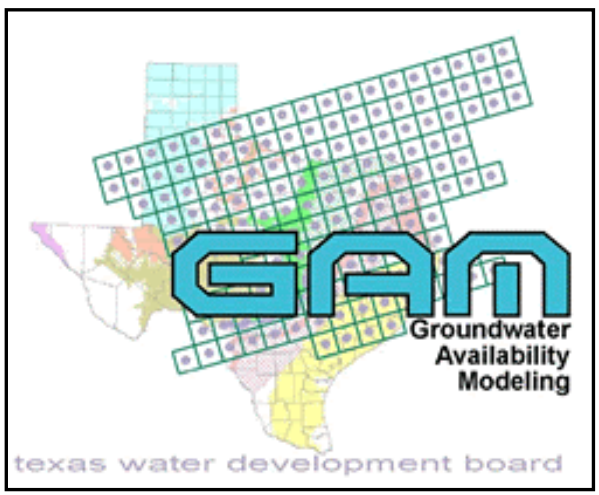
Groundwater Availability Modeling (GAM) for the Seymour Aquifer

Third Stakeholder Advisory Forum
October 20, 2003



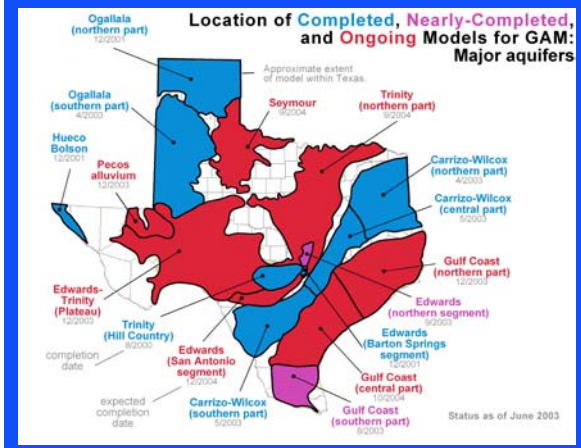
INTERA

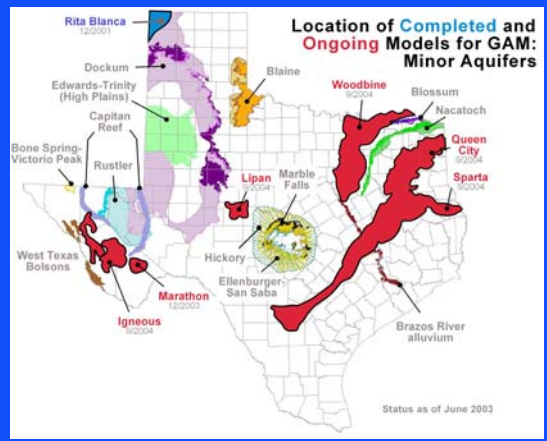
WPRC

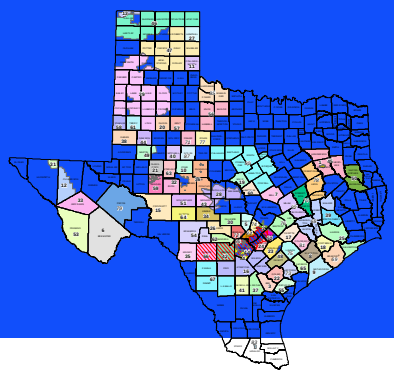
ENPROTEC
Engineering solutions with a view for tomorrow.

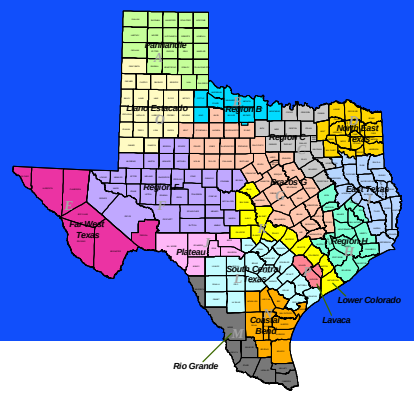
PARSONS

Groundwater Availability Modeling



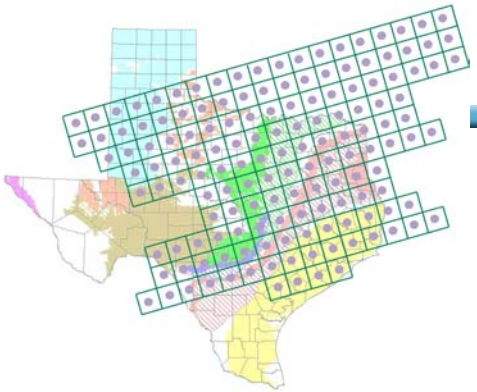






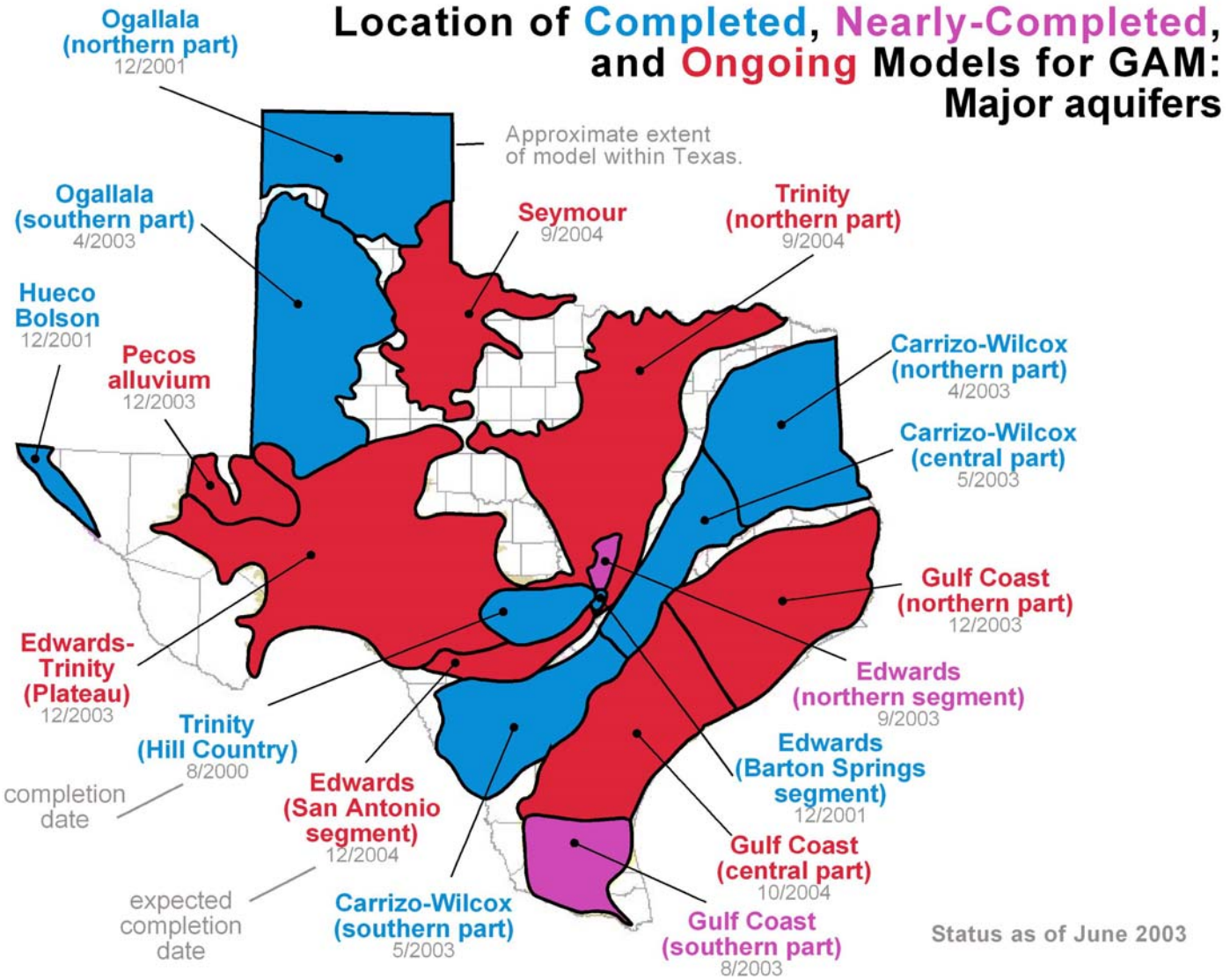
Cindy Ridgeway - Contract Manager
Texas Water Development Board

GAM-overview

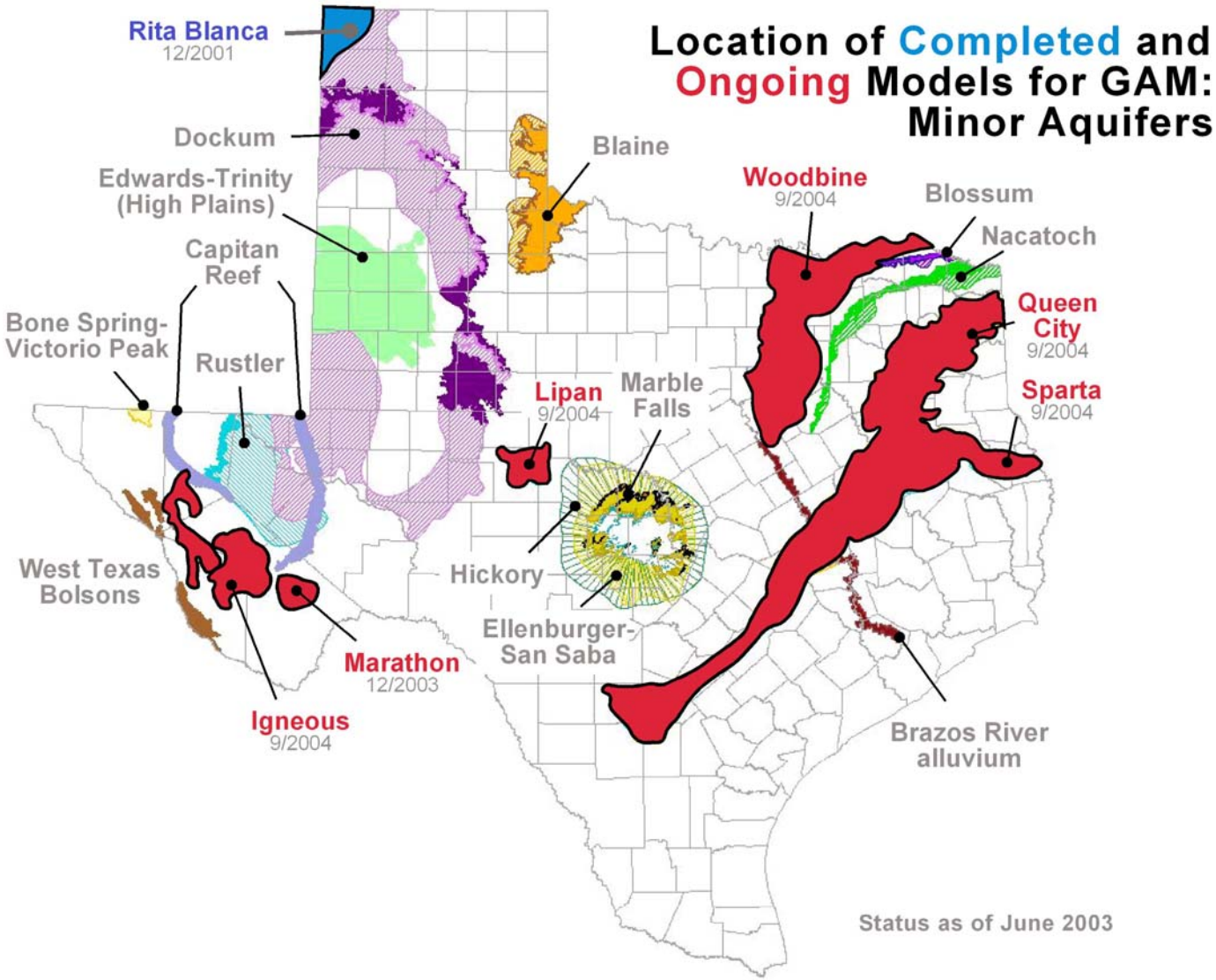


- **Purpose: to develop the best possible groundwater availability model with the available time and money.**
- **Public process: you get to see how the model is put together.**
- **Freely available: standardized, thoroughly documented, and available over the internet.**
- **Living tools: periodically updated.**

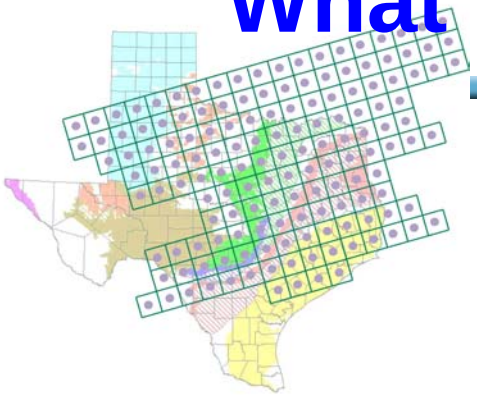
Status- Major aquifers



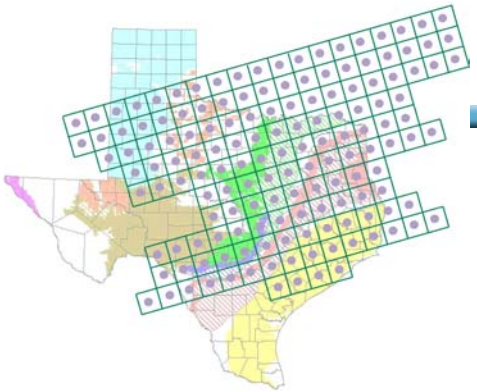
Status – minor aquifers



What is groundwater availability?

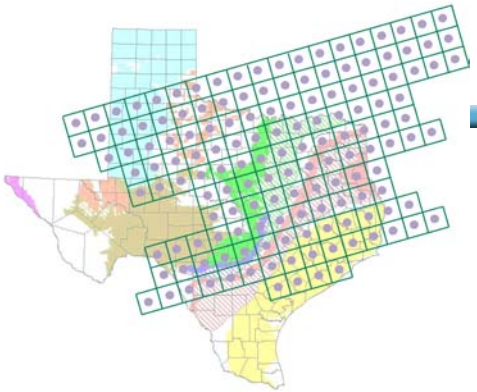


- …the amount of groundwater available for use.
- The State does not decide how much groundwater is available for use: GCDs and RWPGs decide.
- A GAM is a tool that can be used to assess groundwater availability once GCDs and RWPGs decide how to define groundwater availability.



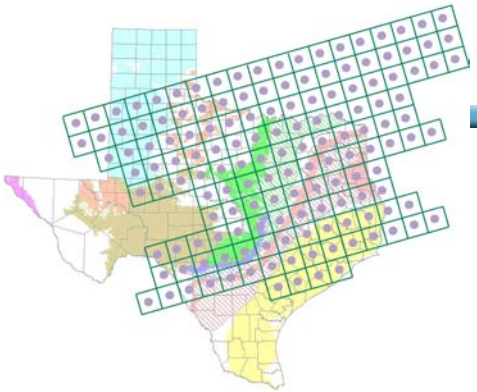
Do we have to use GAM?

- Water Code & TWDB rules require that GCDs use GAM information. Other information can be used in conjunction with GAM information.
- TWDB rules require that RWPGs use GAM information unless there is better site specific information available



How do we use GAM?

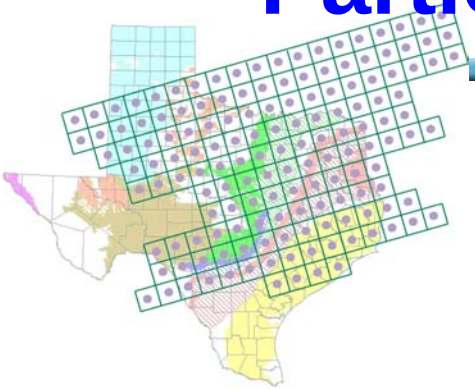
- **The model**
  - predict water levels and flows in response to pumping and drought
  - effects of well fields
- **Data in the model**
  - water in storage
  - recharge estimates
  - hydraulic properties
- **GCDs and RWPGs can request runs. See our website for more information: http://www.twdb.state.tx.us/Gam/GAMruns.htm**



Living tools…

- GCDs, RWPGs, TWDB, and others collect new information on aquifer.
- This information can enhance the current GAMs.
- TWDB plans to update GAMs every five years with new information.
- Please share information and ideas with TWDB on aquifers and GAMs. Timing is important!

Participating in the GAM process



- **SAF meetings**
  - hear about progress on the model
  - comment on model assumptions
  - offer information (timing is important!)
- **Report review**
  - at end of project
- **Contact TWDB**
  - Robert Mace (512) 936-0861
  - Cindy Ridgeway (512) 936-2386

Comments?

Contract Manager
cindy.ridgeway@twdb.state.tx.us
(512)936-2386
www.twdb.state.tx.us/gam

Outline of Presentation

- Pumping
- Groundwater Quality
- GAM schedule

Pumping

- Technical Memorandum 02-02 posted on TWDB website
- Historical groundwater pumpage (1980 – 2000)
- Predictive groundwater pumpage (2000 – 2050)

Seven Categories of Groundwater Use

Well-Specific Use Categories

- Municipal
- Manufacturing
- Power
- Mining

Non-Well-Specific Use Categories

- Irrigation
- Livestock
- Rural Domestic (County-Other)

Data Sources for Groundwater Use Provided by the TWDB (1980-1999)

1. Annual water use summary by major aquifer, county, and river basin for **irrigation** and **livestock** uses for 1980-1997
2. Annual water use summary for each county and river basin for **rural domestic** (county-other) uses for 1980-1997
3. Monthly water use for each **municipal** user – self-reported
4. Monthly water use for each **manufacturing**, **power generation**, and **mining** water user –self-reported
5. Missing water use data was estimated by regression with time, temperature, and precipitation

Database Processing

Utilize TWDB Technical Memorandum 02-02

Prepare a model grid of 1 mile by 1 mile cells covering the model domain. Grid has 208 rows x 180 columns x 2 layers

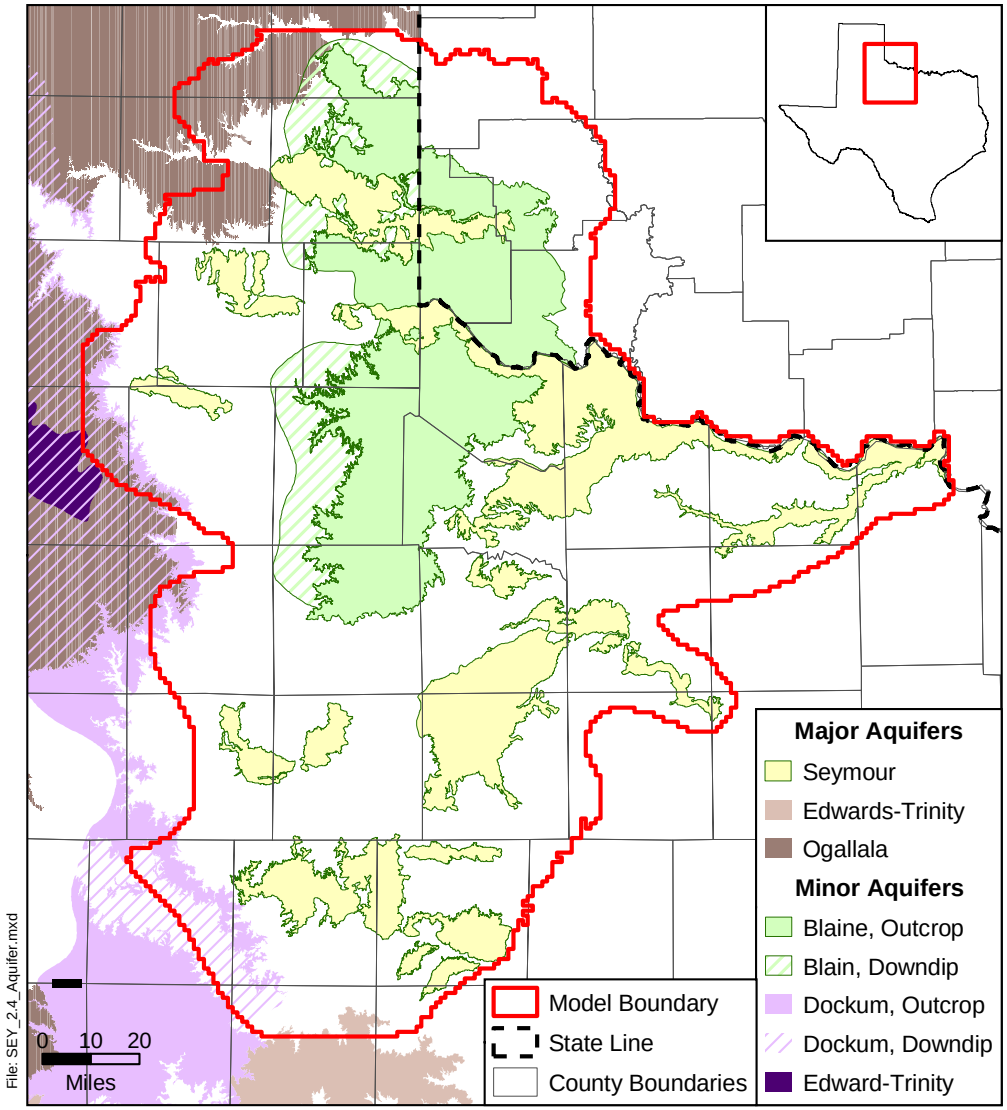
Layer 1 = Seymour Aquifer

Layer 2 = Blaine Aquifer

Use GIS (Geographic Information Systems) computer programs to identify the grid cell from which groundwater is pumped

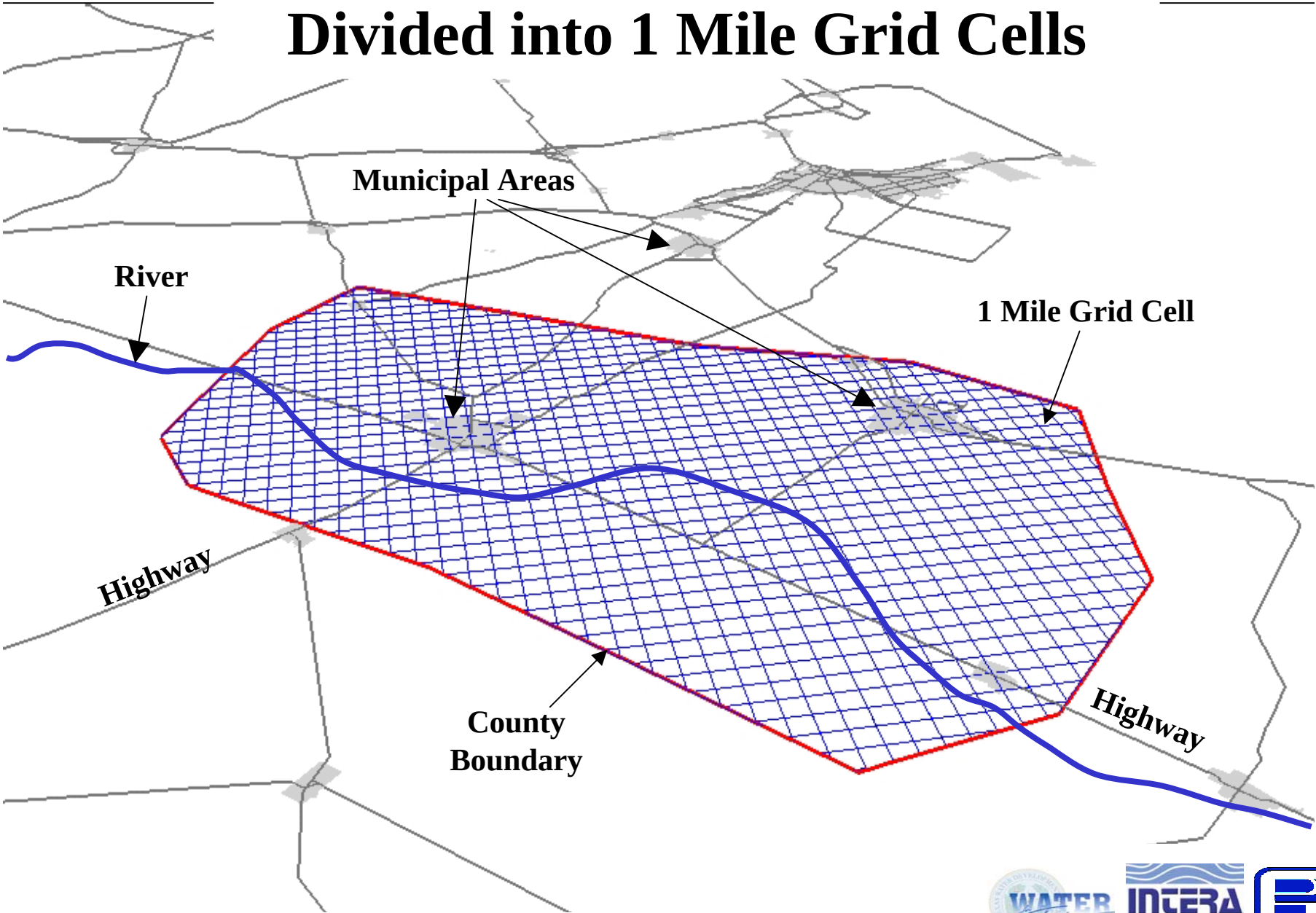
Distribute pumpage for each of the 7 groundwater uses across each grid cell by year and month

