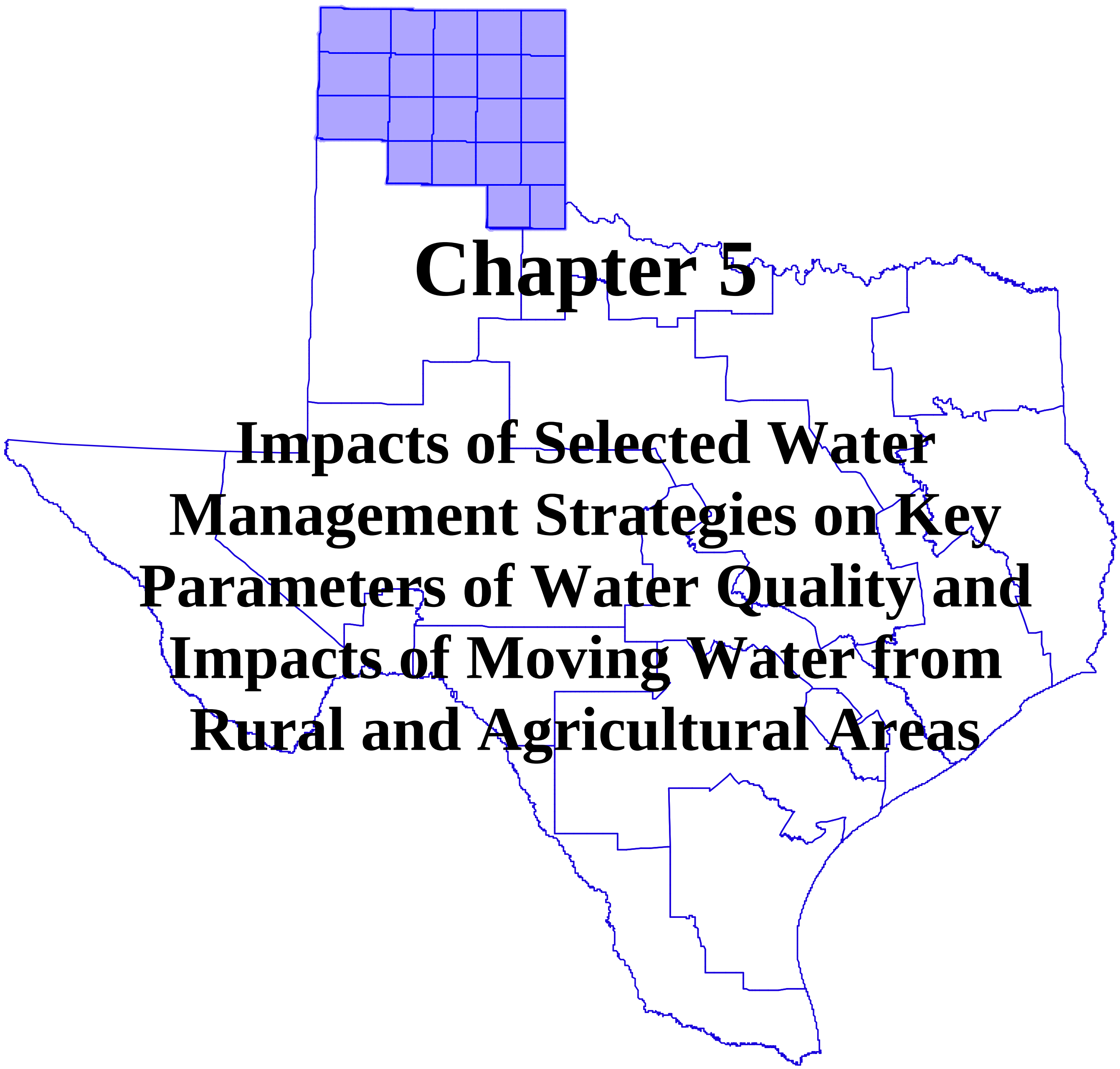


Chapter 5

Impacts of Selected Water Management Strategies on Key Parameters of Water Quality and Impacts of Moving Water from Rural and Agricultural Areas

5.1 Introduction

Water quality plays an important role in determining the availability of water supplies to meet current and future water needs in the region. In addition, SB2 requires that water management strategy evaluations consider the impacts to water quality. This chapter describes the general water quality of the surface water and groundwater sources in the region, discusses specific water quality concerns/issues, and details potential impacts on water quality that water management strategies may have for the region.

5.2 Water Quality Standards

Screening levels for public drinking water supplies were used for comparisons of water quality data for the region. Drinking water standards are based on Maximum Contaminant Levels (MCLs) and secondary constituent levels ("secondary standards") established in the Texas Administrative Code (30 TAC, Chapter 290, Subchapter F). Primary MCLs are legally enforceable standards that apply to public drinking water supplies in order to protect human health from contaminants in drinking water. Secondary standards are non-enforceable guidelines based on aesthetic effects that these constituents may cause (taste, color, odor, etc.). In addition to primary MCLs and secondary standards, two constituents, lead and copper, have action levels specified. These action levels apply to community and non-transient non-community water systems, and to new water systems when notified by the Texas Commission on Environmental Quality (TCEQ). A summary of the public drinking water supply parameters used to evaluate water quality is provided in Table 5-1.

Table 5-1: Selected Public Drinking Water Supply Parameters

Constituent	Screening Level (mg/L unless otherwise noted)	Type of Standard
Nitrate-N	10	MCL
Fluoride	4	MCL
Barium	2	MCL
Alpha	15 pc/L	MCL
Cadmium	0.005	MCL
Chromium	0.1	MCL
Selenium	0.05	MCL
Arsenic	0.01	MCL
Mercury	0.002	MCL
Lead	0.015	Action Level
Copper	1.3	Action Level

Table 5-1 (continued)

Constituent	Screening Level (mg/L unless otherwise noted)	Type of Standard
TDS	1000	SS
Chloride	300	SS
Sulfate	300	SS
pH	6.5 – 8.5	SS
Fluoride	2	SS
Iron	0.3	SS
Manganese	0.05	SS
Copper	1	SS

MCL- Primary drinking water standard (maximum contaminant level) from 30 TAC Chapter 290.104(b) Subchapter F
Action Level- Copper and Lead have action levels as defined by 30 TAC 290.117
SS- Secondary Standard from 30 TAC from 30 TAC 290.105(b)

5.2.1 Surface Water Quality

The state's Clean Water Program administers federal Clean Water Act directives through TCEQ's Water Quality Inventories. TCEQ is the responsible agency for identifying water-quality problems within the Water Quality Inventory. However, the Inventory does not identify sources of water-quality problems, as in most cases, the problems are "non-point source" pollutants. TCEQ, EPA and other agencies have discussed and researched methodologies by which non-point source pollution could be modeled, but thus far modeling efforts have been less than satisfactory. Under the Clean Water Program, water quality is managed statewide through the Texas Clean Rivers Program (TCRP) and locally through TCRP partners such as the Canadian River Municipal Water and Red River Authorities.

