

# Management Actions Available to Address Elevated Sulfate in Groundwater and Surface Water within the Lower Horse Creek Basin



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Horse Creek Stewardship Program; Technical Advisory Group  
Bradenton, August 4, 2010

An aerial photograph of a lush, green landscape. A winding stream flows through the center, surrounded by dense trees and vegetation. A road or path is visible on the right side, cutting through the forest. The overall scene is a mix of green fields, dense woods, and a waterway.

## ▪ On-Going Progress To-Date

- **Groundwater/Surface-Water Quality: Characteristics, Reconnaissance, and Sampling**
- **Landowner/Corporation Sulfate Sampling Cooperation**
- **Available Management Actions (FARMS Program)**
- **Monitoring Support**

# Groundwater/Surface-Water Quality Background: Characteristics, Reconnaissance, and Sampling

## Water Use Permit Review: Horse Creek Basin – South of SR 64

- Approx. 430 WUP wells (Upper Floridan Aquifer), 286 wells w/total depths >500 ft
- Reported well sulfate values range from 59 – 1,510 mg/L
- Priority wells/properties selected based on water quality, permitted, and actual pumpage amounts

## 2008 Reconnaissance Surface-Water Sampling

Objective: Locate the potential sources of elevated sulfate affecting Horse Creek and its tributaries

Collect water samples from direct runoff and base flow derived from agricultural irrigation well water

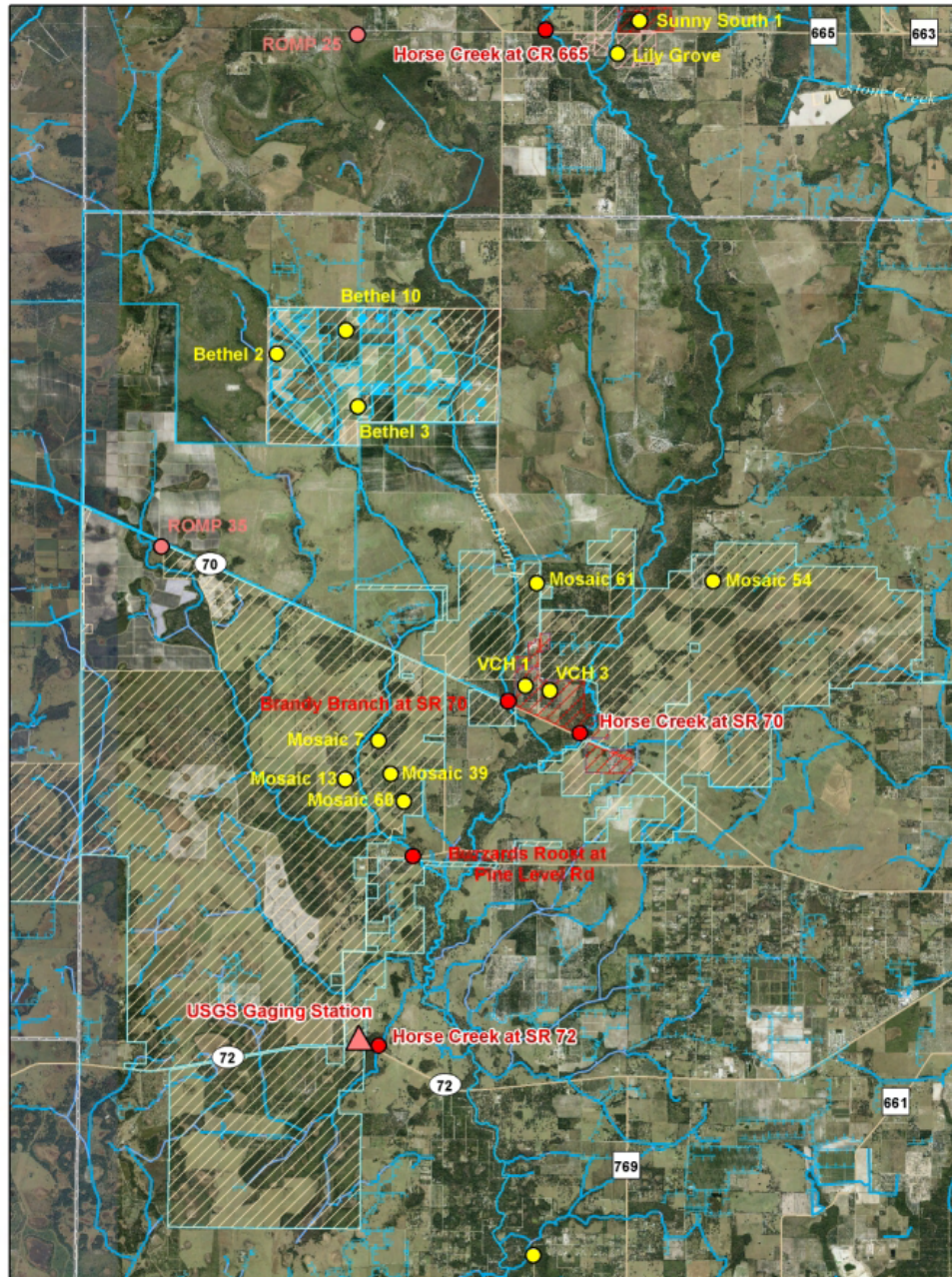
Determine geographic areas (farms) where potential sources of elevated sulfate levels in surface water are present based on field samples



# Cooperative Agricultural Well Sampling Network

FARMS personnel contacted and interviewed prospective corporation representatives & landowners of various agricultural WUPs within the lower Horse Creek basin to inform them of the need to perform reconnaissance sampling to assess the areal distribution of elevated sulfate concentrations in groundwater and its subsequent effect to the water quality of Horse Creek.

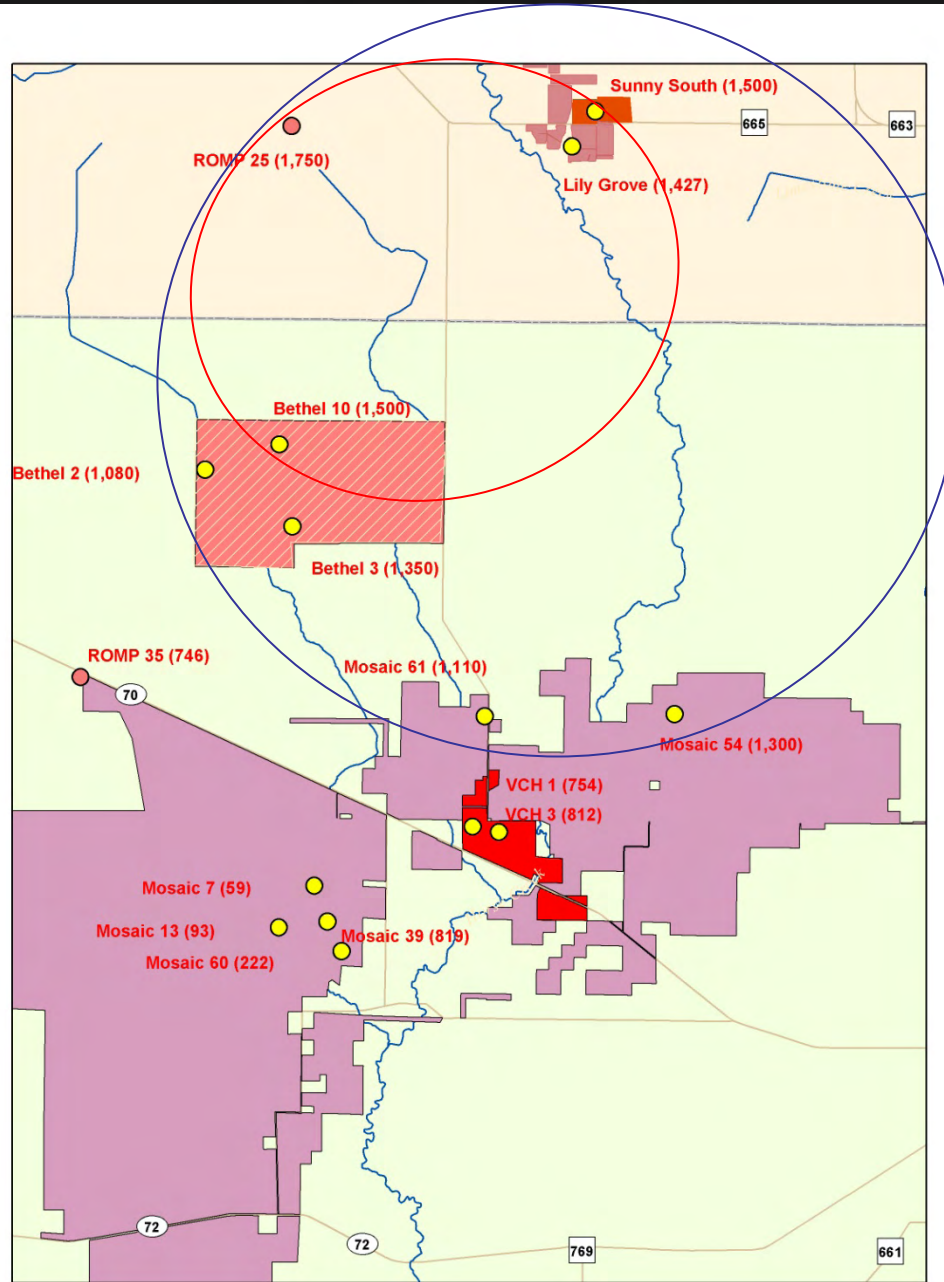
- Mosaic Phosphate MP, Inc.
- Bethel Farms Limited
- V.C. Hollingsworth
- Sunny South Packing Company
- Latt Maxcy Corporation (Lily Grove)



