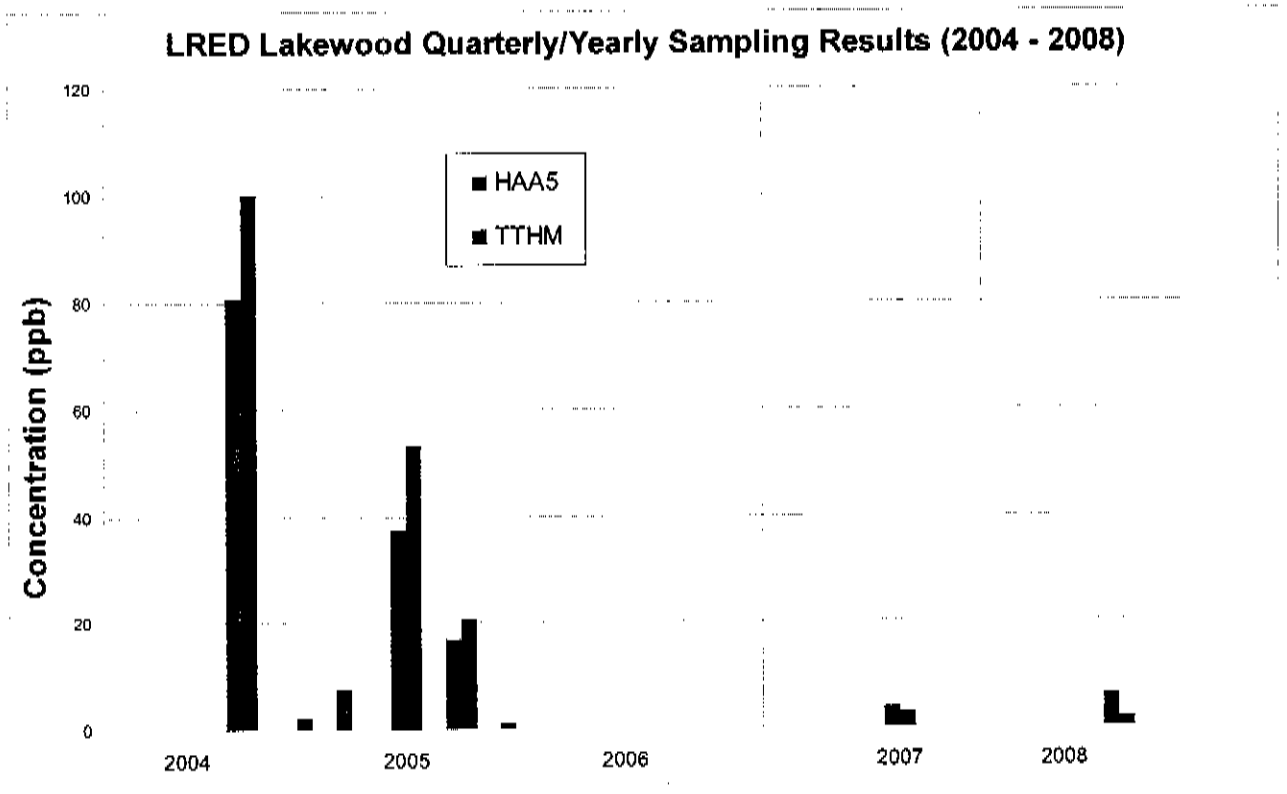


Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from second quarter of 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the first quarter of 2005
4. Calculation of HAA5 RAA concentration is slightly modified due to missing data
5. After 2007, only one sample per year taken at DBPMX

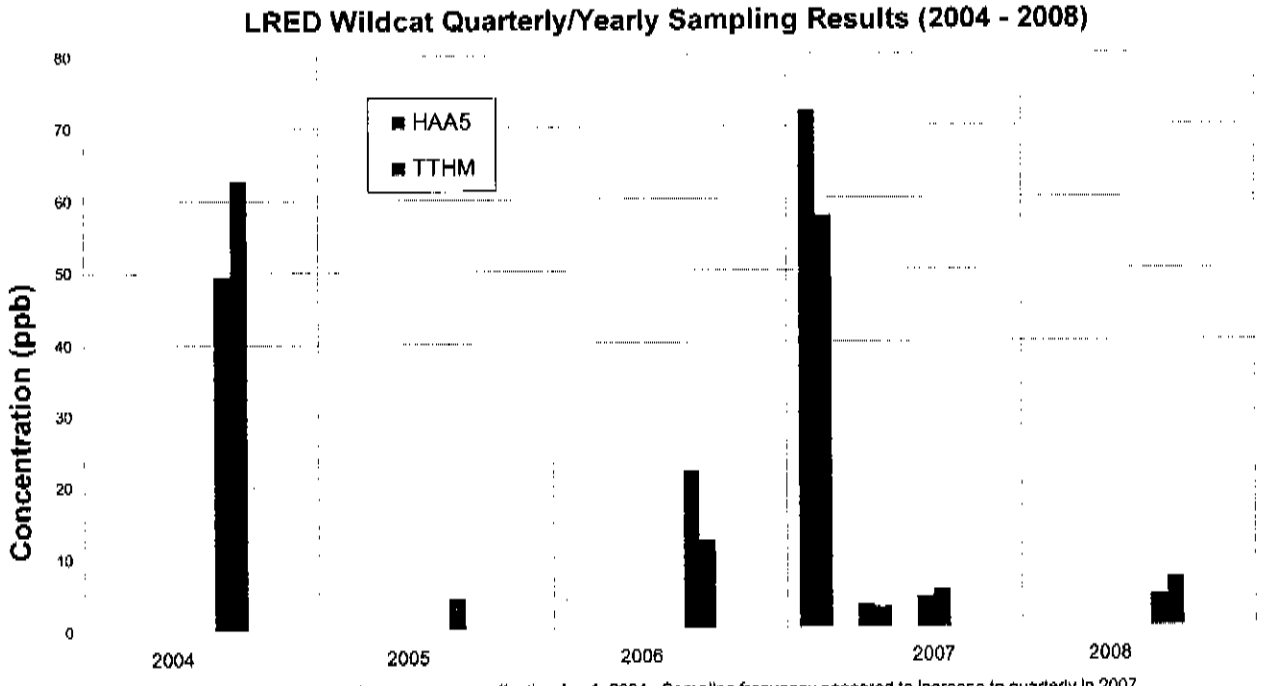
LRED Chicken Creek (cont.)



LRED Lakewood



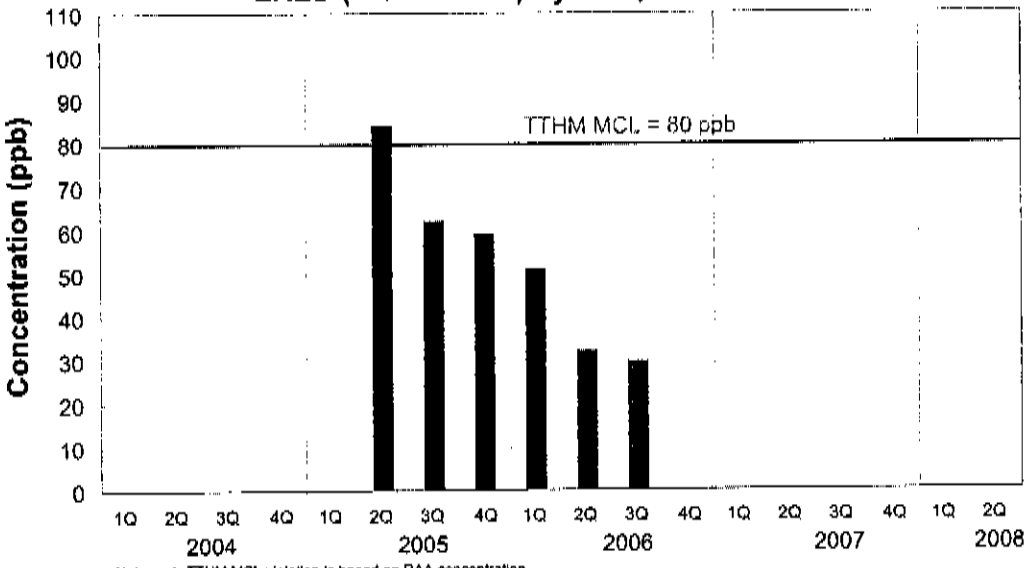
LRED Wildcat



DBP monitoring frequency is once per year effective Jan 1, 2004. Sampling frequency appeared to increase to quarterly in 2007 as a result of high TTHM and HAA5 values in the first quarter of 2007.