The TCRP is a unique water quality monitoring, assessment, and public outreach program that is funded by state fees. The CRP is a collaboration of 15 regional water agencies along with the TCEQ, and is authorized by Senate Bill 818.

The TCRP program within the PWPA includes portions of the Canadian River and Red River Basins. The major reservoirs in the PWPA are Lake Meredith, Greenbelt Lake, and Palo Duro Reservoir. According to the TCEQ's 2008 State of Texas Water Quality Inventory (TCEQ, 2008), the principal water quality problems in the Canadian and Red River Basins are elevated dissolved solids and bacteria. Natural conditions including the presence of saline springs, seeps, and gypsum outcrops contribute to dissolved solids in most surface waters of the PWPA and elevated metals in localized areas. Elevated nutrients are most often associated with municipal discharge of treated wastewater to surface waters and agricultural runoff.

Water bodies which are determined by TCEQ as not meeting Texas Surface Water Quality Standards are included on the State of Texas Clean Water Act Section 303(d) list. Eleven segments in the PWPA were identified on the 2008 303(d) list. Constituents of concern and 303(d) listing of segments in the PWPA are shown in Table 5-2.

Table 5-2: 2008 303d Listed Segments in the PWPA

		Constituents of Concern						
Water Body	**Segment Number**	**bacteria**	**pH**	**mercury in edible tissue**	**dissolved oxygen**	**total dissolved solids**	**Chloride**	**Sulfate**
Canadian River Basin								
Dixon Creek	0101A	X			X			
Rock Creek	0101B	X						
Lake Meredith	0102			X		X	X	X
Canadian River above Lake Meredith	0103						X	
Rita Blanca Lake	0105		X					
Palo Duro Reservoir	0199A				X			
Red River Basin								
South Groesbeck Creek	0206B	X						
Lower Prairie Dog Town Fork of Red River	0207	X						
Buck Creek	0207A	X						
Upper Prairie Dog Town Fork of Red River	0229		X					
Sweetwater Creek	0299A	X						

Table 5-3: Surface Water Segments in the PWPA and Associated Water Quality Issues

Canadian River Basin				
Water Body	**Segment Number**	**Constituents of Concern**	**Use Concern/Water Quality Concern**	**Potential Contaminant Sources**
Canadian River below Lake Meredith	0101	Ammonia	Nutrient Enrichment Concern	Agriculture, Grazing-related sources
Dixon Creek	0101A	Bacteria, Depressed Dissolved Oxygen, Chlorophyll-a, Nitrate, Orthophosphorus	Contact Recreation Use Concern, Nutrient Enrichment Concern	Grazing-related sources
Rock Creek	0101B	Bacteria, Nitrate	Contact Recreation Use Concern	Grazing-related sources, Underground injection control wells, Petroleum/natural gas activities
Lake Meredith	0102	Chloride, Sulfate Total Dissolved Solids, Mercury	Public Water Supply Concern, Fish Consumption Concern	Natural/Upstream sources Possible atmospheric deposition (mercury)
Canadian River above Lake Meredith	0103	Chloride		Natural/Upstream sources
East Amarillo Creek	0103A	Chlorophyll-a, Nitrate	Nutrient Enrichment Concern	Municipal runoff/discharges, urban runoff/storm sewers
Wolf Creek	0104	Chlorophyll-a		Unknown
Rita Blanca Lake	0105	Ammonia, pH, Chlorophyll-a, Orthophosphorus, Total Phosphorus	Nutrient Enrichment Concern	Natural sources, Waterfoul
Palo Duro Reservoir	0199A	Ammonia, Depressed Dissolved Oxygen	Nutrient Enrichment Concern	Grazing-related sources, Animal feeding operations, Impacts from hydrostructure flow regulation/modifications
South Groesbeck Creek	0206B	Bacteria, Nitrate	Contact Recreation Use Concern	Grazing-related sources

Table 5-3 (continued)

Red River Basin				
Water Body	**Segment Number**	**Constituents of Concern**	**Use Concern/Water Quality Concern**	**Potential Contaminant Sources**
Lower Prairie Dog Town Fork of Red River	0207	Bacteria, Chlorophyll-a, Orthophosphorus	Contact Recreation Use Concern, Nutrient Enrichment Concern	Grazing-related sources
Buck Creek	0207A	Bacteria, Nitrate	Contact Recreation Use Concern	Grazing-related sources, Wildlife other than waterfoul
Upper Prairie Dog Town Fork of Red River	0229	pH, Chlorophyll-a, Nitrate, Orthophosphorus, Total Phosphorus	Nutrient Enrichment Concern	On-site treatment systems, Impacts from hydrostructure flow regulation/modifications, Municipal Discharges/Runoff
Lake Tanglewood	0229A	Nitrate, Chlorophyll-a Orthophosphorus Total phosphorus	Nutrient Enrichment Concern	Golf Courses, On-site treatment systems, Impacts from hydrostructure flow regulation/modifications, Municipal Discharges/Runoff
Sweetwater Creek	0229A	Bacteria	Contact Recreation Use Concern	Grazing-related sources

Source: http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/08twqi/08_list.html

Table 5-3 shows stream segments within the PWPA that did not meet standards laid out in the 2008 Water Quality Inventory and identifies concerns and potential sources of contamination. The Total Maximum Daily Load (TMDL) Program works to improve water quality in impaired or threatened water bodies in Texas. The program is authorized by and created to fulfill the requirements of Section 303(d) of the federal Clean Water Act.

The goal of a TMDL is to determine the amount (or load) of a pollutant that a body of water can receive and still support its beneficial uses. The load is then allocated among all the potential sources of pollution within the watershed, and measures to reduce pollutant loads are developed as necessary. The 2008 Index of Water Quality Impairments show no TMDL assessments scheduled or currently underway in the PWPA

The 2008 303(d) list was created by the TCEQ on March 19, 2008. This list, with the addition of Corpus Christi Bay, was approved by the EPA on July 9, 2008.