Upper Floridan Aquifer Sulfate Reconnaissance Data-Collection Network and Participating Corporations & Landowners, Lower Horse Creek Basin

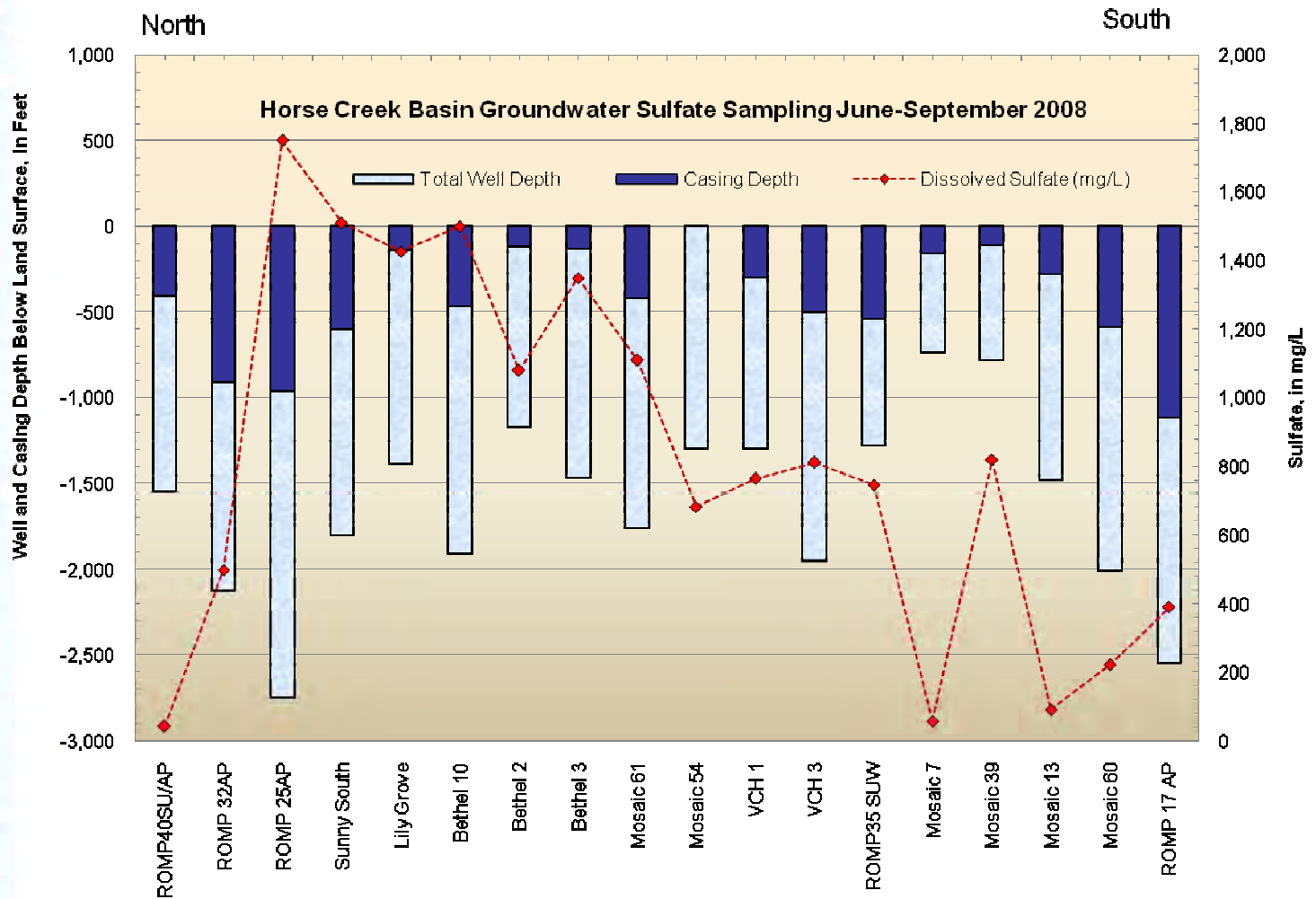
## Results of the Lower Horse Creek Upper Floridan Aquifer Sulfate Reconnaissance Sampling, May-September 2008

• Mosaic Phosphate – 6 wells	59 – 1,110 mg/L
• Bethel Farms – 5 wells	1,080 – 1,500 mg/L
• V.C. Hollingsworth – 2 wells	764 – 812 mg/L
• Sunny South Corp. 1 well	1,510 mg/L
• Lily Grove 1 well	1,427 mg/L
• ROMP 40	44 mg/L
• ROMP 32	498 mg/L
• ROMP 25	1,750 mg/L
• ROMP 35	746 mg/L
• ROMP 17	390 mg/L

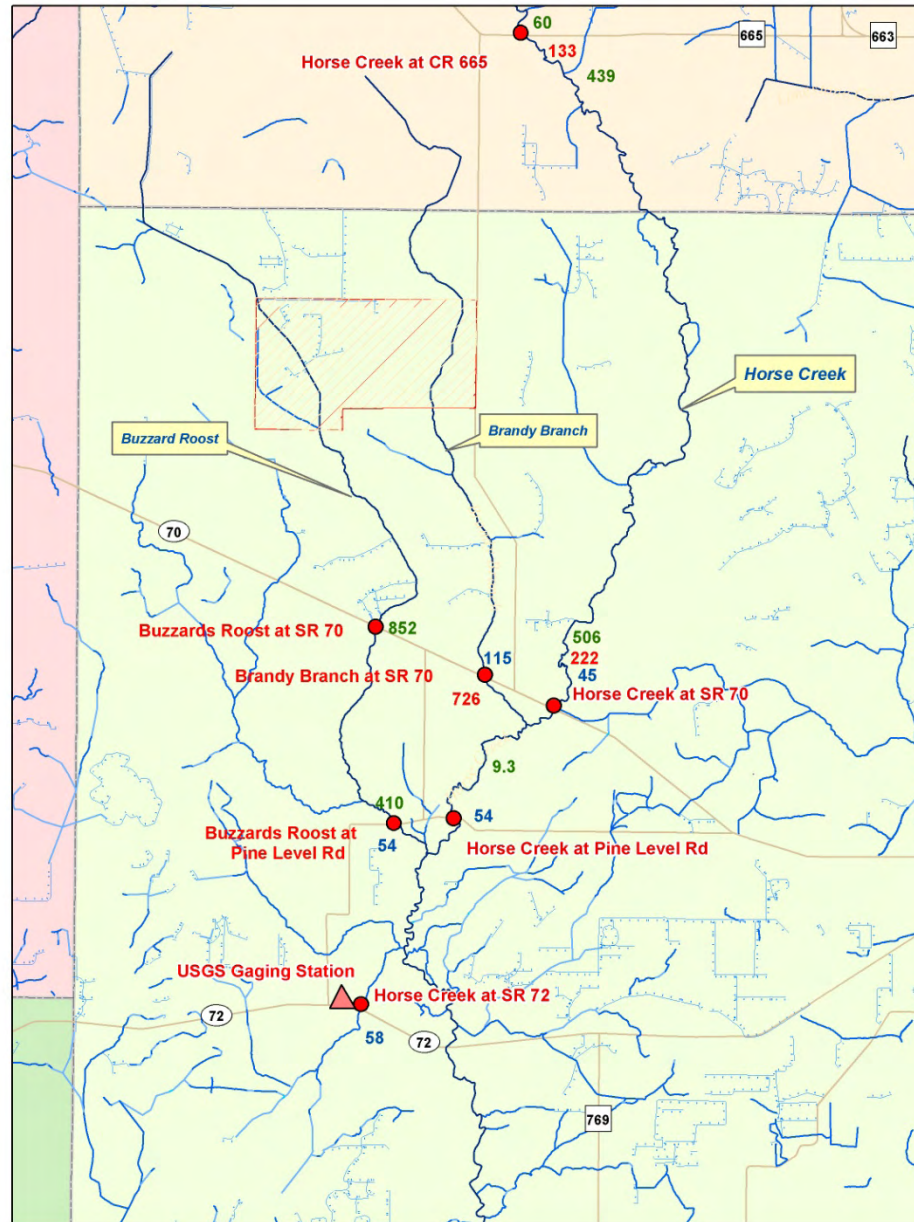


**Areal Distribution of Upper Floridan Aquifer Sulfate Concentrations  
--Reconnaissance Groundwater Sampling, May-September 2008**