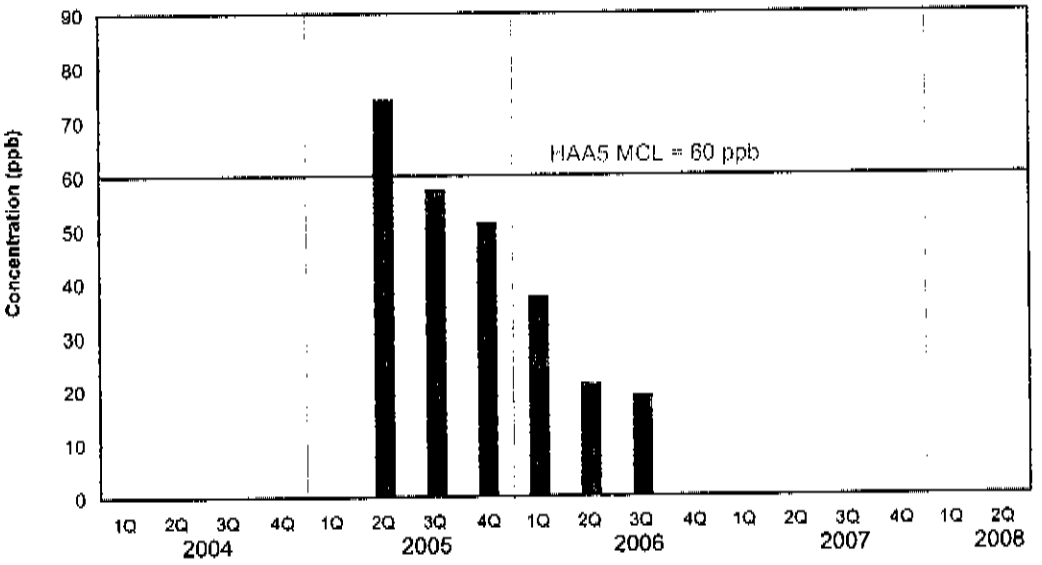
LRED Woodhaven

TTHM Running Annual Average (RAA) Concentrations in LRED (Woodhaven) System, 2005 to 2006



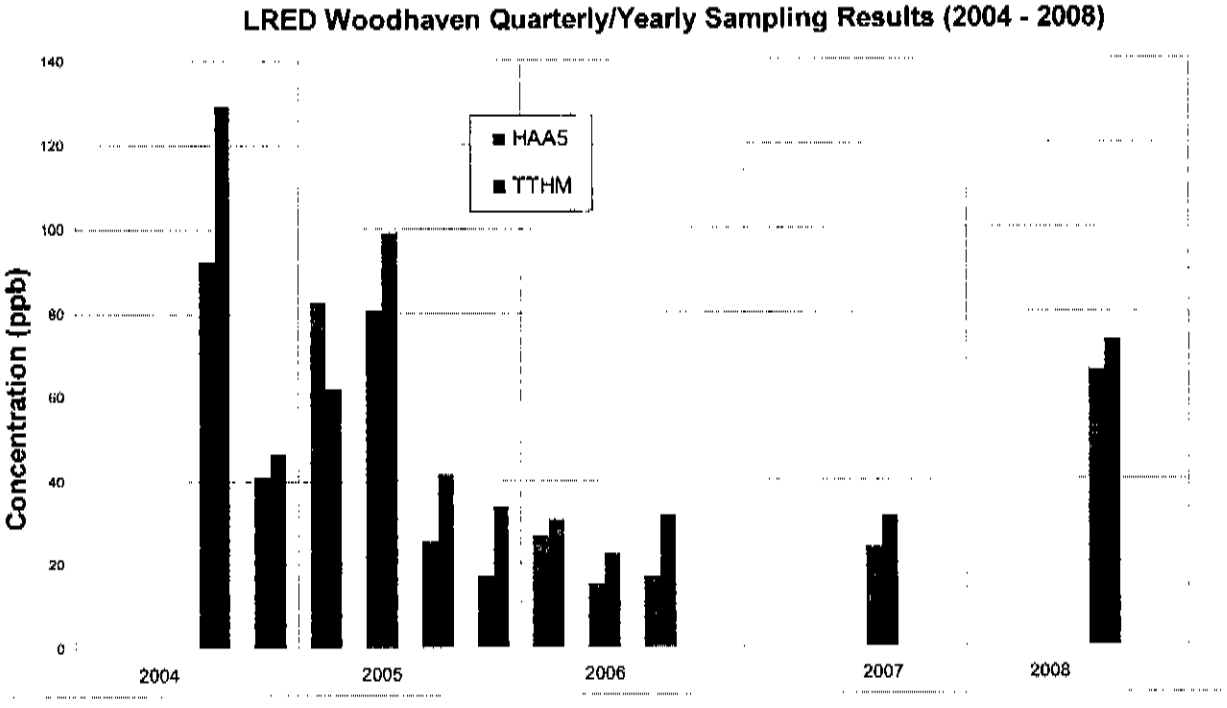
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the third quarter of 2004 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the second quarter of 2005
4. Effective May 17, 2006, DBP sampling frequency is yearly

HAA5 Running Annual Average (RAA) Concentrations in LRED (Woodhaven) System, 2005 to 2006

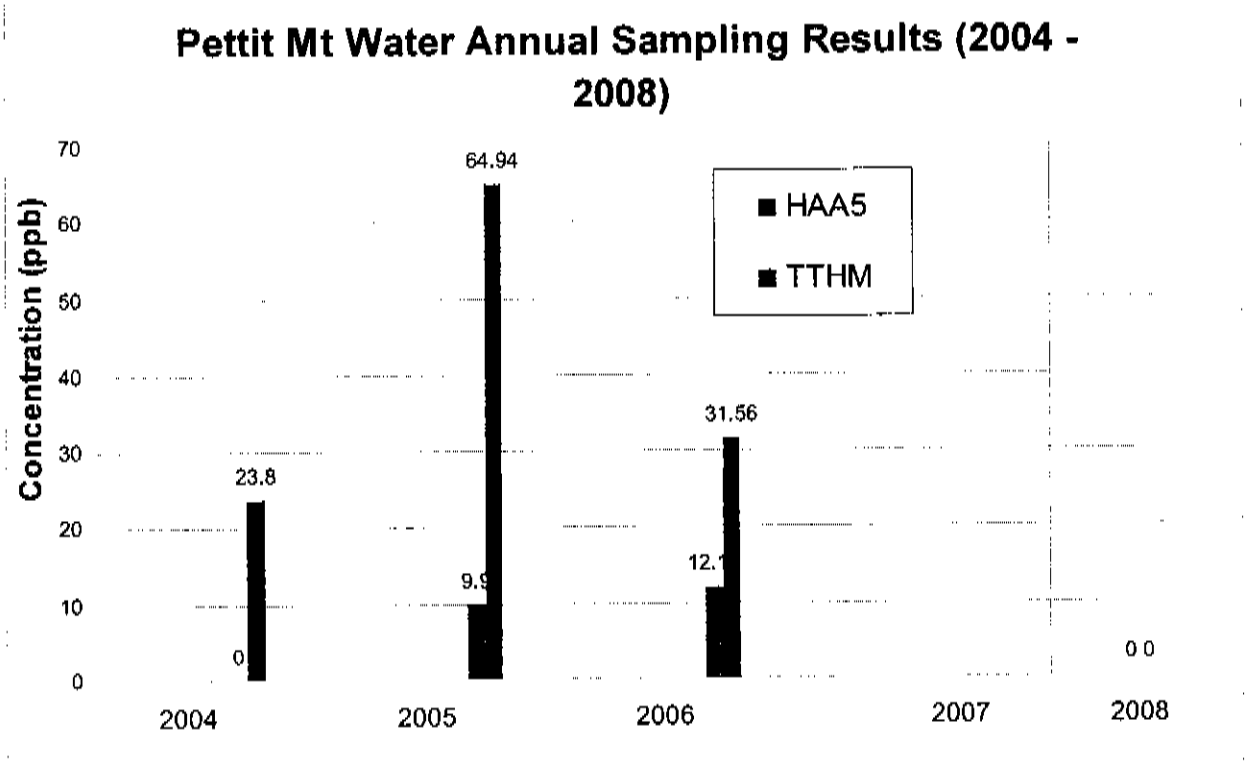


Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the third quarter of 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the second quarter of 2005
4. Effective May 17, 2006, DBP sampling frequency is yearly

LRED Woodhaven (cont.)



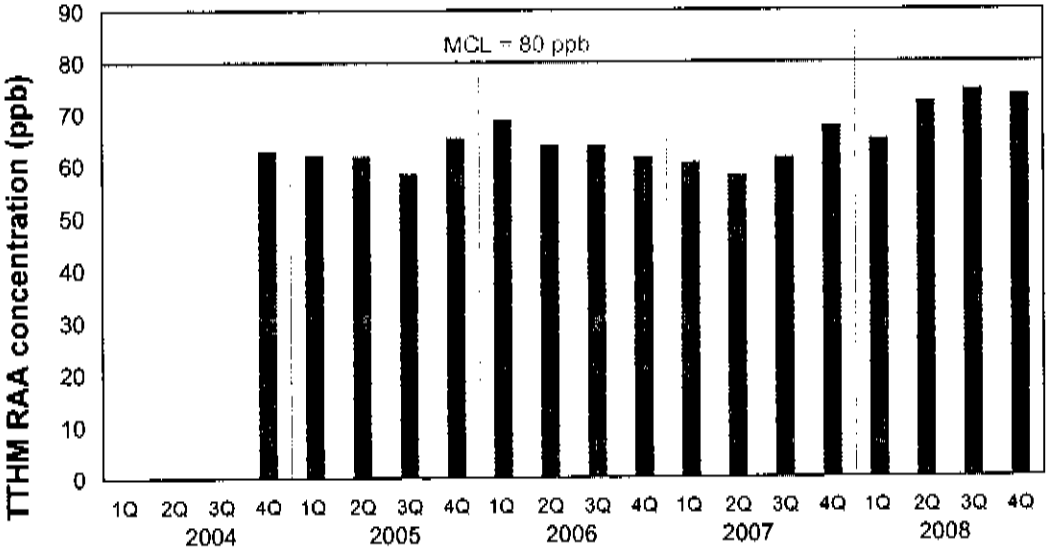
Pettit Mt Water



Effective Jan 1, 2004, DBP sampling frequency is yearly.

