



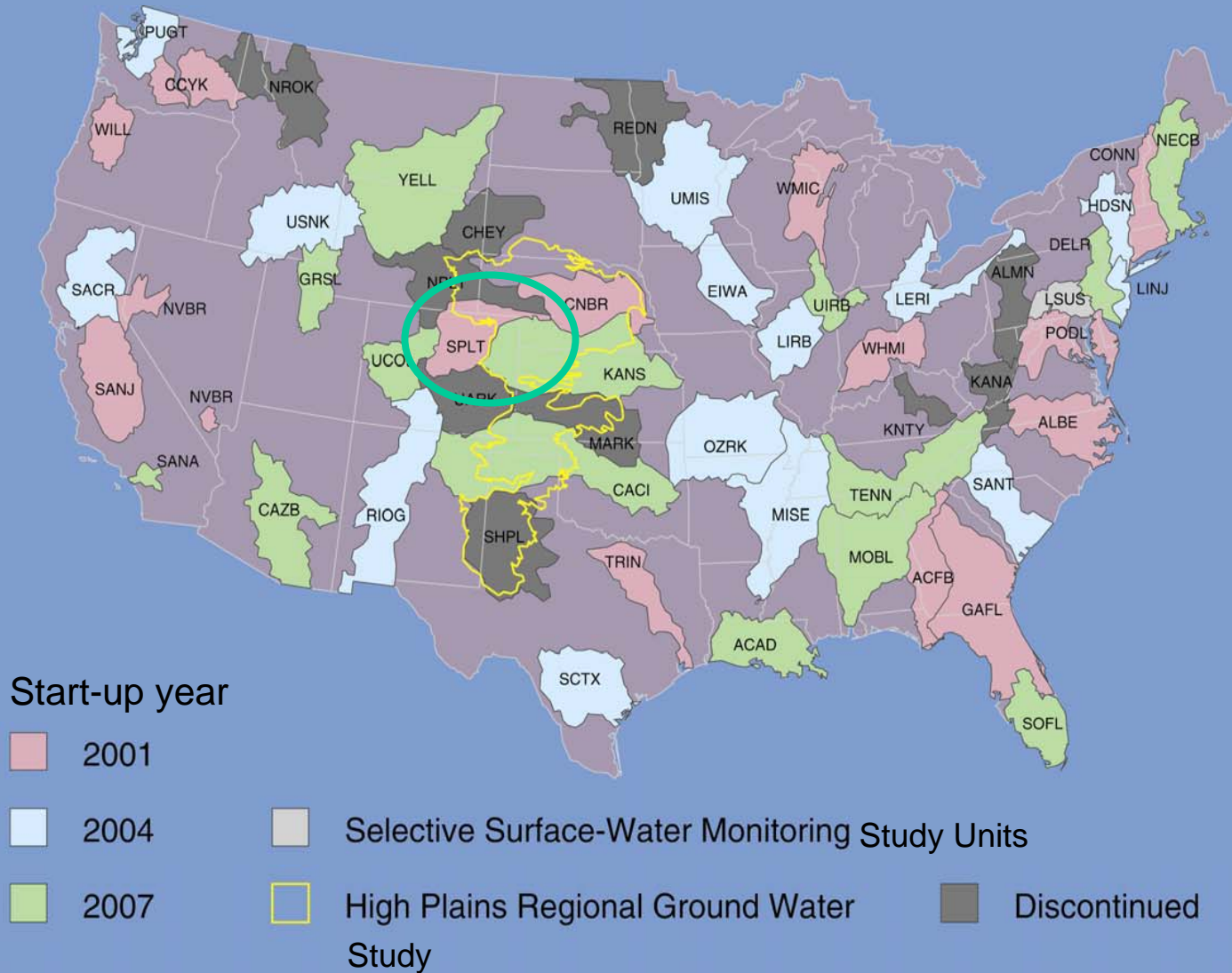
# Ground-Water Quality Trends in the South Platte River Alluvial Aquifer, Colorado

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Colorado Water Science Center, Denver, CO  
2006 National Monitoring Conference**