**North to South Trending Upper Floridan Aquifer Sulfate Concentrations and Sample Well Construction, Reconnaissance Sampling, May-September 2008**

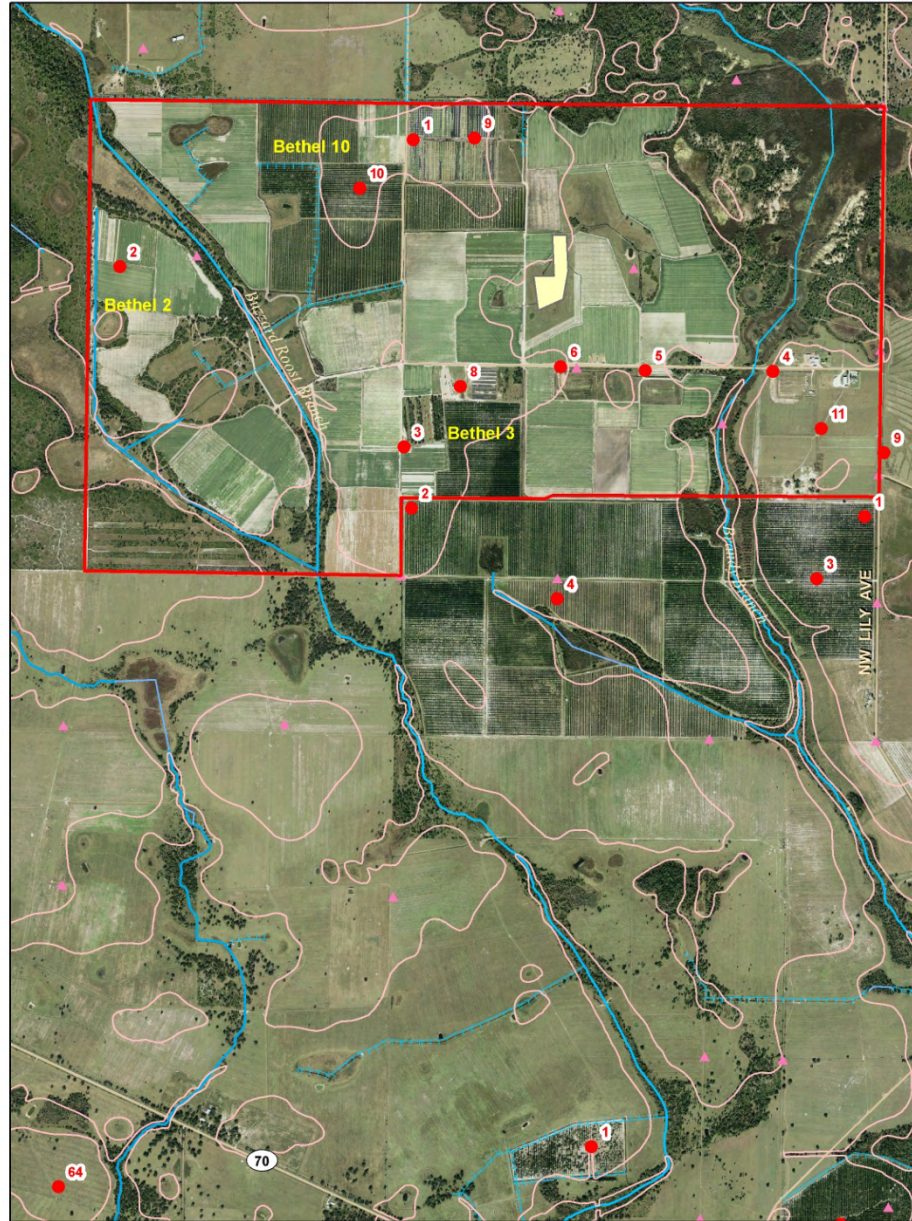


Reconnaissance Surface-Water Sampling Locations and Values,  
 January, June, and September 2008

## **Bethel Farms--A Site Specific Management Action Used to Reduce Sulfate Concentrations Draining to Brandy Branch and Buzzard Roost Branch, Tributaries to Horse Creek**

### **Site Specific Problem:**

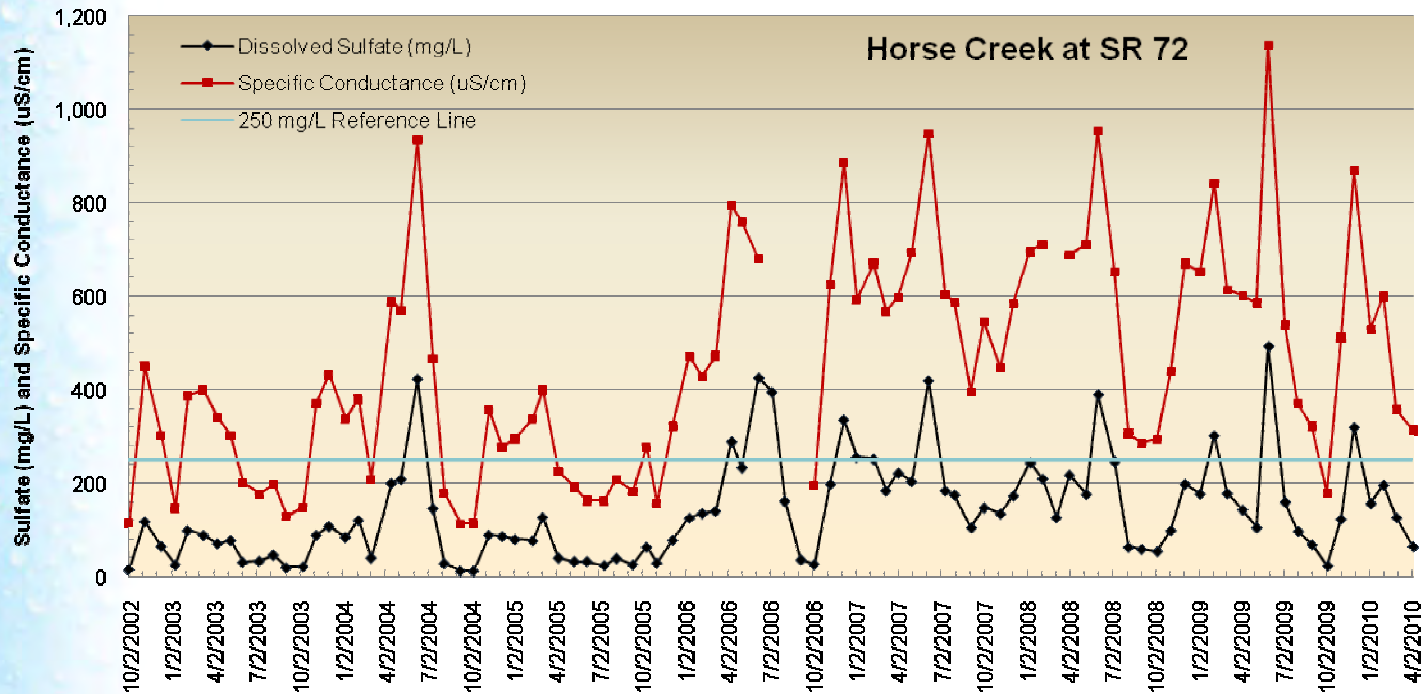
- Sulfate concentrations in irrigation groundwater at five sampled Bethel Farm wells ranged from 1,080 to 1,500 mg/L.
- Historical turf farming practices implemented at Bethel Farms involved periodically flooding fields with sulfate enriched irrigation water that would subsequently runoff into adjacent Brandy Branch and Buzzard Roost Branch channels.
- Enhanced recharge to the water table by irrigation water resulted in enriched sulfate concentrations in base flow to Brandy Branch and Buzzard Roost Branch.
- Shallow-depth of underlying geologic 'hard pan' layer facilitated soil saturation and subsequent base-flow discharge to Brandy Branch and Buzzards Roost Branch



**Bethel Farm**  
Drainage to Brandy  
Branch and Buzzard  
Roost Branch

# Sulfate Level Attenuation Downstream at SR 72

## Spring-Summer Low Flow Increases



## **FARMS Management Action--a *Cooperative Two-Part Solution:***

- 1) Cost-share eight electronic precision irrigation weather station and soil-moisture probes systems to reduce duration and frequency of pumping.
- 2) Cost-share equipment: pumps, filters, engines, PVC piping for a 5-acre tailwater recovery pond to augment groundwater withdrawal with surface water.
- 3) Extensive ditching network to capture tailwater from adjacent fields.

### **NRCS Equip Program**

- 1) In 1997, the NRCS Equip Program cost-shared with Bethel Farms a network of underground drainage tiles that provides for more efficient sub-surface irrigation to 500-acres.
- 2) NRCS designed and cost-shared the construction of the 5-acre tailwater pond.