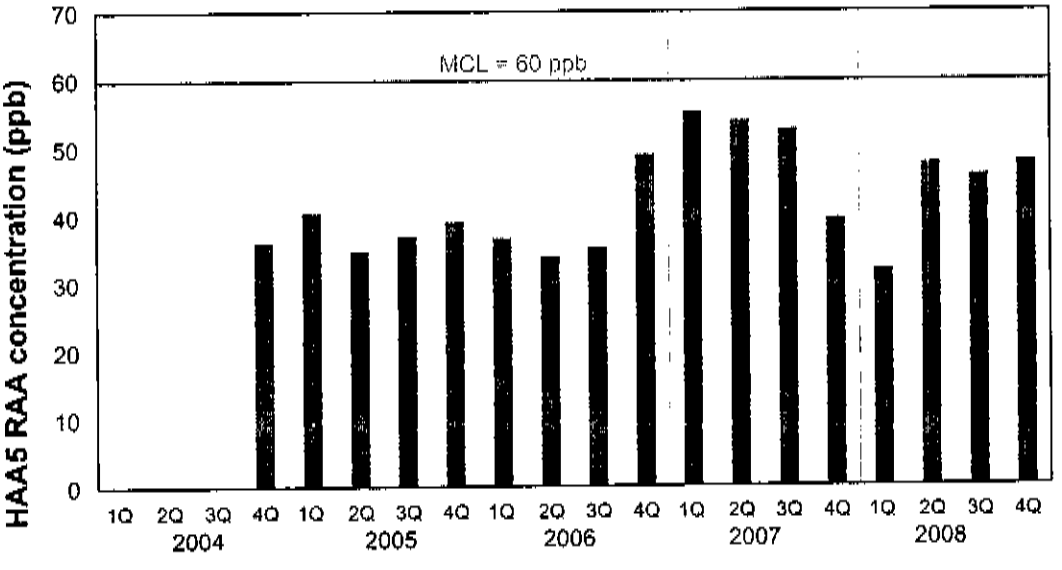
Sequoyah Co RWD #5

TTHM Running Annual Average (RAA) Concentrations in Sequoyah County RWD #5 System, 2004 to 2008



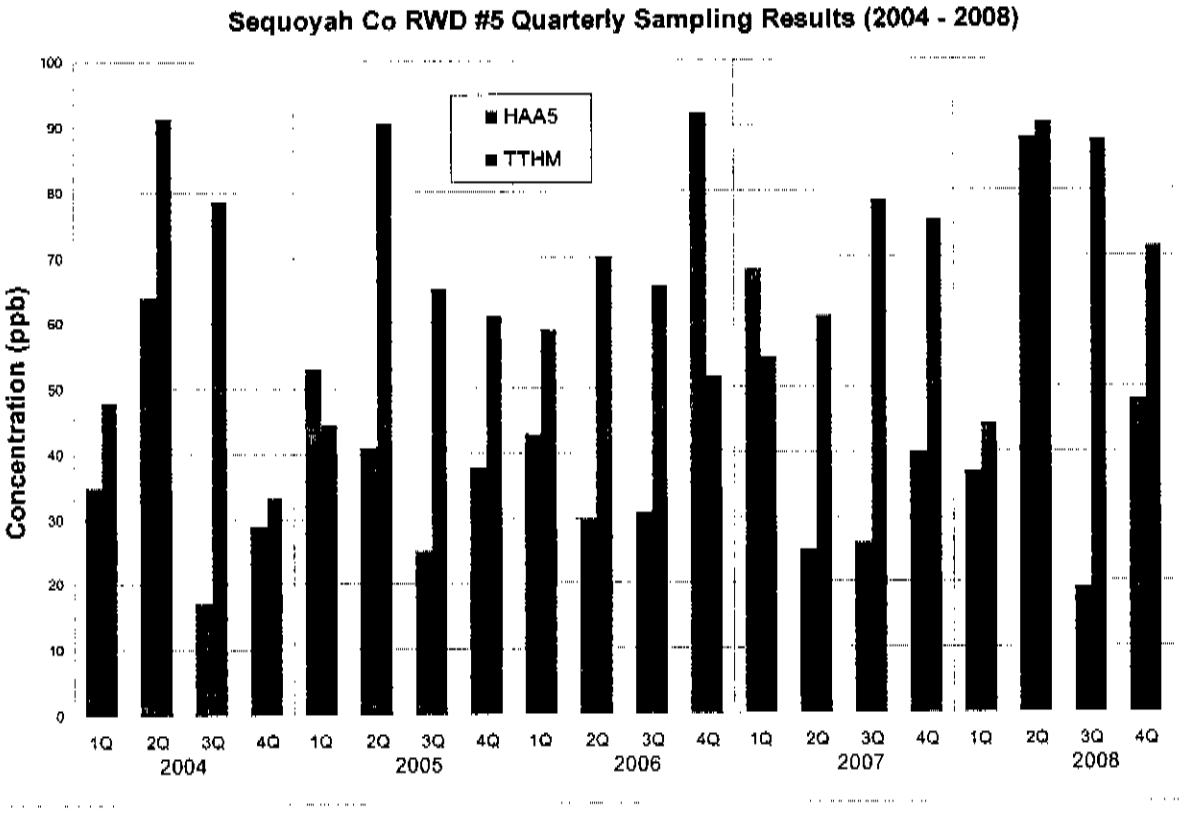
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the fourth quarter of 2004

HAA5 Running Annual Average (RAA) Concentrations in Sequoyah County RWD #5 System, 2004 to 2008



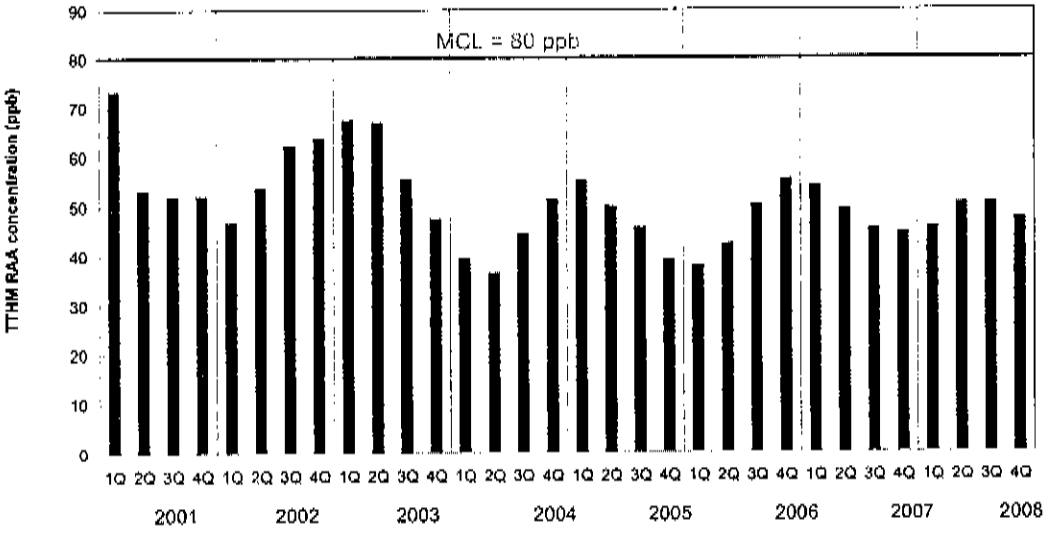
Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the beginning of 2004 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the fourth quarter of 2004

Sequoyah Co RWD #5 (cont.)