# NAWQA CYCLE II STUDY UNITS

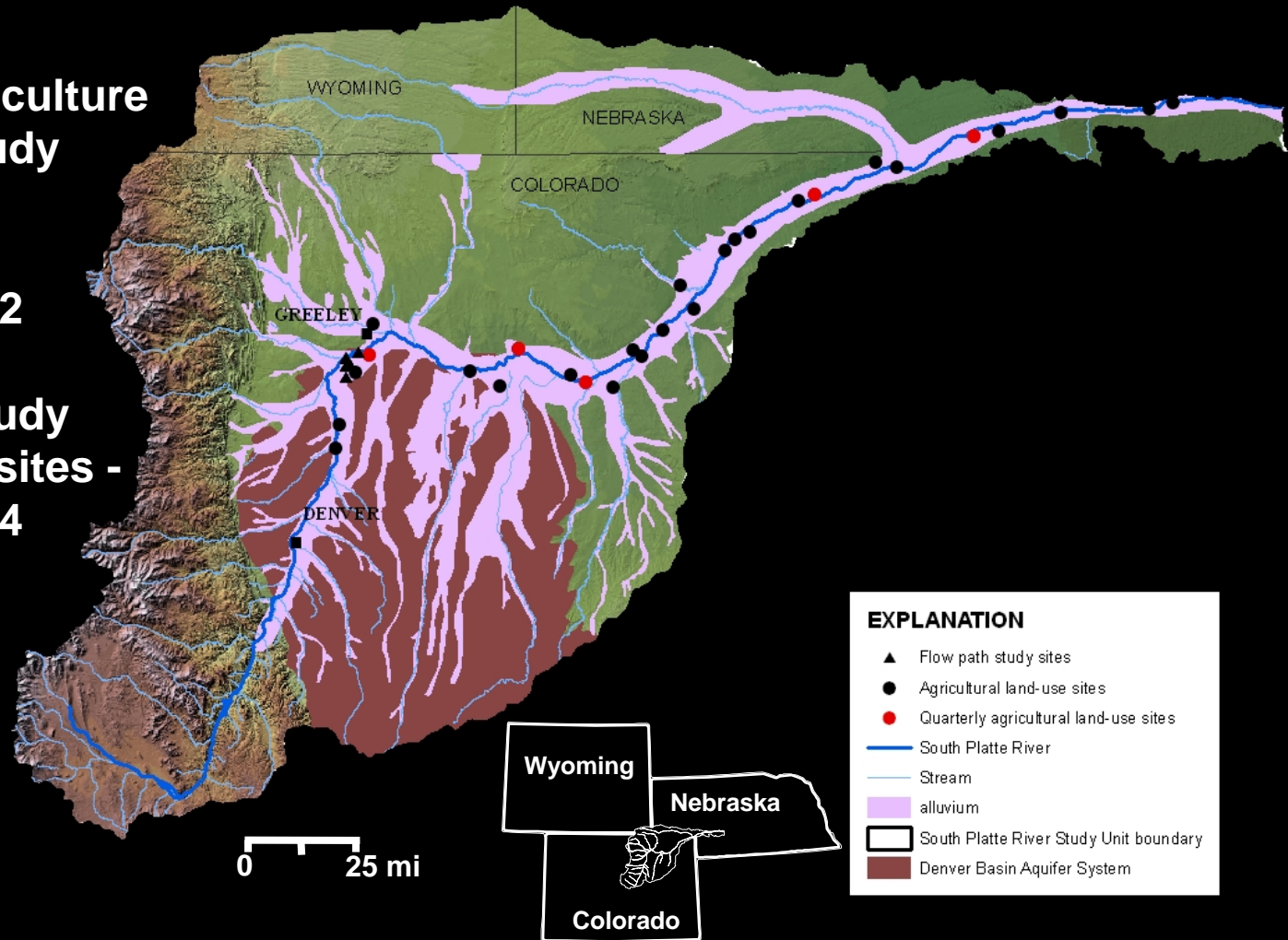


# South Platte Setting



# South Platte Ground-Water Networks

- **Irrigated Agriculture Land-Use Study (AgLUS)**  
29 wells -  
1994 and 2002
- **Flow-Path Study**  
19 wells at 8 sites -  
1993 and 2004





# Irrigated AgLUS - Parameters

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- Field parameters
- Major ions
- Trace metals
- Dissolved organic carbon
- Nutrients
- Pesticides



# Irrigated AgLUS Trends – Nitrate Results

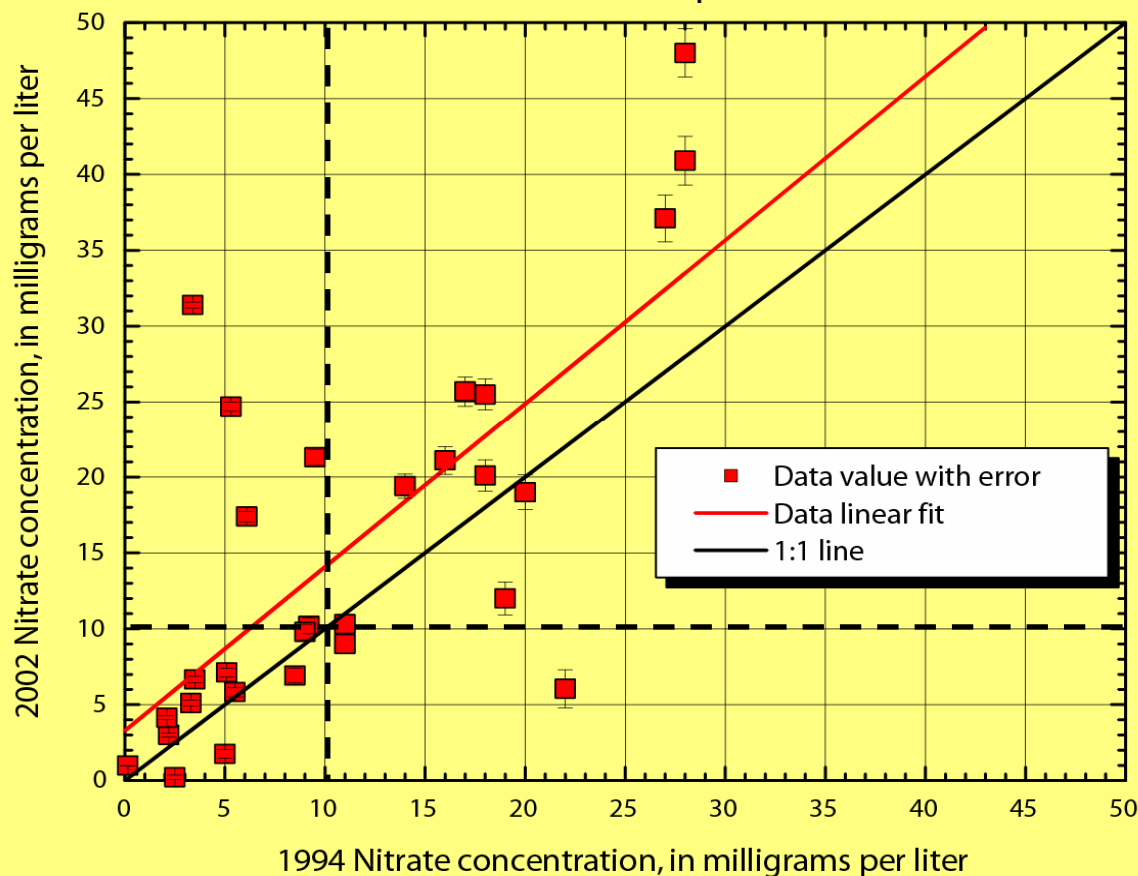
**NO<sub>3</sub> detected  
in all wells  
1994 and 2002**

**1994  
NO<sub>3</sub> > 10mg/L  
in 14/30 wells**

**2002  
NO<sub>3</sub> > 10 mg/L  
in 16/29 wells**



Scatterplot Comparison of Ground-Water Nitrate Concentrations  
South Platte Alluvial Aquifer 1994-2002