5.2.2 Groundwater Quality

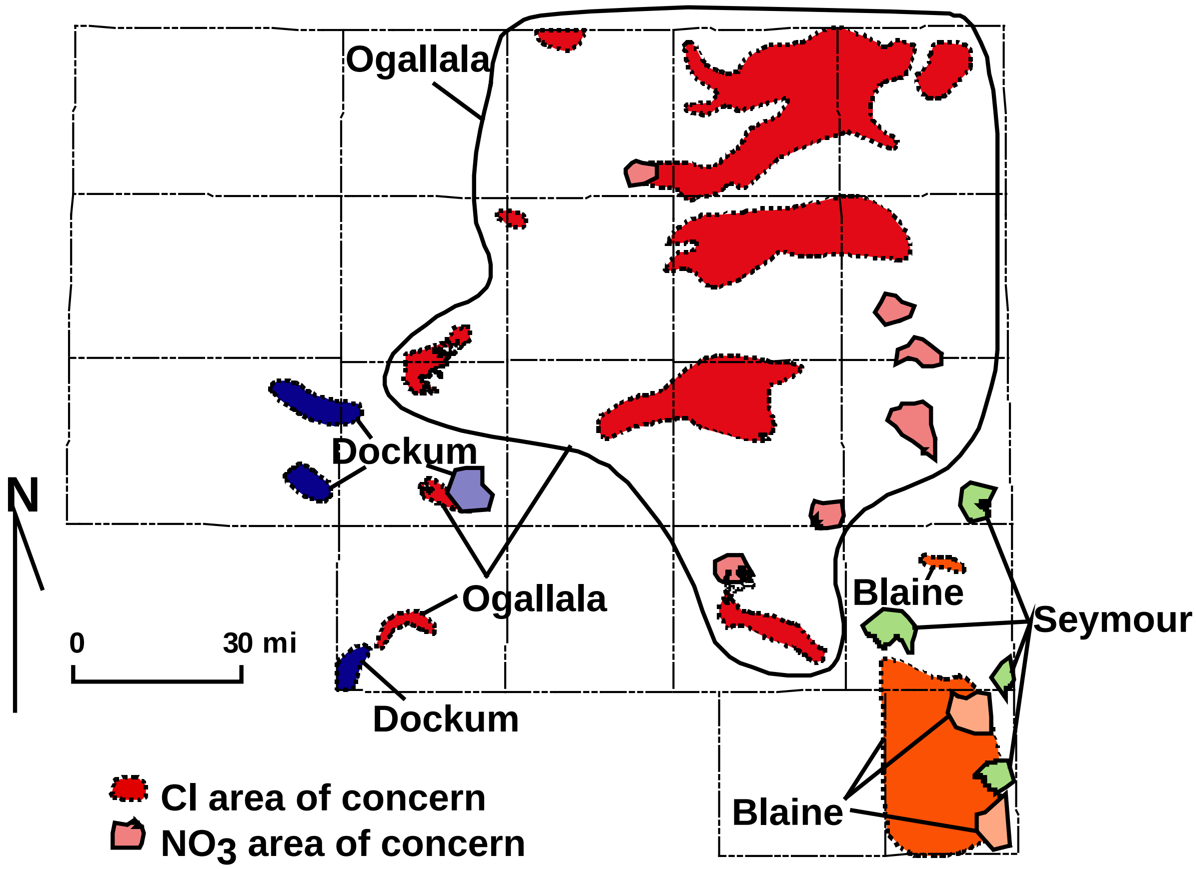
All groundwater contains minerals carried in solution and their concentration is rarely uniform throughout the extent of an aquifer. The degree and type of mineralization of groundwater determines its suitability for municipal, industrial, irrigation and other uses. Groundwater resources in the Panhandle region are generally potable, although region-wide up to approximately thirteen percent of the groundwater may be brackish. Groundwater quality issues in the region are generally related to elevated concentrations of nitrate (NO_3), chloride (Cl), and total dissolved solids (TDS). Sources of elevated NO_3 include cultivation of soils, which released soil NO_3, and domestic and animal sources – for example, septic tanks and barnyard wastes (Dutton, 2005). Elevated concentrations of Cl are due to dissolution of evaporite minerals and upwelling from underlying, more brackish groundwater formations. Elevated concentrations of TDS are primarily the result of the lack of sufficient recharge and restricted circulation. Together, these limit the flushing action of fresh water moving through the aquifers.

As of 2008, 113 reported or confirmed cases of groundwater contamination, 2.4 percent of the statewide total, were in the PWPA and were being investigated, monitored, or remediated by governmental agencies. Fuel hydrocarbons (gasoline, diesel, and kerosene) are the most frequently cited constituents in the PWPA. Potter, Hutchinson, and Randall Counties have nearly half of the groundwater contamination cases, which probably reflects the greater population and industrial activity in those counties than in the rest of the PWPA.

Areas of concern for dissolved chloride and nitrate in groundwater in the major and minor aquifers were identified to evaluate whether there are water-quality issues to be addressed along with water-supply issues in the Panhandle Water Planning Area (PWPA). It is generally assumed that water supply shortages are the result of a lack of a quantity of supply; however, impaired water quality can lower the amount of usable supply. The areas of concern were defined on the basis of the following criteria. For Cl: (a) individual reported analyses with Cl>250 mg/L, or (b) clusters or groups where Cl>50 mg/L. For NO_3: (a) individual reported analyses with NO_3 >44 mg/L, or (b) clusters or groups where NO_3 >20 mg/L. The Cl area of concern covers approximately13 percent and the NO_3 area of concern covers approximately2 percent of the aquifer areas of the PWPA. Not all of the area within each area of concern has solute concentrations that exceed maximum contaminant levels. Some wells have concentrations less than MCLs and many even have concentrations less than the cut-off values used to define the clusters.

The identified areas of concern are shown in Figure 5-1 for the five aquifers included in this study of the PWPA. The areas includes apparent clusters of wells with Cl>50 mg/L or with NO_3 >20 mg/L, in addition to wells that exceed the MCL for either Cl or NO_3. Other wells with concentrations less than the MCLs and less than the cut-off values used to define the clusters may lie within the identified areas of concern. The purpose of identifying the areas of concern is to draw attention to these areas and to raise the question of whether there are water-quality issues to be addressed along with water-

Figure 5-1: Areas of Concern within PWPA for Nitrates and Chlorides



supply issues. Pinpointing the hydrogeologic controls, sources, or local causes of contamination may require collection and further analysis of additional water samples and consideration of local hydrogeologic conditions.