**Bethel Farms Weather Station and Soil Moisture Probe**

# **District Management Actions Available to Reduce Sulfate Concentrations Originating from Groundwater Irrigation**

Three District Programs:

- Well Back-Plugging Program
- Quality of Water Improvement Program (QWIP)
- Facilitating Agricultural Resource Management Systems (FARMS) Program



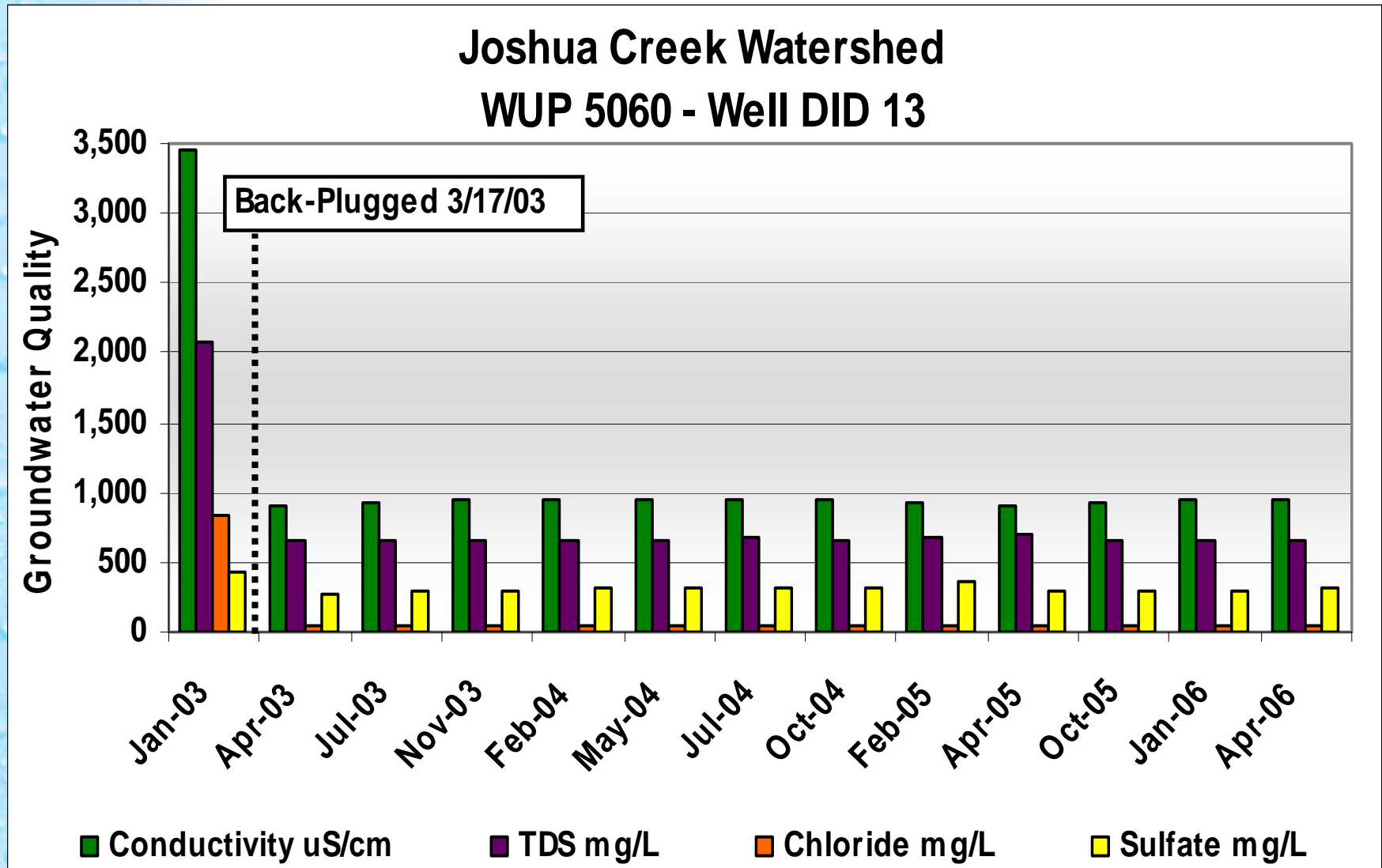
# Well Back-Plugging

- Funding assistance provided
- Max. reimbursement \$6,500/well
- Designed to back-plug wells to improve water quality
  - 1,000 uS/cm specific conductance goal for each well
  - To date 46 wells have been back-plugged in Shell, Prairie, and Joshua Creek watersheds
    - Avg. reduction in Cl = 66%
    - Avg. reduction in TDS = 47%
    - Avg. yield loss = 23%



# Pre- and Post Well Back Plugging Results

Highly Effective to Reduce Chloride, but Limited Effects on Sulfate



# Quality of Water Improvement Program

- Established in 1974 to improve impacted water quality due to improper well construction or abandoned flowing wells
  - 45 wells plugged (total plug) in SPJC watersheds
  - Long-term program with approximate annual funding level of \$650,000
  - Maximum reimbursement \$5,000/well

# FARMS Program

- FARMS is a BMP cost-share reimbursement program for agricultural projects District-wide
  - Reduce groundwater withdrawals
  - Improve water quality
  - Conserve, restore, or augment water resources and improve natural system functions
- Provides up to 75% reimbursement for project costs
- Total funding for FY2010 1.05M

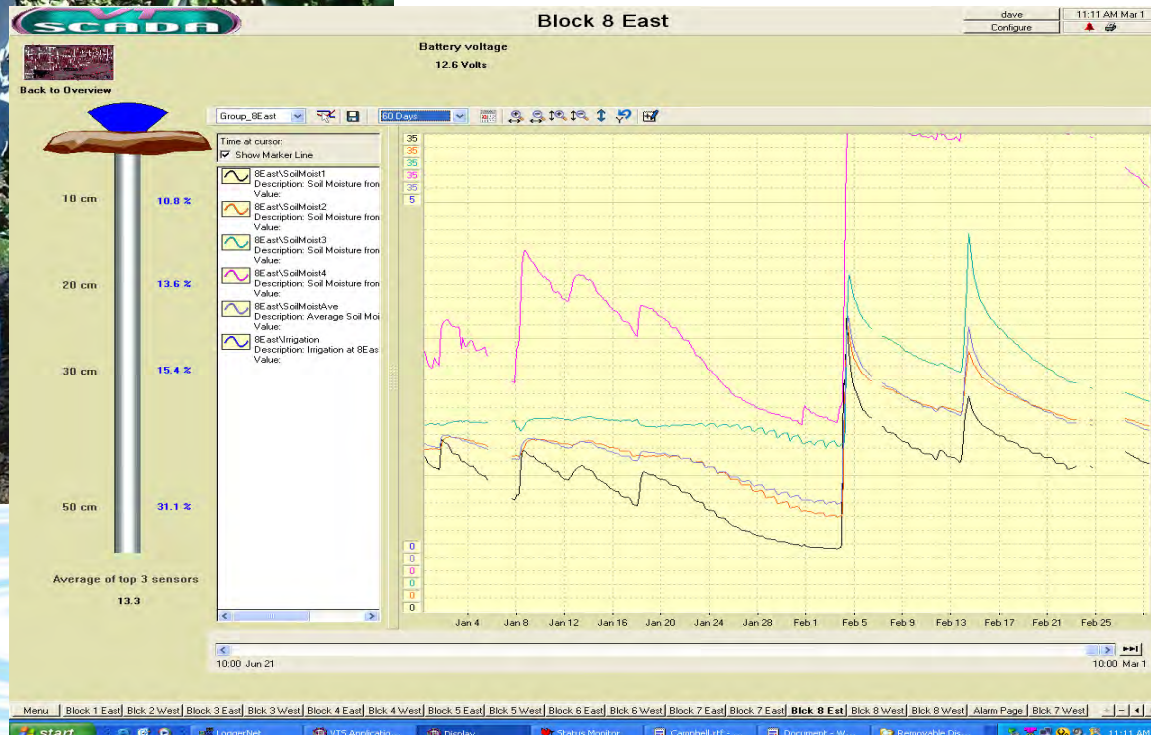
# FARMS Program Status

- Three priority areas in the District
  - Upper Myakka Watershed
  - Shell, Prairie, and Joshua Creek Watersheds
  - Dover/Plant City Area (Pending Board Approval Frost/Freeze Rules)
- District-wide expansion of FARMS in FY2008 beyond SWUCA
- Projects
  - 91 Board approved projects
  - 63 Complete and operational projects
    - Approx. 9.7 mgd of ground-water use offset as of June 2010

# What does FARMS Fund?



- Precision Irrigation
  - Soil moisture meters
  - Auto pump starts/valves





- Alternative Supplies
  - Surface water
  - Tailwater recovery
- Requires agricultural reservoirs

## On-going Management Actions Being Pursued

- Follow-up contact with landowners of sampled wells in the Horse Creek basin to discuss sulfate sampling results and available FARMS Program water-quality/ quantity options.
- The FARMS Program is actively pursuing projects throughout the District and encouraging cooperation with various agencies, agricultural interest, and individuals to reduce groundwater withdrawals, improve water quality, and facilitate natural systems.
- FARMS staff are available to talk to all interested organizations/groups.