Seymour Active Model Domain



Source: Online: Texas Water Development Board, August 2003

Conceptual County & River Basin Divided into 1 Mile Grid Cells



Locate Pumpage Using Well-Specific Data

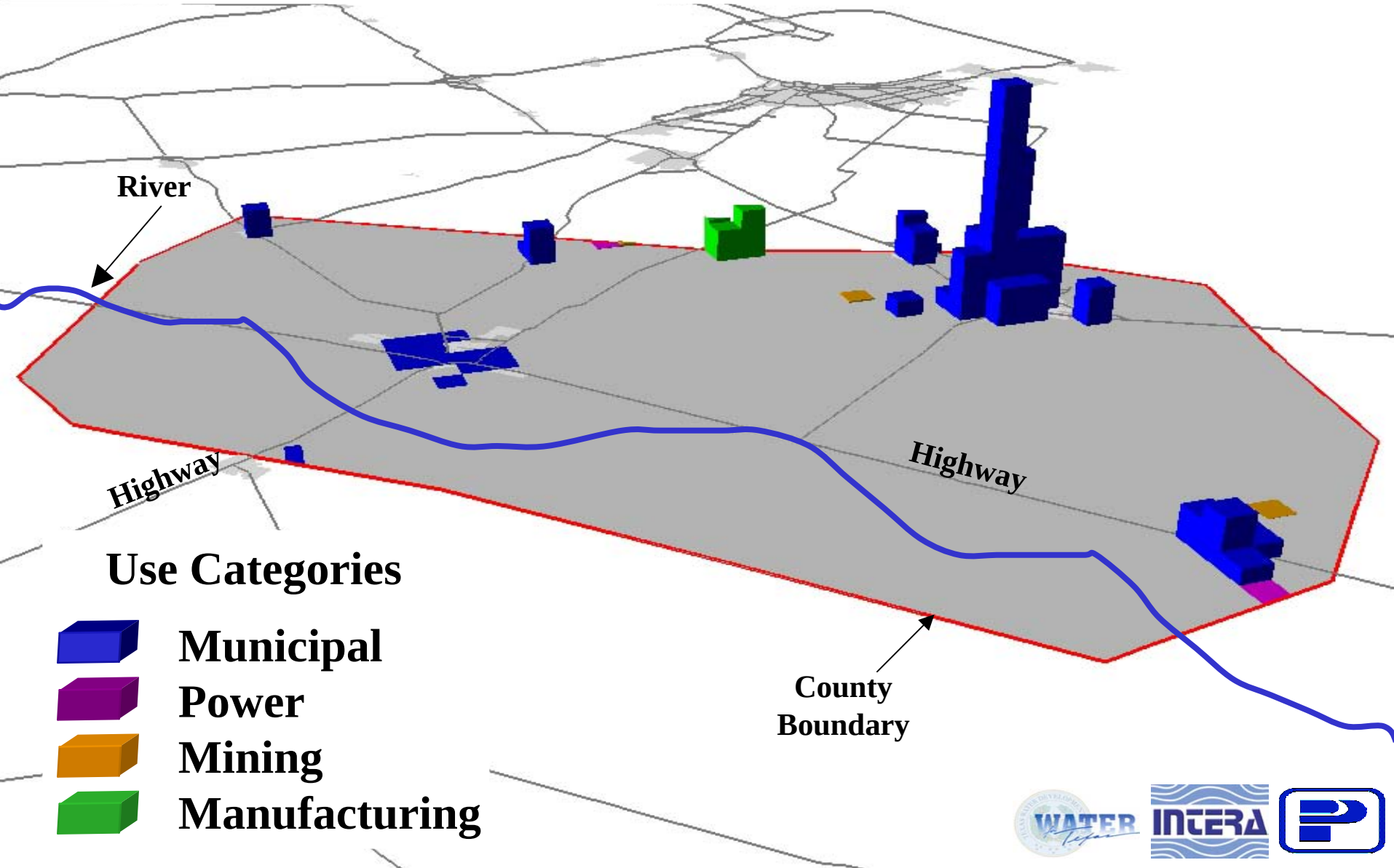
Applicable for **municipal, manufacturing, power** and **mining** uses

Identify specific wells for each water user, utilizing TWDB water use survey and TWDB well database

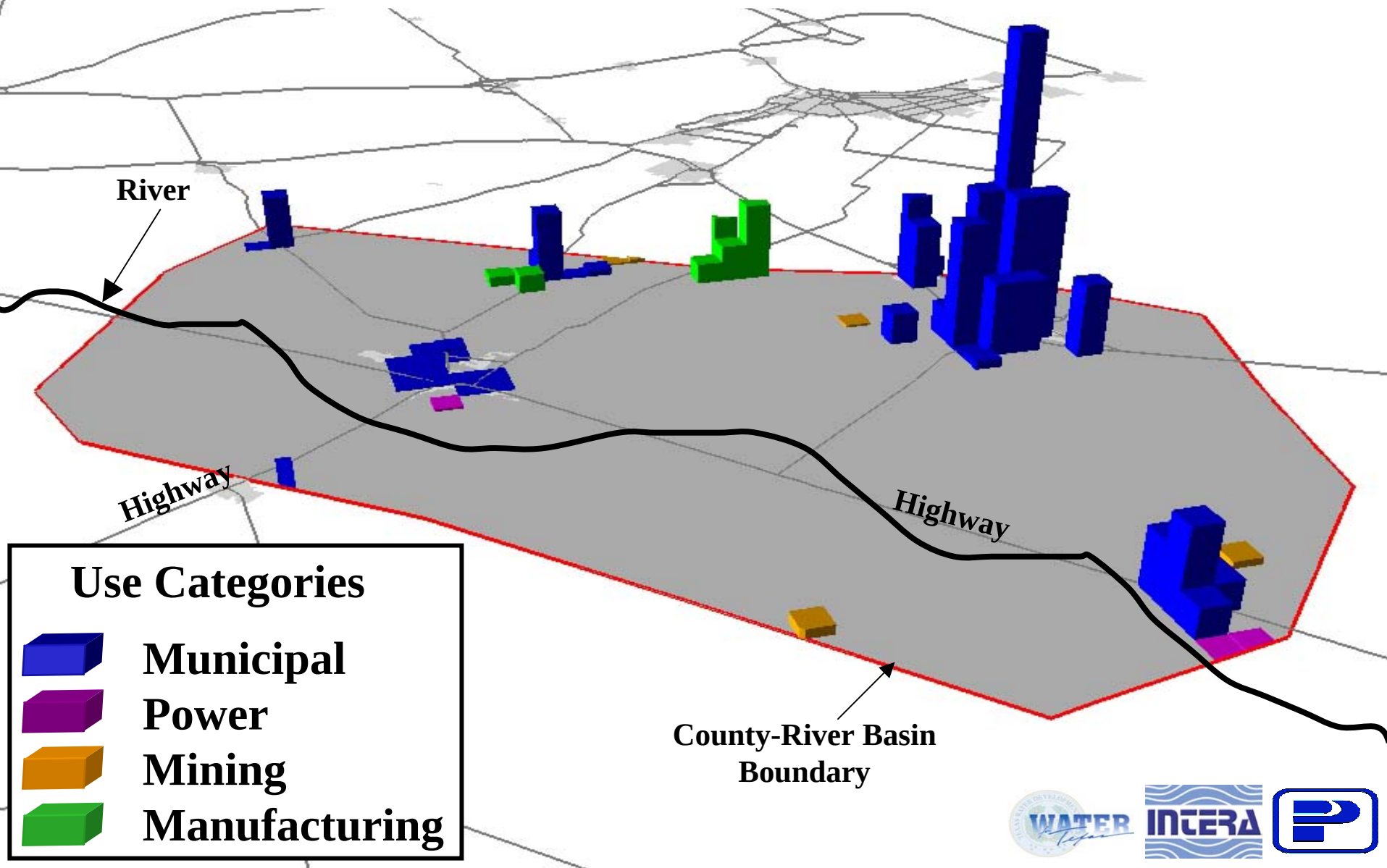
Identify location of each well and the source model layer

Label each pumping record with the appropriate grid cell identifier

Conceptual County & River Basin Well-Specific Pumpage for February, 1980



Conceptual County & River Basin Point Source Data for February, 1990



Distributing Irrigation Pumpage to Grid

Locate irrigated areas based on 1989 and 1994 NRCS irrigated farmlands survey areas that coincide with cropland land use

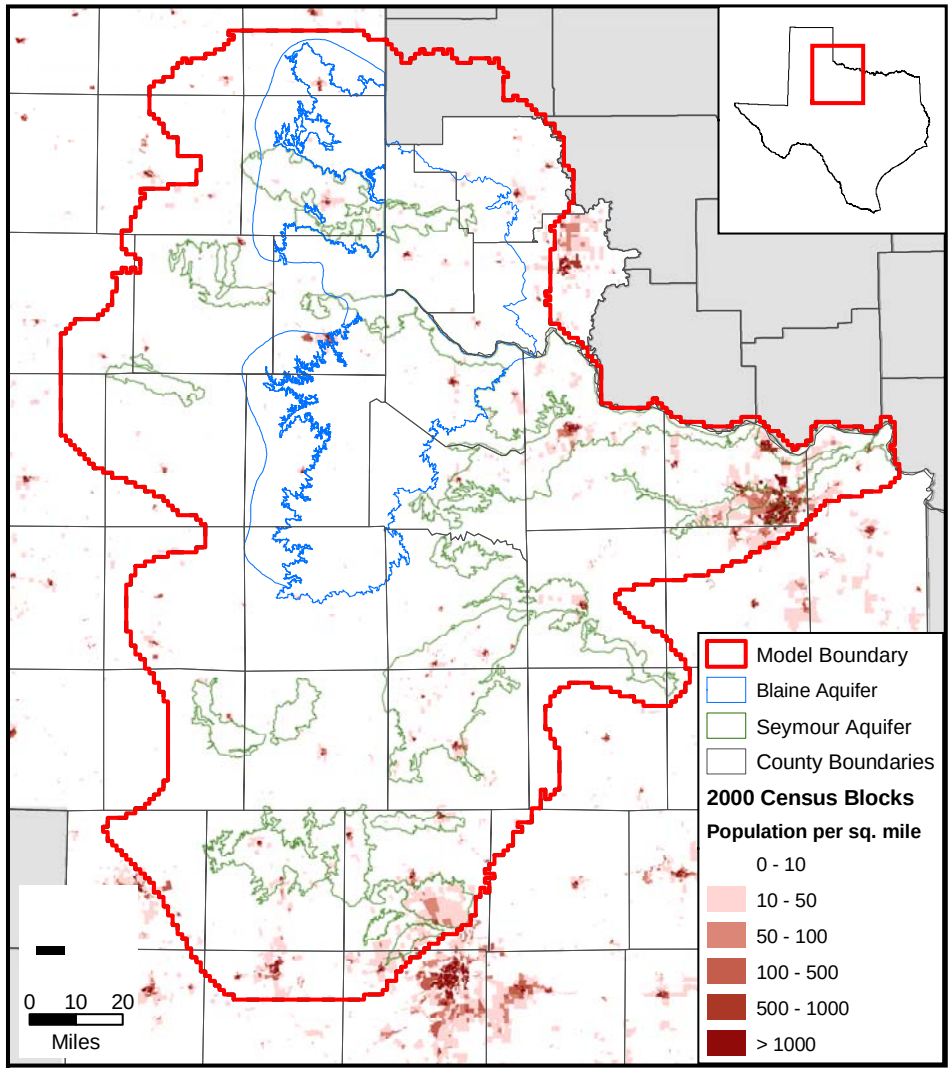
Assign monthly pumpage amounts based on rainfall, temperature, and crop demand data

Distributing Rural Domestic Pumpage to Grid

Distribute pumpage data based on population density, excluding municipalities with a public water supply (used 1980 and 1990 block-level census data)

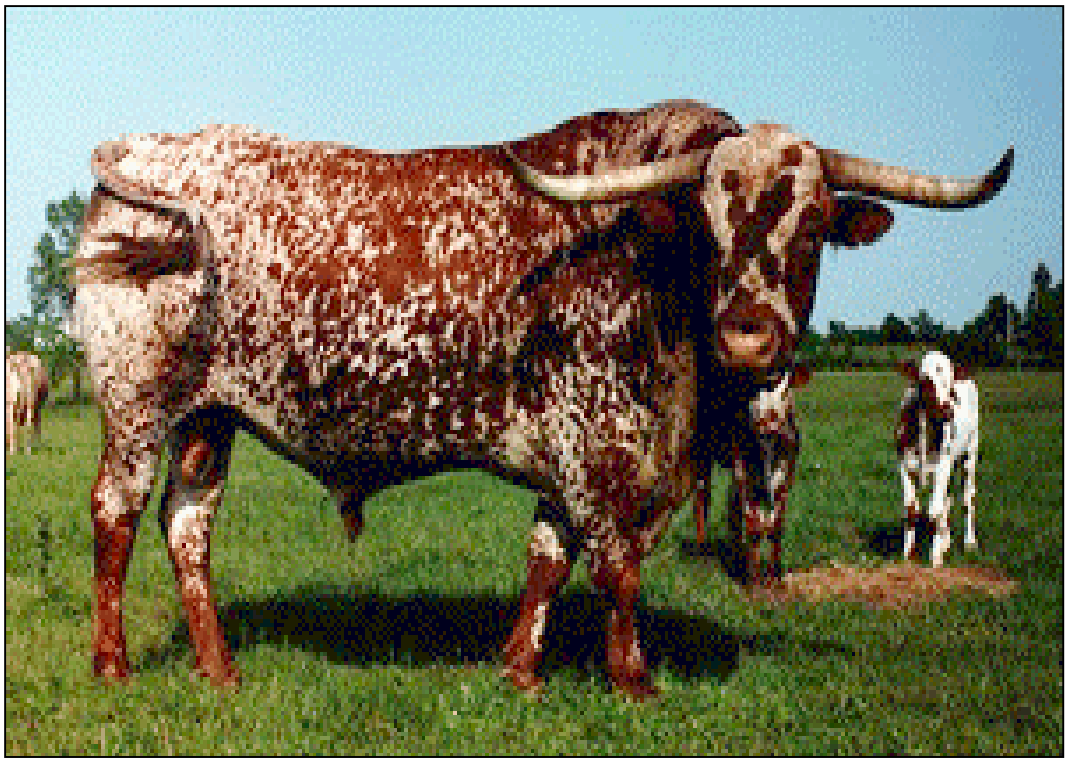
Distribute annual pumpage into monthly increments in proportion to nearby municipalities

Population Density

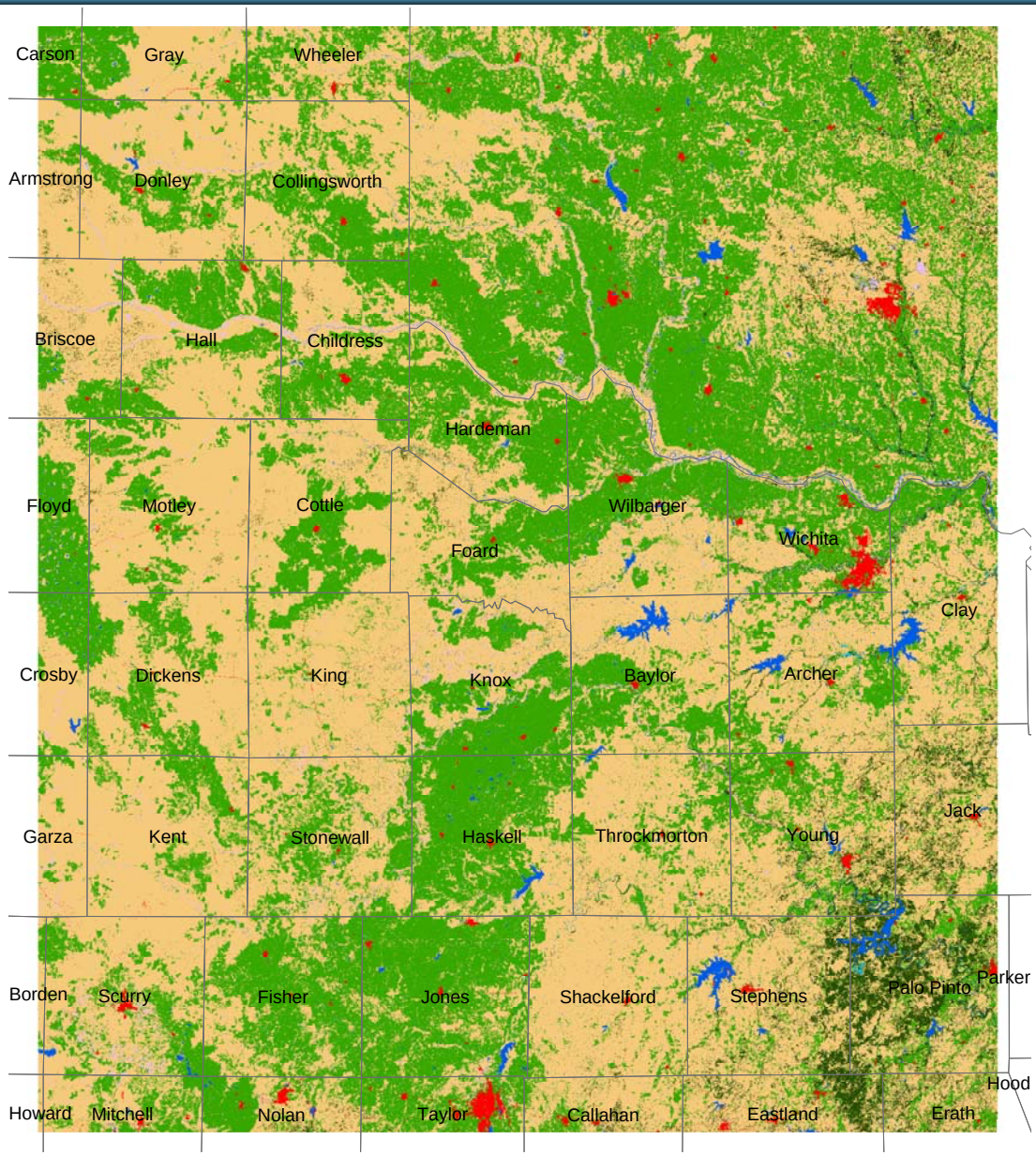


Distributing Livestock Pumpage to Grid

Distribute livestock pumpage across rangeland land use that overlies the source aquifer