5.2.2.1 Ogallala Aquifer

Areas of concern for Cl along the Canadian River and in Carson and Gray counties (Figure 5-1) match those areas marked by Mehta and others (2000) as having Cl greater than 50 mg/L. Another large area extends from southeastern Hansford County to northwestern Lipscomb County. There are other smaller areas in parts of Randall, Potter, Moore, Hansford, and Donley Counties, where elevated Cl might reflect movement of water from the underlying Permian section, as suggested by Mehta and others (2000). Some of these areas are defined by one or just a few samples. Some of the samples may come from wells completed not only in the Ogallala aquifer but also partly in the Permian section. Samples from dual-completion wells could falsely indicate a Cl problem for the Ogallala aquifer.

Areas of concern are smaller for NO_3 than Cl in the Ogallala aquifer. Most of the areas fall near the eastern side of the Panhandle (Figs. 5.1). Some are defined by single samples. Individual samples might reflect local problems with well completion allowing vertical migration of contaminated water, and might not reflect widespread contamination of the aquifer.

The Cl areas of concern in the Ogallala aquifer include public-water-supply well fields (Figure 5-2) operated by:

- City of Perryton in Ochiltree County,
- City of Pampa in Gray County,
- City of Lefors in Gray County, and
- Red River Authority in Donley County.

Elevated Cl concentrations in most of the reported samples are less than the secondary MCL for dissolved chloride.

The NO_3 areas of concern in the Ogallala aquifer include public-water-supply well fields operated by:

- City of McLean in Gray County,
- City of Wheeler in Wheeler County, and
- Red River Authority in Donley County, which well field also lies in the Cl area of concern.

A more recent study examining nitrate levels was discussed in the 2008 State Of Texas Water Quality Inventory Groundwater Assessment. TCEQ entered into a cooperative agreement with the Bureau of Economic Geology, Jackson School of Geosciences, and University of Texas at Austin to characterize nitrate reservoirs beneath natural ecosystems and irrigated and rainfed agricultural ecosystems. Areas of high groundwater nitrate contamination in Seymour, southern High Plains (Ogallala), and southern Gulf Coast aquifers were included in the study. Profiles were drilled beneath natural and irrigated and nonirrigated ecosystems in the aquifers previously listed. Nitrate levels beneath natural rangeland ecosystems tended to be low in the various aquifer regions. Much higher nitrate concentrations were found at depth beneath cultivated areas which reflect precultivation rangeland conditions. These findings suggest that nitrate accumulations under current rangeland conditions may not be typical of those beneath rangeland conditions prior to cultivation. The profiles drilled beneath rainfed agricultural areas showed moderate nitrate concentrations because of generally low to moderate fertilizer application rates combined with frequent precipitation. High nitrate concentrations were found beneath irrigated agriculture. In the southern High Plains (Ogallala) this is likely due to lack of flushing associated with deficit irrigation and may indicate salt buildup in the soil rather than groundwater contamination. Figure 5-3 shows nitrate concentrations in the Ogallala aquifer.

Figure 5-2: Locations of Public Water-Supply Wells located in Areas of Concern

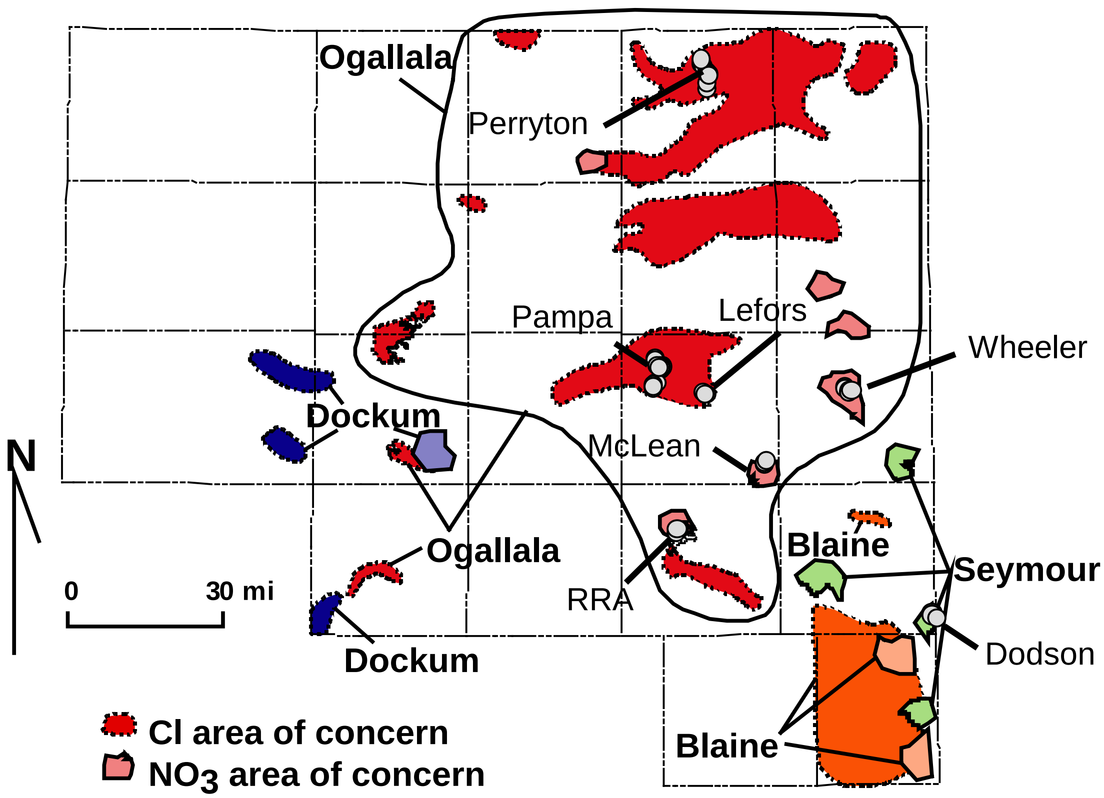
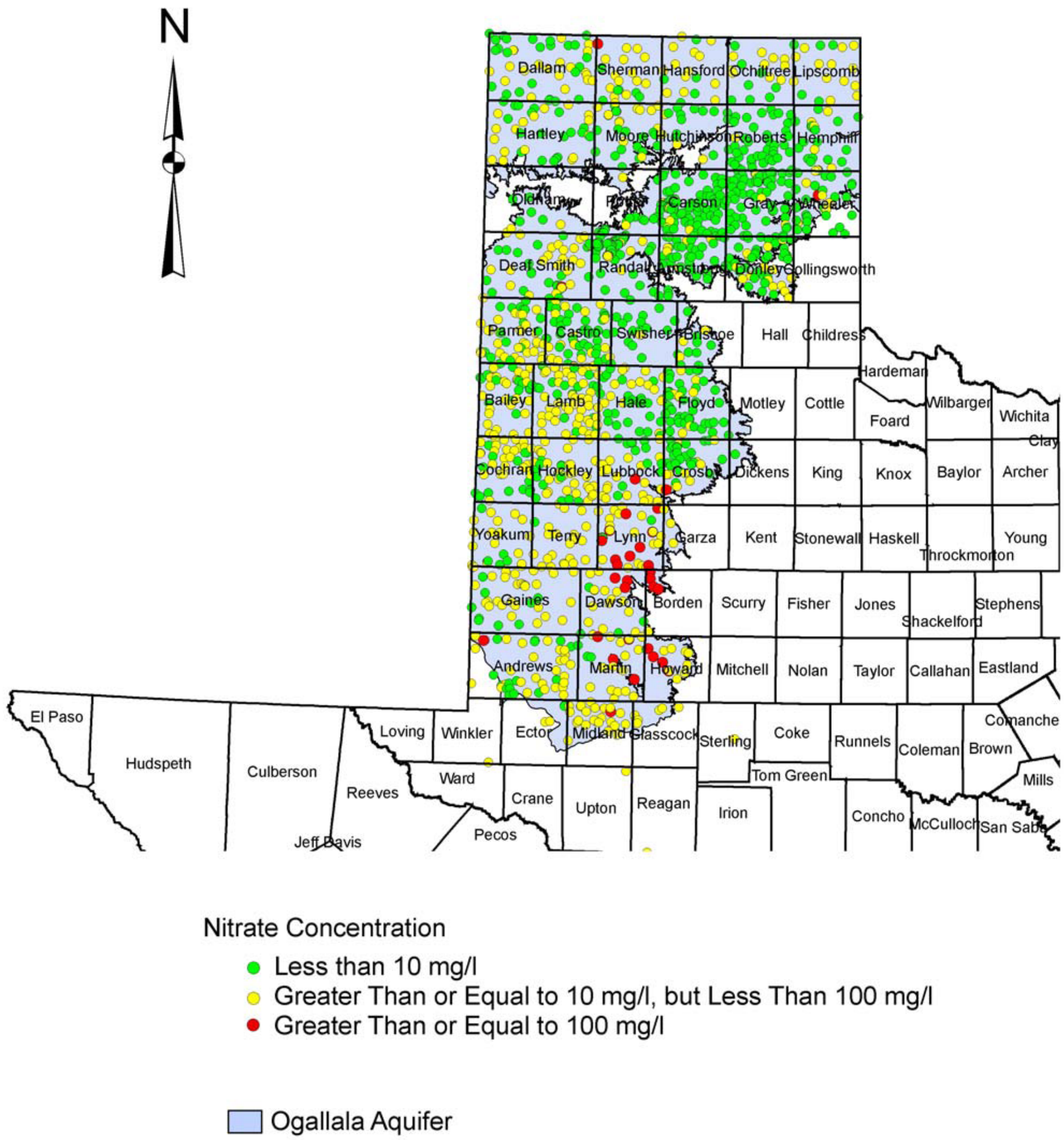