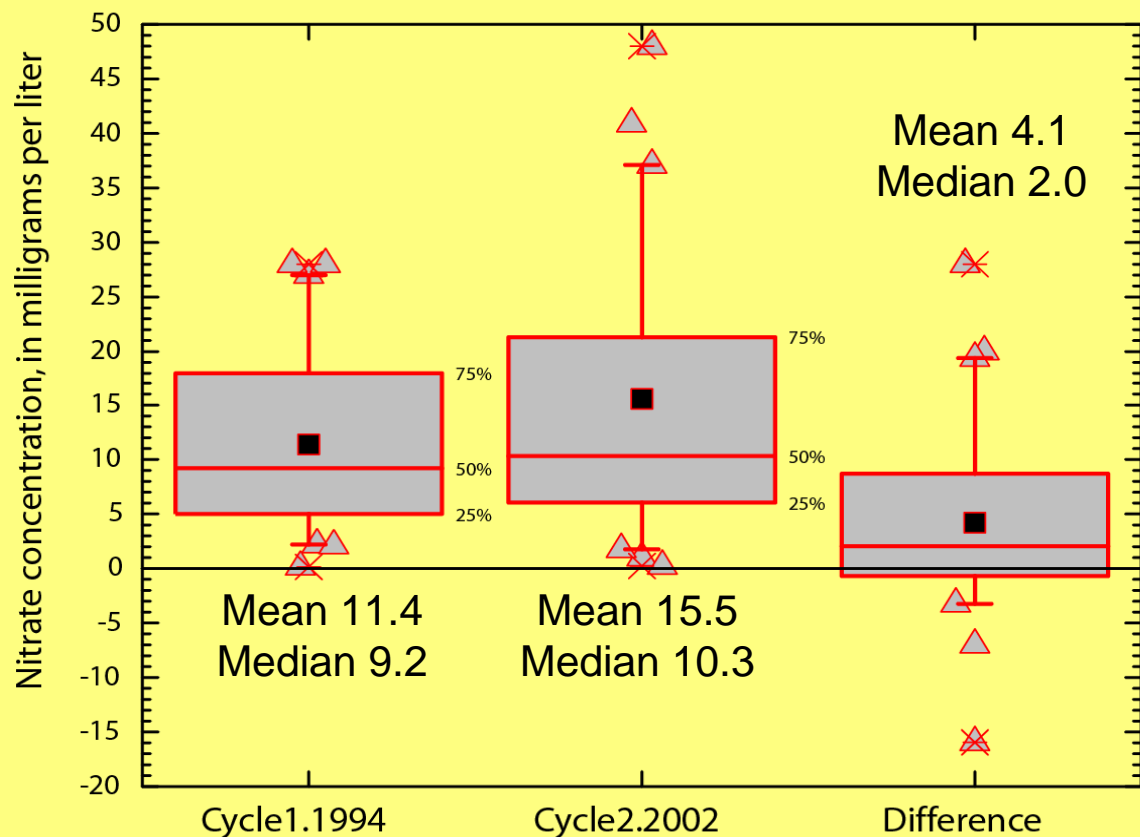
# Irrigated AgLUS Trends – Nitrate Results

**NO<sub>3</sub>  
concentrations  
increased in  
21/29 wells  
decreased in  
8/29 wells**

**NO<sub>3</sub>  
concentration  
increase  
statistically  
significant  
( $p=0.0121$  for 2-  
sided Wilcoxon  
signed-rank  
test)**



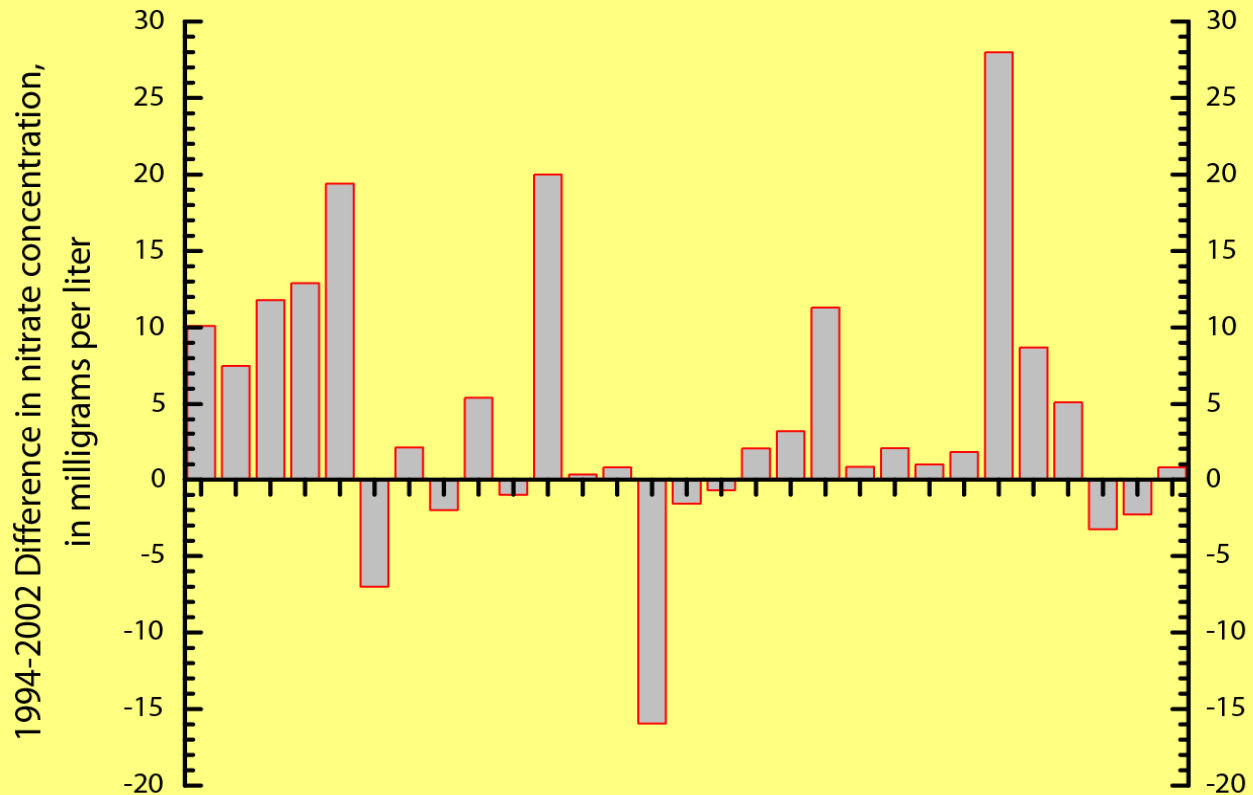
Boxplot Comparison of Ground-Water Nitrate Concentrations  
South Platte Alluvial Aquifer 1994-2002