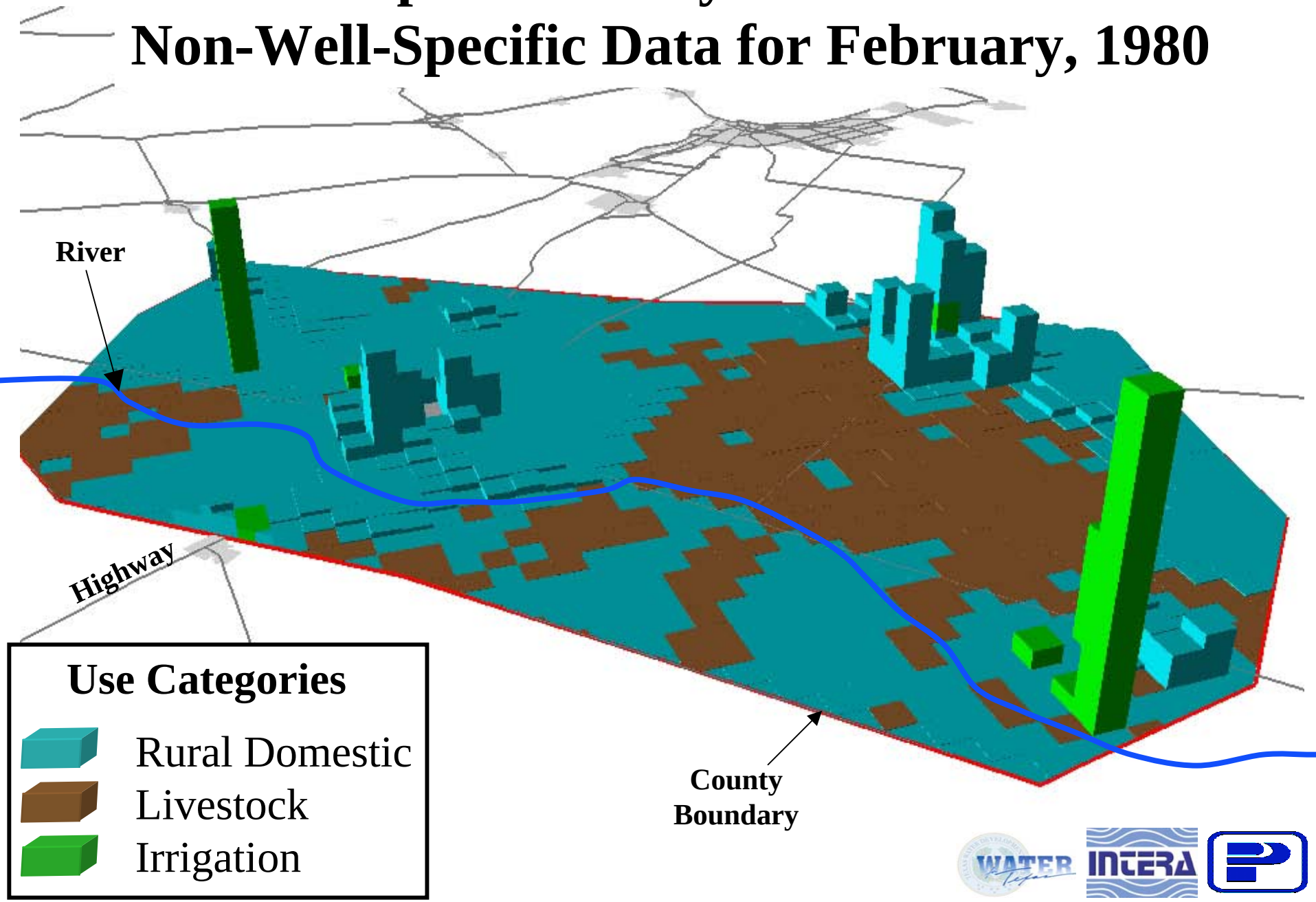


Land Use/Land Cover

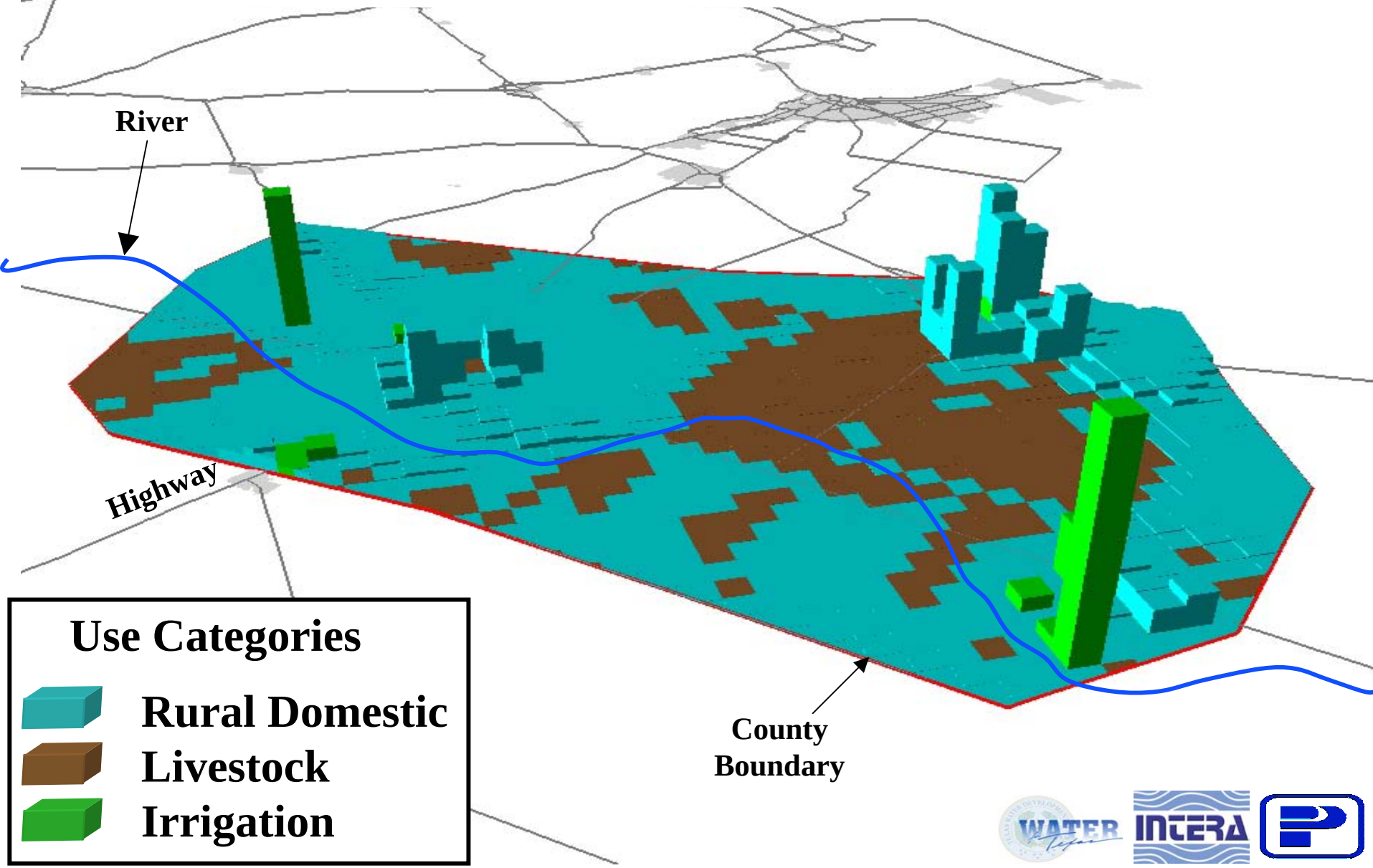


- Urban
- Agriculture
- Rangeland
- Forest
- Water
- Wetland
- Barren Land

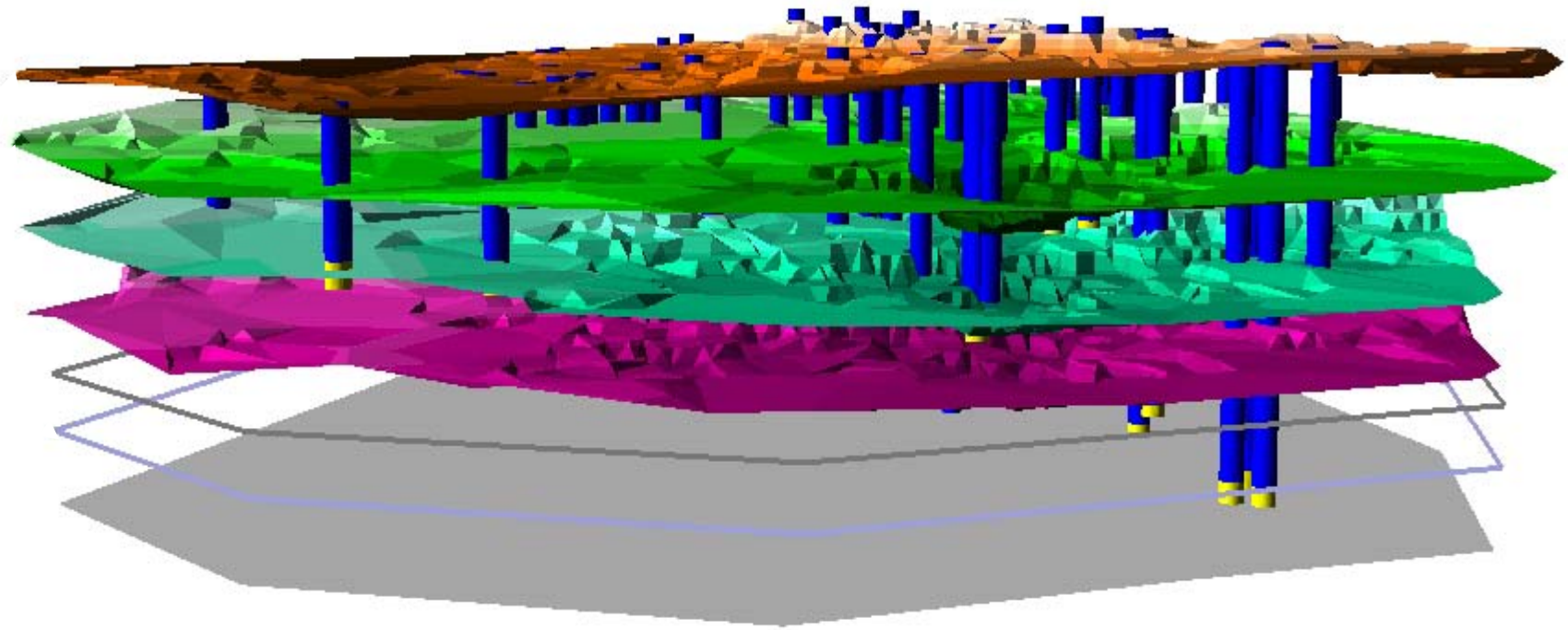
Conceptual County & River Basin Non-Well-Specific Data for February, 1980



Conceptual County & River Basin Non-Well-Specific Data for February, 1990



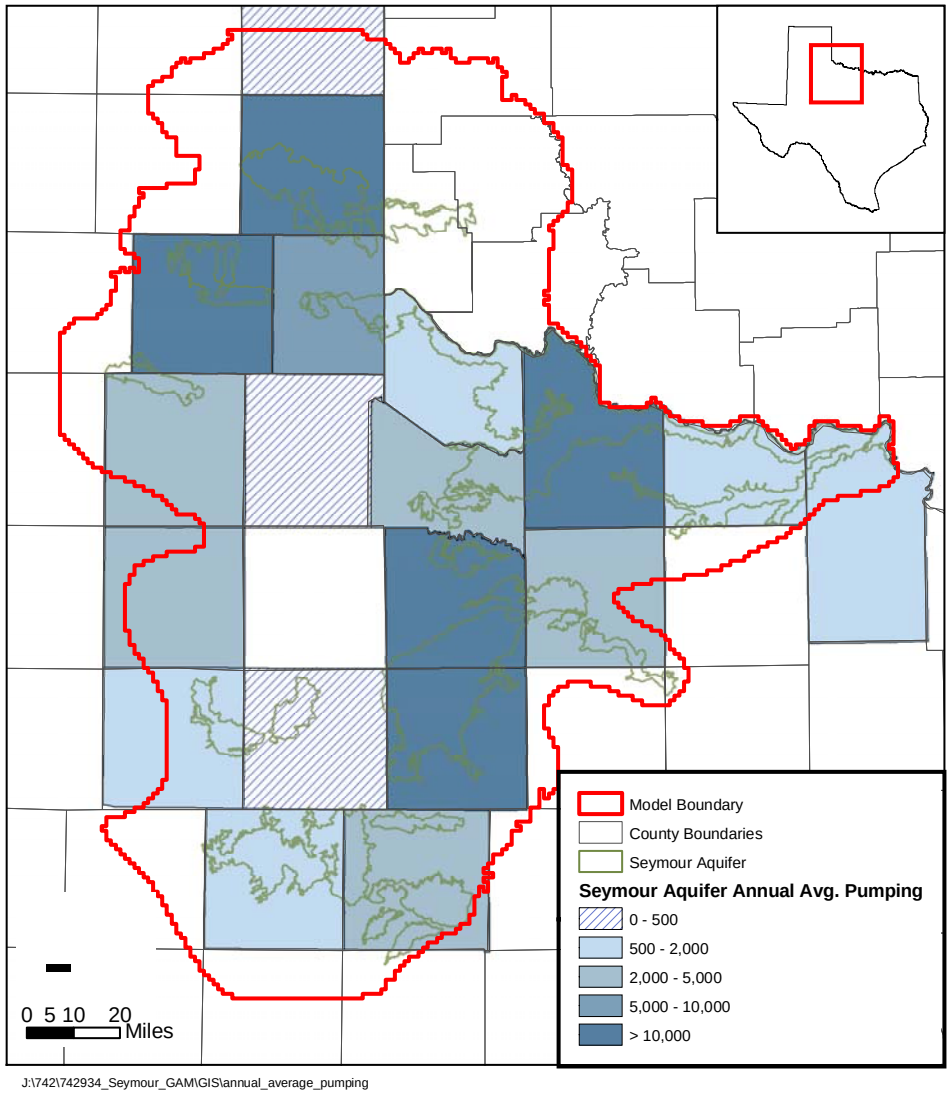
Conceptual County & River Basin Multiple Aquifer Layers and Wells



Predictive Pumpage for 2000 – 2050

- **Pumpage values from State Water Plan Forecasts**
- **Spatially allocated according to the latest available (1999) data**

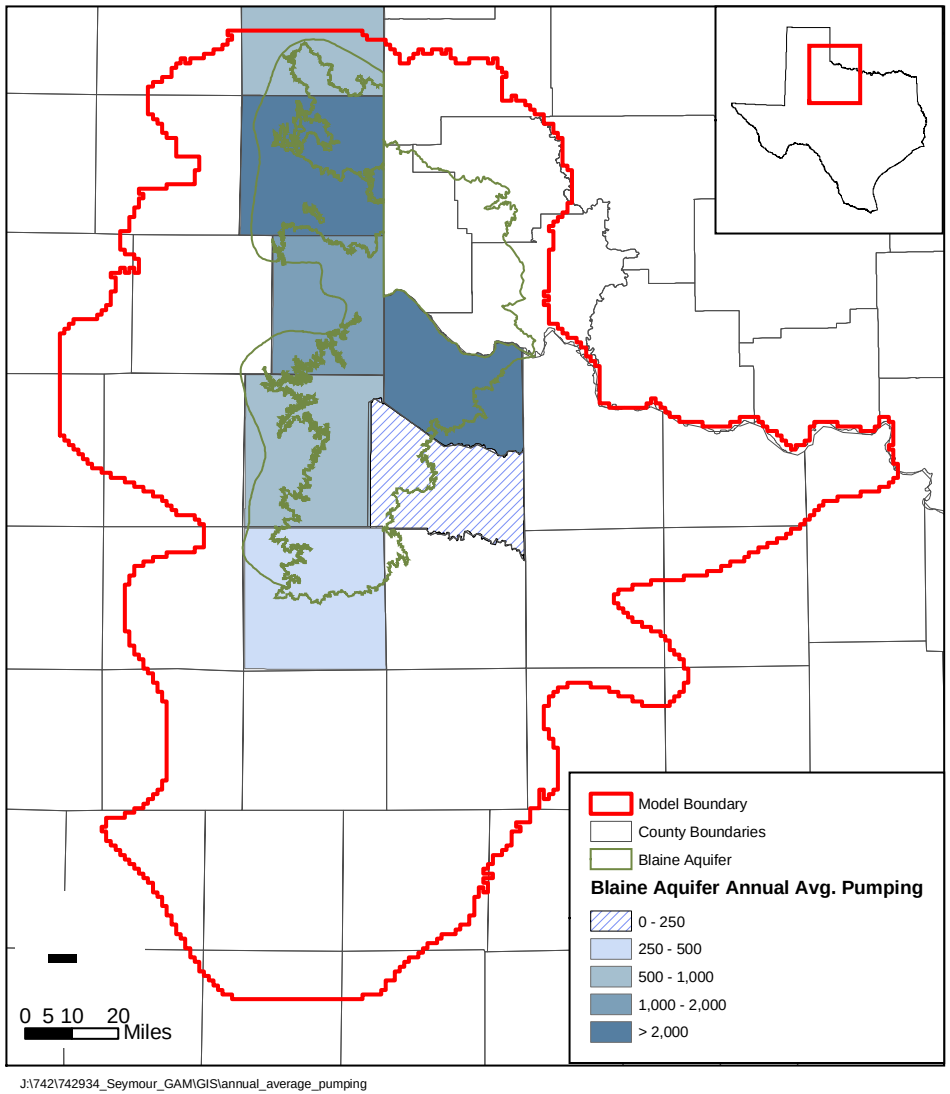
Seymour Aquifer Pumping (AFY) 1980-97 Average



Uses of Water from the Seymour Aquifer (excluding rural domestic)

Water Use Category	Percentage of Total Use
Irrigation	94.3%
Municipal	5.2%
Livestock	0.5%
Manufacturing	0.0%
Mining	0.0%
Power	0.0%
Rural Domestic	?

Blaine Aquifer Pumping (AFY)
1980-1997 Average



Uses of Water from the Blaine Aquifer (excluding rural domestic)

Water Use Category	Percentage of Total Use
Irrigation	98.6%
Municipal	0.0%
Livestock	1.4%
Manufacturing	0.0%
Mining	0.0%
Power	0.0%
Rural Domestic	?

Figure 4.7.4 – Total groundwater withdrawals (excluding county-other) for the Seymour aquifer for 1980-1997

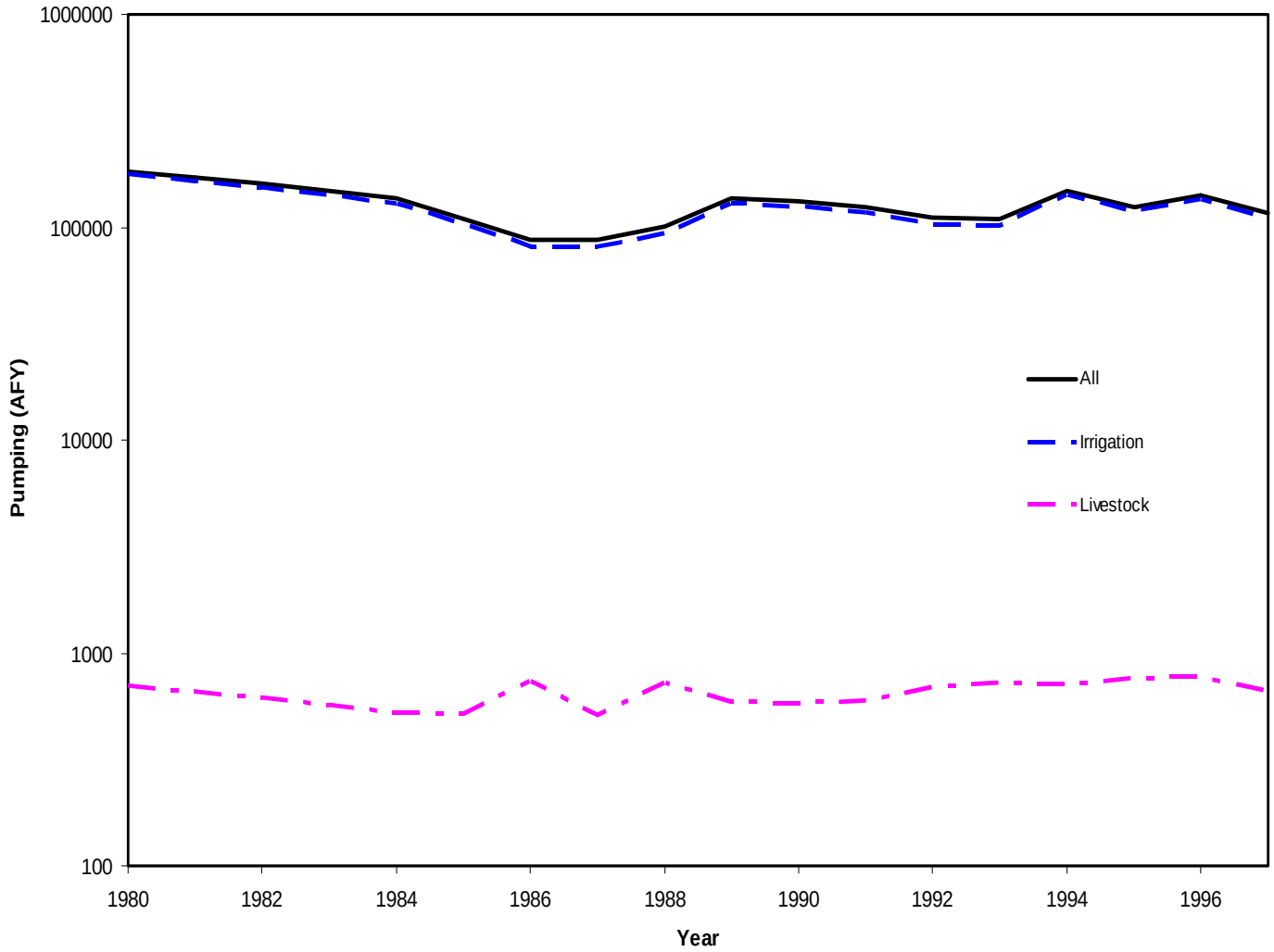


Figure 4.7.5 – Total groundwater withdrawals (excluding county-other) for the Blain aquifer for 1980-1997

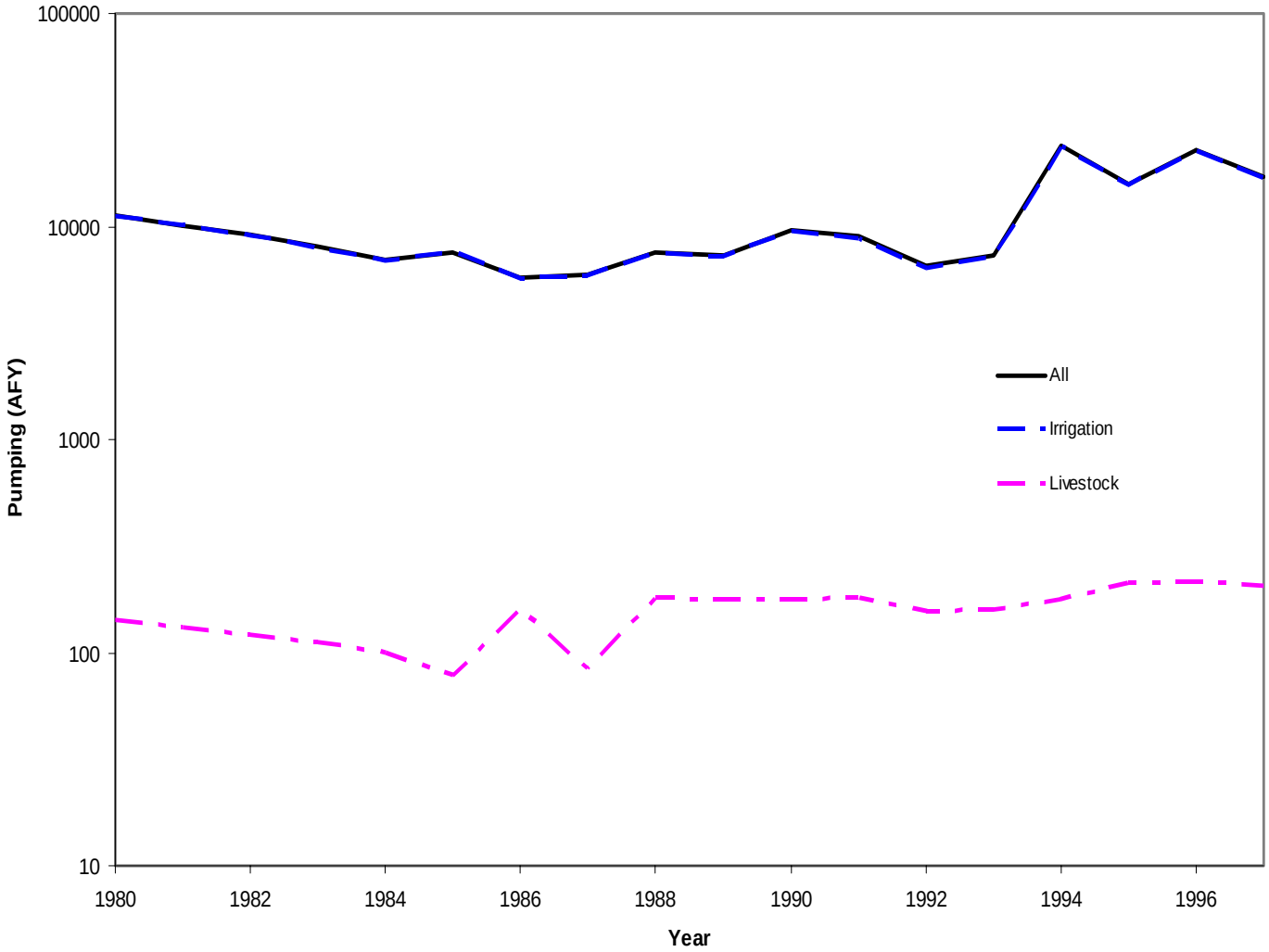


Figure 4.7.6 – Total groundwater withdrawals (excluding county-other) for Baylor County from the Seymour aquifer for 1980-1997

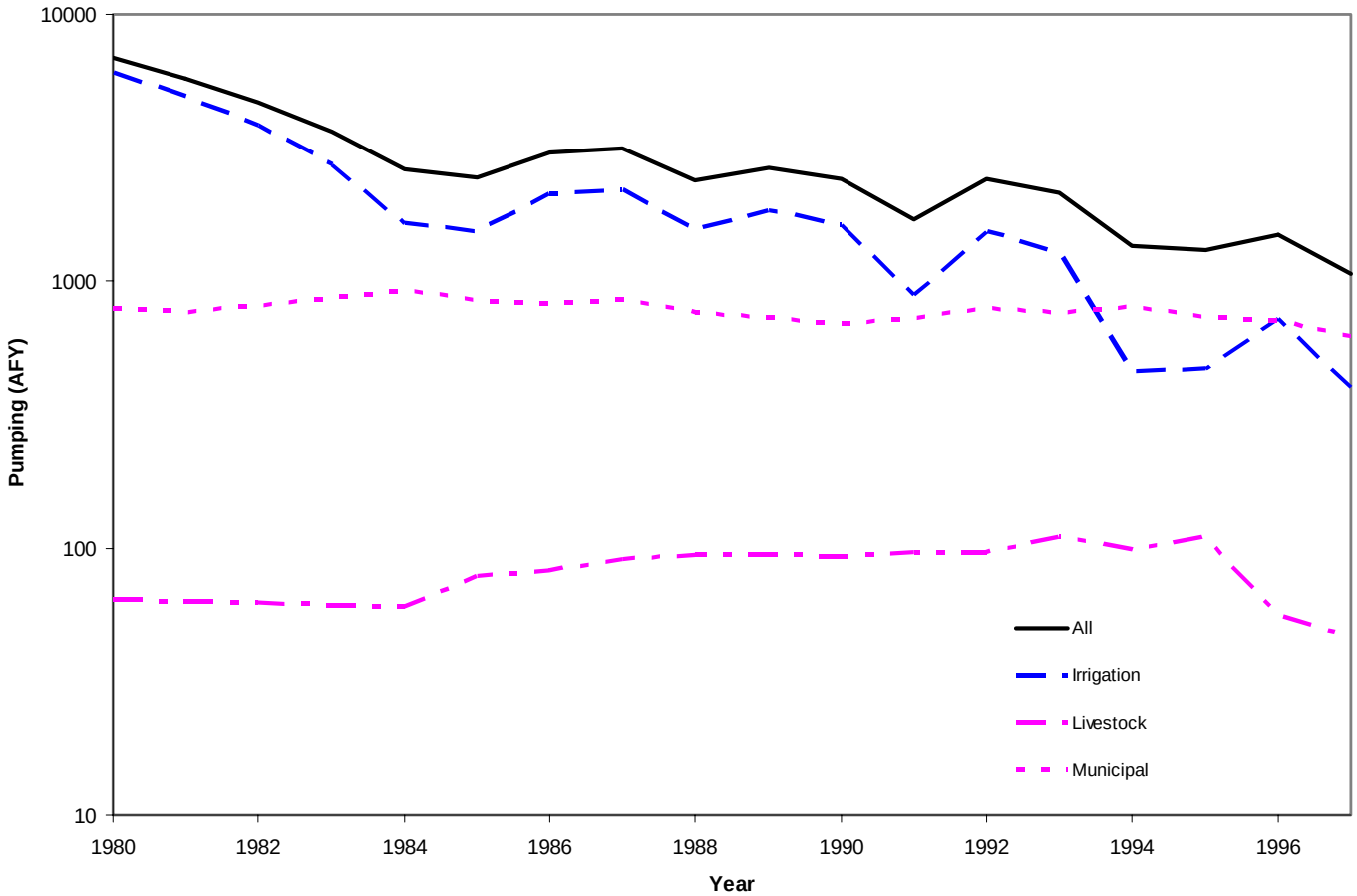


Figure 4.7.7 – Total groundwater withdrawals (excluding county-other) for Childress County from the Seymour aquifer for 1980-1997