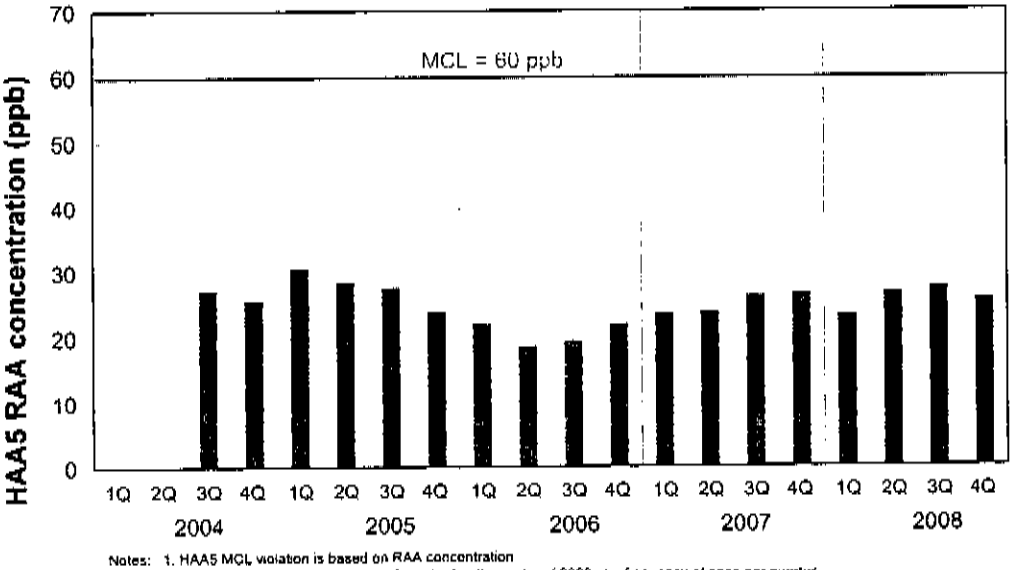
Sequoyah Co Water Assoc

TTHM Running Annual Average (RAA) Concentrations in Sequoyah County Water Association System, 2001 to 2008



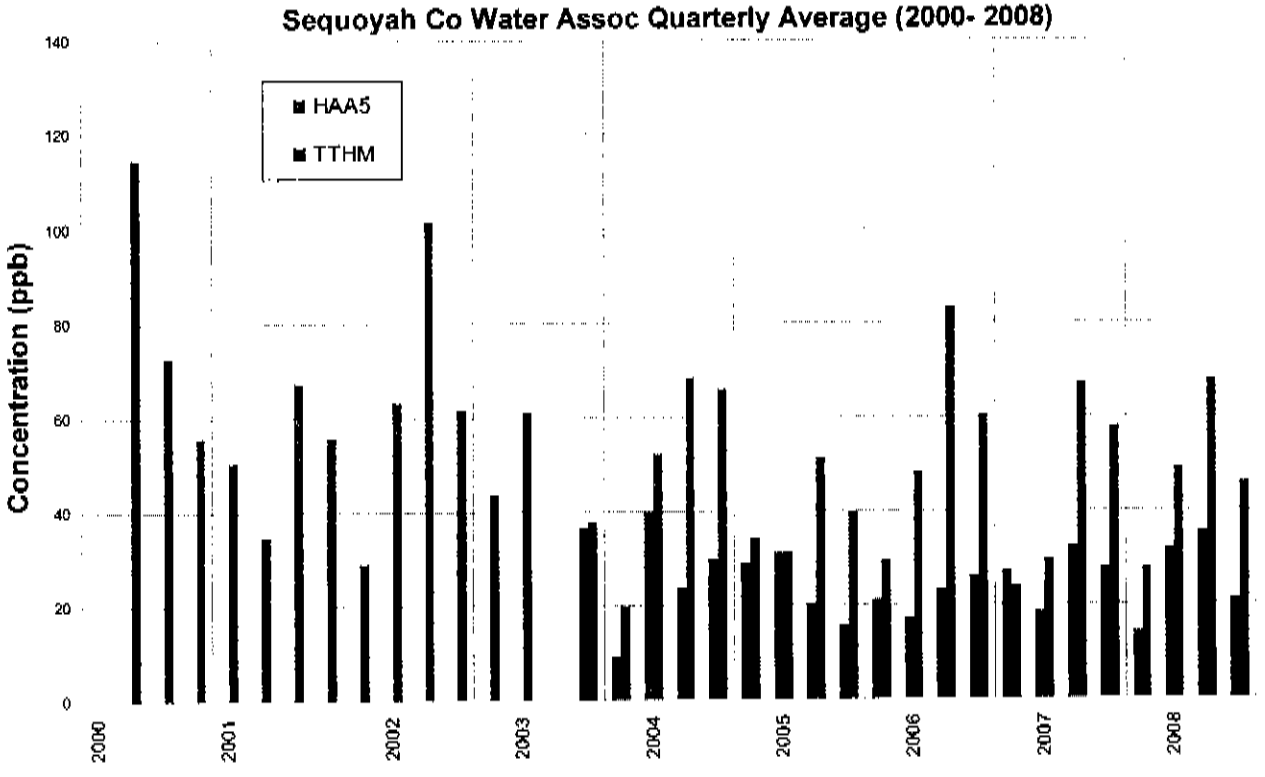
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the second quarter of 2000 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the first quarter of 2001
4. Calculation of TTHM RAA concentrations for 2004 is slightly modified due to missing data

HAA5 Running Annual Average (RAA) Concentrations in Sequoyah County Water Association System, 2004 to 2008



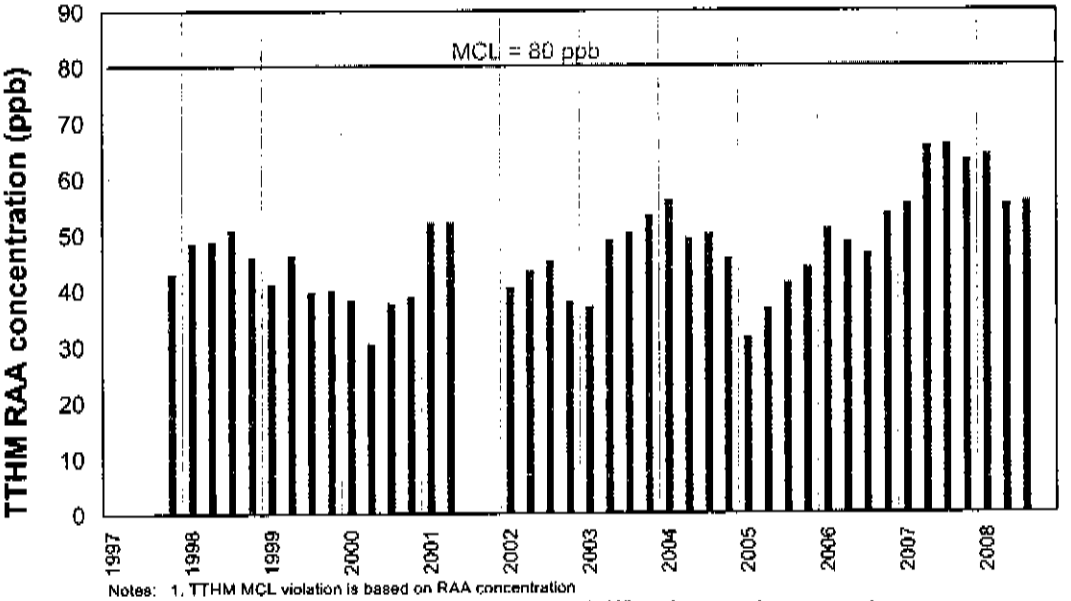
Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the fourth quarter of 2003 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the third quarter of 2004

Sequoyah Co Water Assoc (cont.)



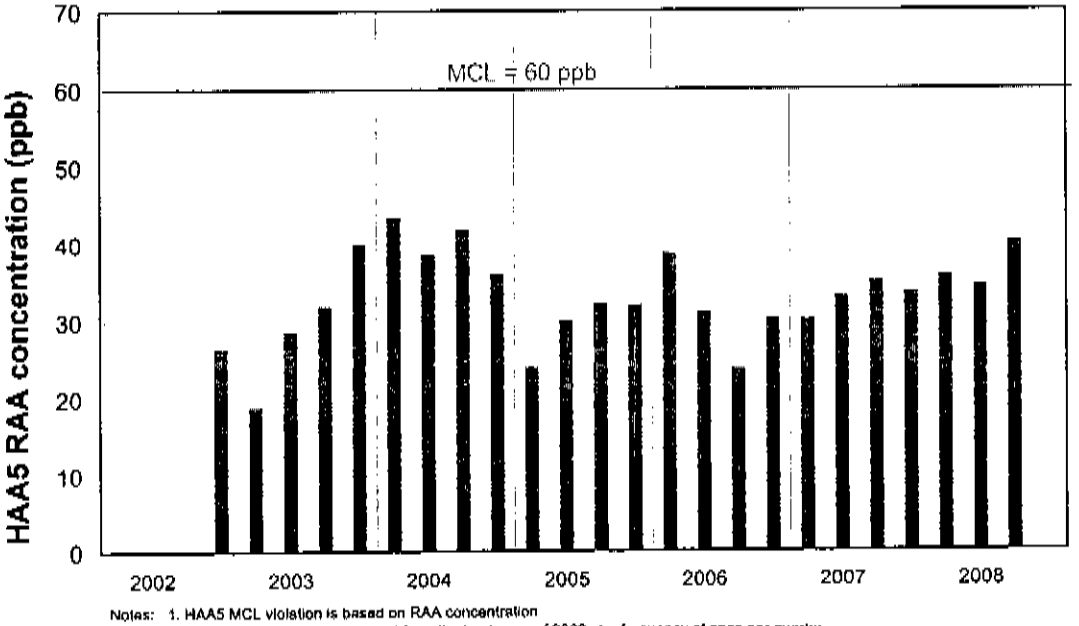
Tahlequah PWA

TTHM Running Annual Average (RAA) Concentrations in Tahlequah PWA System, 1998 to 2008