Table 5-4: List of public water supply well fields occurring in areas of concern for dissolved chloride and nitrate in groundwater

Map label	County	Constituent of concern	Public water supply wells	Aquifer
1	Ochiltree	Chloride	City of Perryton	Ogallala
2	Gray	Chloride	City of Pampa	Ogallala
3	Gray	Chloride	City of Lefors	Ogallala
4	Gray	Nitrate	City of McLean	Ogallala
5	Wheeler	Nitrate	City of Wheeler	Ogallala
6	Donley	Chloride and Nitrate	Red River Authority	Ogallala
7	Collingsworth	Nitrate	City of Dodson and Red River Authority - Dodson Water Authority	Seymour and Blaine

Figure 5-3: Distribution of Nitrate in the Ogallala Aquifer



Source: Texas Commission on Environmental Quality: *2008 State of Texas Water Quality Inventory Groundwater Assessment (March 19, 2008)*, [Online], Available URL:
http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/08twqi_groundwater.pdf

A study was conducted by the Bureau of Economic Geology to evaluate how increased pumping of groundwater in the Ogallala aquifer in the Roberts County area might affect future water quality in the aquifer. This was evaluated using a cross-sectional flow model with variable density using the numerical code SUTRA (Voss, 1984). Much of the construction and calibration of the cross-sectional flow model followed the practice of Mehta and others (2001b). Many of the same general findings previously shown by Mehta and others (2001b) were obtained:

- Upward directed TDS gradient,
- Comparable flow velocities in the Ogallala aquifer,
- Range of TDS concentrations in the Ogallala aquifer that reasonably match recorded concentrations,
- Elevated TDS concentrations were simulated for areas observed to have elevated concentrations.

This analysis generally followed the same approach and procedures for construction of the numerical model as did Mehta and others (2000b) and obtained similar results. Model simulations showed that a natural area of elevated TDS would be expected in western Roberts County. The same hydrogeological controls apply to that area as to the one further south (Mehta and others, 2000b):

- Cross-formational flow from underlying units containing evaporate deposits with saline-to-brine water,
- Interaction of cross-formational flow and geometries of formational units partly determines the location of elevated TDS,
- Topographically-driven cross-formational flow locally controls intermediate-scale flow paths that move downward from the Ogallala into underlying units and back into the Ogallala.

Mehta and others (2000b) stated that pumping during a 30-yr period resulted in a small increase in TDS concentration in the Ogallala aquifer. Local concentration increases over a 50-yr period of <500 mg/L in the Ogallala aquifer were simulated in this study. The simulated increase is greater where the drawdown in fluid pressure is greater. A greater increase in TDS was simulated for the Amarillo-Carson County well field than for the CRMWA well field for a 50-yr period. The simulated increase in TDS for the Amarillo-Carson County well field, however, is much greater than the reported increase for that area. The expected change in TDS was small as it takes time to move a mass of water. The distance for moving groundwater vertically from the underlying salt-bearing formations, however, is small.

Additional work should focus on:

(1) Determining the sensitivity of transient TDS change to varying levels of groundwater withdrawal included in the simulation, and
(2) Evaluating which hydrogeologic parameters have the greatest influence on the transient simulation of TDS in the model.

The simulated increase in TDS was greater in this model than reported by Mehta and others. A <500 mg/L local increase in TDS averages to < 10 mg/L increase per year. This rate of change, however, has not been previously recorded for the Amarillo Carson County well field. Therefore, additional work is needed to confirm whether this finding is reasonable, determine how the result depends on the rate of groundwater withdrawal from simulated well fields, and evaluate which hydrogeologic parameters have the greatest influence on the transient simulation of TDS in the model. The entire study report and findings can be found in Appendix X of the PWPA Regional Water Plan (Freese and Nichols, 2006).