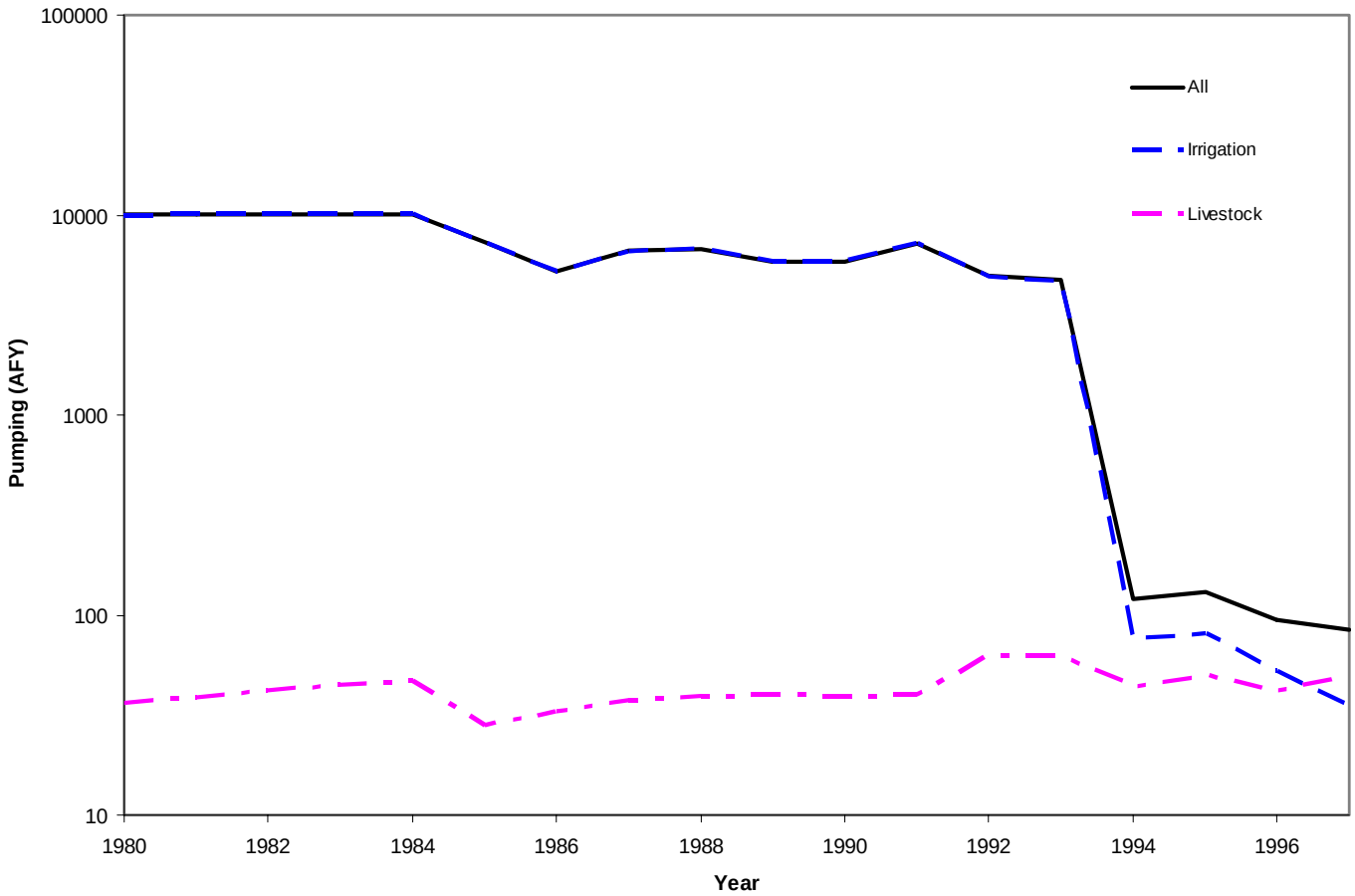


Figure 4.7.8 – Total groundwater withdrawals (excluding county-other) for Clay County from the Seymour aquifer for 1980-1997

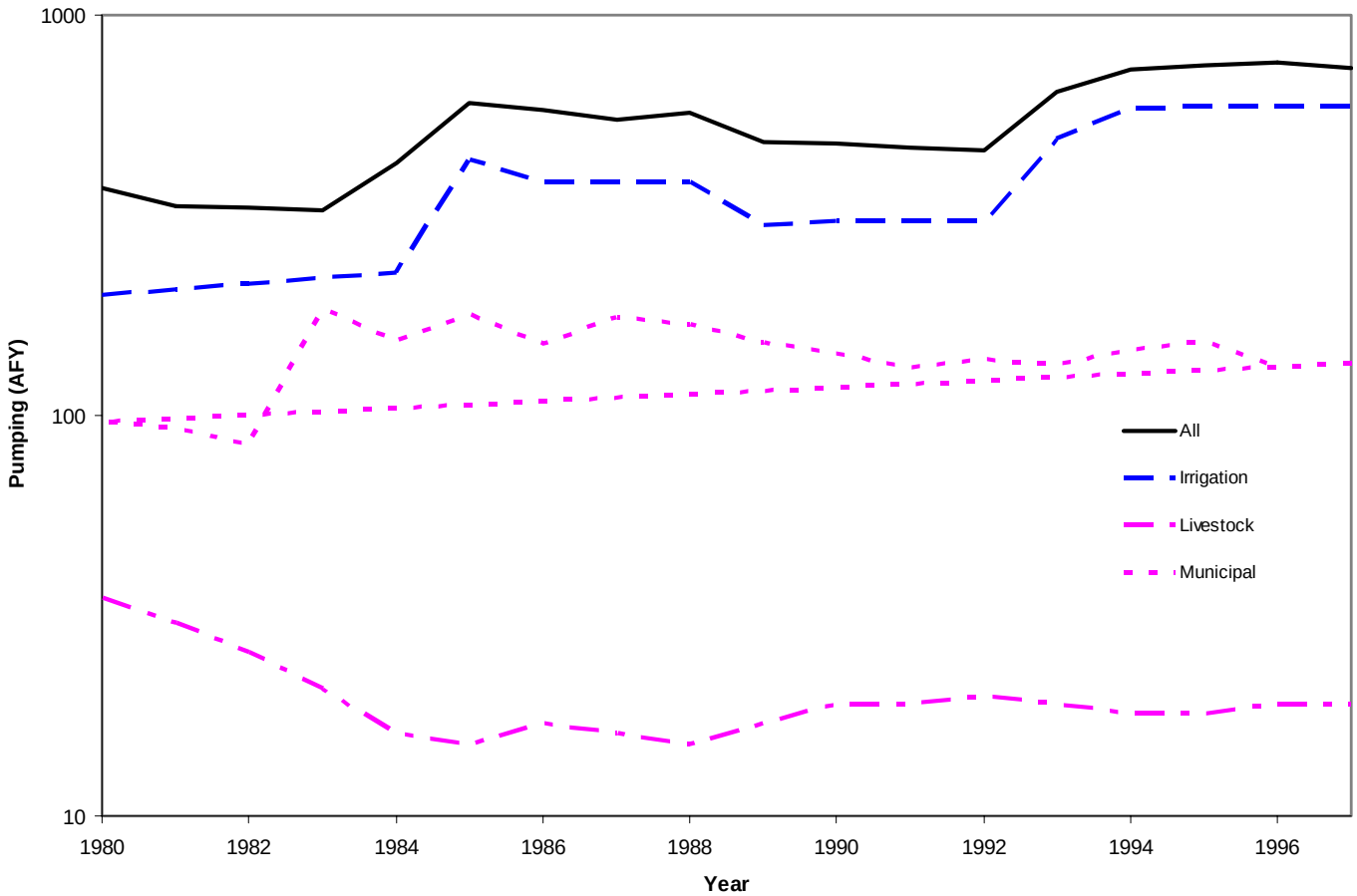


Figure 4.7.9 – Total groundwater withdrawals (excluding county-other) for Collingsworth County from the Seymour aquifer for 1980-1997

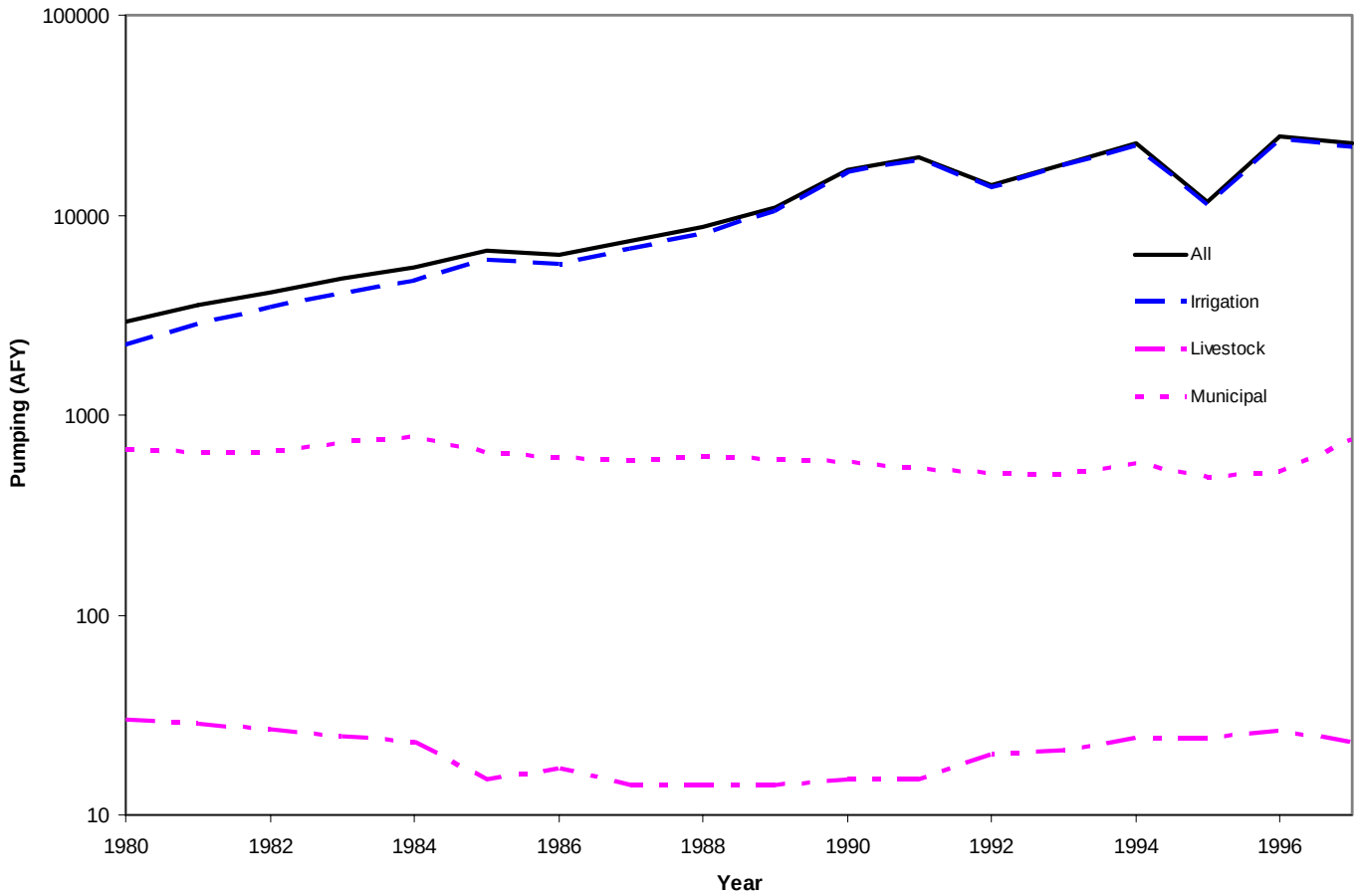


Figure 4.7.12 – Total groundwater withdrawals (excluding county-other) for Fisher County from the Seymour aquifer for 1980-1997

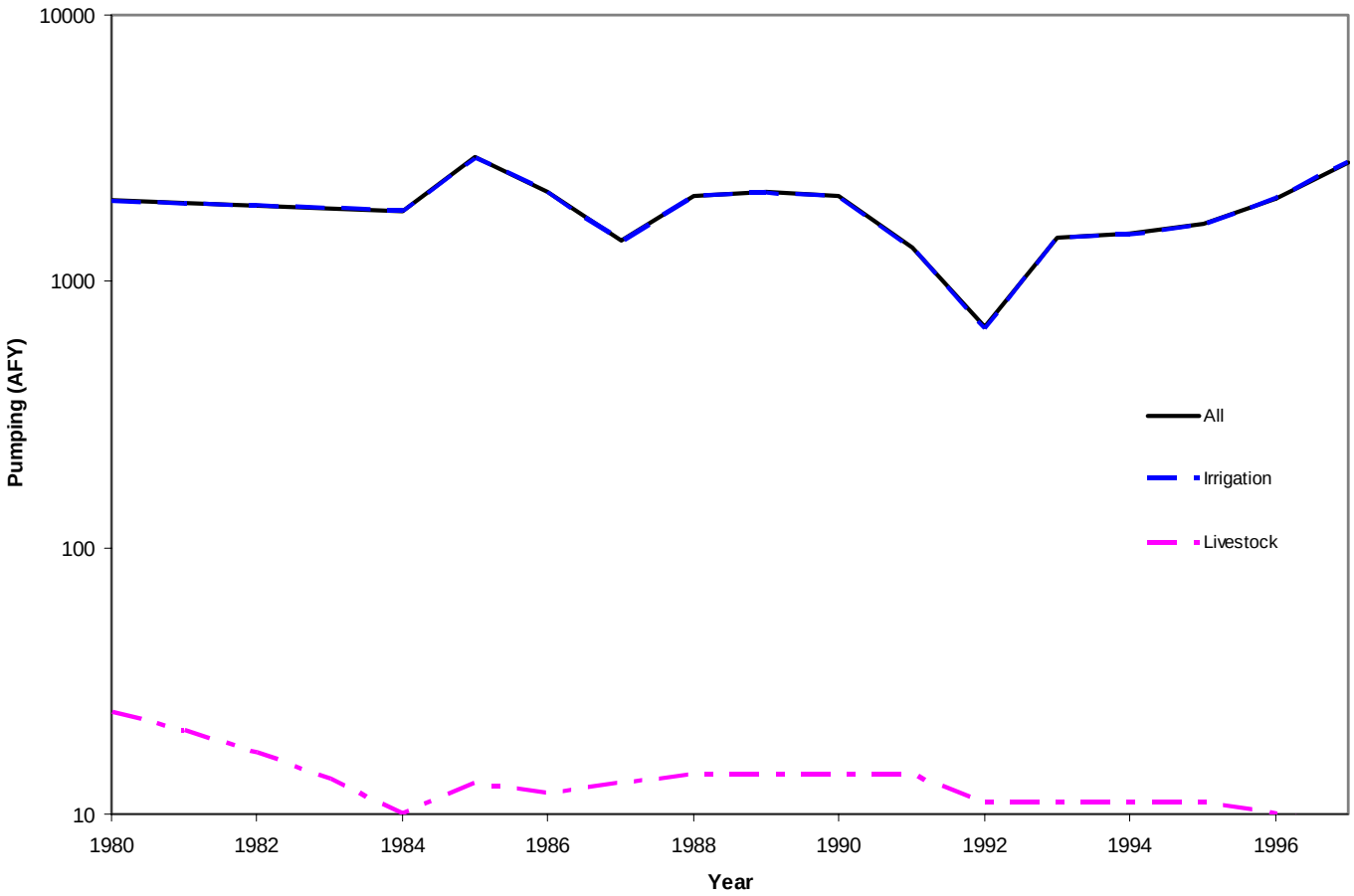


Figure 4.7.13 – Total groundwater withdrawals (excluding county-other) for Foard County from the Seymour aquifer for 1980-1997

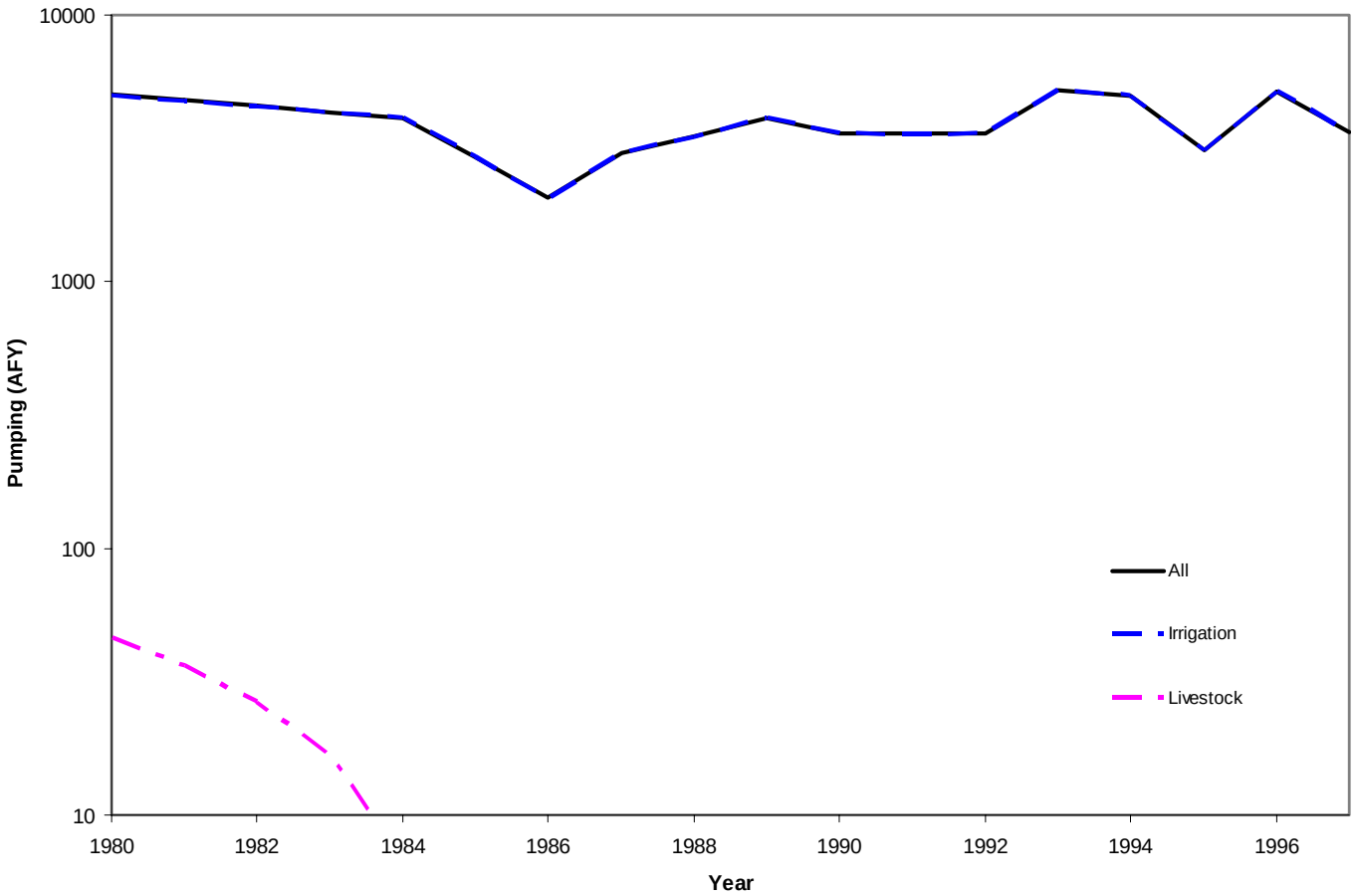


Figure 4.7.15 – Total groundwater withdrawals (excluding county-other) for Hall County from the Seymour aquifer for 1980-1997

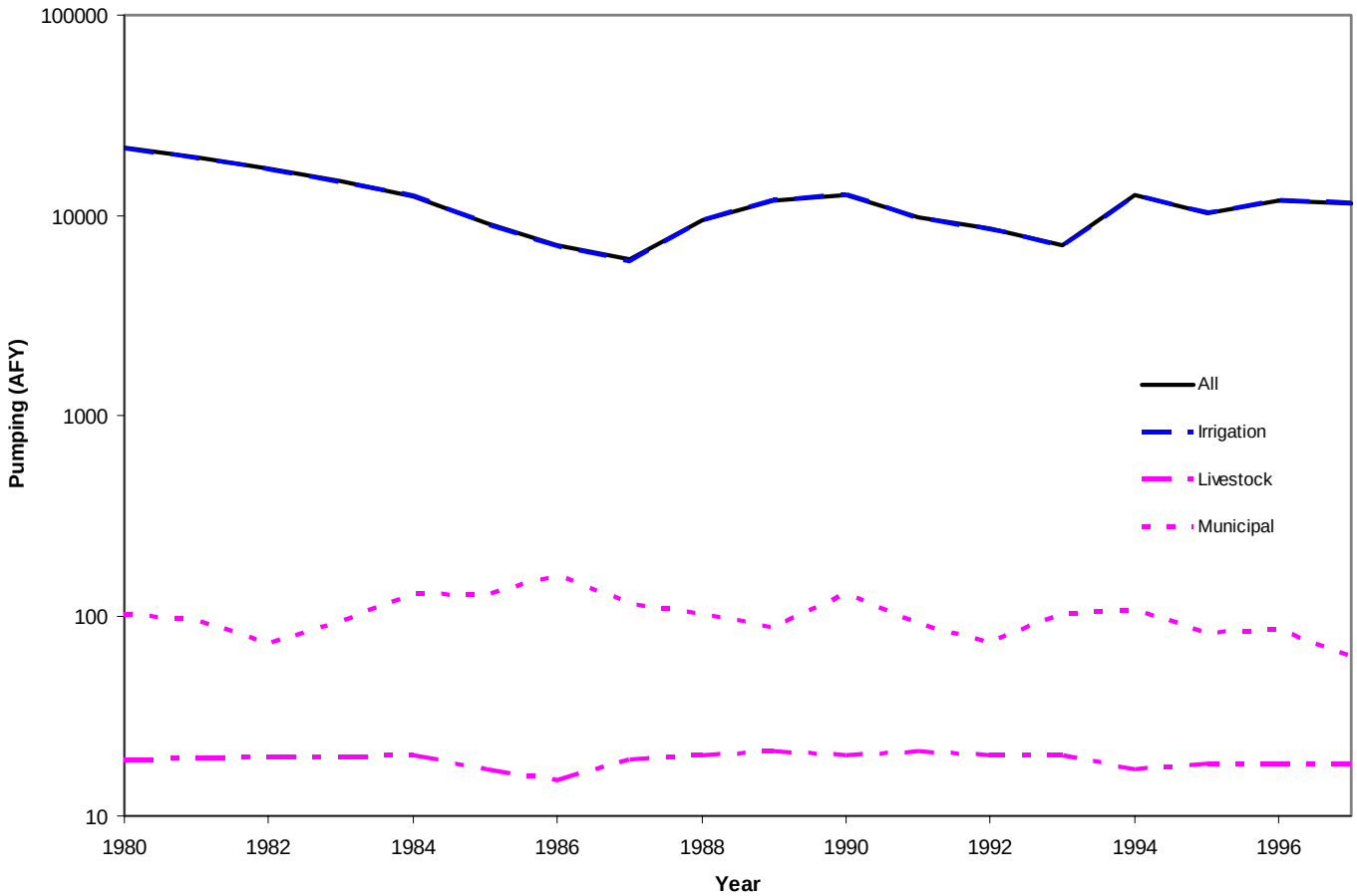


Figure 4.7.16 – Total groundwater withdrawals (excluding county-other) for Hardeman County from the Seymour aquifer for 1980-1997

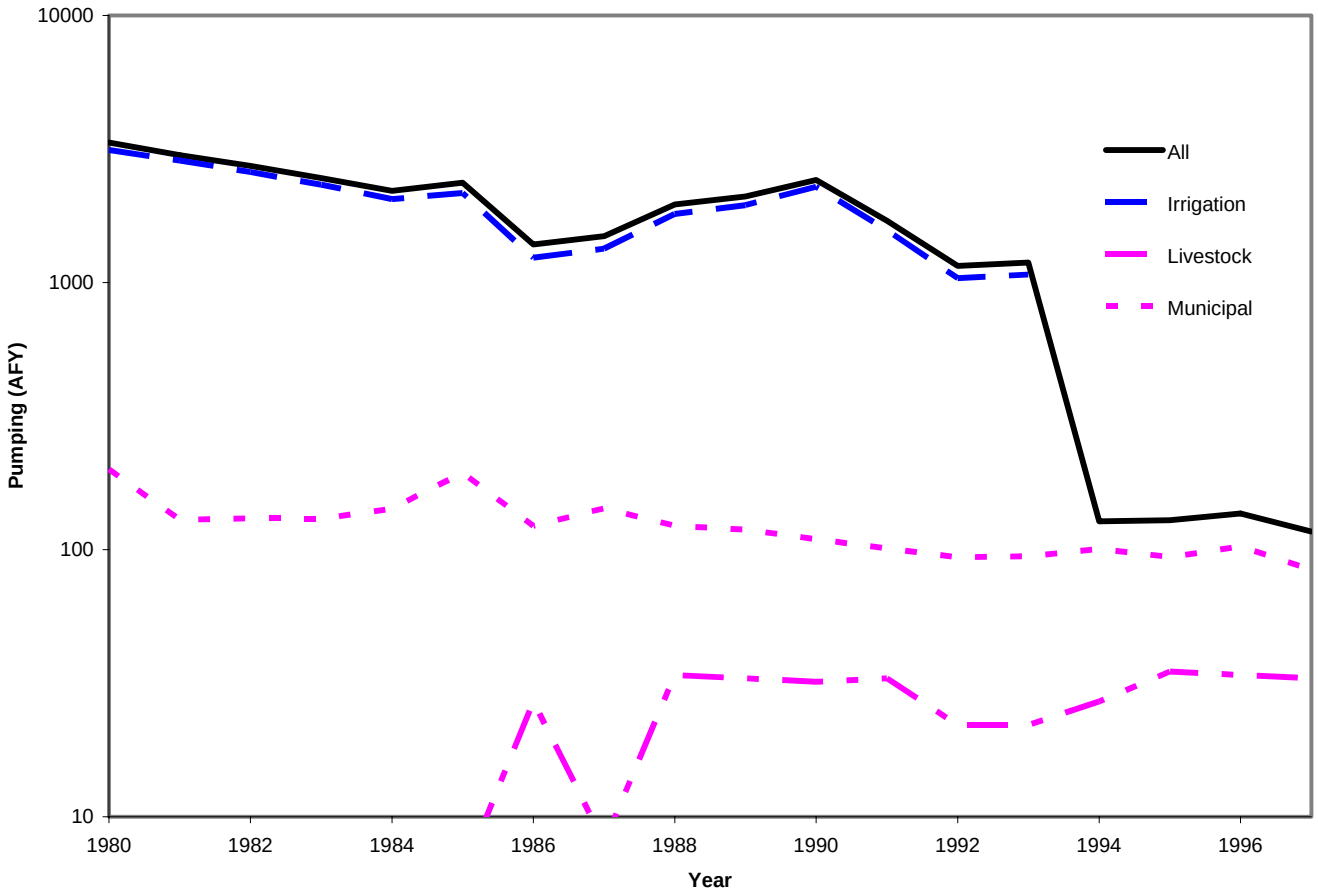


Figure 4.7.17 – Total groundwater withdrawals (excluding county-other) for Haskell County from the Seymour aquifer for 1980-1997