# Irrigated AgLUS – Upstream to Downstream Nitrate Difference

**NO<sub>3</sub>  
concentration  
increases  
near Greeley  
and  
downstream  
from Ft.  
Morgan**

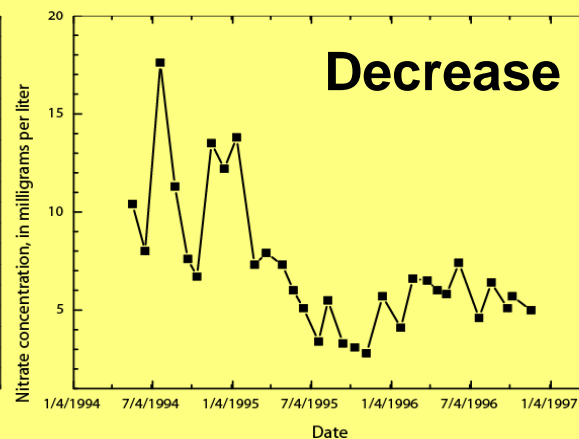
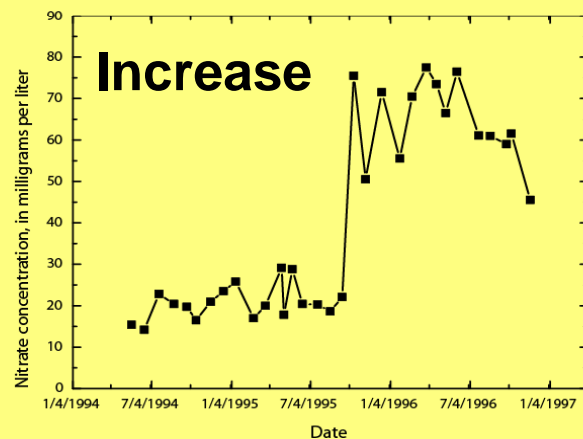
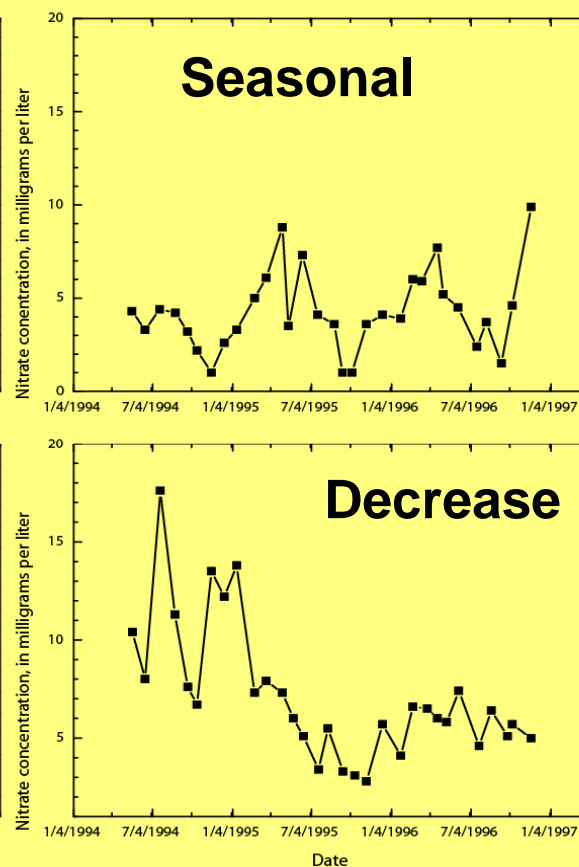
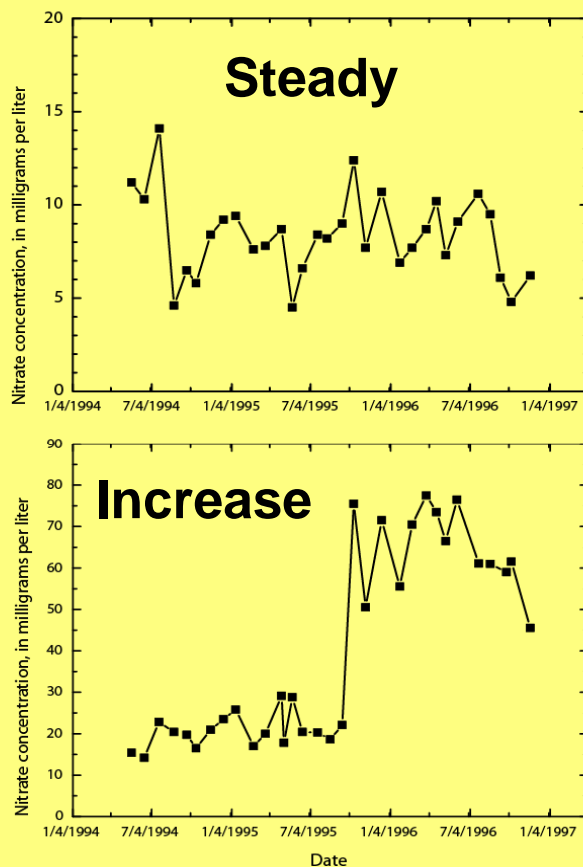
**Further land-  
use analysis  
in progress**





# Irrigated AgLUS – Local affects

Local pumping,  
irrigation, and  
sources affect  
nitrate response  
at individual  
wells