5.2.2.2 Dockum Aquifer

The primary water-bearing zone in the Dockum Group, commonly called the "Santa Rosa," consists of up to 700 feet of sand and conglomerate interbedded with layers of silt and shale. Aquifer permeability is typically low, and well yields normally do not exceed 300 gal/min (Ashworth & Hopkins, 1995).

Concentrations of TDS in the Dockum aquifer range from less than 1,000 mg/L in the eastern outcrop of the aquifer to more than 20,000 mg/L in the deeper parts of the formation to the west. The highest water quality in the Dockum occurs in the shallowest portions of the aquifer and along outcrops at the perimeter. The Dockum underlying Potter, Moore, Carson, Armstrong, and Randall Counties has a TDS content of around 1,000 mg/L (Bradley, 1997). The lowest water quality (highest salinity) occurs outside of the PWPA. Dockum water, used for municipal supply by several cities, often contains chloride, sulfate, and dissolved solids that are near or exceed EPA/State secondary drinking-water standards (Ashworth & Hopkins, 1995).

Areas of concern for Cl in the Dockum aquifer may all occur beneath and alongside topographically low-lying areas, where there may be cross-formational flow of water from the Permian section into the Dockum aquifer. Most of the area with poor water quality in the Dockum aquifer lies south of the PWPA (Dutton and Simpkins, 1986).

5.2.2.3 Blaine Aquifer

The Blaine is a minor aquifer located in portions of Wheeler, Collingsworth, and Childress Counties of the RWPA and extends into western Oklahoma. Saturated thickness of the formation in its northern region varies from approximately 10 to 300 feet. Recharge to the aquifer travels along solution channels which contribute to its overall poor water quality. Dissolved solids concentrations increase with depth and in natural discharge areas at the surface, but contain water with TDS concentrations less than 10,000 mg/L. The primary use is for irrigation of highly salt-tolerant crops, with yields varying from a few gallons per minute (gpm) to more than 1,500 gpm (TWDB, 1995).

Chronic water quality problems in the Blaine aquifer, especially elevated concentrations of Cl (Fig. 5.1) and sulfate, are typically related to the aquifer's position down-gradient of the salt-dissolution zone beneath the eastern rim of the High Plains. Cl and TDS are expected to be greater beneath valleys in the confined part of the aquifer than in upland areas in the unconfined part.

5.2.2.4 Rita Blanca Aquifer

No areas of concern were defined for Cl or NO_3 on the basis of criteria defined in this study.

Table 5-5 below lists the areas of groundwater contamination in the PWPA according to TCEQ.

Table 5-5: Areas of Groundwater Contamination in the PWPA

Number	County	Division	File name	Location	Contamination description
1	Carson	RMD/CA	USDOE Pantex Plant	Amarillo 79120	Benzene, TCE, High explosives, Chromium
2	Carson	RMD/CA	USDOE Pantex Plant	Amarillo 79120	Organic solvents, Metals, Explosives
3	Carson	RMD/CA	Pantex Plant (USDOE)	Hwy 60	Trichloroethylene, 1-2 Dichloroethane, Chromium
4	Carson	RMD/PST	Panhandle Butane & Oil Co Inc	Panhandle	Gasoline
5	Carson	Oil & Gas	Walt Poling vs. Unknown (Frank Sheehan)	Fritch	Drip gas or condensate
6	Childress	RMD/CA	TXDOT (Childress Maintenance Facility)	Childress	Chloroform
7	Childress	RMD/PST	TXDOT	Childress	Gasoline
8	Childress	RMD/PST	Jimmy Bridges	Childress	Gasoline, Diesel
9	Childress	RMD/PST	Joe Tarrant Oil Co	Childress	Gasoline, Diesel
10	Childress	RMD/PST	Anadarko Development Co	Childress	Unknown
11	Childress	RMD/PST	Geo Bit Exploration Inc	Childress	Unknown
12	Childress	RMD/PST	RDJ Investments	Childress	Unknown
13	Childress	RMD/PST	Fred Garrison Oil Co.	Childress	Gasoline
14	Childress	RMD/PST	Havins Distributors Inc.	Childress	Gasoline, Diesel
15	Childress	RMD/VC	Burlington Northern Railroad	Childress	Chlorinated solvents
16	Collingsworth	RMD/CA	TXDOT	Wellington	TPH

Table 5-5 (Continued)

Number	County	Division	File name	Location	Contamination description
17	Collingsworth	RMD/PST	Holton Oil Co.	Wellington	Gasoline
18	Collingsworth	RMD/PST	Owens Trust	Wellington	Gasoline
19	Collingsworth	RMD/PST	TXDOT	Wellington	Gasoline, Waste oil
20	Dallam	RMD/PST	Dalhart Consumers Fuel Assoc	Dalhart	Unknown
21	Dallam	RMD/PST	Sam & Gerrie Putts Estate	Dalhart	Unknown
22	Dallam	RMD/PST	State LeadPerforming	Dalhart	Unknown
23	Gray	RMD/CA	Celenese Ltd	Pampa	Benzene, Acetone, MTBE
24	Gray	RMD/PST	Brock Crockett	Alanree	Gasoline
25	Gray	RMD/PST	Taylor Petroleum	Lefors	Gasoline
26	Gray	Oil & Gas	Matt Hinton Complaint		BTEX
27	Gray	Oil & Gas	Plains Marketing, LP	Lefors	BTEX
28	Gray	Oil & Gas	Plains Marketing, LP	Bowers	PSH, BTEX, TPH
29	Gray	Oil & Gas	Plains Marketing, LP	Lefors	Crude Oil (PSH)
30	Hall	RMD/PST	OR Saye Enterprises	Memphis	Gasoline
31	Hall	RMD/PST	TXDOT	Memphis	Gasoline
32	Hall	RMD/PST	Bobby Maddox	Memphis	Gasoline
33	Hemphill	RMD/PST	Canadian Fuel Supply Inc	Canadian	Gasoline
34	Hemphill	RMD/PST	Small Business Administration	Canadian	Gasoline
35	Hemphill	RMD/PST	Canadian Fuel Properties LLC	Canadian	Gasoline
36	Hemphill	RMD/VCIO	BNSF Canadian Property	Canadian	VOCS, TPH
37	Hemphill	Oil & Gas	BP American Prod. Forgery 94 #2094 Gas Line		BTEX, TPH
38	Hemphill	Oil & Gas	Enbridge Gathering LP (Texas Gathering)	Hobart Ranch Gas Plant	PTEX
39	Hemphill	Oil & Gas	Oneok Field Services	Lora Booster Station	PTEX
40	Hutchinson	RMD/CA	Agrium US Inc	Borger	Arsenic