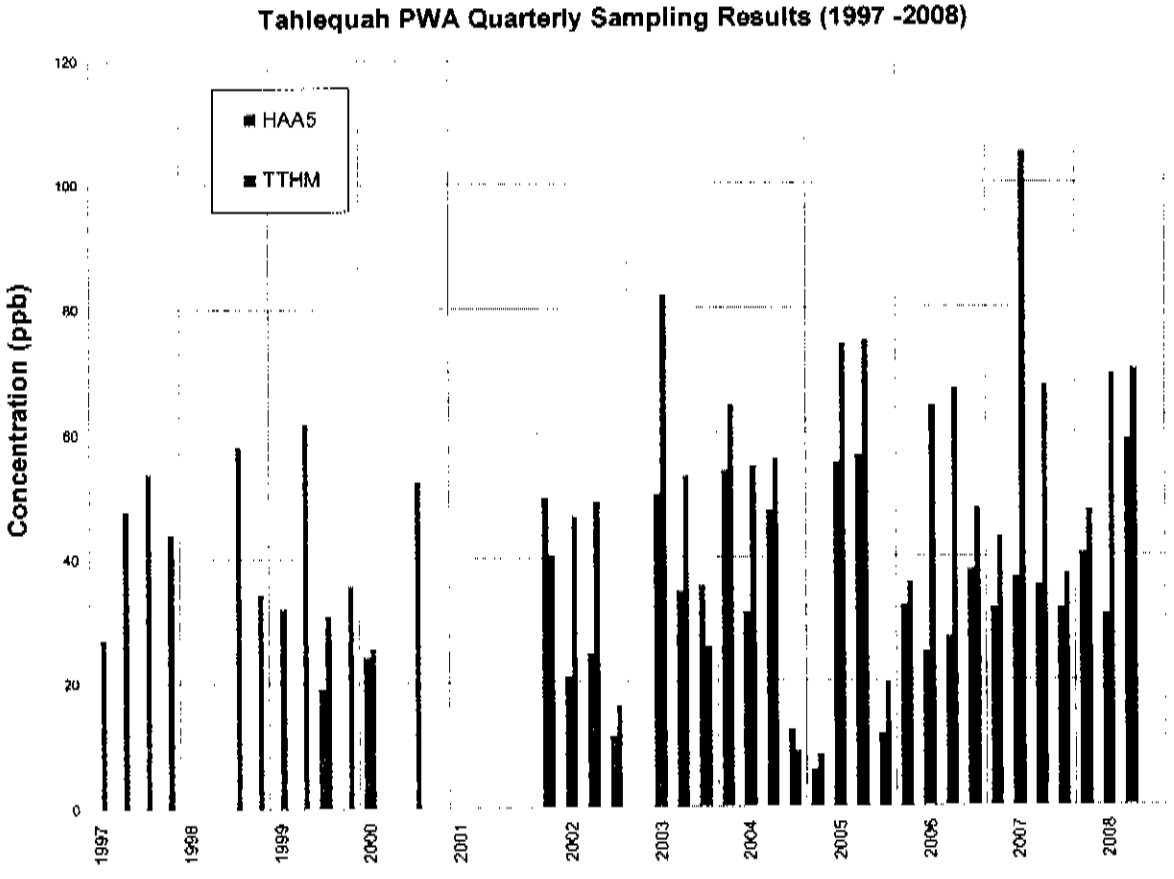
Notes: 1. TTHM MCL violation is based on RAA concentration
2. Routine TTHM sampling started from the beginning of 1997 at a frequency of once per quarter
3. The first available TTHM RAA concentration is from the fourth quarter of 1997
4. Calculation of TTHM RAA concentrations for several quarters is slightly modified due to missing data

HAA5 Running Annual Average (RAA) Concentrations in Tahlequah PWA System, 2002 to 2008

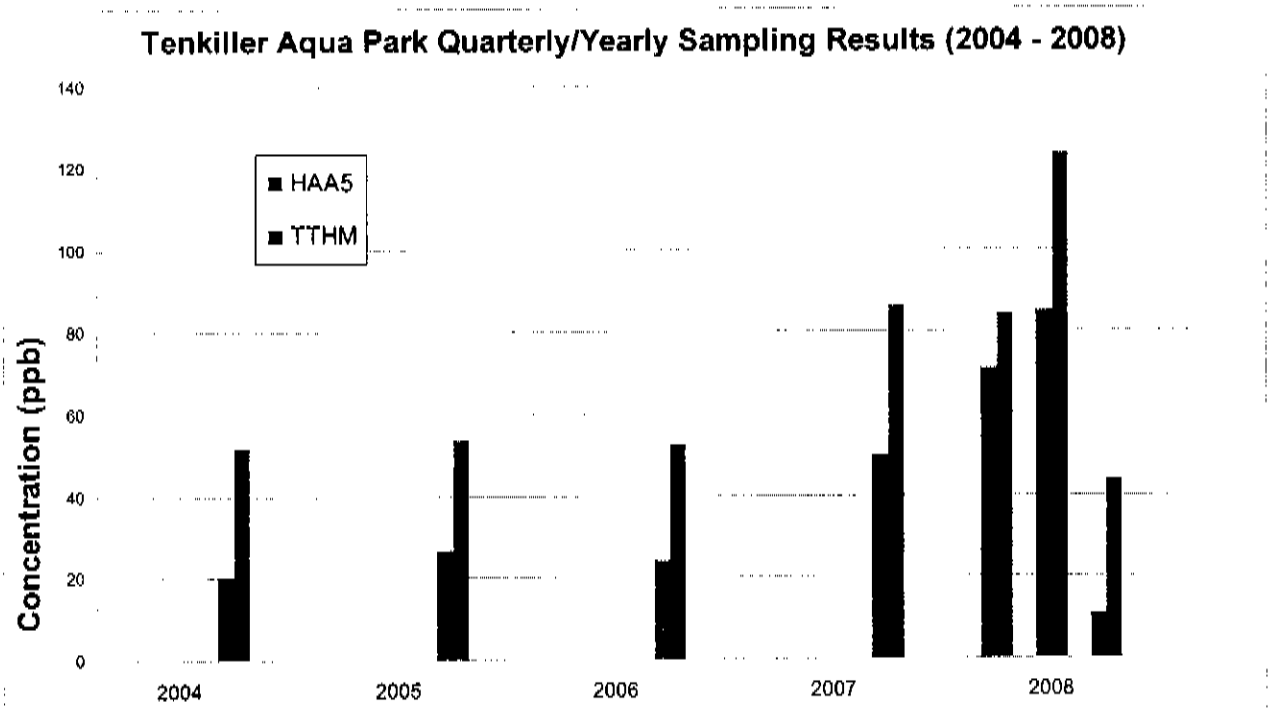


Notes: 1. HAA5 MCL violation is based on RAA concentration
2. Routine HAA5 sampling started from the beginning of 2002 at a frequency of once per quarter
3. The first available HAA5 RAA concentration is from the fourth quarter of 2002
4. Calculation of HAA5 RAA concentrations for 2003 is slightly modified due to missing data

Tahlequah PWA (cont.)