# Irrigated AgLUS Pesticide Detections

	Number of Cycle 1 Detections (30 wells)	Number of Cycle 2 Detections (29 wells)
★ Atrazine	29	28
★ DEA	29	28
★ Prometon	22	25
Alachlor	1	0
Carbofuran	2	5
Cyanazine	1	0
DCPA	1	0
Diazinon	1	0
Dieldrin	1	2
EPTC	2	0
Metolachlor	10	13
Simazine	11	10
Tebuthiuron	5	3

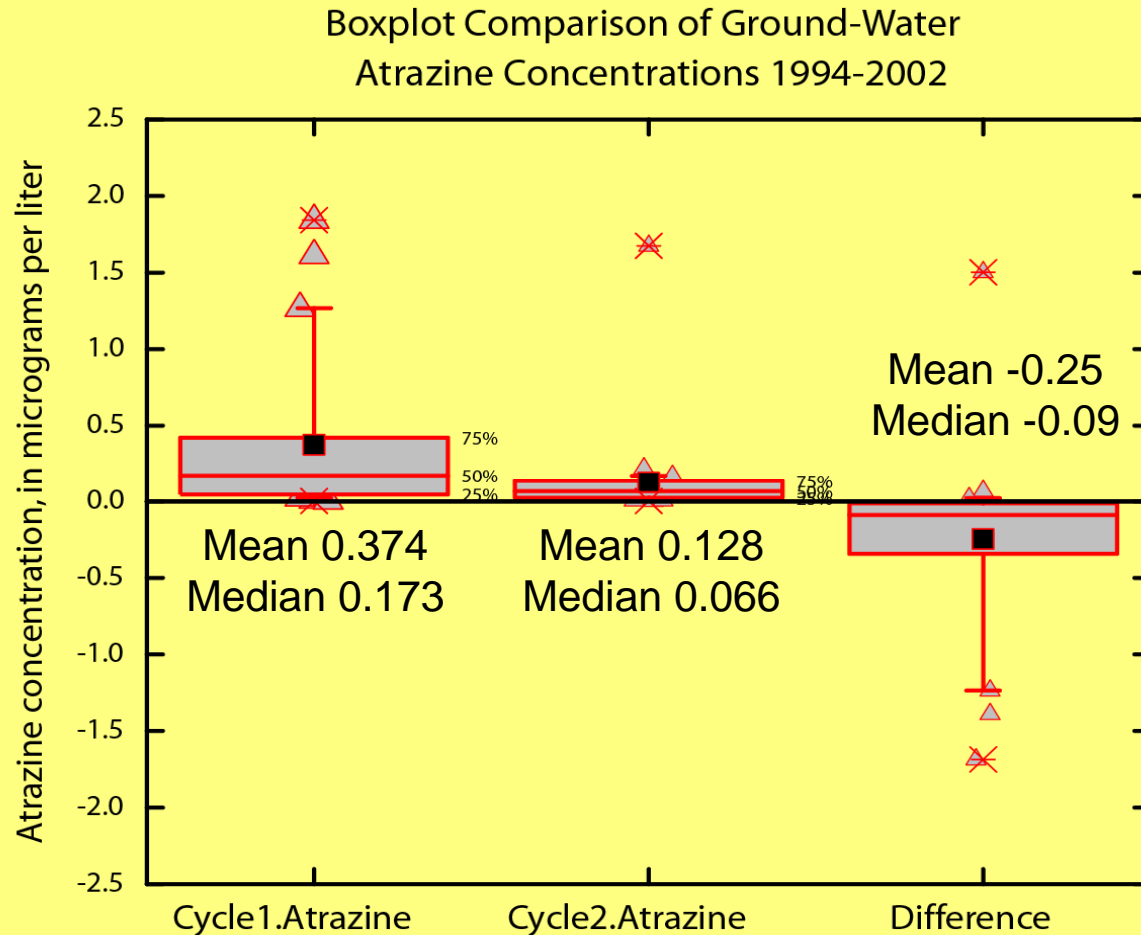
■ 13 pesticides detected in Cycle I, 8 pesticides detected in Cycle II

■ Atrazine, DEA, and Prometon most frequently detected in both Cycle I and Cycle II

# Irrigated AgLUS Trends – Atrazine Results

Atrazine concentrations increased in 4/29 wells decreased in 25/29 wells

Atrazine concentration decrease statistically significant ( $p=0.0004$  for 2-sided Wilcoxon signed-rank test)



# Irrigated AgLUS – Upstream to Downstream Atrazine Difference

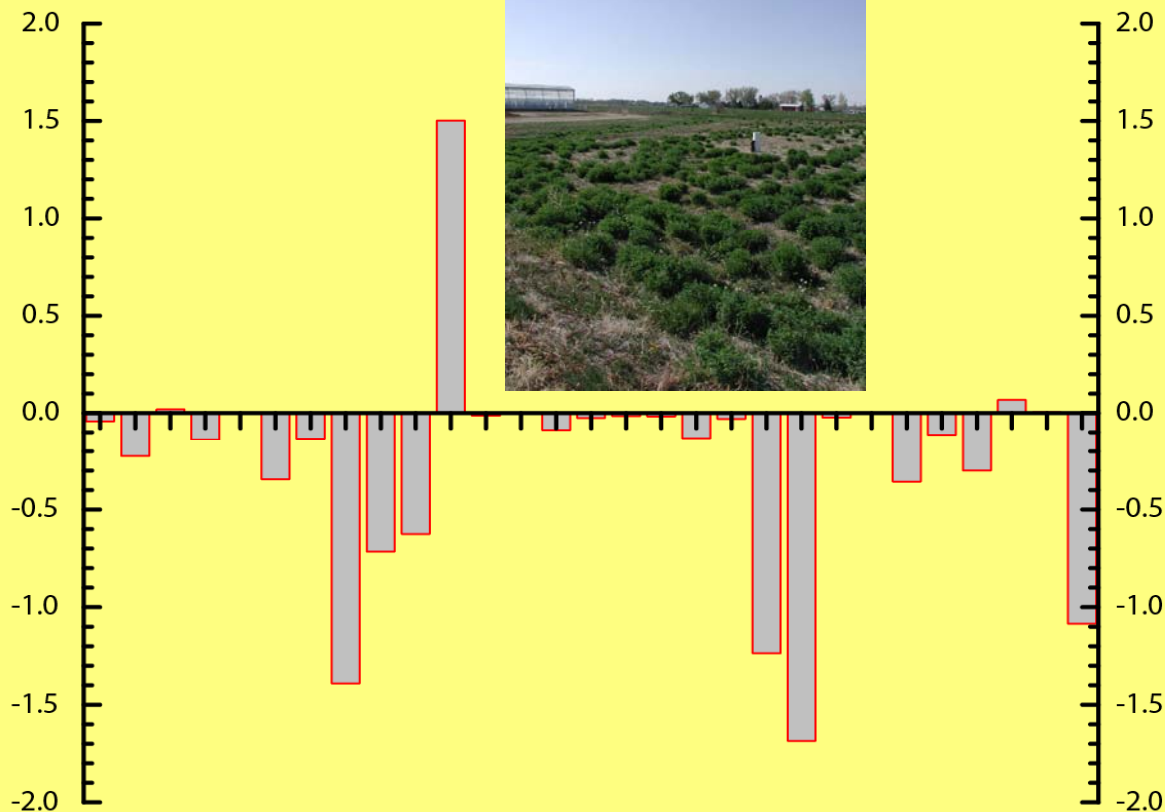
**Atrazine concentrations decreased in 25/29 wells**