Table 5-5 (Continued)

Number	County	Division	File name	Location	Contamination description
41	Hutchinson	RMD/CA	Chevron Phillips Chemical Company LP (Philtex-Ryton Plant)	Borger	Hydrocarbons, Sulfolane, 1,4-Dichlorobenzene
42	Hutchinson	RMD/CA	Phillips 66 Co	Borger	Organics, Inorganics
43	Hutchinson	RMD/CA	Phillips Rubber Chemical Complex	Borger	Organics, Metals
44	Hutchinson	RMD/CA	Dowell Schlumberger Inc	Borger	TPH, VOCs
45	Hutchinson	RMD/PST	Blaine Edwards	Borger	Gasoline
46	Hutchinson	RMD/PST	Claude P Robinson	Borger	Gasoline
47	Hutchinson	RMD/PST	National Park Service	Sanford Marina	Gasoline
48	Hutchinson	RMD/PST	Phillips 66 Co	Borger	Kerosene
49	Hutchinson	Oil & Gas	C & C Oil Producers, Hill Lease		NACL
50	Hutchinson	Oil & Gas	Ranger Gathering Corp (Sanford Yard)	Sanford	Benzene & free phase HC
51	Hutchinson	Oil & Gas	El Paso Corp.	Sanford	Free phase HC & BTEX
52	Hutchinson	Oil & Gas	Phillips Petroleum Co (Patton Creek)	Borger	Hydrocarbons & SW
53	Hutchinson	Oil & Gas	Pioneer Natural Resources USA	Panhandle Field Compressor No. 6	BTEX
54	Lipscomb	Oil & Gas	Northern Natural Gas		BTEX, TPH
55	Moore	RMD/CA	Diamond Shamrock Refining Co (McKee)	Sunray	Benzene, LNAPL
56	Moore	RMD/SSDAT	Cactus Ordnance Works	12 mi N of Dumas	Bis(2-Ethylhexy)Phthlate
57	Moore	RMD/VC	Cactus Plant	Cactus	Nitrates, Metals
58	Moore	Oil & Gas	Colorado Interstate Gas (Bivins Sta)	Masterson	VOCs
59	Moore	Oil & Gas	Pioneer Natural Resources USA	Panhandle Field Compressor No. 2	BTEX

Table 5-5 (Continued)

Number	County	Division	File name	Location	Contamination description
60	Moore	Oil & Gas	Pioneer Natural Resources USA	Panhandle Field Compressor No.10	BTEX
61	Moore	Oil & Gas	Pioneer Natural Resources USA	Panhandle Field Compressor No. 11	BTEX
62	Moore	Oil & Gas	Pioneer Natural Resources USA	Panhandle Field Compressor No. 15	BTEX
63	Moore	WPD/HW	Diamond Shamrock Refining Co. LLC	Sunray	BTEX, Barium, Chromium, lead, zinc
64	Moore	RMD/VC	Exell Helium Plant	Masterson	VOCs, SVOCs, metals, chlorinated solvents, TP
65	Ochiltree	RMD/SC	City of Perryton Well 2	Perryton	Carbon tetrachloride, Nitrates
66	Ochiltree	Oil & Gas	DCP Midstream	Perryton-Barlow	BTEX, TPH
67	Potter	RMD/CA	Elementis LTP Inc	Amarillo	Chromium
68	Potter	RMD/CA	Texaco Refining & Marketing Inc	Amarillo	Hydrocarbons
69	Potter	RMD/CA	Diamond Shamrock Refining & Marketing Co	Amarillo	TPH, Benzene
70	Potter	RMD/CA	Amarillo Copper Refinery	Amarillo	Selenium
71	Potter	RMD/PST	Petro Shopping Centers	Amarillo	Diesel
72	Potter	RMD/PST	Buffalo Energy	Amarillo	Gasoline
73	Potter	RMD/PST	Burlington Northern Railroad	Amarillo	Gasoline
74	Potter	RMD/PST	Chevron Products Co.	Amarillo	Gasoline
75	Potter	RMD/PST	Macks Super Market	Amarillo	Gasoline
76	Potter	RMD/PST	James Smithson Estate	Amarillo	Gasoline
77	Potter	RMD/PST	Triple S Refining Corporation	Amarillo	Gasoline
78	Potter	RMD/PST	Toot N Totum Food Stores	Amarillo	Gasoline

Table 5-5 (Continued)

Number	County	Division	File name	Location	Contamination description
79	Potter	RMD/PST	Toot N Totum Food Stores	Amarillo	Gasoline
80	Potter	RMD/PST	Toot N Totum Food Stores	Amarillo	Gasoline
81	Potter	RMD/PST	Toot N Totum Food Stores	Amarillo	Gasoline
82	Potter	RMD/PST	Toot N Totum Food Stores	Amarillo	Gasoline
83	Potter	RMD/PST	Toot N Totum Food Stores	Amarillo	Gasoline
84	Potter	RMD/PST	W A Innes	Amarillo	Gasoline
85	Potter	RMD/PST	Katharine O'Brien	Amarillo	Gasoline, Diesel
86	Potter	RMD/PST	Pro Am III Truck Stop	Amarillo	Gasoline, Diesel
87	Potter	WQD/WQAS	Southwestern Public Service Co	NE of Amarillo	Nitrate, Chloride, Sulfate
88	Potter	Oil & Gas	Williams Energy Service, Inc.	Pioneer Tank Battery #2	BTEX, Condensate
89	Potter	Oil & Gas	Pioneer Natural Resources USA	Panhandle Field Compressor No. 20	BTEX
90	Potter	Oil & Gas	Pioneer Natural Resources USA	Fain Gas Plant	BTEX, TPH
91	Potter	Oil & Gas	Turkey Creek Ranch	Fritch	BTEX
92	Potter	WPD/MSW	City of Amarillo Landfill	Amarillo	MW: Nickel, MW: VOCs
93	Randall	RMD/CA	Valero Logistics	Palo Duro	Gasoline
94	Randall	RMD/PST	Jo Ray Energy Co.	Amarillo	Gasoline, Diesel
95	Randall	RMD/PST	Glenna Scott	Amarillo	Gasoline, Waste oil
96	Randall	RMD/PST	City of Canyon	Canyon	Gasoline
97	Randall	RMD/PST	Consumers Fuel Association	Canyon	Gasoline
98	Randall	RMD/PST	Estate of Annie Weaver	Canyon	Gasoline
99	Randall	RMD/PST	Exxon Mobile	Canyon	Gasoline
100	Randall	RMD/PST	Lagrone H. Odell	Canyon	Gasoline
101	Randall	RMD/PST	Weingarten Realty	Amarillo	Gasoline
102	Randall	RMD/PST	BFI / Southwest Landfill	N of Canyon	MW-12: VOCs (Methlyene chloride)
103	Randall	RMD/PST	SJKR, Inc.	Canyon	Unknown
104	Randall	RMD/PST	Sun Country, Inc.	Canyon	Unknown
105	Roberts	RMD/PST	Bailey Oil Products, Co.	Miami	Gasoline