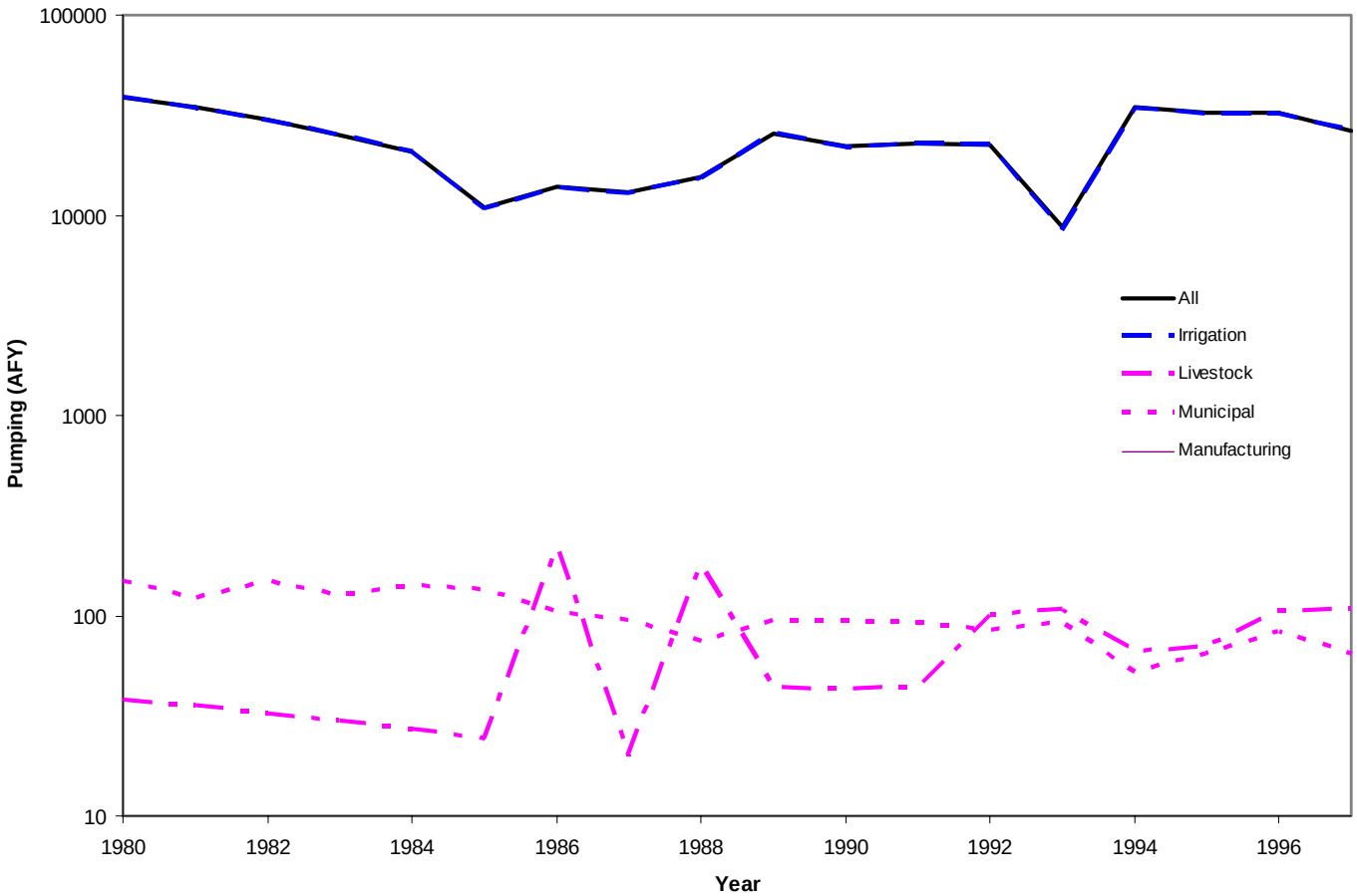


Figure 4.7.18 – Total groundwater withdrawals (excluding county-other) for Jones County from the Seymour aquifer for 1980-1997

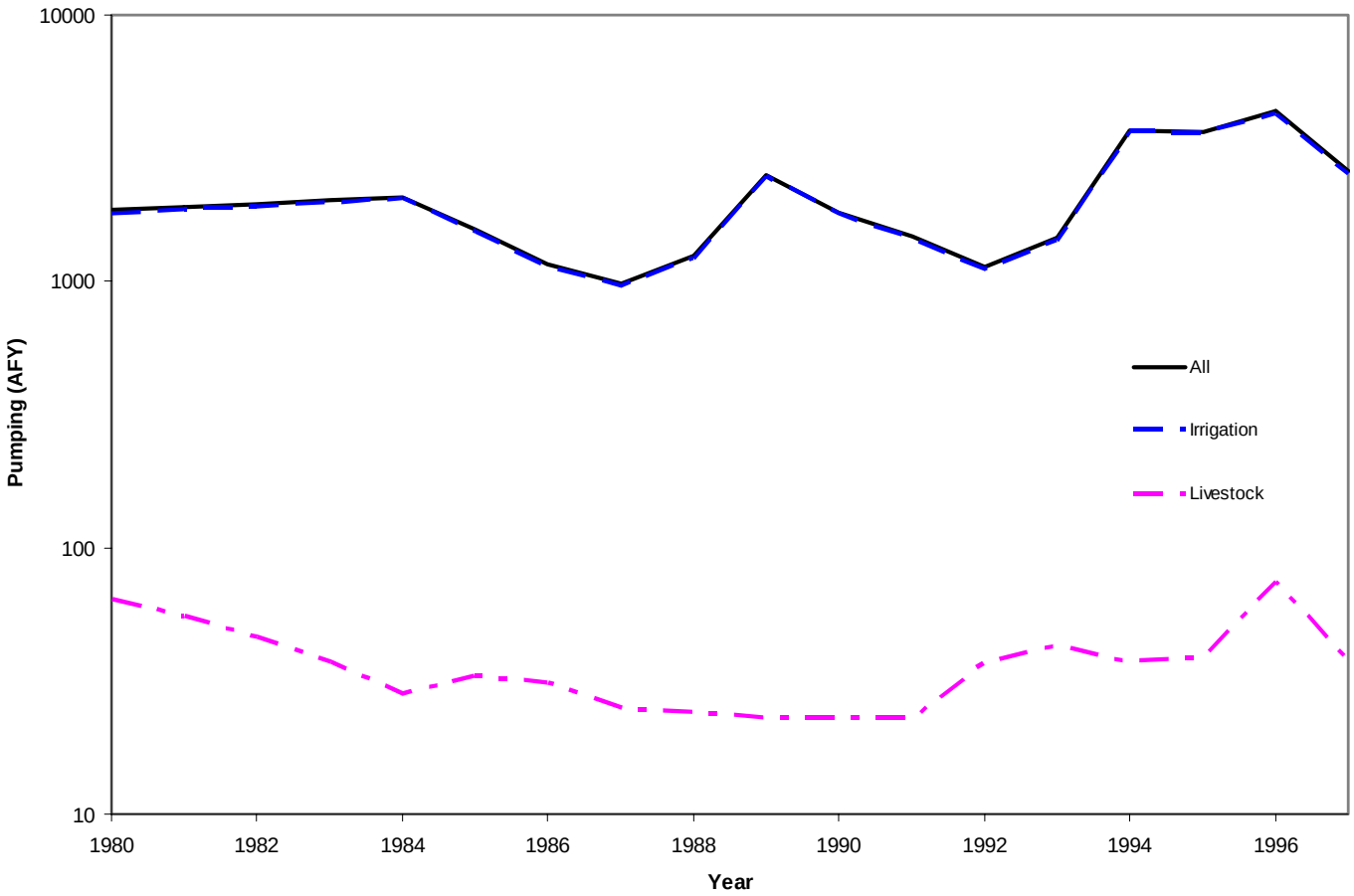


Figure 4.7.19 – Total groundwater withdrawals (excluding county-other) for Kent County from the Seymour aquifer for 1980-1997

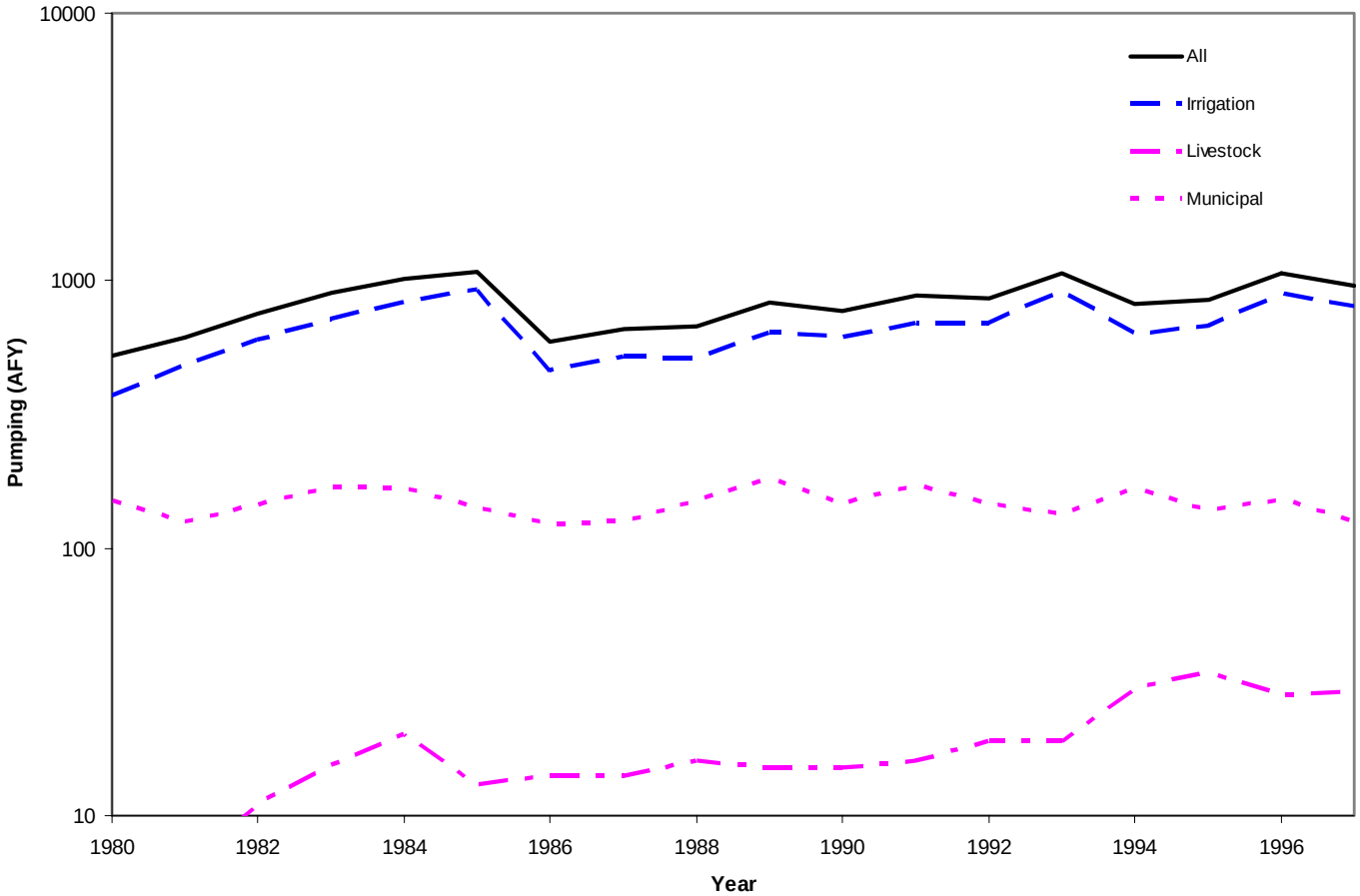


Figure 4.7.20 – Total groundwater withdrawals (excluding county-other) for Knox County from the Seymour aquifer for 1980-1997

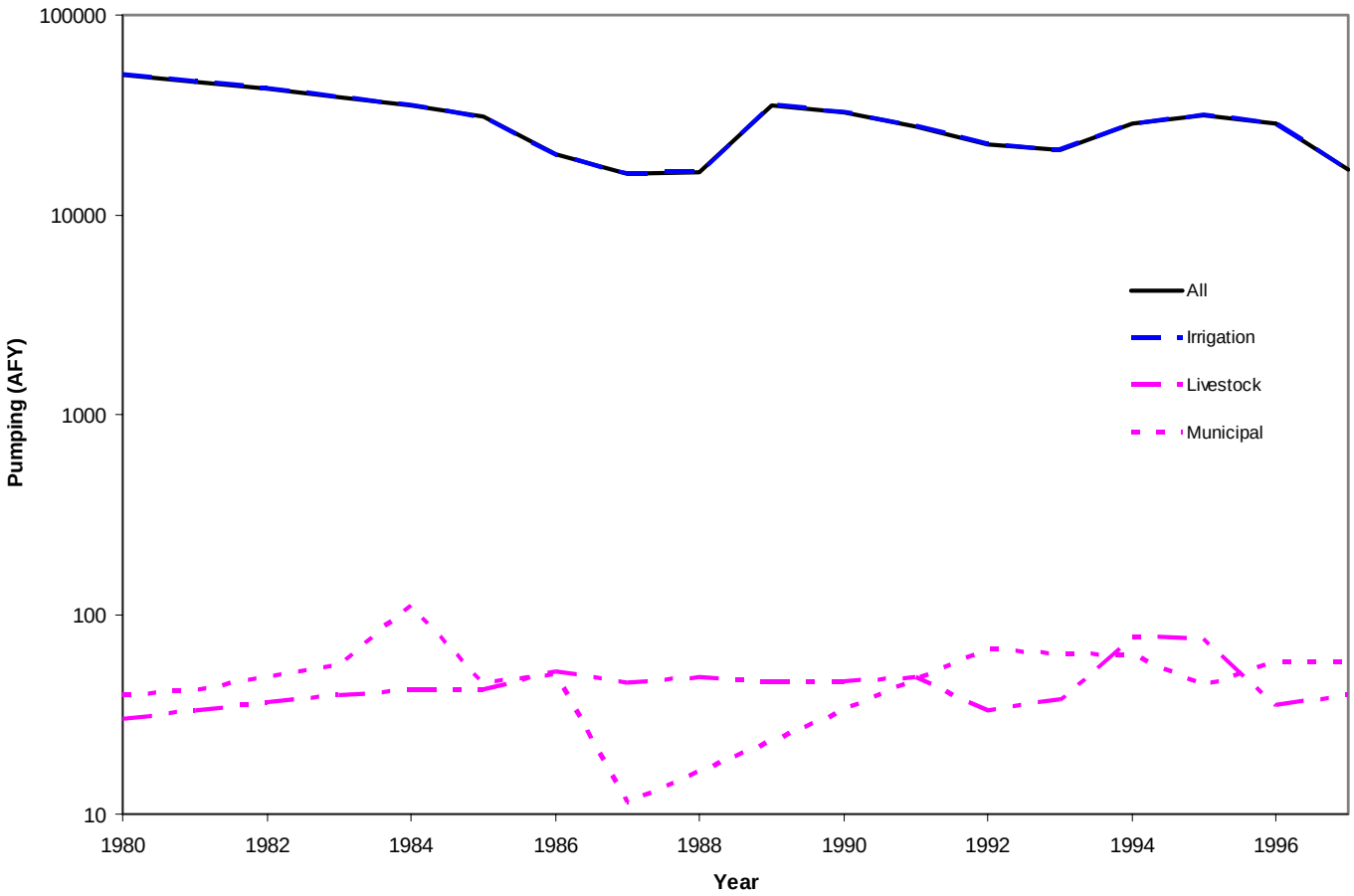


Figure 4.7.21 – Total groundwater withdrawals (excluding county-other) for Motley County from the Seymour aquifer for 1980-1997

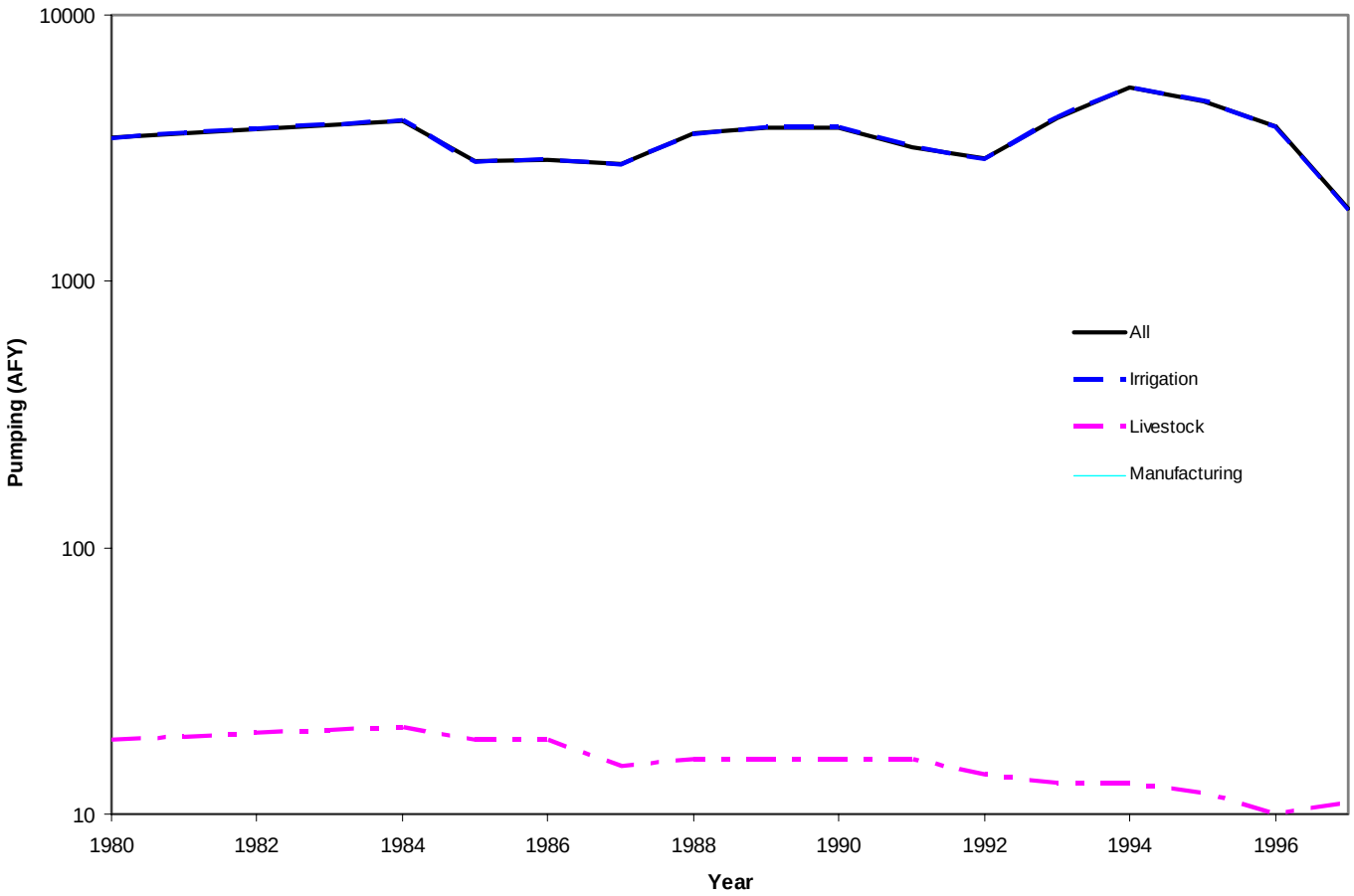


Figure 4.7.22 – Total groundwater withdrawals (excluding county-other) for Stonewall County from the Seymour aquifer for 1980-1997

Figure 4.7.24 – Total groundwater withdrawals (excluding county-other) for Wichita County from the Seymour aquifer for 1980-1997

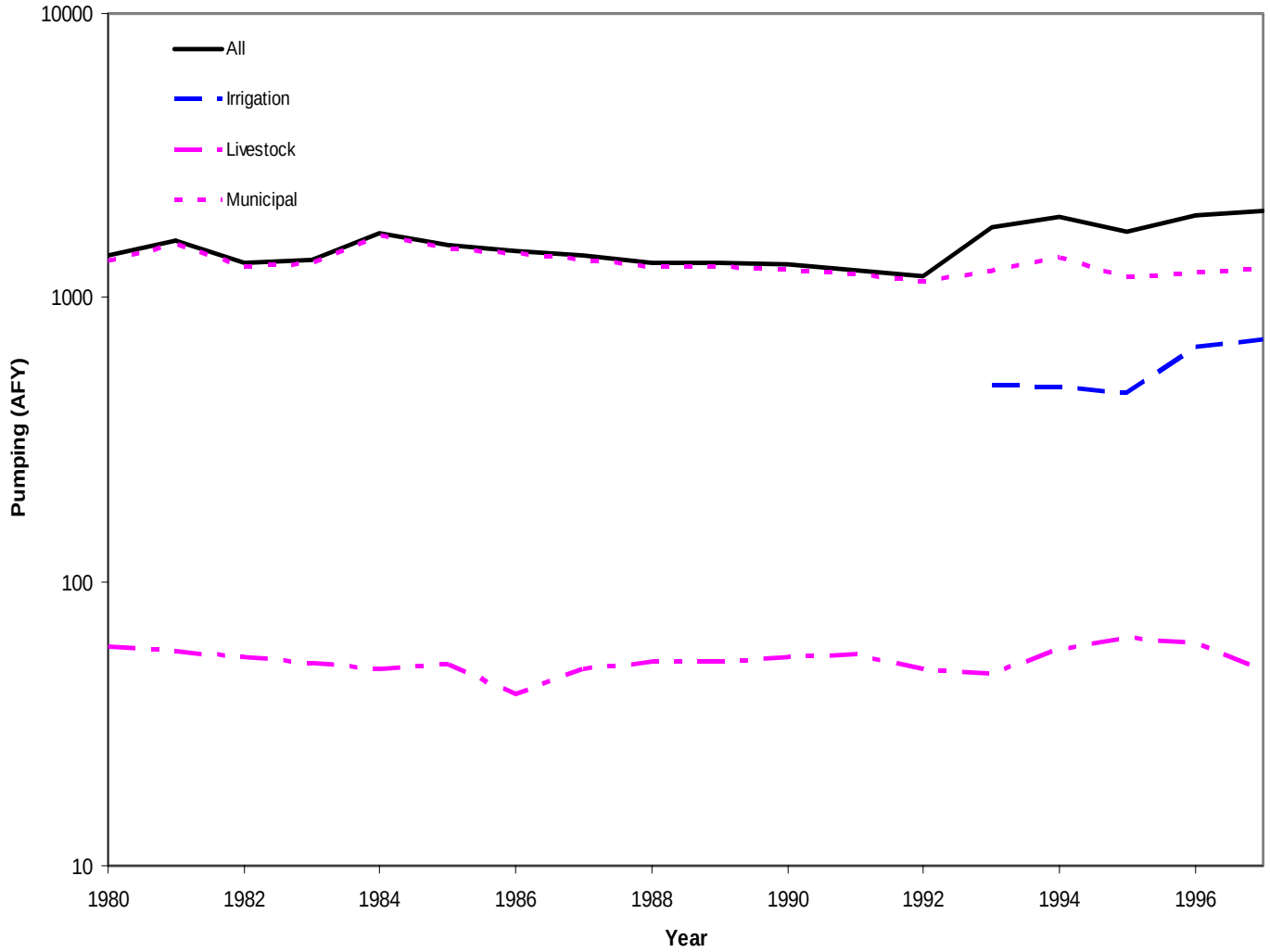


Figure 4.7.25 – Total groundwater withdrawals (excluding county-other) for Wilbarger County from the Seymour aquifer for 1980-1997