**Only one significant increase**

**Re-labeling of atrazine in 1990s possible explanation for decrease**



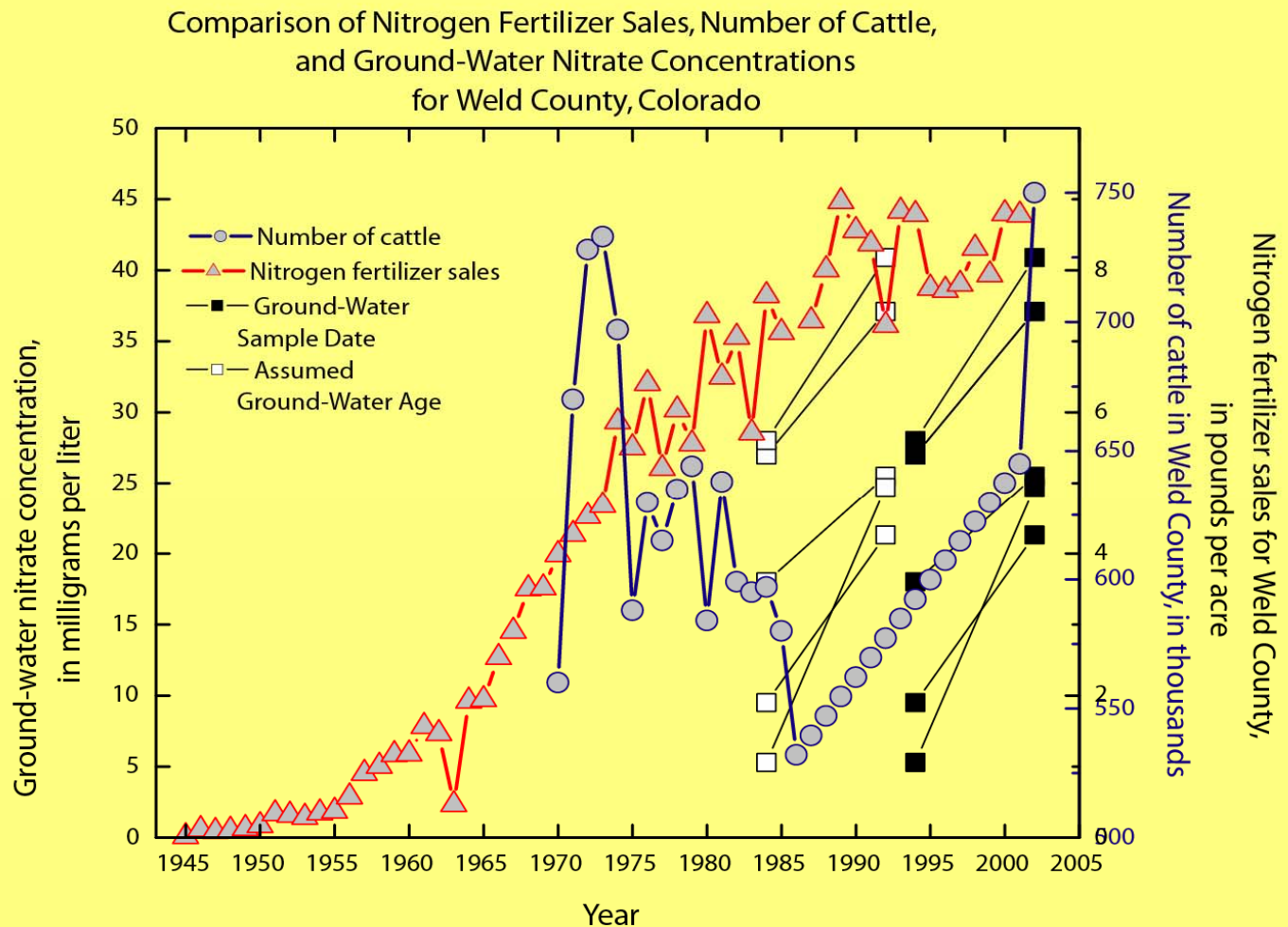
1994-2002 Difference in atrazine concentration,  
in micrograms per liter