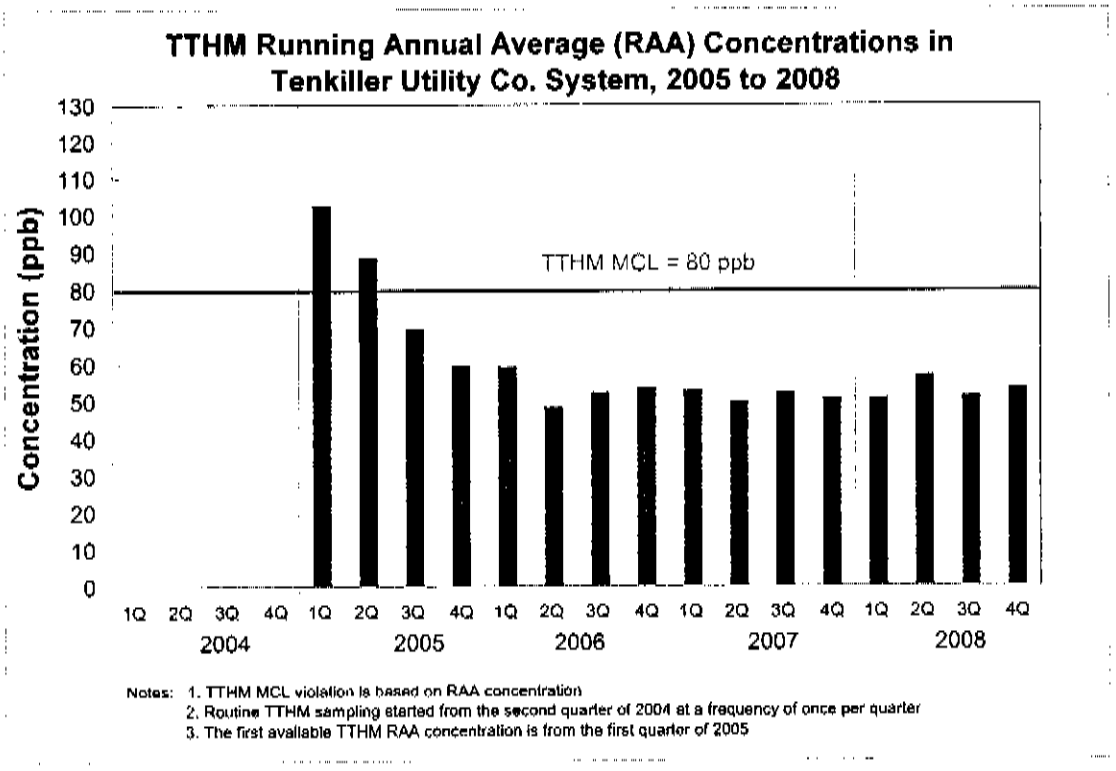


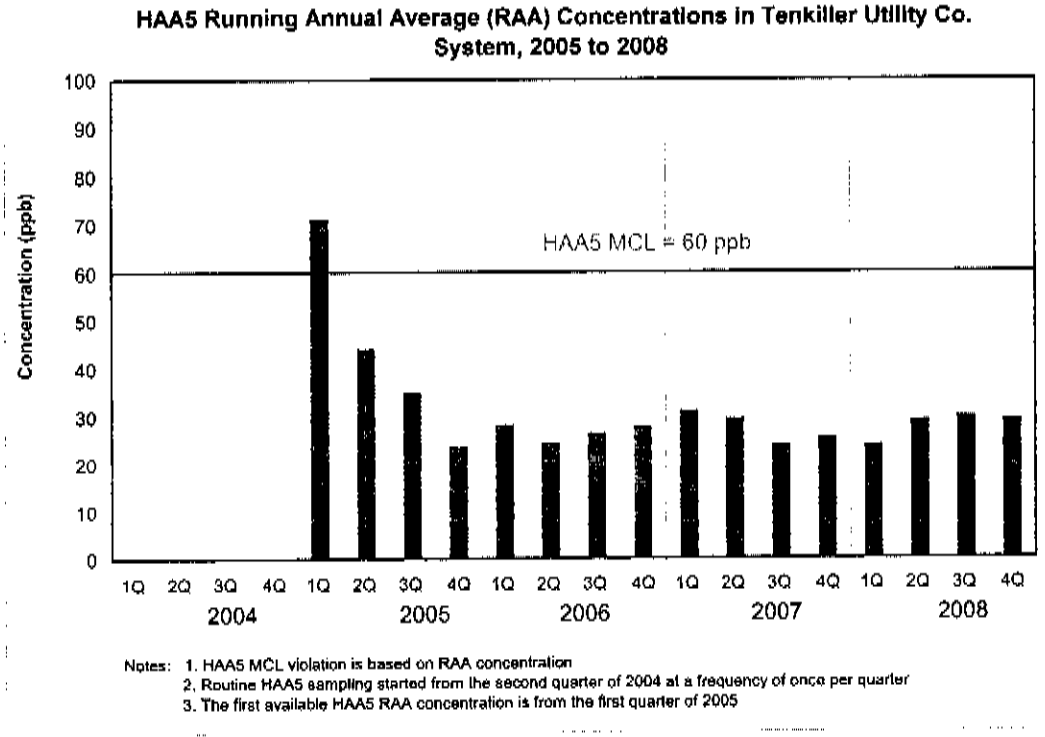
Tenkiller Aqua Park



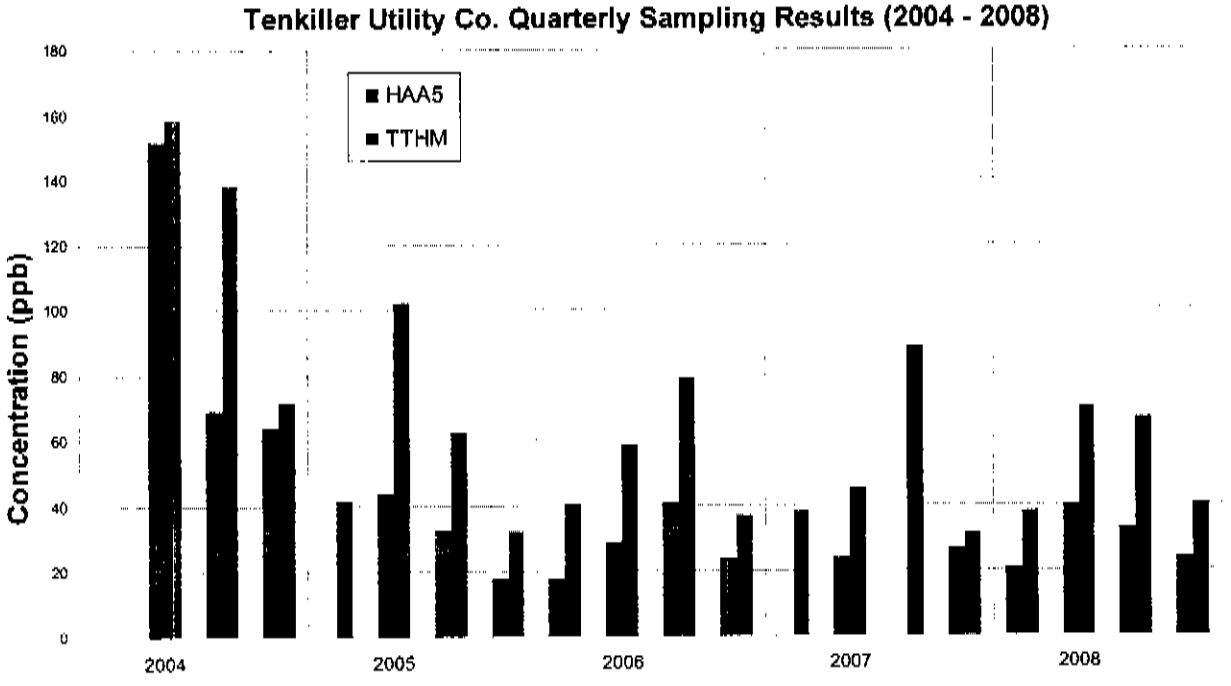
Effective Jan 1, 2008, DBP sampling frequency is quarterly. Before that, the sampling frequency was yearly.
Not enough data to calculate running annual average concentrations for HAA5 and TTHM.

Tenkiller Utility Co

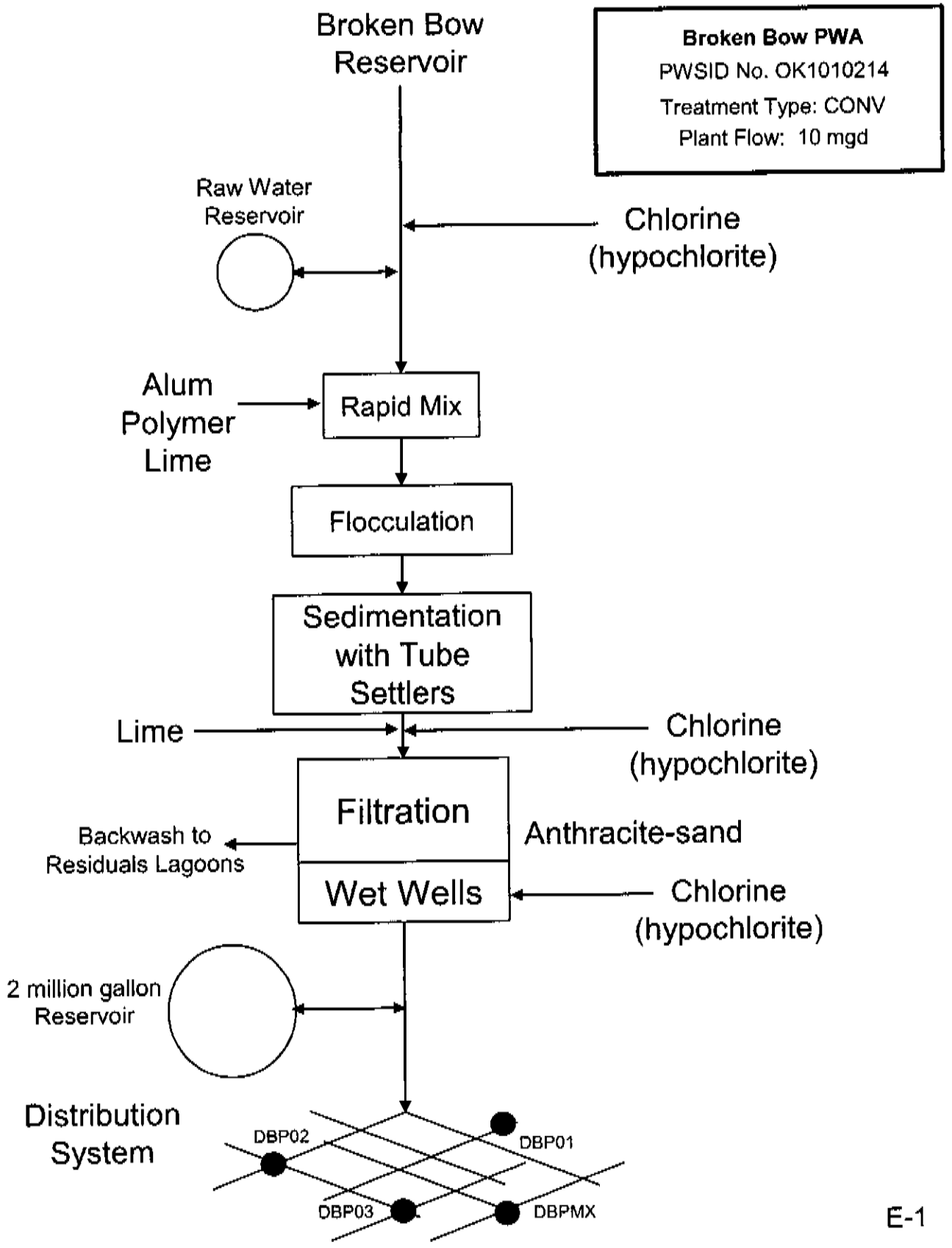




Tenkiller Utility Co (cont.)