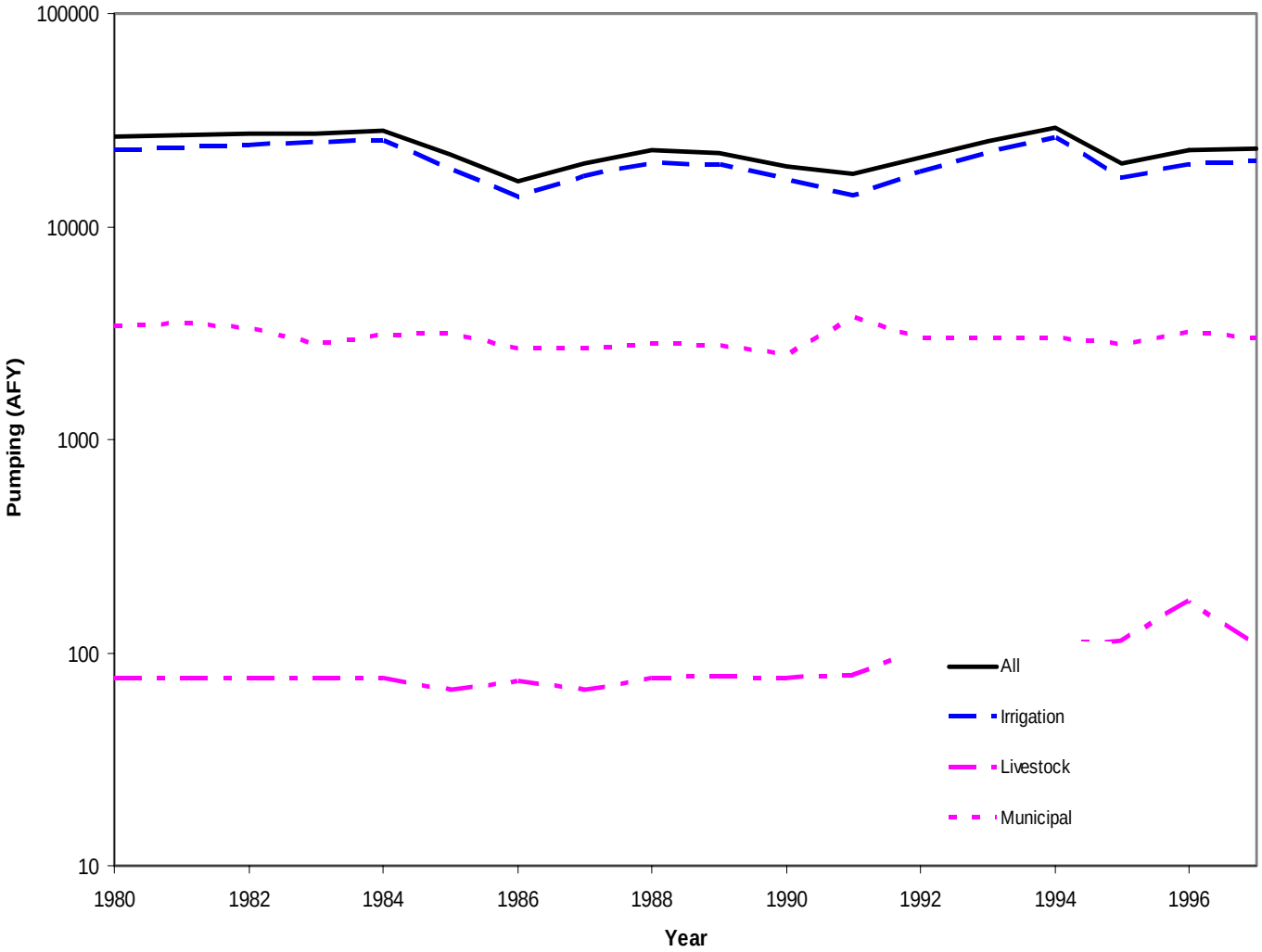


Figure 4.7.26 – Total groundwater withdrawals (excluding county-other) for Childress County from the Blaine aquifer for 1980-1997

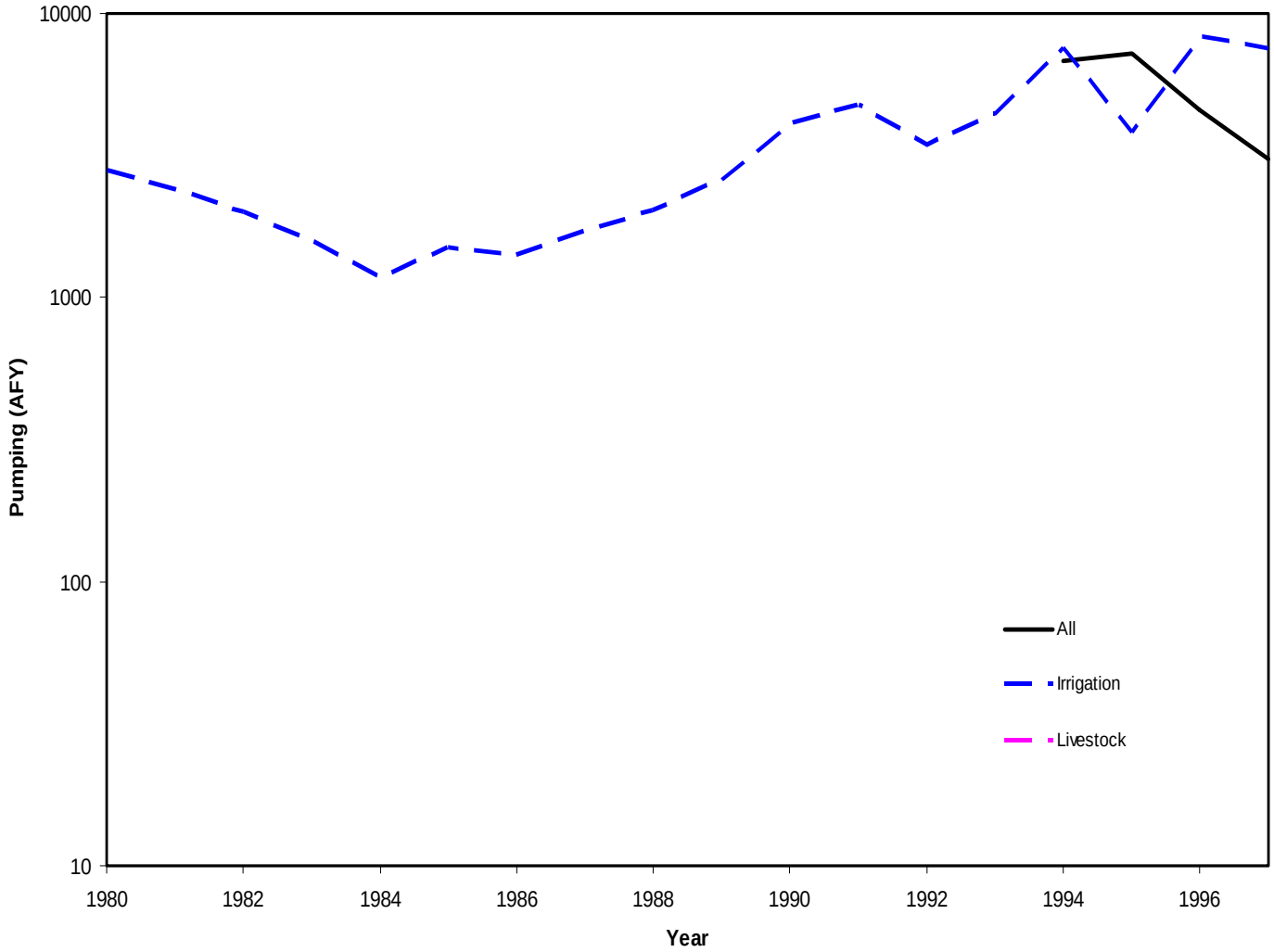


Figure 4.7.27 – Total groundwater withdrawals (excluding county-other) for Collingsworth County from the Blaine aquifer for 1980-1997

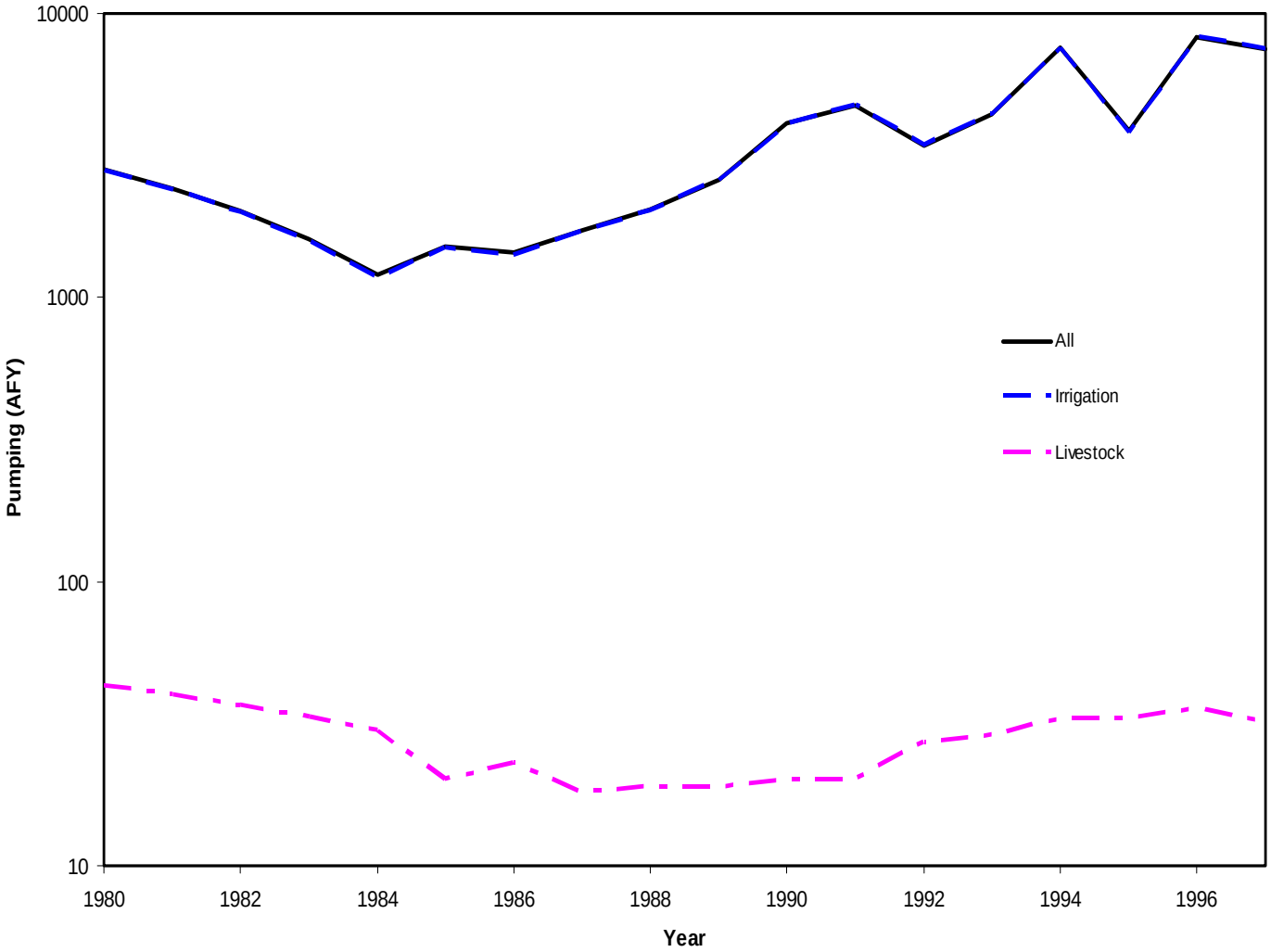


Figure 4.7.28 – Total groundwater withdrawals (excluding county-other) for Cottle County from the Blaine aquifer for 1980-1997

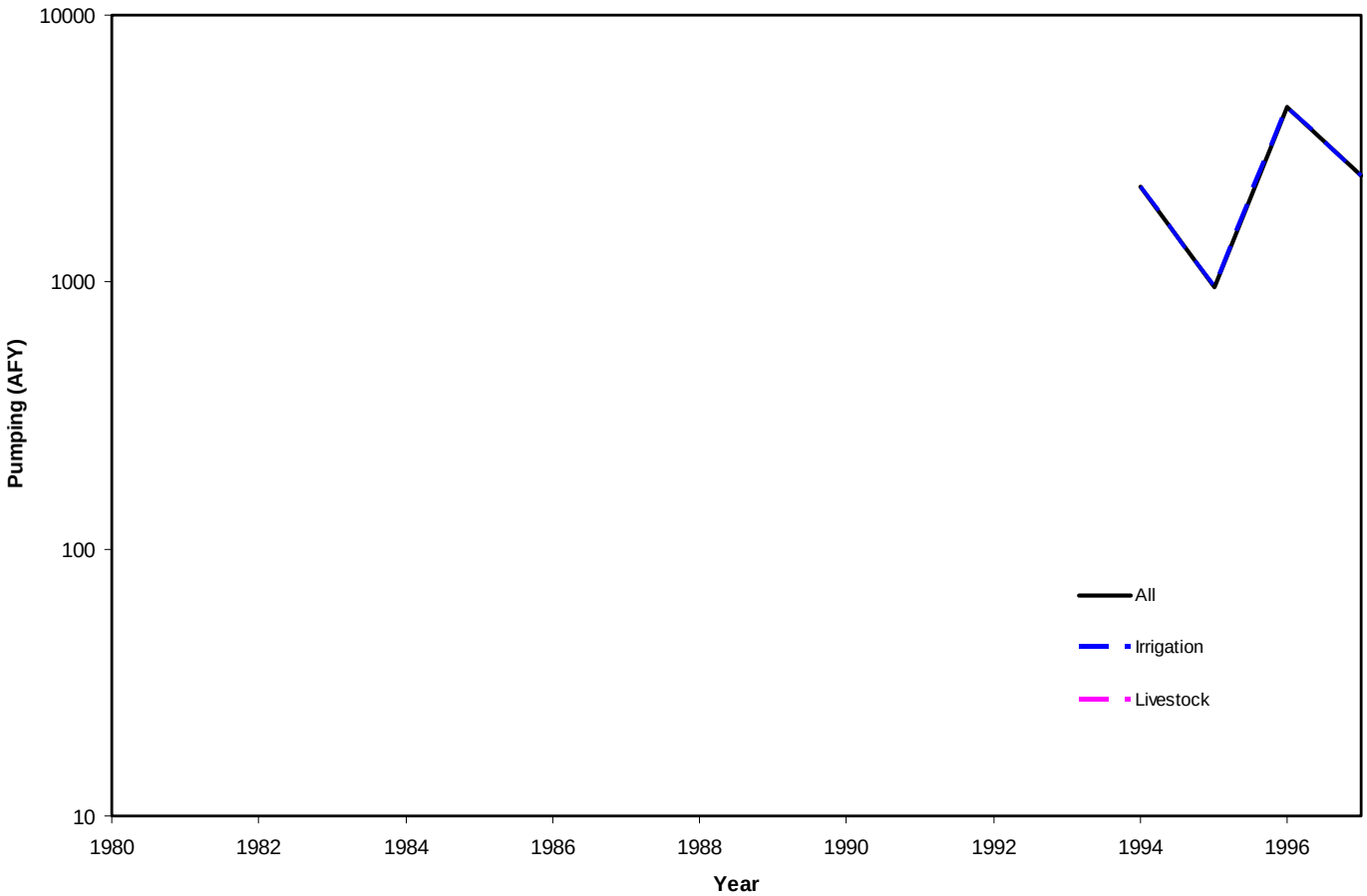


Figure 4.7.30 – Total groundwater withdrawals (excluding county-other) for Hardeman County from the Blaine aquifer for 1980-1997

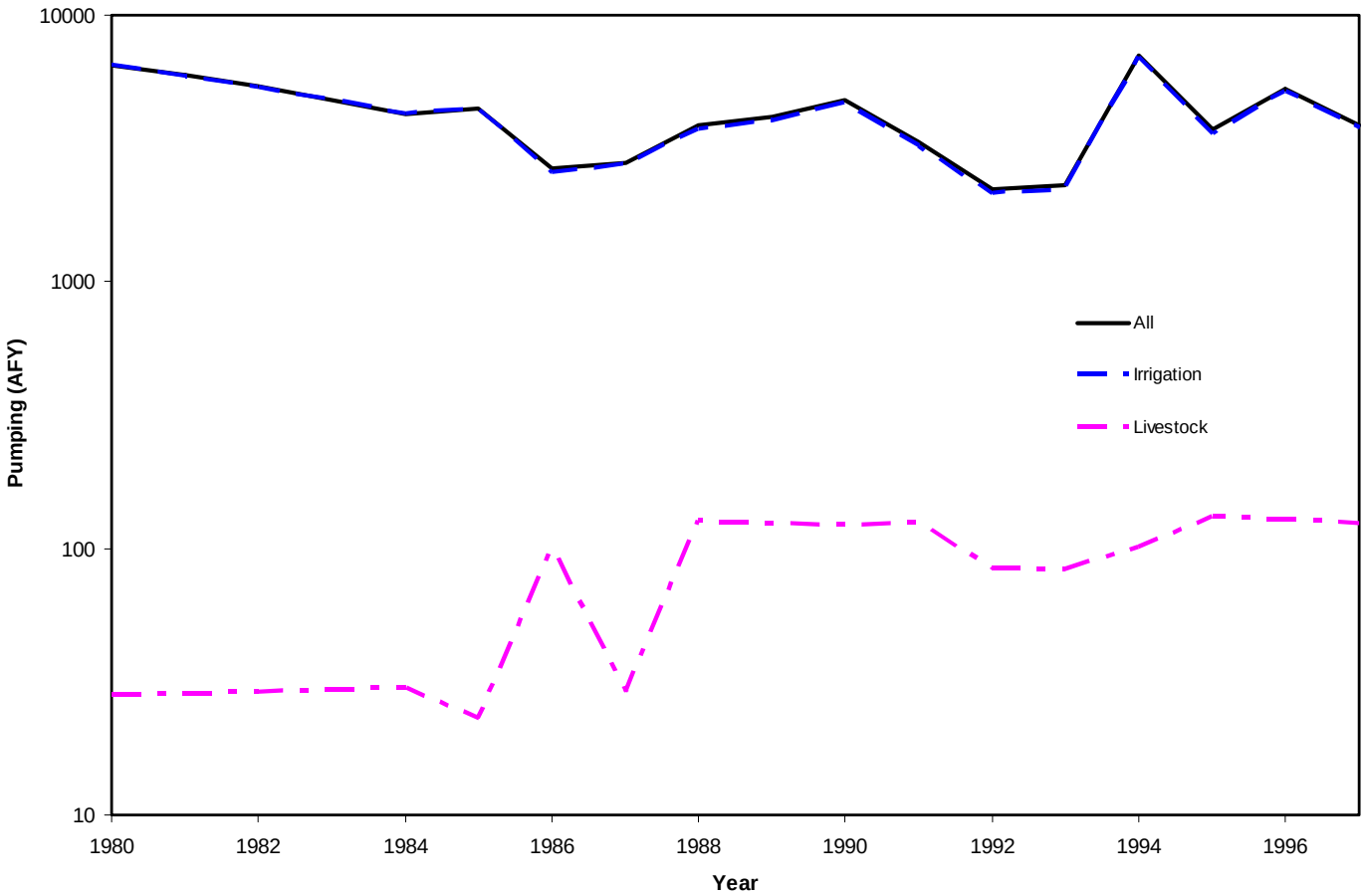
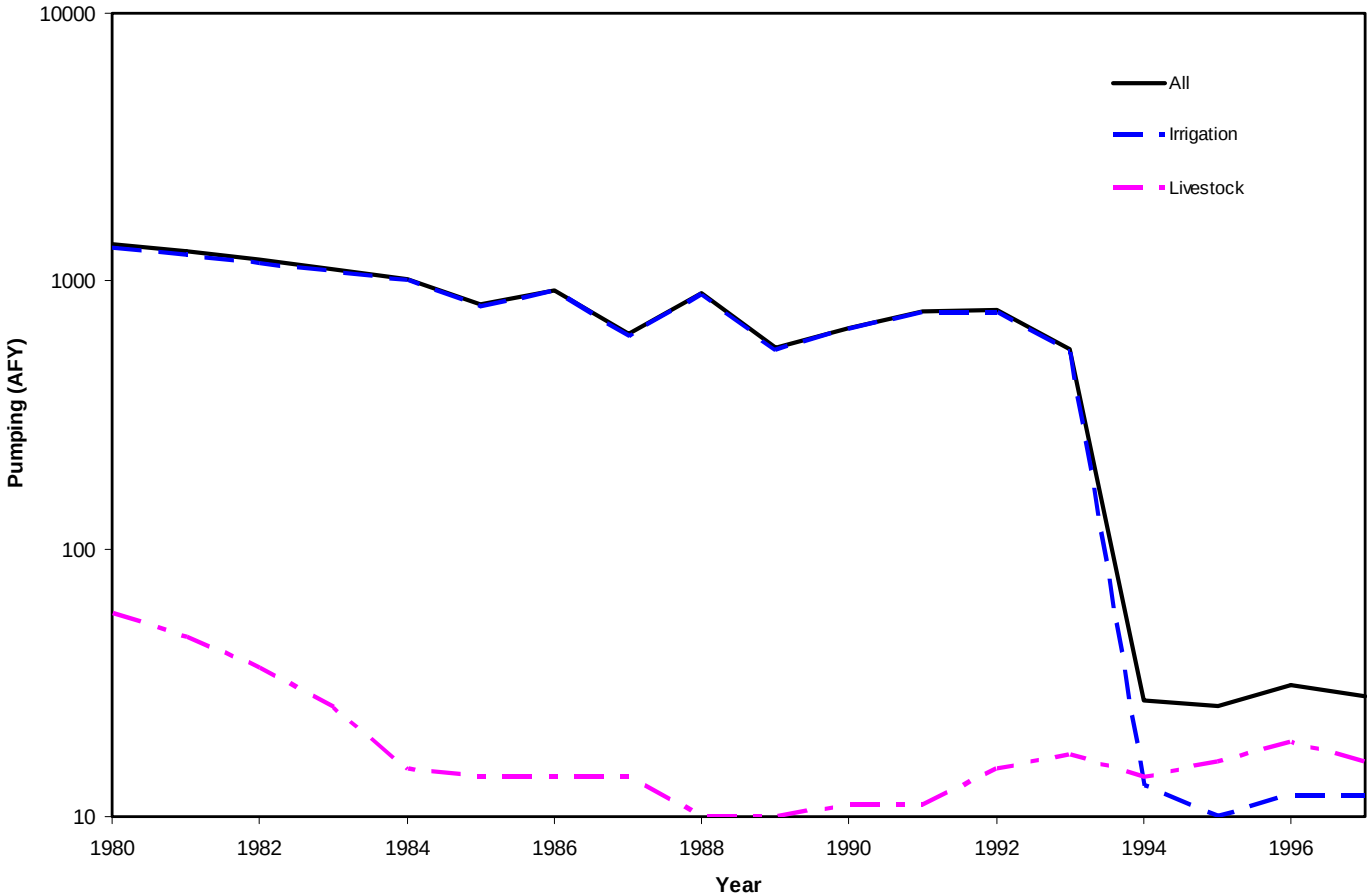


Figure 4.7.31 – Total groundwater withdrawals (excluding county-other) for King County from the Blaine aquifer for 1980-1997

Figure 4.7.32 – Total groundwater withdrawals (excluding county-other) for Wheeler County from the Blaine aquifer for 1980-1997



Groundwater Quality

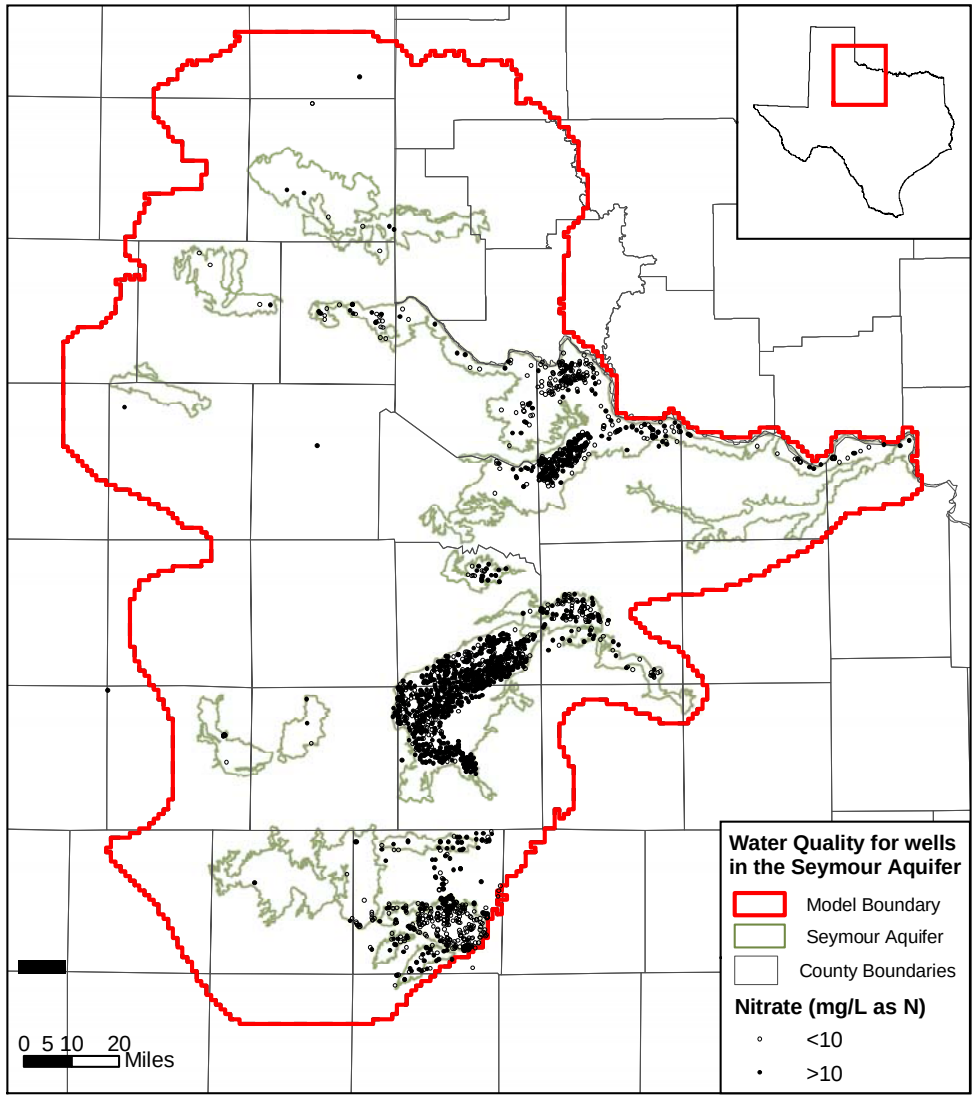
Groundwater Quality

- **Water Quality Measures Compared to Screening Levels for Drinking Water Supply and Irrigation**
- **Drinking Water**
  - National Primary Drinking Water Regulations – 40 CFR 141 - legally enforceable standards to protect human health from contaminants in drinking water
  - National Secondary Drinking Water Regulations – 40 CFR 143 - guidelines to prevent aesthetic effects (taste, odor, color), cosmetic effects (staining) in drinking water, and technical effects (corrosion, expense of treatment)
- **Irrigation Water Screening Levels**
  - Based on crop tolerances
  - Major irrigated crops: cotton, wheat, peanuts, hay, sorghum