# Irrigated AgLUS Trends – Explanations?

Increase in  
nitrate  
accompanied  
by decrease in  
pesticides

Increase in  
fertilizer sales  
and cattle  
production





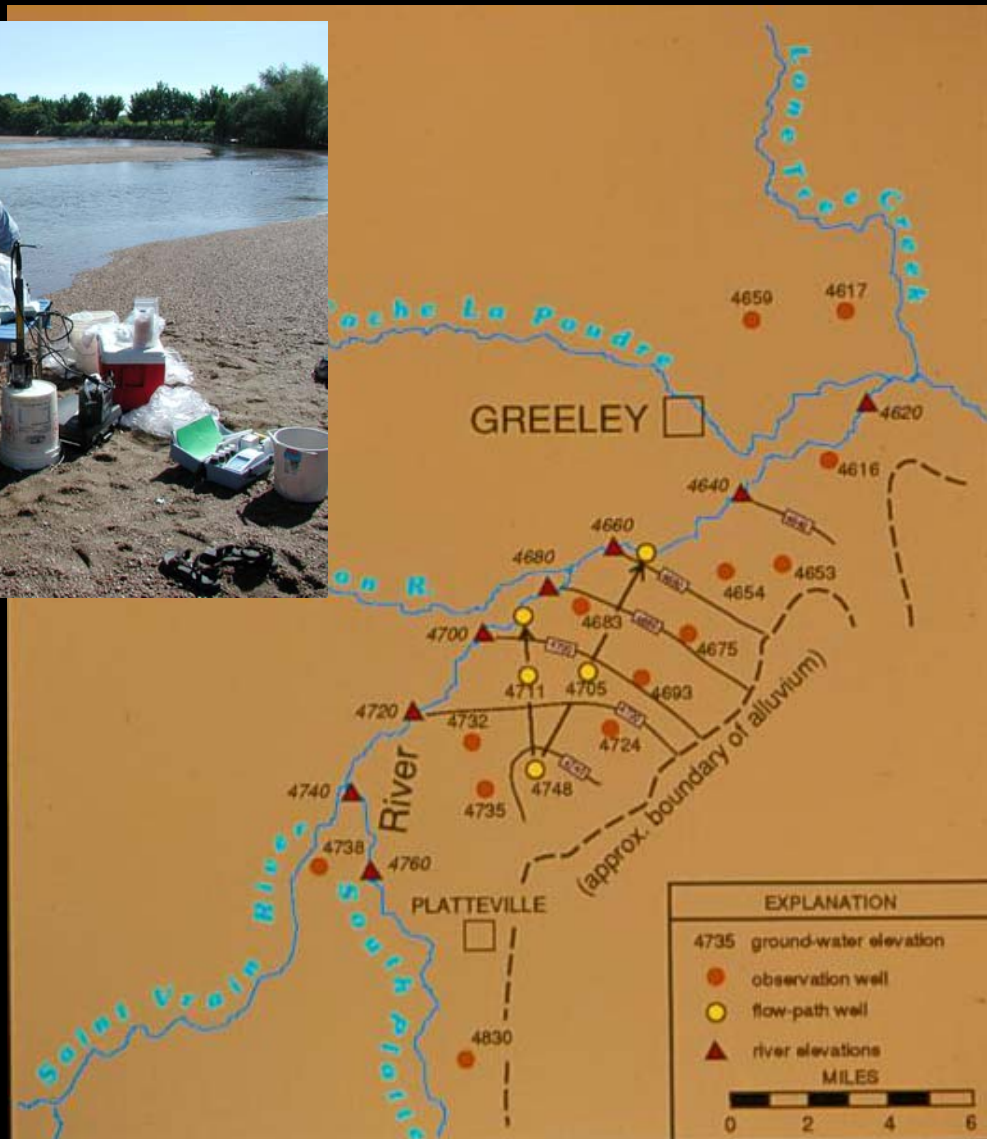
# South Platte Flow-Path Study

Monitoring well  
nets along 2  
flow paths

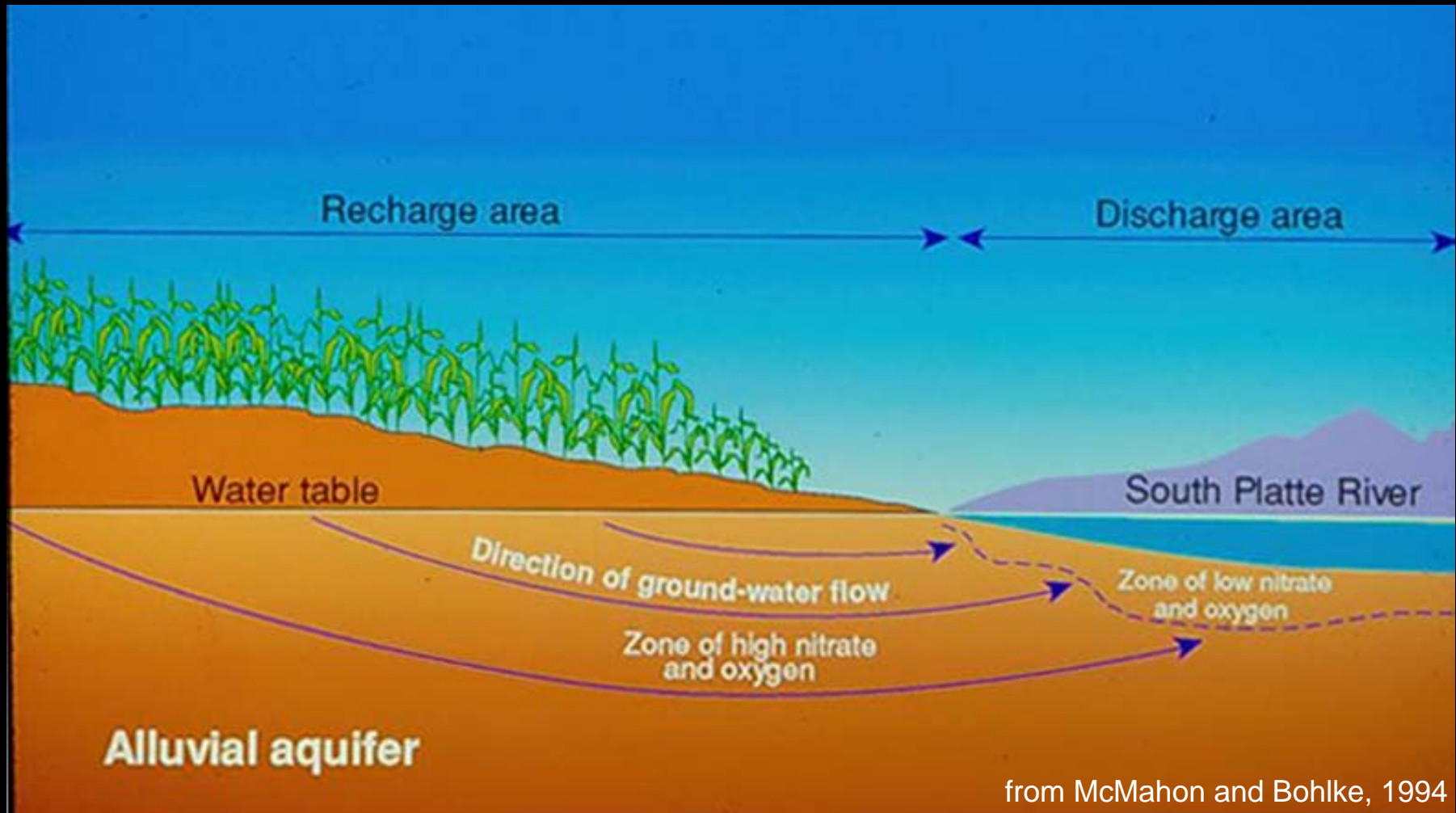
Sampled in 1993  
and 2004 to  
examine spatial  
trends and  
travel time