Appendix E—Water Quality and Treatment Information for Broken Bow PWA

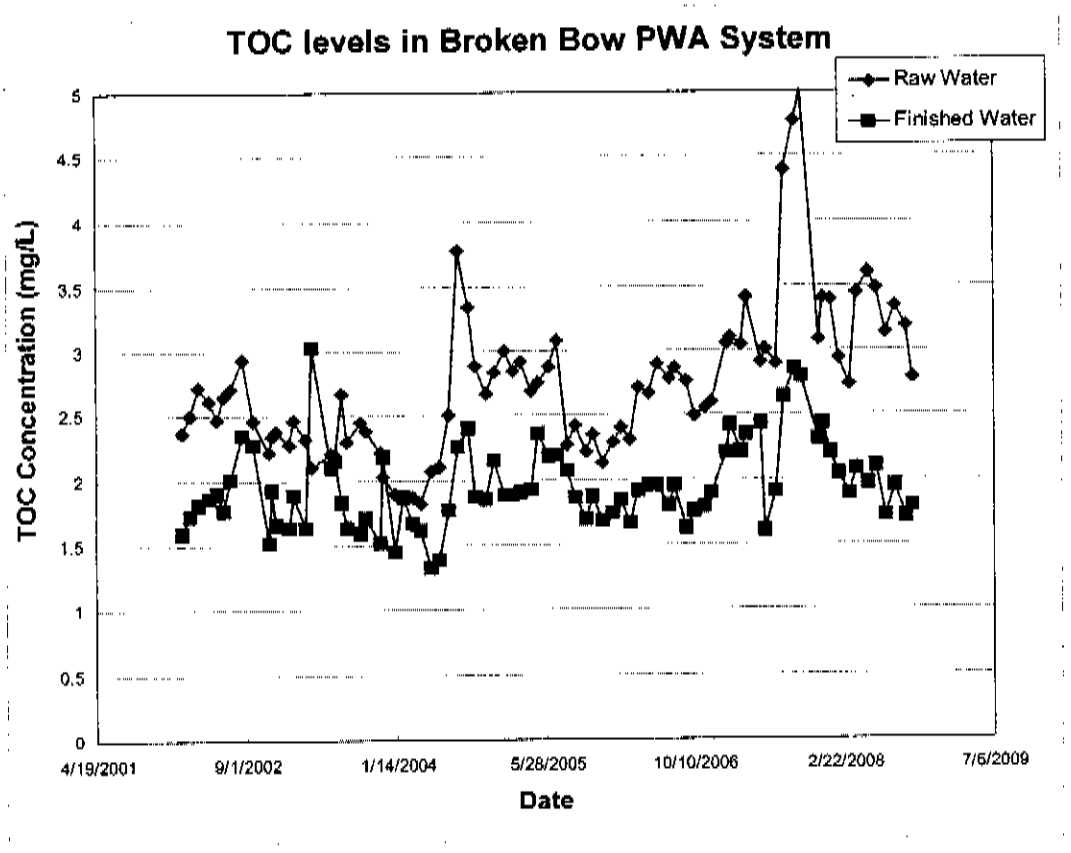


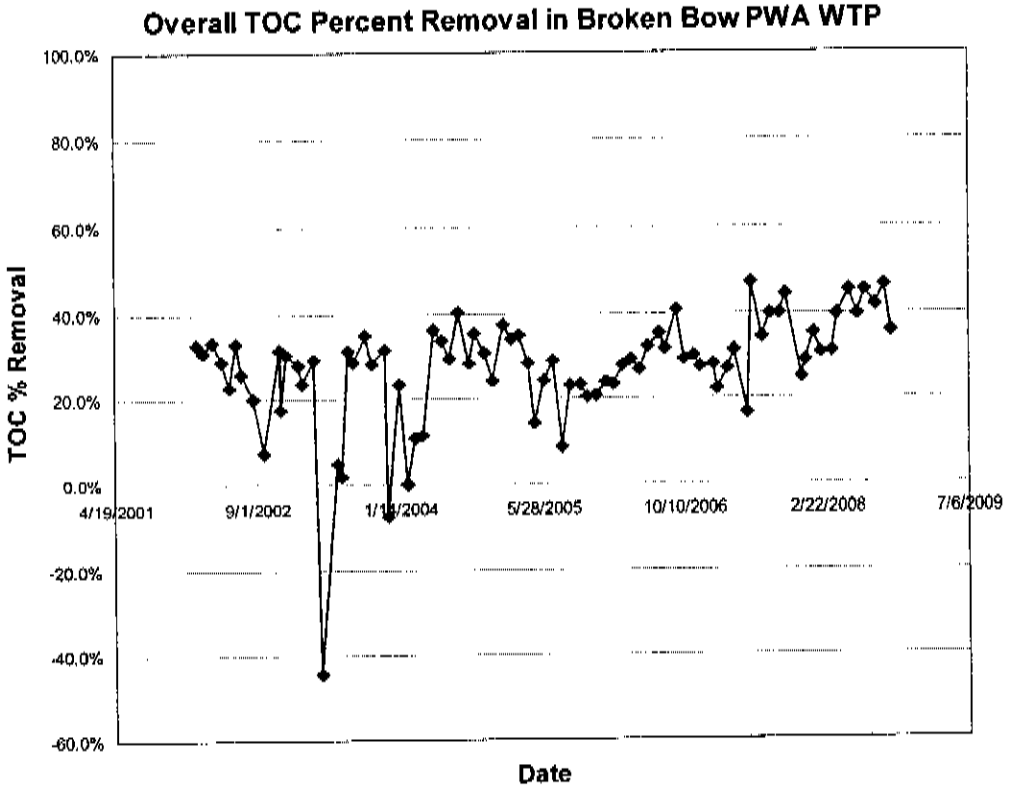
E-1

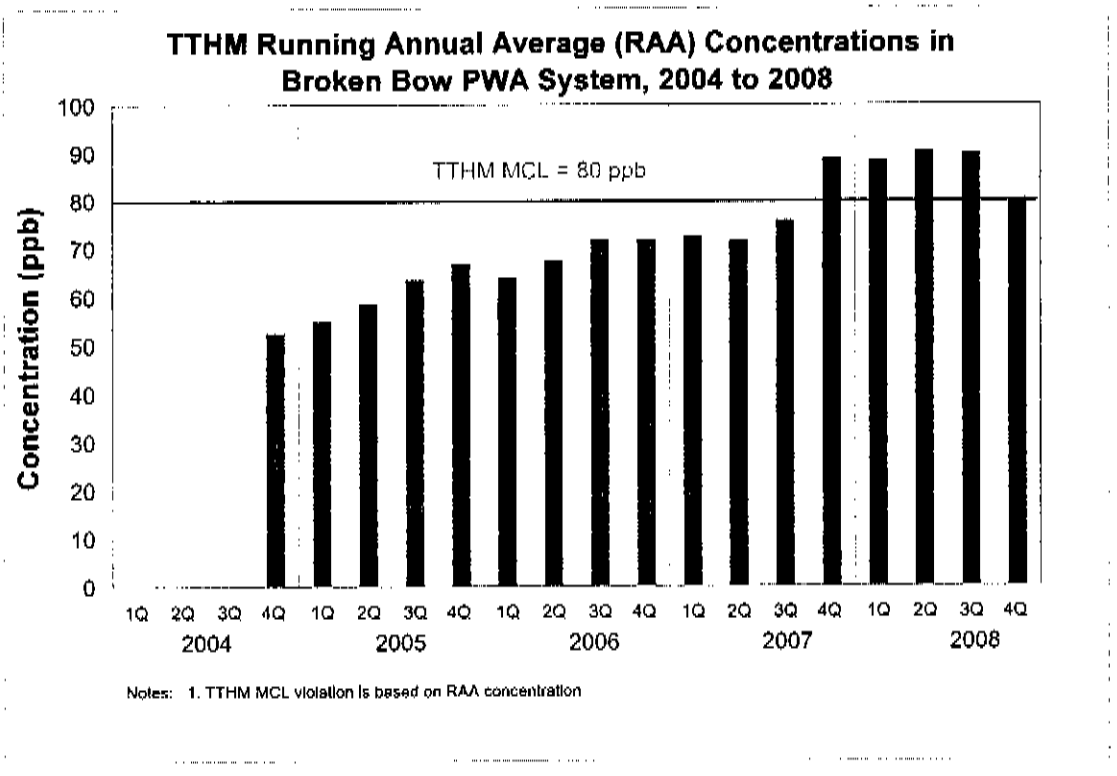
Source: (Woods 2009)