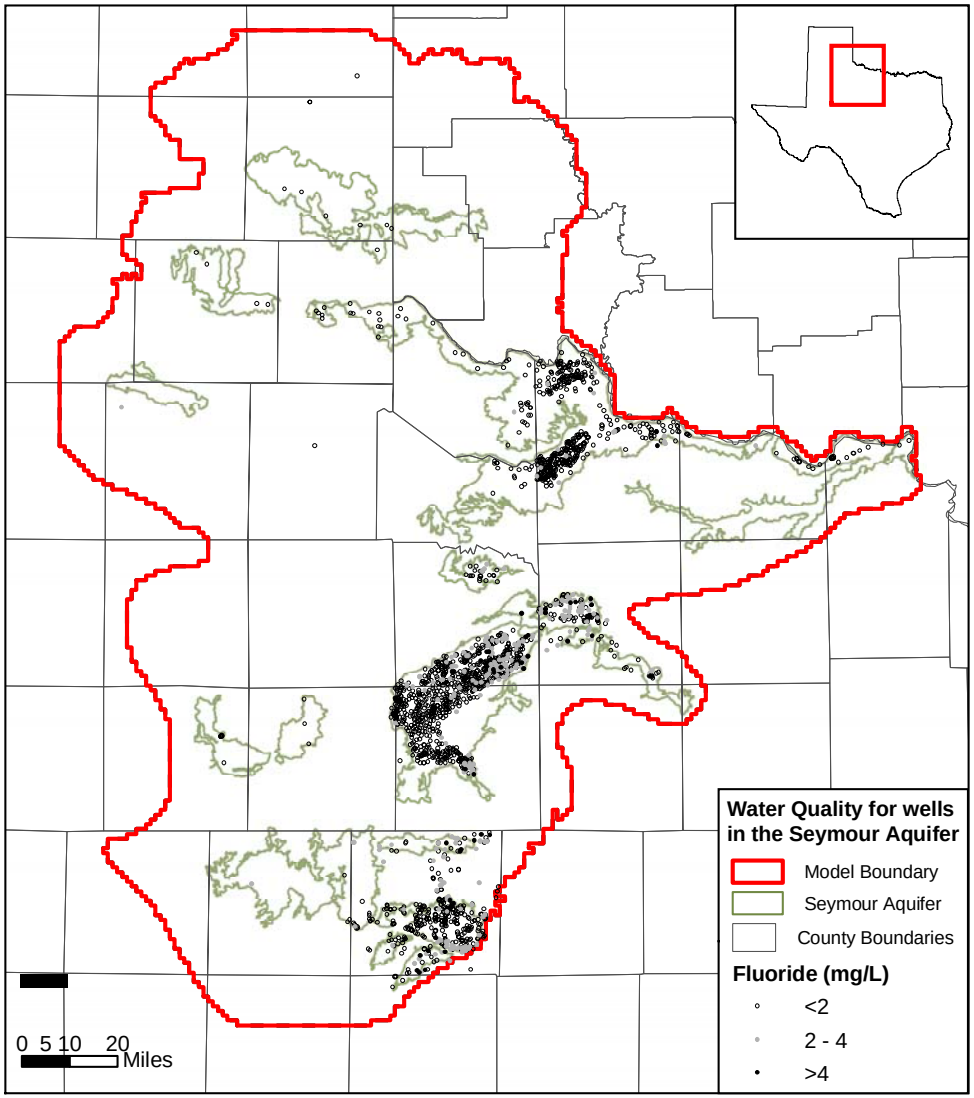
Seymour Aquifer - Selected Primary MCLs

Water Quality Constituent	Wells Monitored	Screening Level	Wells > S.L.
Nitrate Nitrogen	2200	10 mg/L	56%
Fluoride	2081	4 mg/L	1.9%
Alpha Activity	63	15 pCi/L	5%
Nitrite Nitrogen	141	0.010 mg/L	1.4%
Selenium	153	0.050 mg/L	1.3%

Nitrate Nitrogen in the Seymour Aquifer



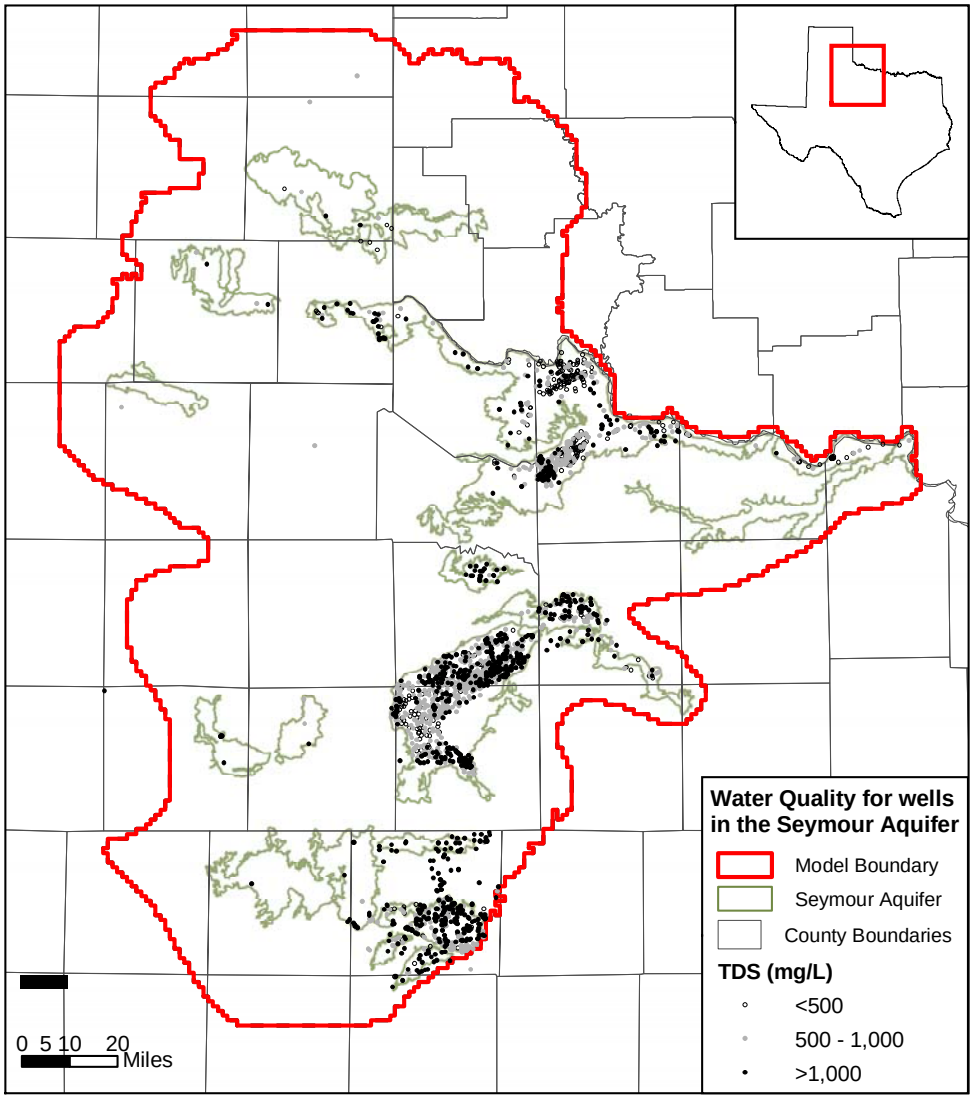
Fluoride in the Seymour Aquifer



Seymour Aquifer - Selected Secondary MCLs

Water Quality Constituent	Wells Monitored	Screening Level	Wells > S.L.
Total Dissolved Solids	2070	500 mg/L(EPA)	84%
		1000 mg/L(TX)	41%
Chloride	2438	250 mg/L	35%
Sulfate	2290	250 mg/L	23%
Fluoride	2081	2 mg/L	14%
Iron	321	0.3 mg/L	15%
Manganese	314	0.05 mg/L	10%
Aluminum	133	0.2 mg/L	1.5%

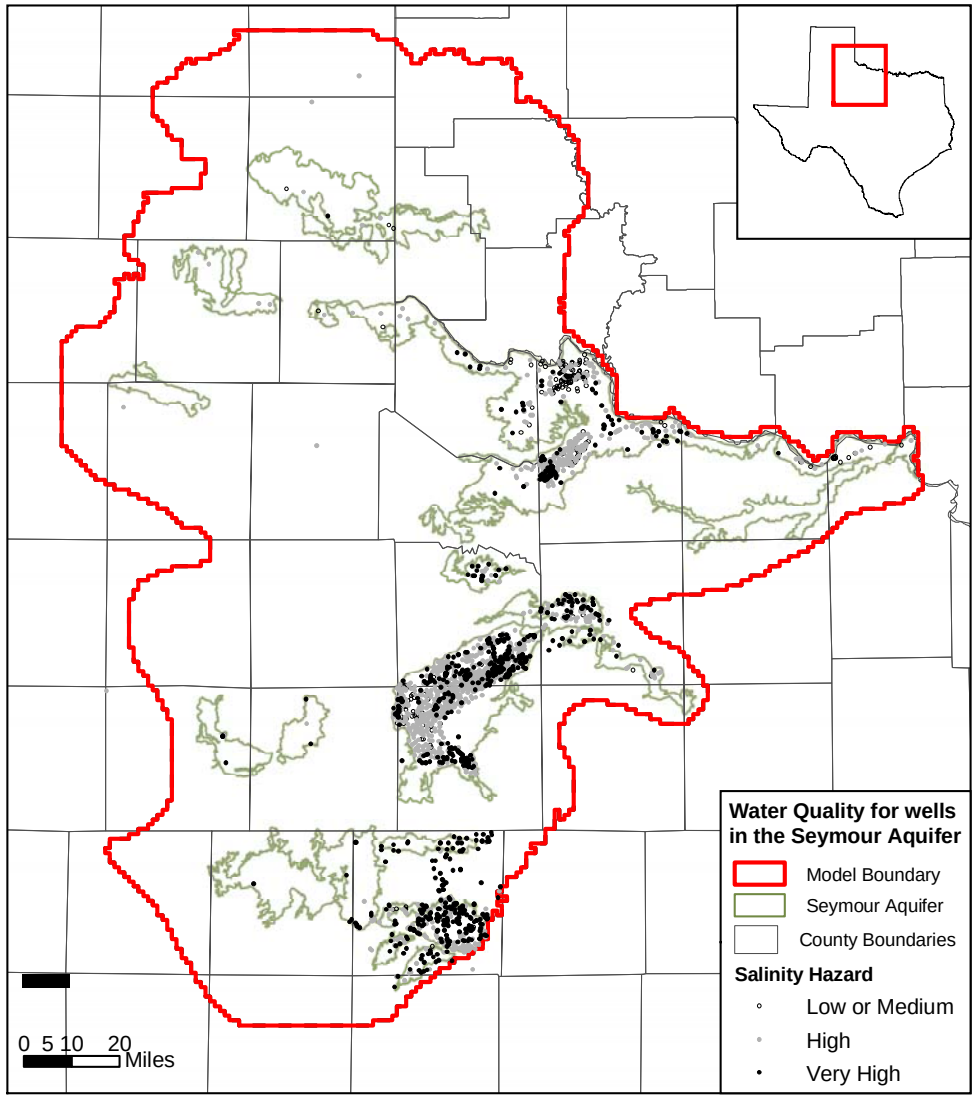
Total Dissolved Solids in the Seymour Aquifer



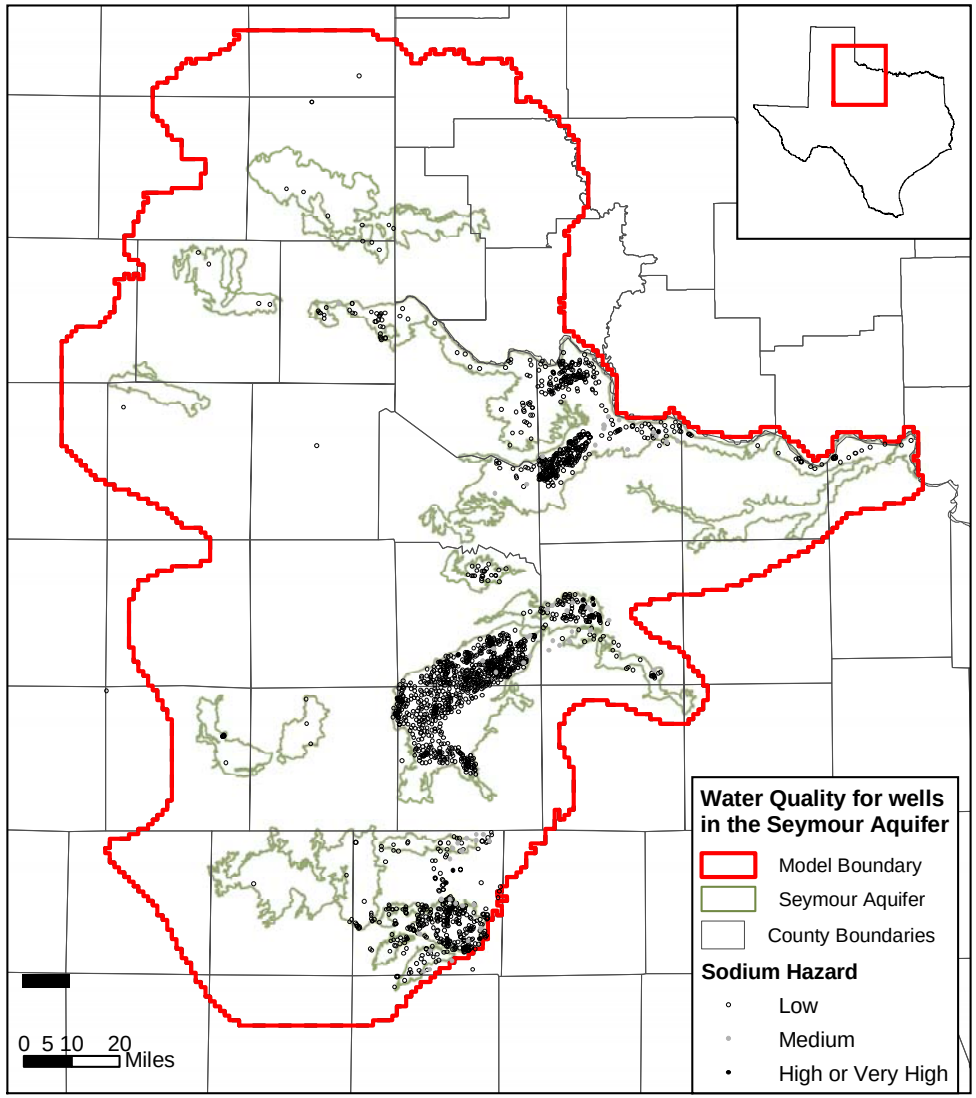
Seymour Aquifer - Irrigation Screening Levels

Water Quality Constituent	Wells Monitored	Screening Level	Wells > S.L.
Salinity Hazard	2103	High	91%
		Very High	30%
Sodium Hazard	2057	High	0.5%
		Very High	0.1%
Boron	602	1.5 mg/L	3.8%
		0.75 mg/L	13%
Chloride	2438	1000 mg/L	5.6%
		400 mg/L	21%

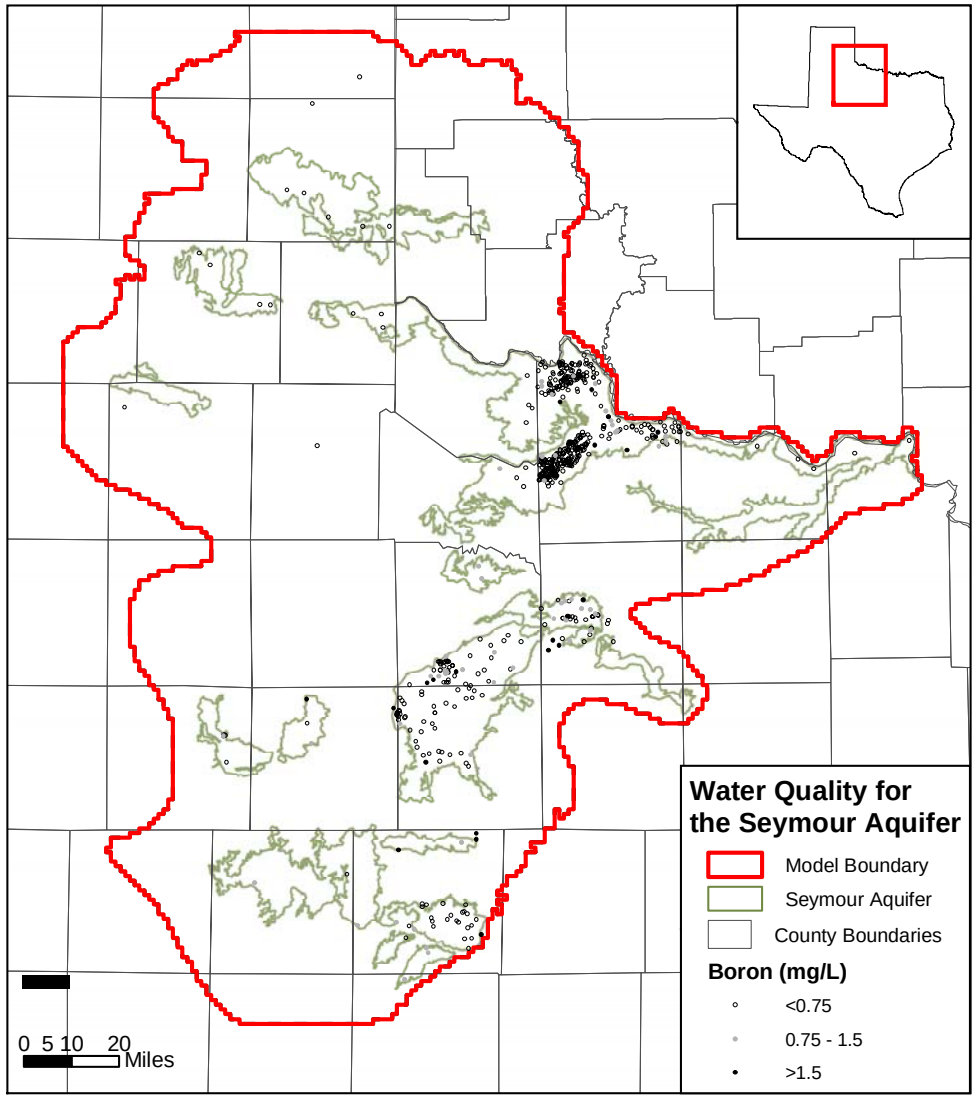
Salinity Hazard in the Seymour Aquifer



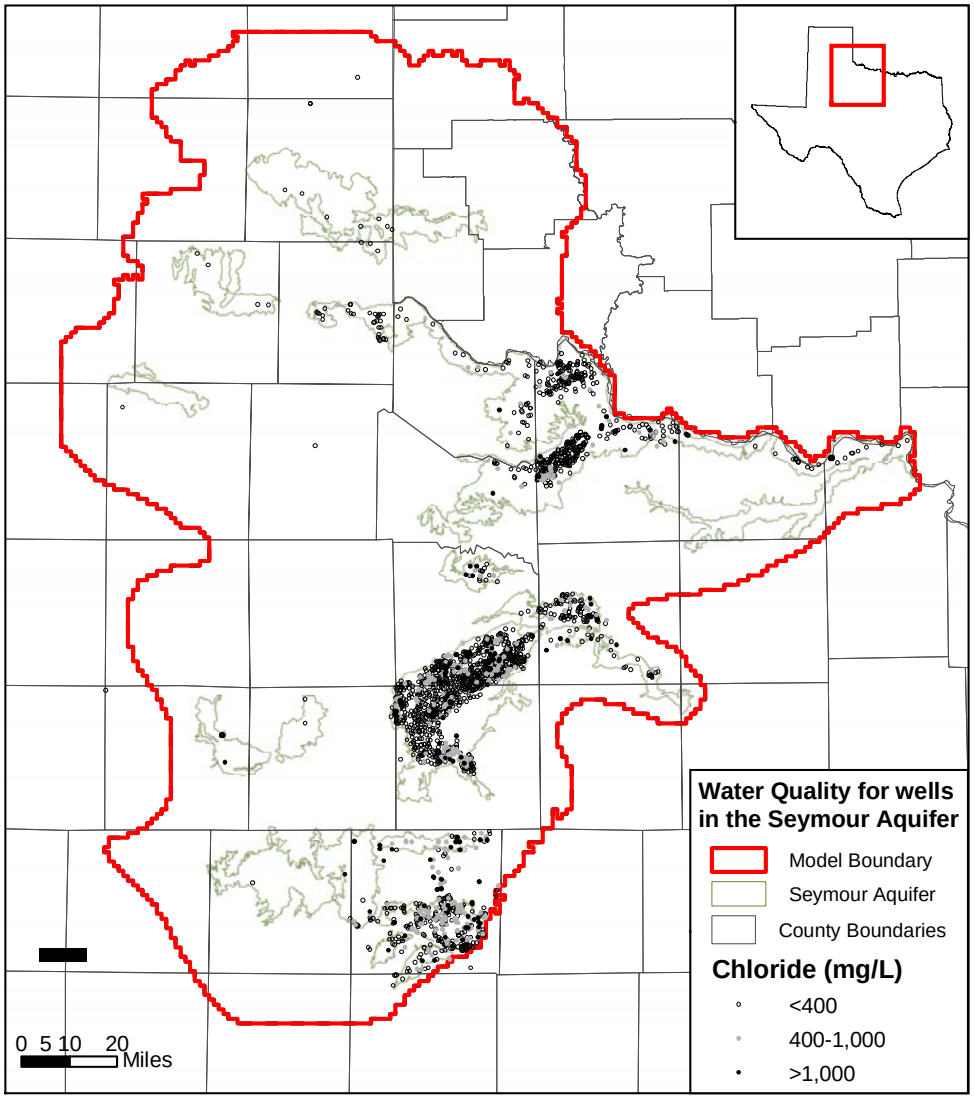
Sodium Hazard in the Seymour Aquifer



Boron in the Seymour Aquifer



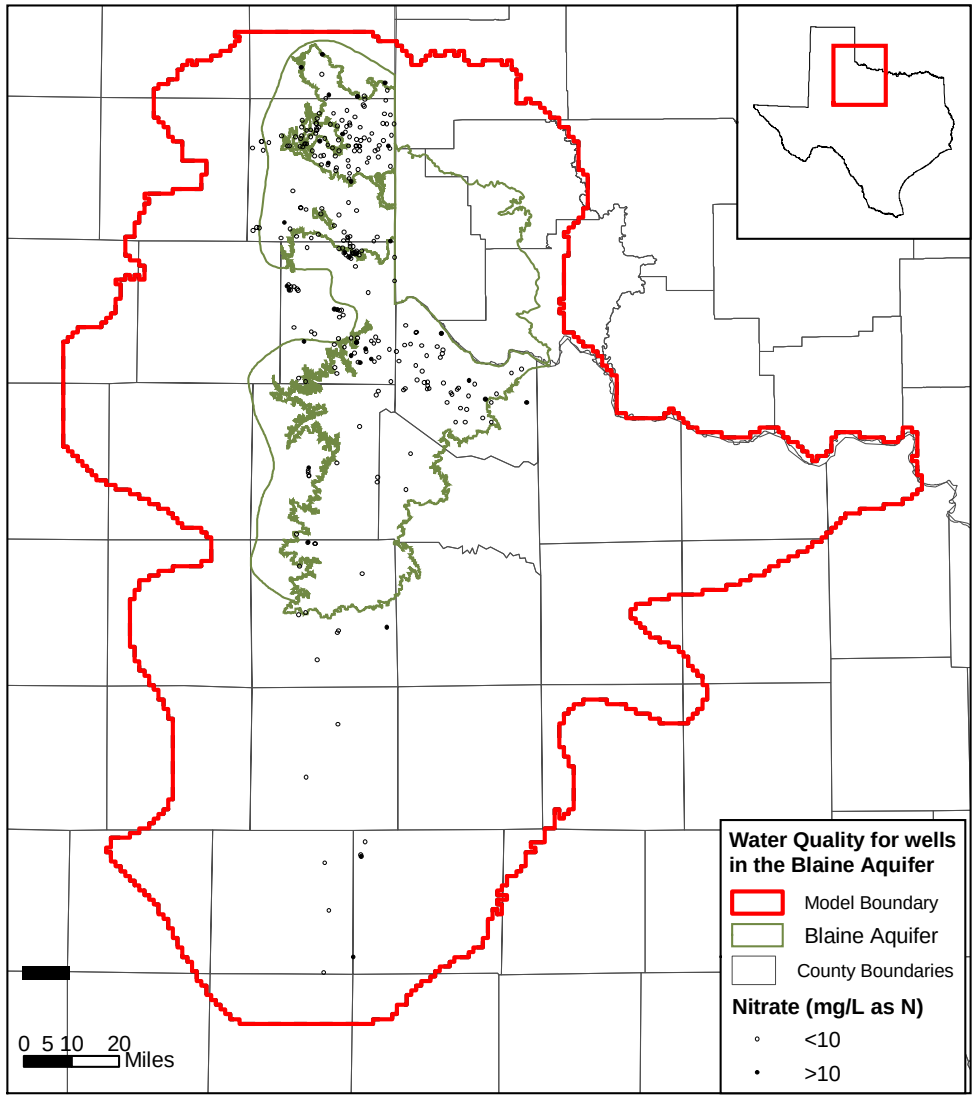
Chloride in the Seymour Aquifer



Blaine Aquifer - Selected Primary MCLs

Water Quality Constituent	Wells Monitored	Screening Level	Wells > S.L.
Nitrate Nitrogen	286	10 mg/L	12%
Selenium	35	0.05 mg/L	11%
Alpha Activity	26	15 pCi/L	8%
Arsenic	35	0.01 mg/L	6%
Fluoride	182	4 mg/L	0%