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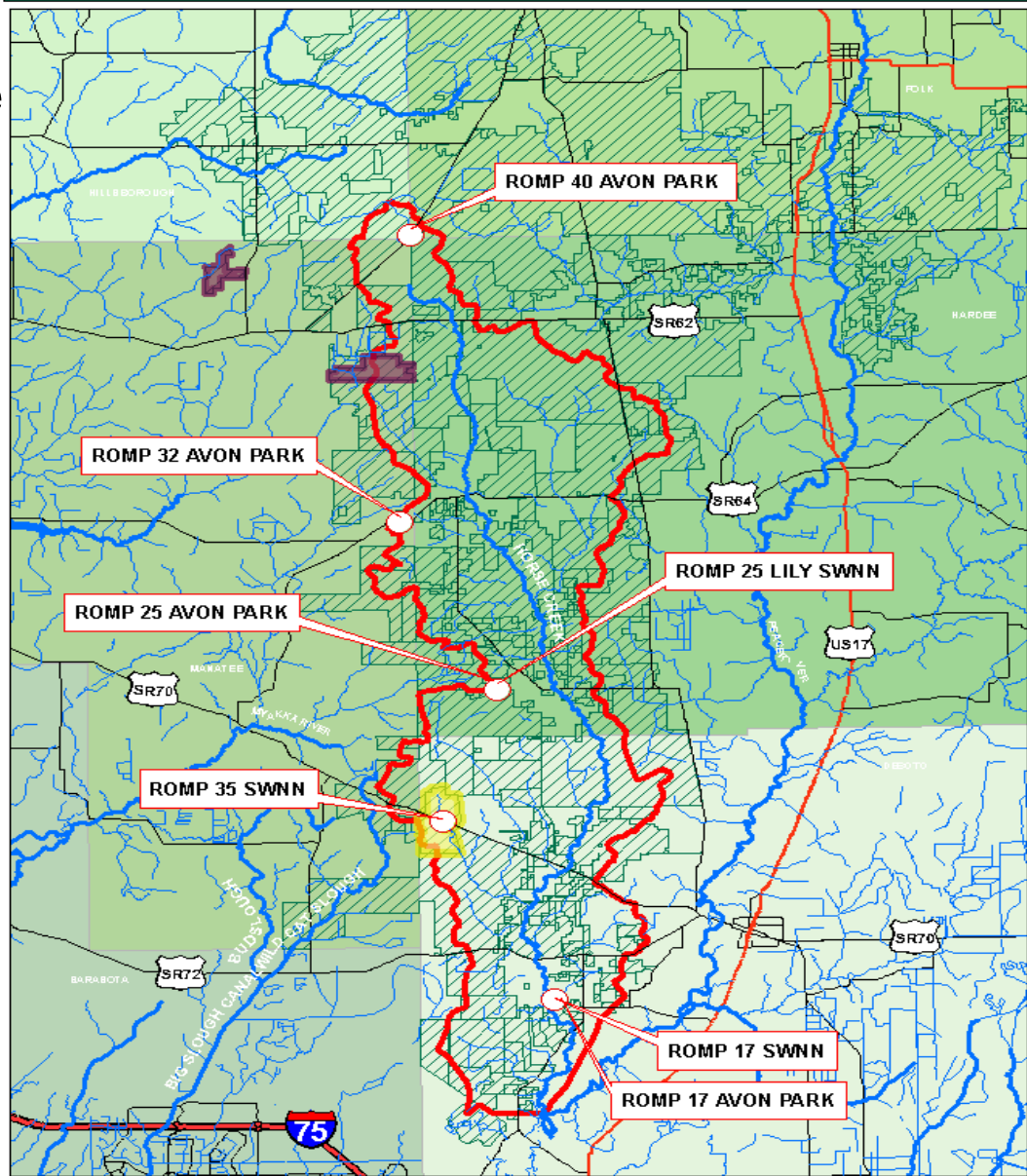
Southwest Florida  
*Water Management District*



**GROUND WATER QUALITY MONITORING SITES CURRENTLY MONITORED BY THE WATER QUALITY MONITORING PROGRAM WITHIN THE HORSE CREEK SUBBASIN**

District Upper Floridan Aquifer ROMP monitor wells in the Horse Creek basin are periodically sampled for sulfate/specific conductance

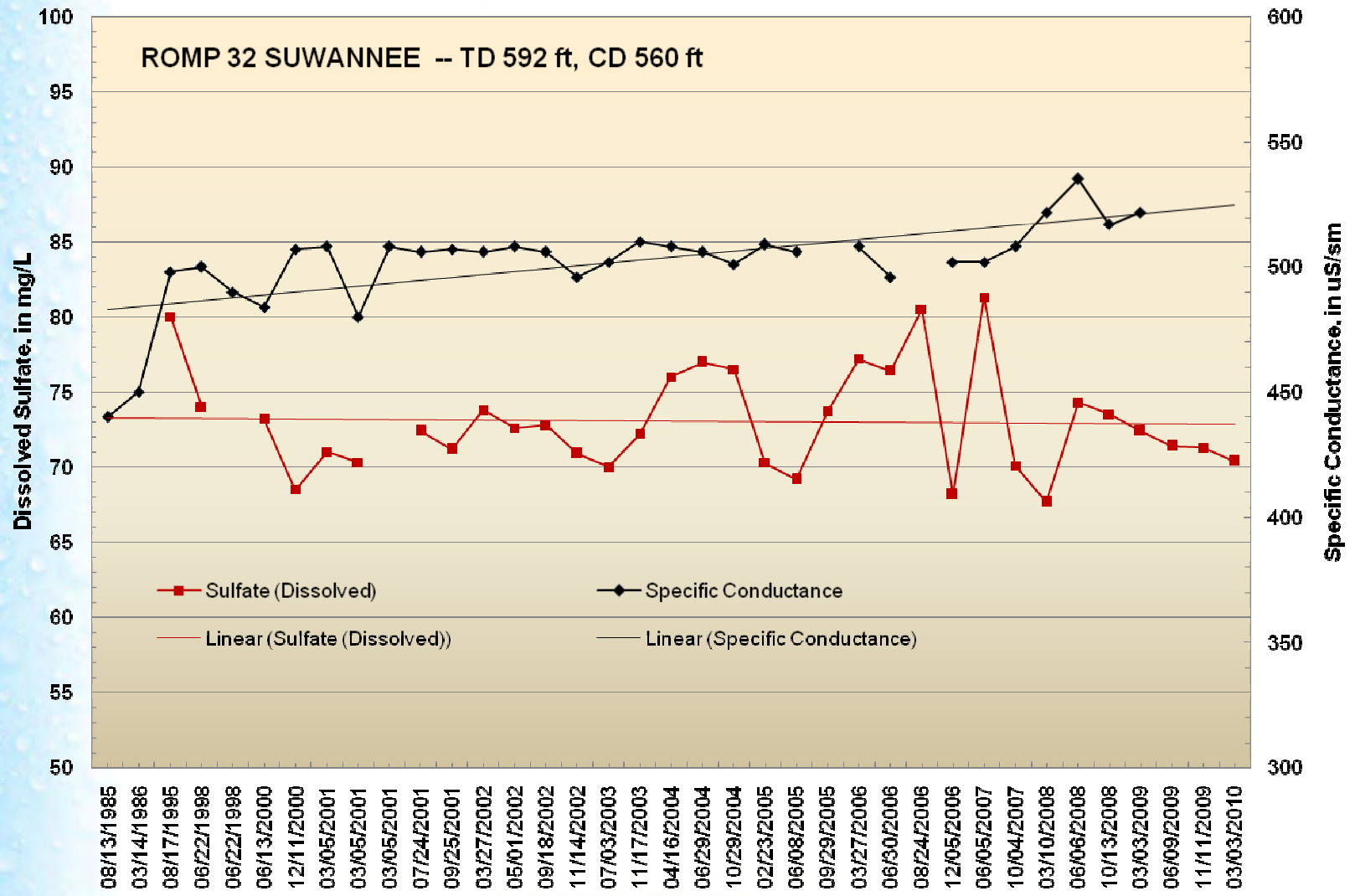
Sulfate and specific conductance concentrations can vary widely between aquifer zones and regionally within the Horse Creek basin