- Major ions
- Nutrients
- Pesticides
- Trace elements
- Nitrogen isotopes
- CFCs
- Dissolved gases



# Fate and Transport of Nitrate in South Platte Alluvium



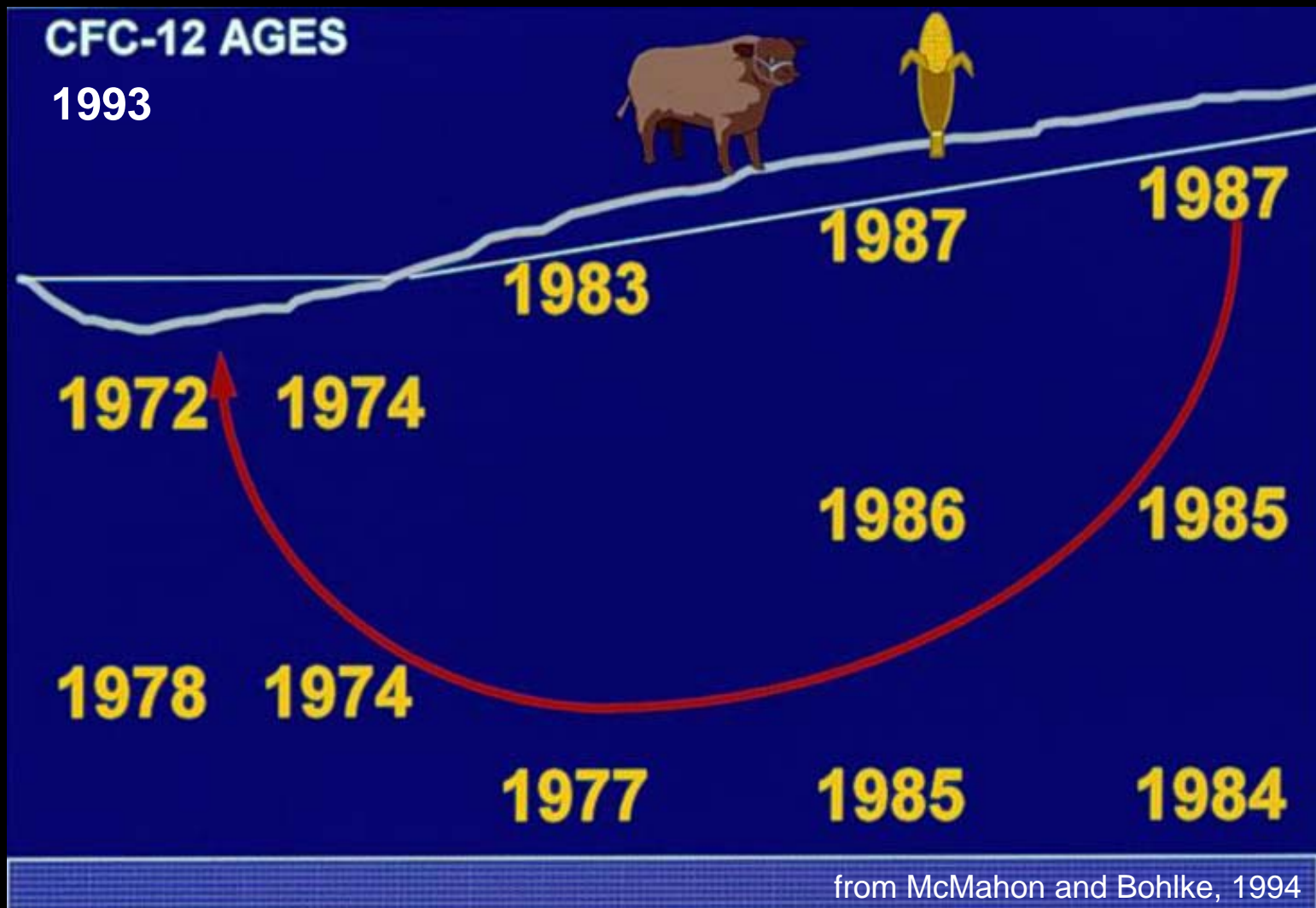
# Flow-Path Ground-Water Age Results

CFC-12 AGES

1993

Travel time  
to terrace  
= 6-14 years

Travel time  
to discharge  
(floodplain)  
= 21-34 years



from McMahon and Bohlke, 1994

# South Platte GW Trends – Conclusions

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- Nitrate concentrations increased in South Platte alluvial aquifer from 1994 to 2002.
- Atrazine concentrations decreased in South Platte alluvial aquifer from 1994 to 2002.
- Increase in nitrate is plausibly caused by an increase in cattle production and associated use of manure fertilizer.
- Decrease in pesticide concentrations possibly caused by re-labeling and associated reduction of atrazine application rates.
- Flowpath study results indicate 21-34-year ground-water travel times from recharge to floodplain.



**Questions?**  
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