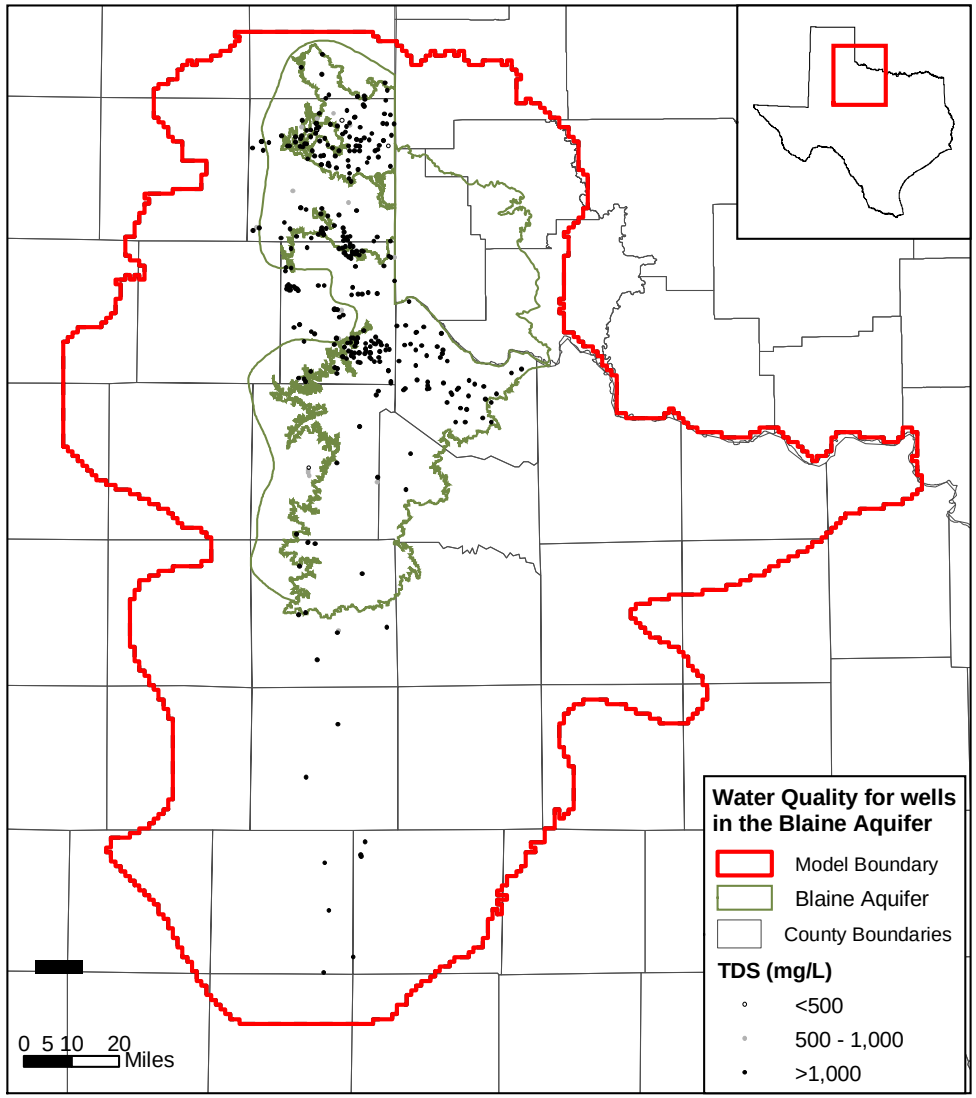
Nitrate Nitrogen in the Blaine Aquifer



Blaine Aquifer - Selected Secondary MCLs

Water Quality Constituent	Wells Monitored	Screening Level	Wells > S.L.
Total Dissolved Solids	363	500 mg/L(EPA)	98%
		1000 mg/L(TX)	94%
Sulfate	428	250 mg/L	97%
Chloride	429	250 mg/L	31%
Iron	47	0.3 mg/L	23%
Manganese	39	0.05 mg/L	8%
Aluminum	32	0.2 mg/L	6%
Fluoride	182	2 mg/L	0.5%

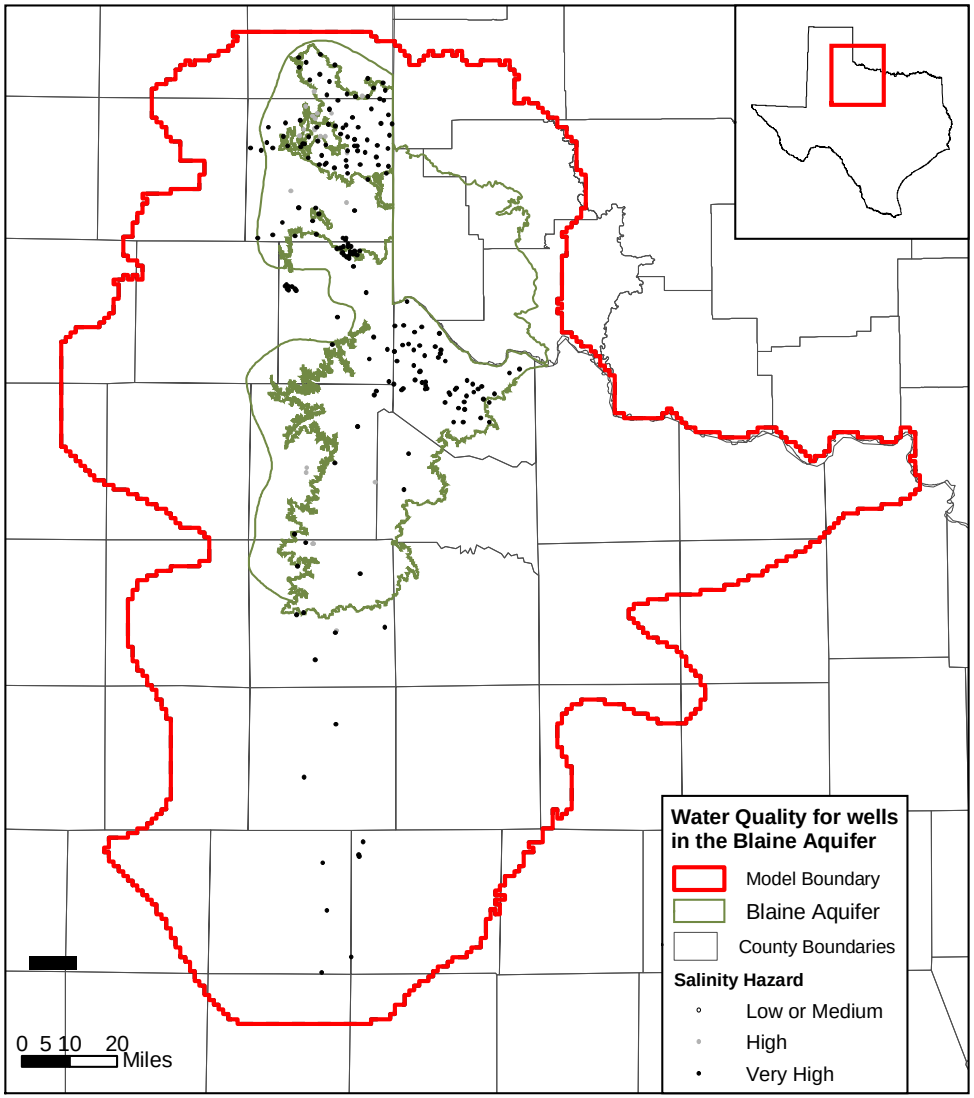
Total Dissolved Solids in the Blaine Aquifer



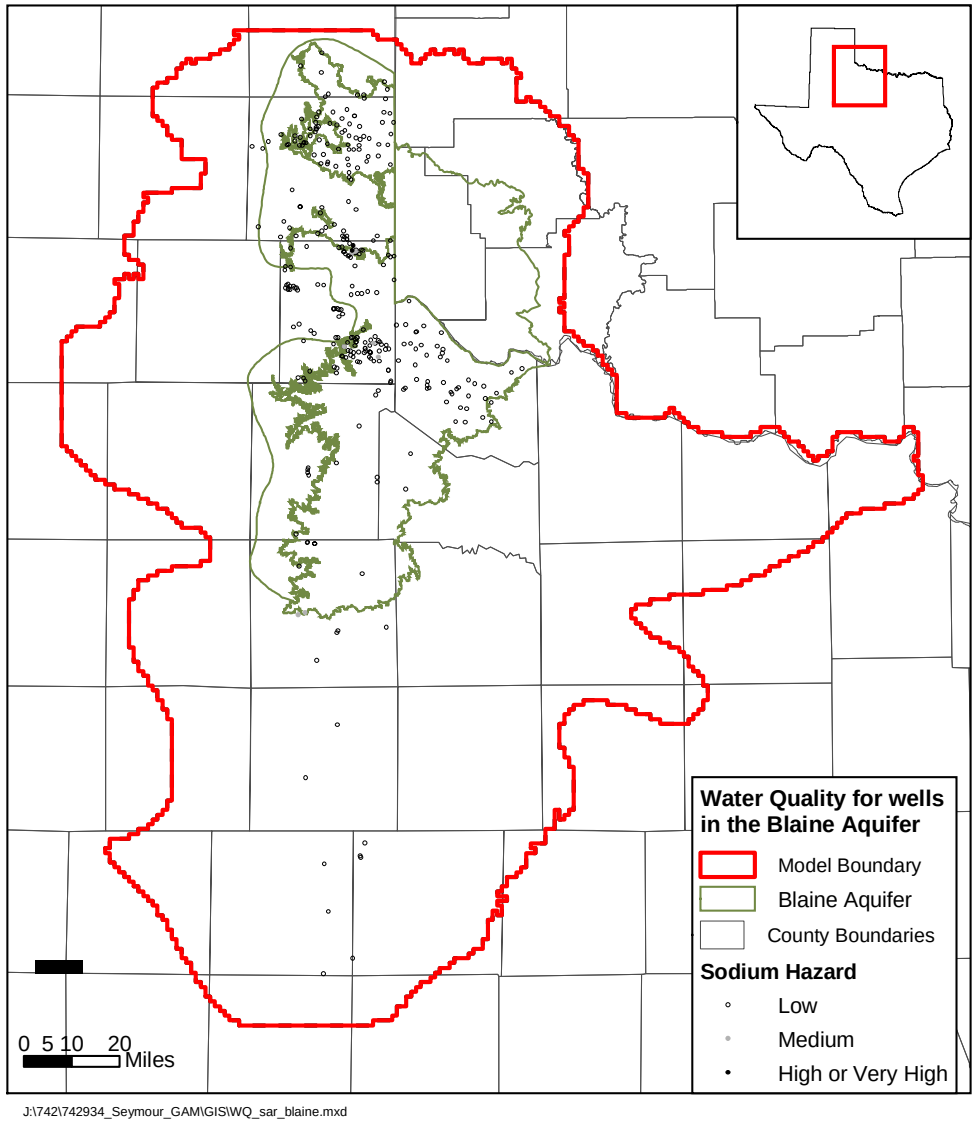
Blaine Aquifer - Irrigation Screening Levels

Water Quality Constituent	Wells Monitored	Screening Level	Wells > S.L.
Salinity Hazard	229	High	100%
		Very High	90%
Sodium Hazard	317	High	0.6%
		Very High	0.3%
Boron	55	1.5 mg/L	13%
		0.75 mg/L	36%
Chloride	429	1000 mg/L	8.4%
		400 mg/L	21%

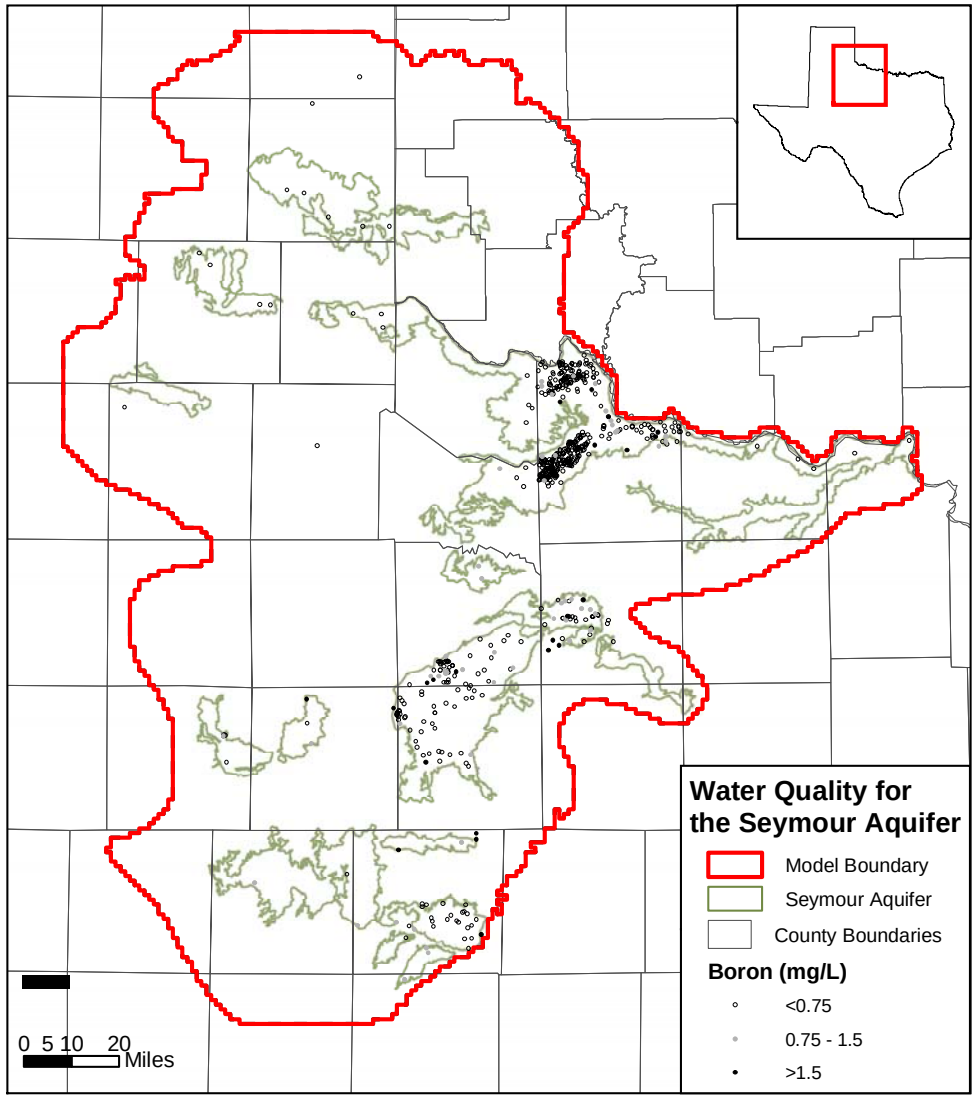
Salinity Hazard in the Blaine Aquifer



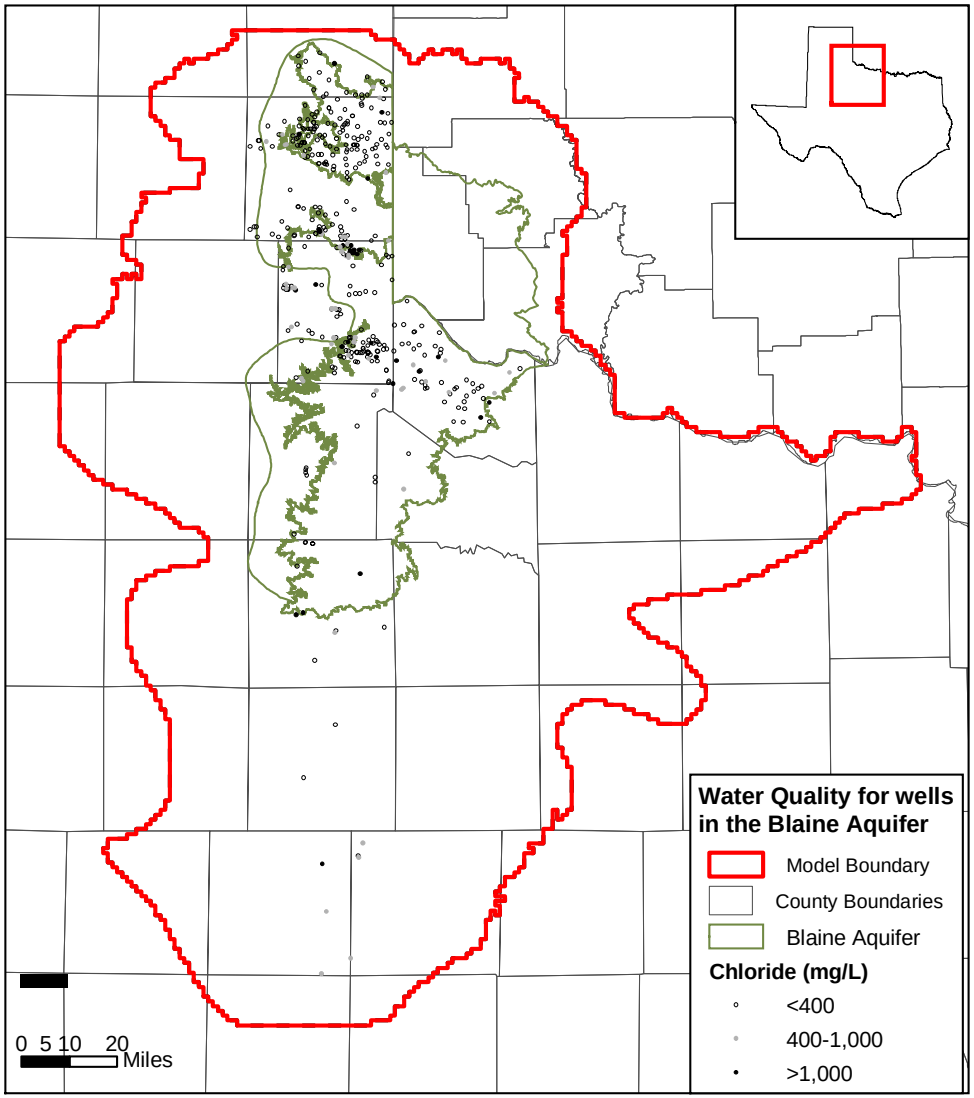
Sodium Hazard in the Blaine Aquifer



Boron in the Blaine Aquifer



Chloride in the Blaine Aquifer



GAM Schedule

- Project start – Nov. 2002
- Draft conceptual model – August 15, 2003*
- Draft conceptual model report – Aug. 31, 2003
- Steady-state model calibration – Nov. 2003*
- Transient calibration & verification – Jan. 2004*
- Predictions – Feb. 2004*
- Draft Model Report to TWDB – Mar. 1, 2004
- TWDB feedback on Draft Report – April 2004*
- Model Training Seminar – Apr. 2004
- Final Model Report to TWDB – Jun. 30, 2004

Note: * means technical review meeting scheduled with the TWDB

SEYMOUR AQUIFER GAM STAKEHOLDERS ATTENDANCE LIST
Stakeholders Advisory Forum #3
Held
October 20, 2003 in Seymour, Texas

NAME	AFFILIATION
Richard Beck	West Central Texas MWD
Dan Craighead	City of Seymour
Tommy Powell	Collingsworth UWCD
Cindy Ridgeway	TWDB
David Meesey	TWDB
Mike McGuire	Rolling Plains GCD
Andrew Chastain-Howley	WPRC
Joe Shephard	City of Seymour
Curtis Campbell	Red River Authority
C. L. Wall	Tri-County Water District
Kirk Dean	Parsons
Nancy Johnson	WPRC

Summary Memorandum Report
Seymour Aquifer GAM
Stakeholders Advisory Forum #3, Seymour, Texas
October 20, 2003

PRESENTATION

The third Stakeholder Advisory Forum was held on Monday, October 20, 2003 at 1:30 p.m. at the Portwood Arts and Civic Center, 800 East Morris Street, Seymour, Texas.

The presentation topics for this form included:

(1)GAM overview and status
(2)Aquifer discharge through pumping (by County)
(3)Water quality in the Seymour and Blaine Aquifers

A summary of questions, answers and other discussion is listed below.

QUESTIONS AND ANSWERS

Q: Curtis Campbell: Why has there been such a large decrease in pumping in Childress County?
A: Kirk Dean: There may have been a decrease in withdrawal, or there may have been a shift in pumping from the Seymour Aquifer to pumping from the Blaine Aquifer. The decrease in Seymour pumping does appear to be offset somewhat by the increase in Blaine pumping in the same period.

Info: C.L. Wall, Mike McGuire: More acreage is now in CRP [the Conservation Reserve Program, administered by the USDA's Farm Service Agency]. The ceiling has been raised for the CRP government program [the most recent renewals were in 1996 and 2002]. There has been very little irrigation in Hardeman County since the program was renewed [in 1996].

Info: Tommy Powell: It's the same for Collingsworth, but now there's growth in irrigated acreage in peanuts, so pumping is still increasing.

Info: Mike McGuire: Motley and Stonewall Counties appear to show the same thing.

Q: Andrew Chastain-Howley: What about Knox and Haskell Counties?
A: Mike McGuire: The rougher ground went into CRP. The good land is still in production.

Info: Kirk Dean: The model and therefore pumping data requirements include some of Oklahoma. They have a permit system for each of the uses, so this is generally easier to distribute than the Texas data.

Q: Curtis Campbell: the Red River Authority has just finished a review of the Red River basin WAM and noticed some QA issues. Are there any problems with data QA in the GAM models, and how is QA/QC being approached?
A: Cindy Ridgeway, Kirk Dean, and Andrew Chastain-Howley: The TWDB has set up the Stakeholder meetings as one of the Quality Control points to get feedback to make sure that major data discrepancies do not occur and to involve stakeholders with local knowledge. There are also internal technical review meetings to review the model data and the models are calibrated against real data. Stakeholder input is very important for model accuracy and validation of data.

Q: Mike McGuire, Tommy Powell: There appear to be areas with consistently high water quality concerns, is there any specific reason for these areas.
A: Cindy Ridgeway and Andrew Chastain-Howley: It appears that there is a water quality issue where the Clear Fork and Pease River Groups underlie the Seymour. Knox and Haskell Counties have been focused on in previous studies so there is lots of data in this location, but Collingsworth hasn't been studied to the same degree. The availability of data is inconsistent from county to county. There are a certain number of sources, and if the information is not there or in the database prior to 1999, it will not have been incorporated. The nitrate levels in Collingsworth County are high in some areas and these are not recorded on the maps in the presentation.

Info: Kirk Dean: The information for the water quality maps are based on TWDB, TCEQ or USGS data.

Info: Tommy Powell noted and expressed appreciation for Andrew Chastain-Howley's technical assistance with data. He also stated his opinion that the GAM is the right approach.

Q: Curtis Campbell: What is the possibility of getting a presentation to Regional Water Planning Groups?
A: Cindy Ridgeway, Mike McGuire, Andrew Chastain-Howley: The 30-day public comment period begins after the consultants turn in the draft conceptual model and TWDB posts it on the web. The internal review and public comment period will be during the same time period, approximately the month of March, 2004. This would probably be the best time as the consultants will have submitted their draft report.

Info: Mike McGuire: Please try to arrange RWPG presentation in March, 2004.

Prepared by: Nancy Johnson and Andrew Chastain-Howley
Date: October 23, 2003