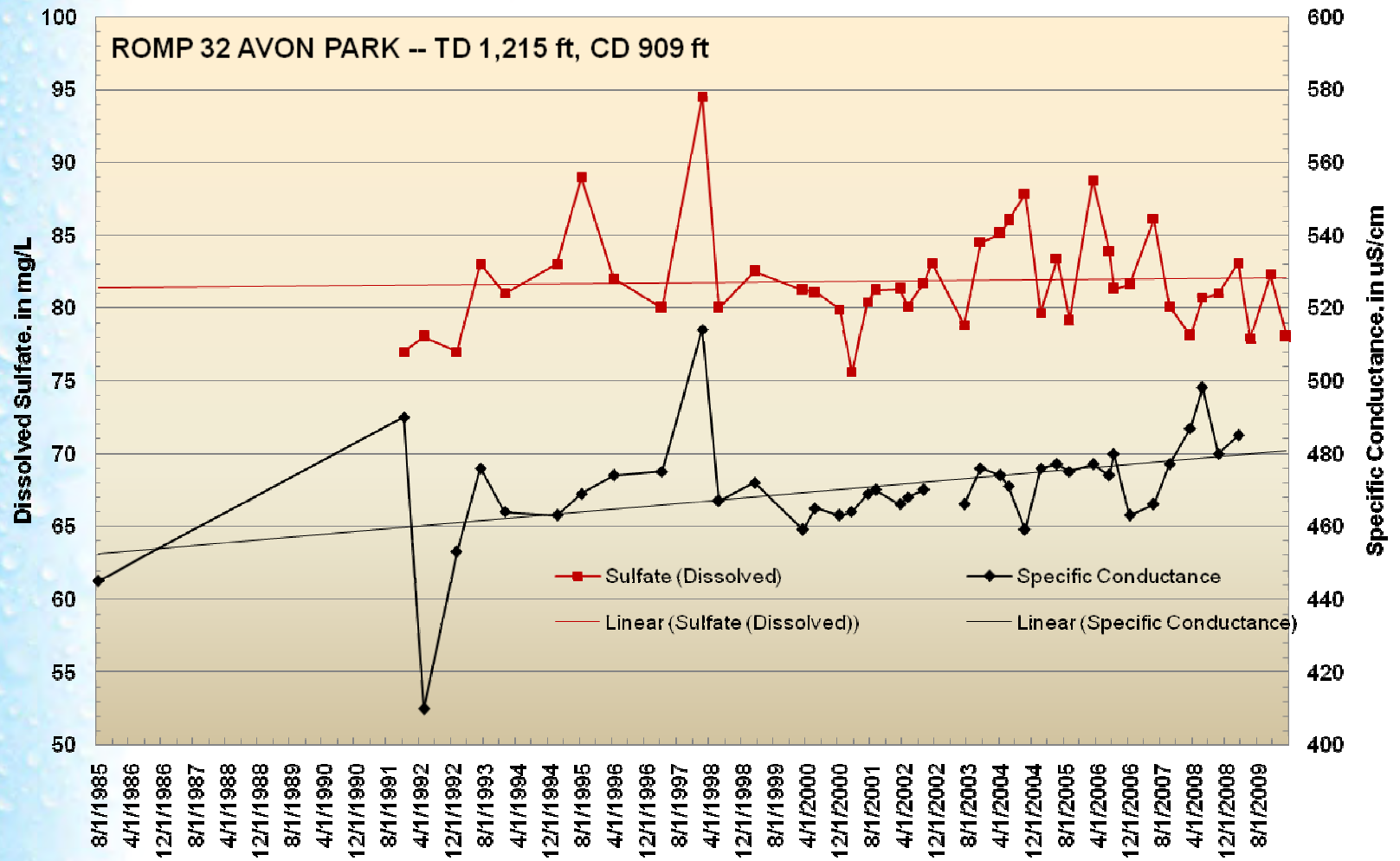


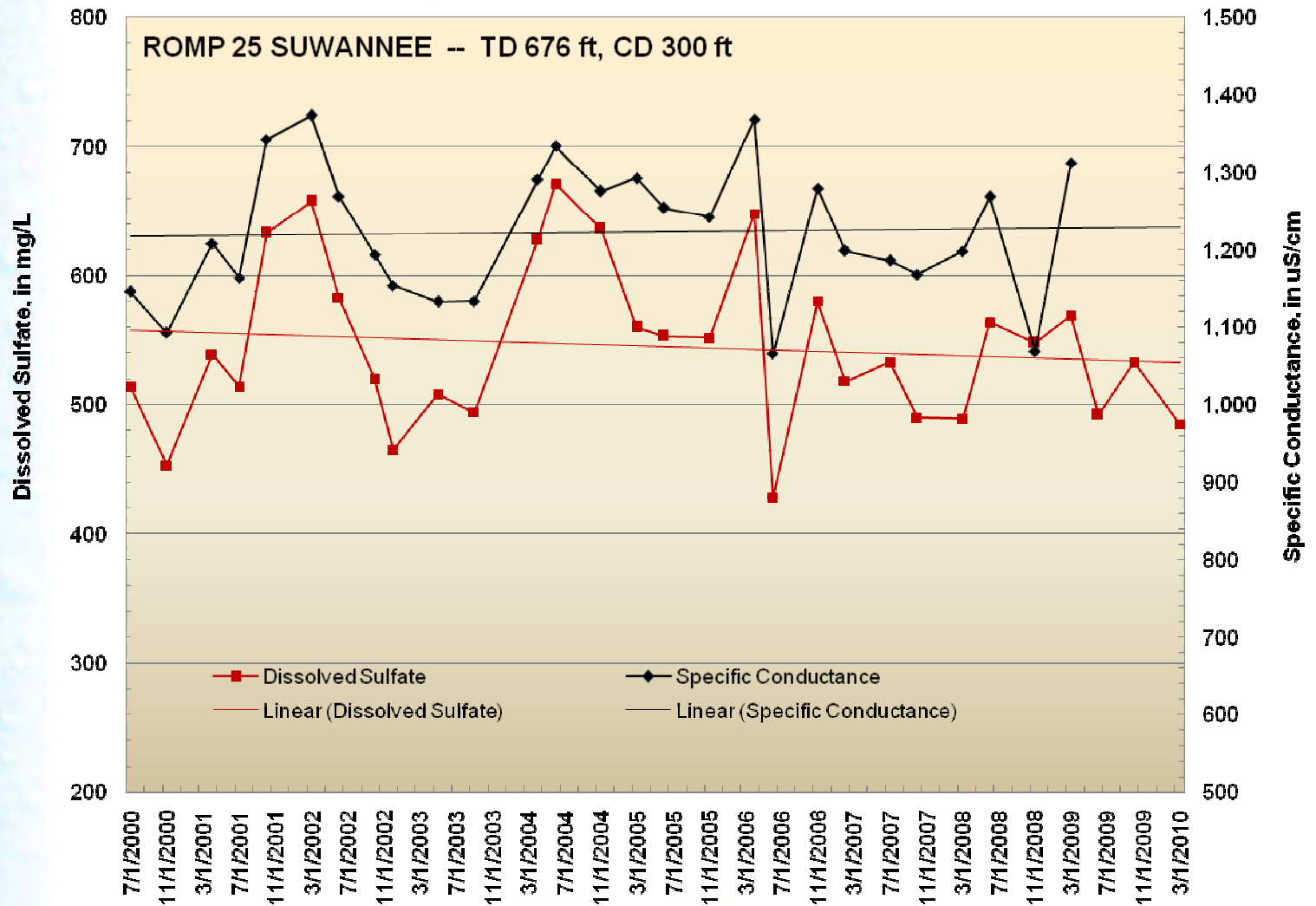
0 3 6 12 Miles

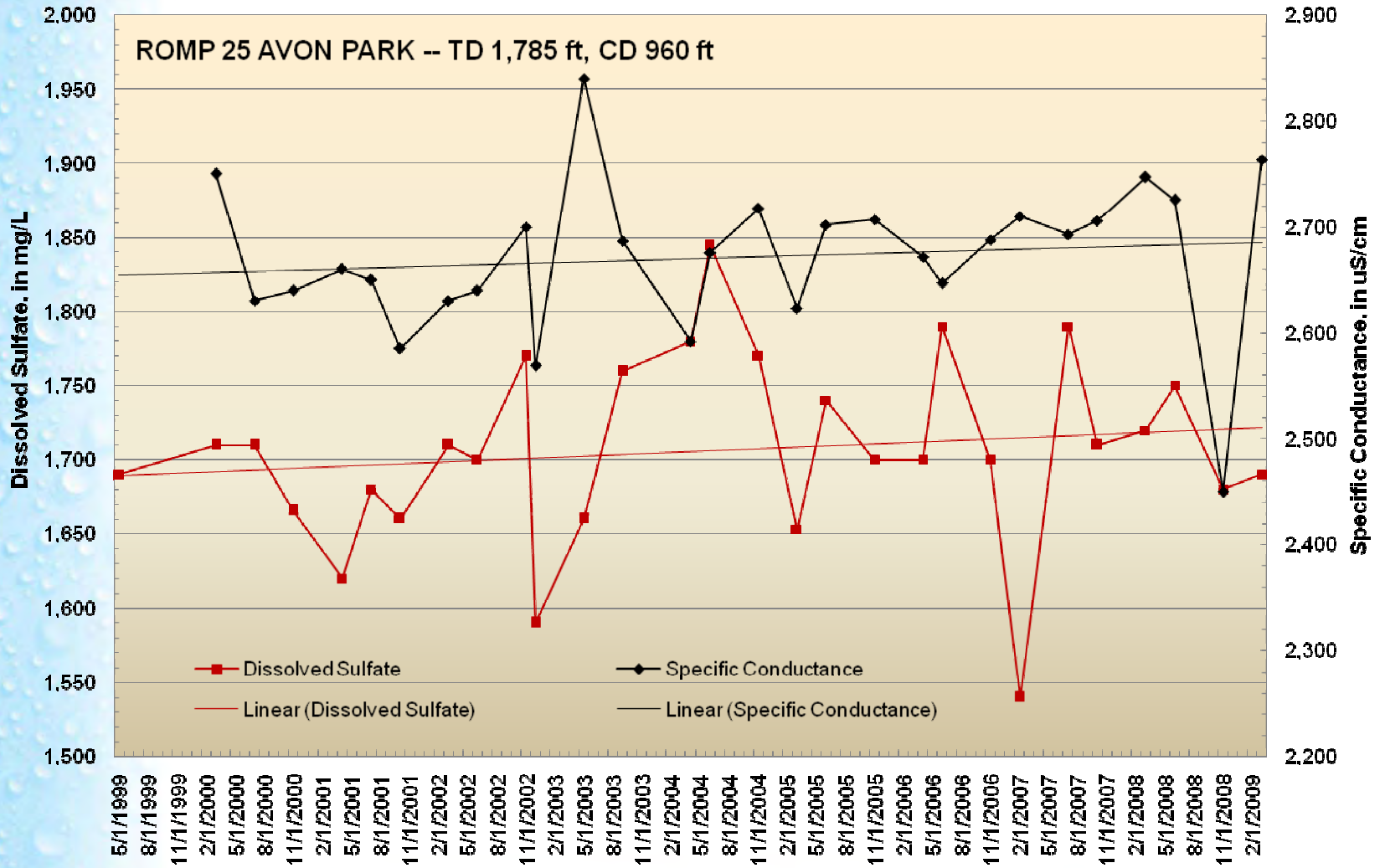
WQMP 500B-FARMS Board Approved Protect  
 WQMP 1112-FARMS Board Approved Protect  