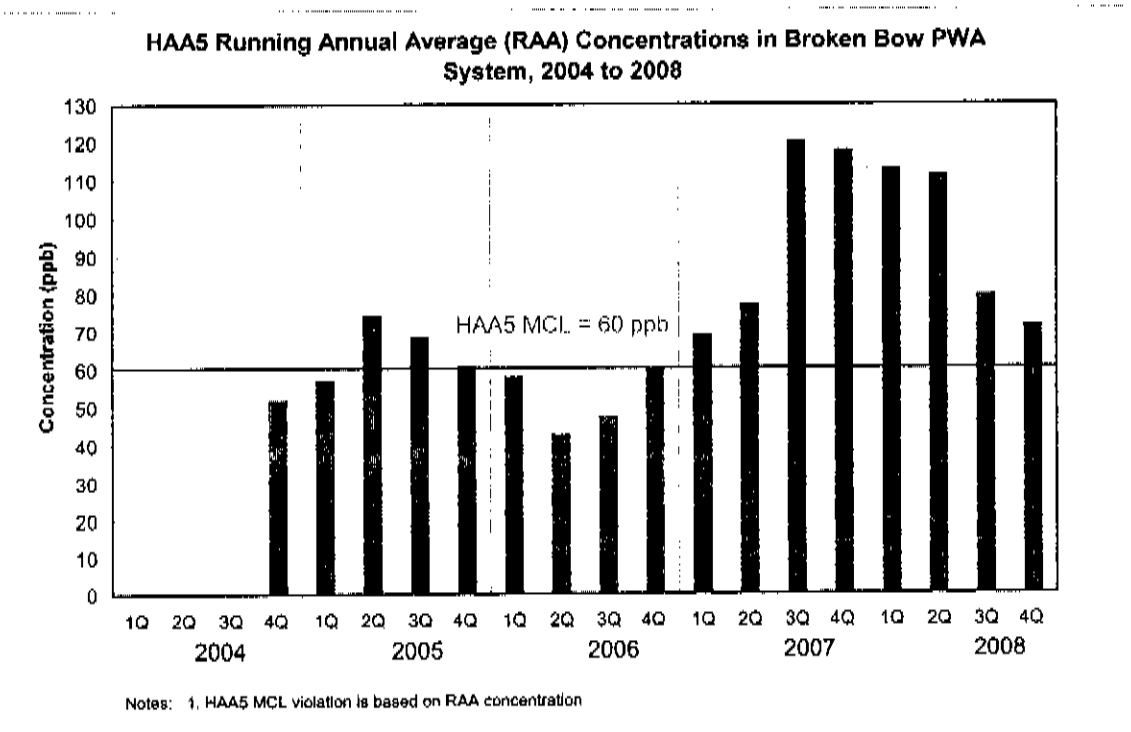
Broken Bow PWA	
Water System Number	OK1010214
Population Served	4,231 retail; 11,055 wholesale
Sources of Supply	Broken Bow Reservoir (100%)
Wholesale Customers	About 10 small water utilities in McCurtain County
Treatment	prechlorination, 100,000 gallon raw water reservoir, rapid mix basin with chemical addition (alum, polymer, lime), flocculation (walking beam), sedimentation basins (tube settlers in last segment), chlorine added before filters, filtration (23" anthracite, 10" sand), post-chlorination in wet wells (total dose about 3.5-4.5 mg/L), sidestream can enter 2 million gallon clearwell
TTHM & HAA5 Control	TOC removal has improved since May 2008 but poor overall DBP control, large number of violations of TTHM and especially HAA5 MCLs; BBPWA must fix piping into 2 million gallon reservoir and stop prechlorinating to have any chance of meeting the DBP regulations
Water Safety	utility staff believe that the water is safe
Taste and Odor	No taste and odor complaints have been noted.

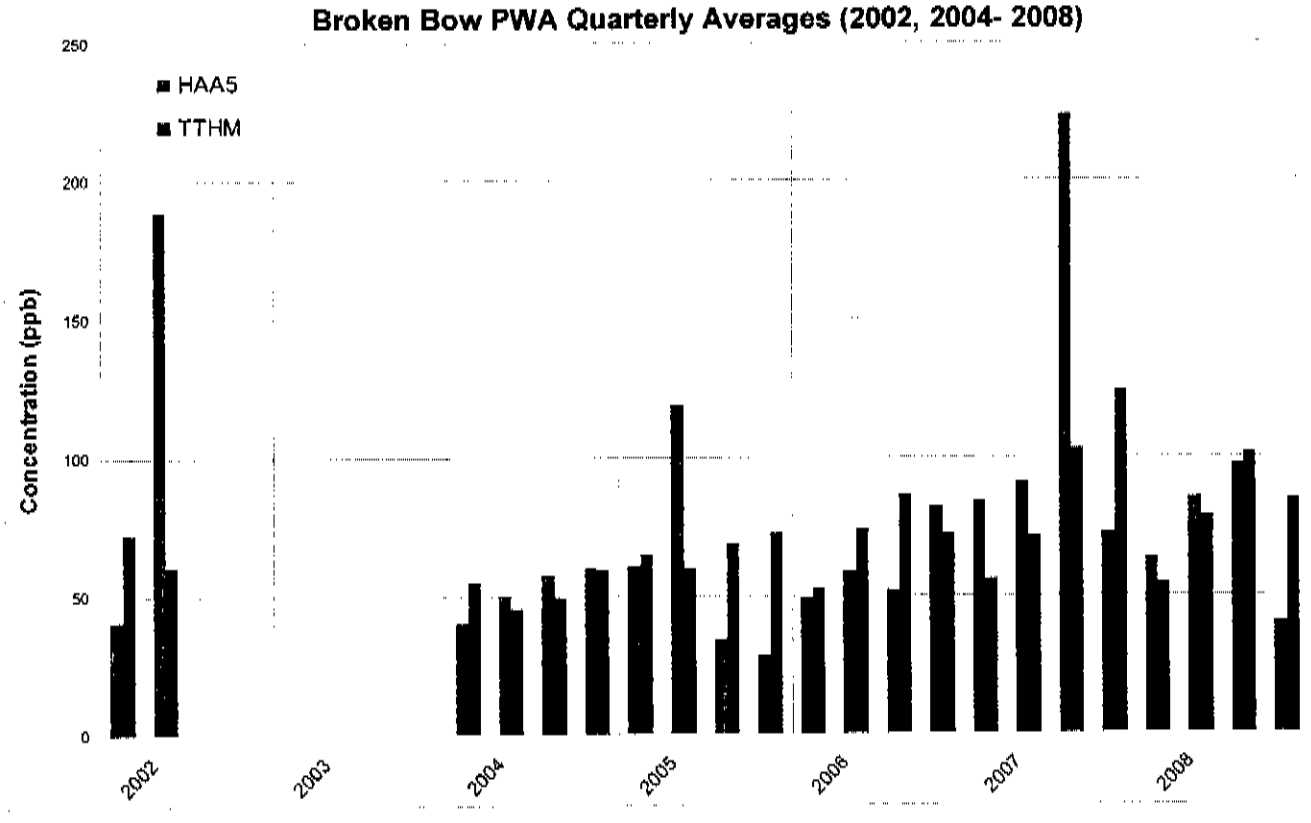
Source: (Woods 2009; CCRs; MORs)


TOC levels in Broken Bow PWA System
Raw Water
Finished Water
TOC Concentration (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4/19/2001
9/1/2002
1/14/2004
5/28/2005
10/10/2006
2/22/2008
7/6/2009
Date


Overall TOC Percent Removal in Broken Bow PWA WTP
TOC % Removal
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
-40.0%
-60.0%
4/19/2001
9/1/2002
1/14/2004
5/28/2005
10/10/2006
2/22/2008
7/6/2009
Date


TTHM Running Annual Average (RAA) Concentrations in Broken Bow PWA System, 2004 to 2008
Concentration (ppb)
100
90
80
70
60
50
40
30
20
10
0
TTHM MCL = 80 ppb
1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q
2004
2005
2006
2007
2008
Notes: 1. TTHM MCL violation is based on RAA concentration


HAA5 Running Annual Average (RAA) Concentrations in Broken Bow PWA System, 2004 to 2008
Concentration (ppb)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
HAA5 MCL = 60 ppb
1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q
2004
2005
2006
2007
2008
Notes: 1. HAA5 MCL violation is based on RAA concentration


Broken Bow PWA Quarterly Averages (2002, 2004- 2008)
HAA5
TTHM
Concentration (ppb)
250
200
150
100
50
0
2002
2003
2004
2005
2006
2007
2008