Table 5-5 (Continued)

Number	County	Division	File name	Location	Contamination description
106	Roberts	RMD/PST	Environmental Impact	Miami	Gasoline
107	Roberts	RMD/PST	FFP Operating Partners	Miami	Gasoline
108	Roberts	Oil & Gas	Duke Energy	Parsell Booster Station	BTEX
109	Wheeler	RMD/PST	Anadarko Development Co.	Shamrock	Gasoline
110	Wheeler	RMD/PST	C&H Supply, Inc.	Shamrock	Gasoline
111	Wheeler	RMD/PST	Kelton ISD	Wheeler	Gasoline
112	Wheeler	RMD/PST	Royce Cantrell Corp.	Shamrock	Gasoline
113	Wheeler	RMD/PST	Tindall Wholesale	Shamrock	Gasoline

RMD/CA TCEQ Remediation Division Corrective Action Section
RMD/PST TCEQ Remediation Division Petroleum Storage Tank Section
RMD/SC TCEQ Remediation Division Superfund Cleanup Section
RMD/SSDAT TCEQ Remediation Division Superfund Site Discovery and Assessment Team
RMD/VC TCEQ Remediation Division Voluntary Cleanup
WQD/WQAS Water Quality Division Water Quality Assessment Section

Source: TCEQ (January 2008)

5.3 Water Quality Issues

Water quality issues have the potential to significantly impact and are impacted by water management strategies for the region. Based on the existing water quality of the surface water and groundwater sources, few impacts are expected to occur due to water quality concerns. Of the four primary groundwater sources in the region, most have acceptable water quality, with only a few parameters of potential concern. The areas of concern should be monitored and records of water quality changes should be maintained.

Surface water quality issues within the Panhandle region were discussed in detail in Section 5.2.1. A brief summary is provided below. Similarly, specific groundwater quality issues were discussed in some detail in Section 5.2.2, and have been summarized as follows. Additionally, both groundwater and surface water qualities are impacted by urban runoff, i.e. from non-point sources and from agricultural runoff.

Groundwater concerns include the presence of nitrate in the Ogallala and Dockum aquifers. Serious water quality issues of the past in the Seymour aquifer associated with nitrate concentrations, and chronic water quality problems with the Blaine aquifer, especially elevated chloride and sulfate concentrations, seem to have stabilized but should be a focus for further study and evaluation in the future. There are seven public water supply systems located within areas of concern for dissolved chloride and nitrates. The TCEQ groundwater contamination file contains 113 reported or confirmed contamination cases within the PWPA. Surface water quality concerns include elevated dissolved solids, nutrients, and dissolved metals in the Canadian River Basin and elevated nutrients and dissolved solids in the Red River Basin.

Another potential water quality issue relating to agricultural activity is the use of pesticides, which poses a potential threat to water quality of the groundwater supply. The propensity for pesticides to leach past the root zone depends on which pesticide is chosen and on the soil's leaching potential. Water quality problems sometimes pose potential threats to natural resources and the ecological environments. Watercourses where high levels of nutrients have been identified have the potential to experience algal blooms, which may consume too much of the available dissolved oxygen in the water, leaving less oxygen for fish. High levels of dissolved minerals such as sodium in water used to irrigate crops can harm or kill the crops. The best preventative for agricultural activities is to minimize usage and not over apply many of the common agricultural chemicals.

In 2003, a survey was sent to all municipal water providers in the region and included several questions relating to parameters of concern regarding water quality. The parameters included nitrates, pH, chlorides, pesticides, hydrocarbons, TDS, DO, metals, fertilizers, and other. Of the 34 respondents, seven indicated that nitrates were an issue, three indicated pH, four responded to chlorides, three for pesticides and TDS, and an entry each for write-in concerns for radon, benzene, and hardness. According to the TCEQ's list of public water systems that currently violate any of the chemical maximum contaminant levels, Shamrock Municipal Water System and Wheeler Municipal Water System both had nitrate violations in 2009. No other violations were noted[1].

5.3.1 Urban Runoff

Increasing population impacts water quality in many ways, one of which is the increase in urban runoff that comes with the increase in impervious cover in populated areas. Within the Panhandle region, urban runoff can impact both surface water and groundwater in a variety of ways. First is the increase in runoff. Impervious cover concentrates runoff into storm sewers and drains, which then discharges into streams, increasing the flow, which also increases the erosion power of the water. Groundwater can also be impacted due to this increase in runoff, including a decrease in the infiltration of precipitation into the ground due to impervious cover, impacting recharge to the aquifers.

In addition to the problem with increase in runoff, urbanization also causes increased pollutant loads, including sediment, oil/grease/toxic chemicals from motor vehicles, pesticides/herbicides/fertilizers from gardens and lawns, viruses/bacteria/ nutrients from human and animal wastes including septic systems, heavy metals from a variety of sources, and higher temperatures of the runoff. All of these can have significant adverse impacts on the water quality in both surface waters and groundwater, as all of the contaminants that are increased in surface waters through runoff from impervious cover can be introduced into groundwater via the infiltration of the runoff.

[1] Correspondence with TCEQ, December 2009.

5.4 Water Quality Impacts of Implementing Water Management Strategies

The implementation of water management strategies recommended in Chapter 4 of this regional plan is not expected to have any impact on native water quality. However, local groundwater conditions may limit availability due to water quality considerations. A previous study conducted by the Bureau of Economic Geology concluded that no identifiable relationship can be found at this time relating increased pumping to the deterioration of water quality (Freese and Nichols, Inc., 2006).

5.5 Impacts of Moving Water From Agricultural Areas

The implementation of water management strategies recommended in Chapter 4 of this regional plan is not expected to impact water supplies that are currently in use for agricultural purposes. The voluntary transfer of water from agricultural use to municipal use is predicated on a willing buyer/ willing seller basis. Most of the recommended water management strategies for municipal water users rely on developing existing water rights. The methodology for assessing the available supply of water rights for this regional water plan protects the existing supplies of all current and future users.