 Horse Creek Subbasin  
 WQMPs within Horse Creek  
 WQMP Ground Water Sites  
 Streams

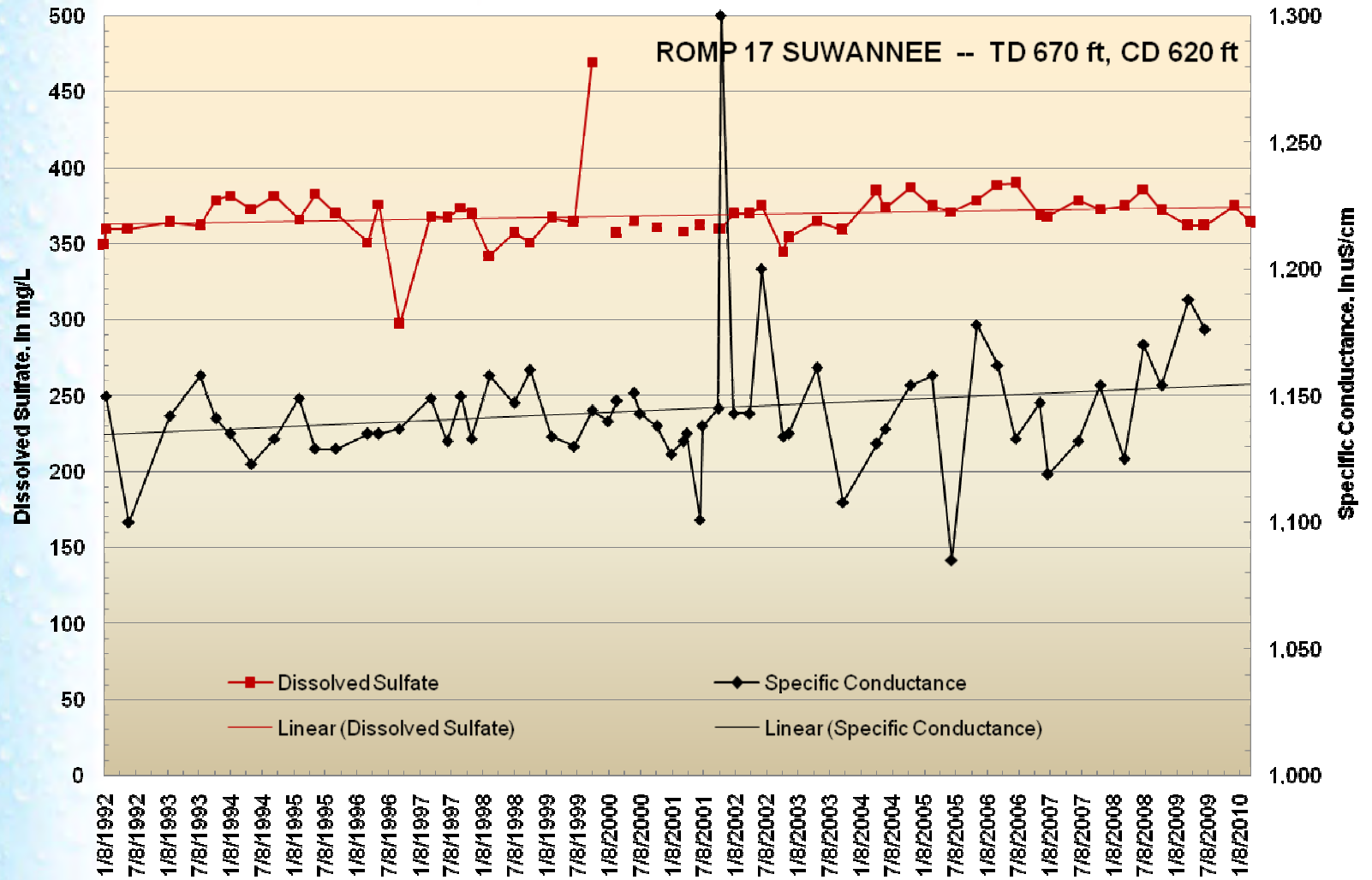
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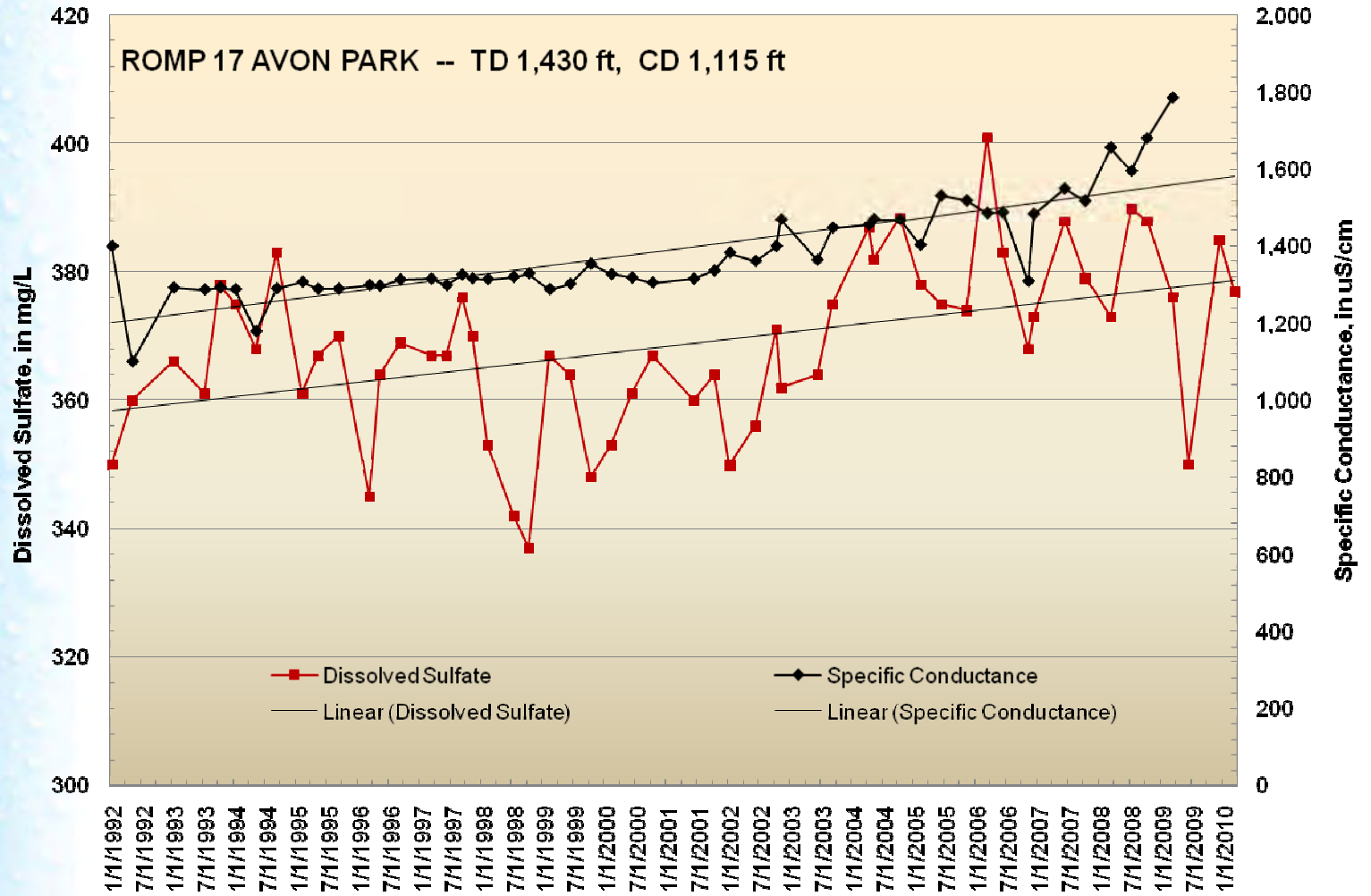














# Results of Lower Horse Creek Surface-Water Sulfate Reconnaissance Sampling

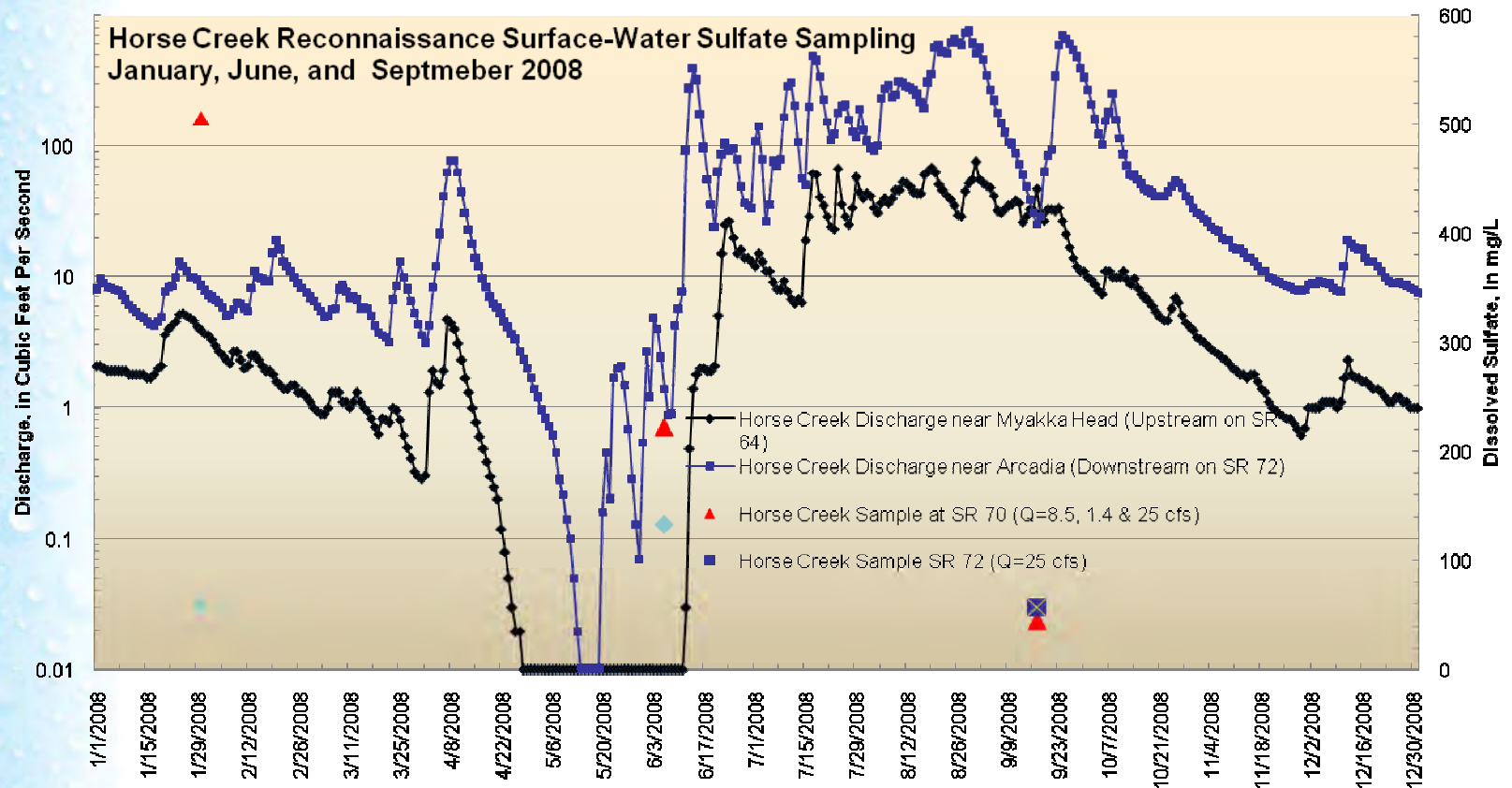
## January 29-30, June 6, and September 17, 2008

### Horse Creek Main Channel Sampling

	Jan	June	Sept
• Horse Creek at CR 665 near Limestone	60	133	-- mg/L
• Horse Creek at SR 70	506	222	45 mg/L
• Horse Creek at Pine Level Road	--	--	54 mg/L
• Horse Creek below SR 70	9.3	--	-- mg/L
• Horse Creek at SR 72	--	--	58 mg/L

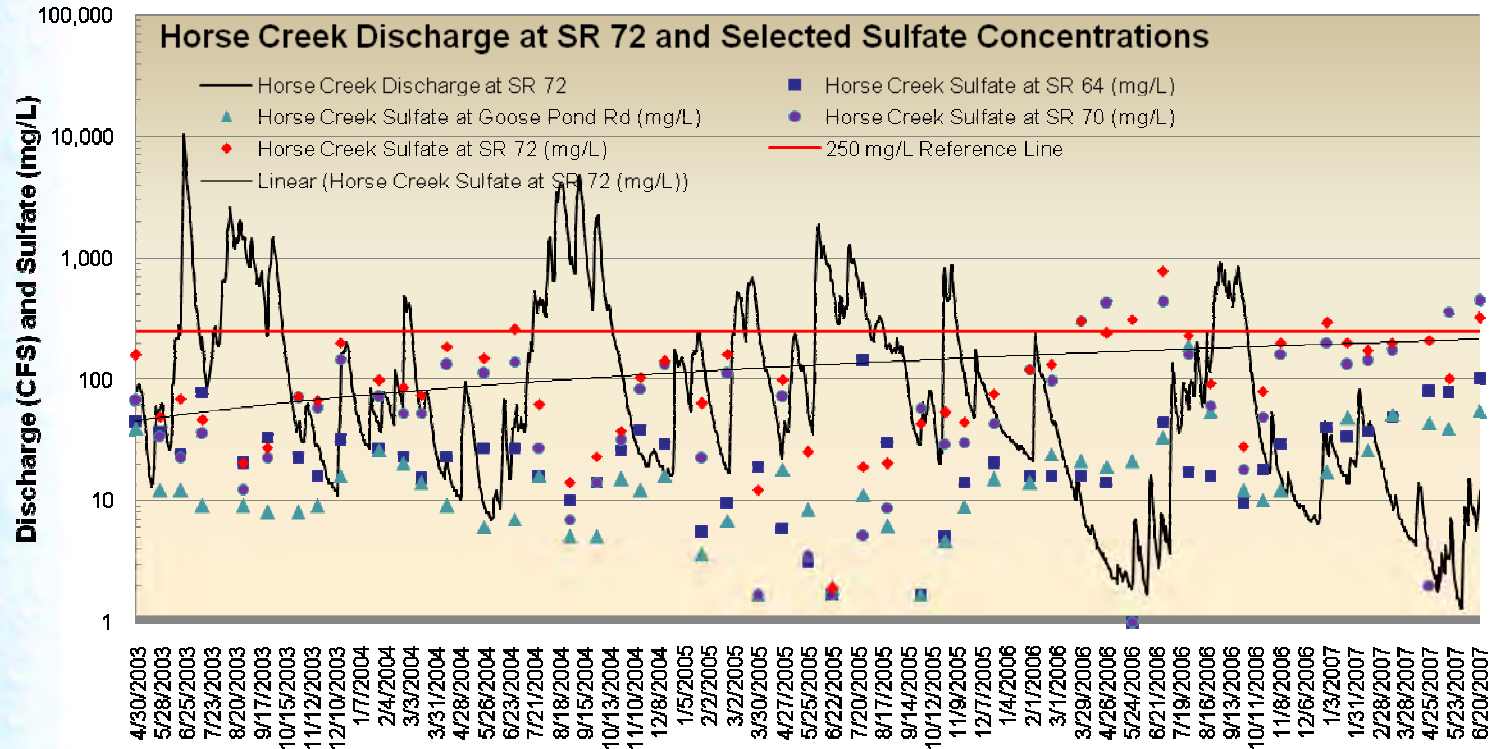
### Tributary Sampling

• Unnamed Tributary at CR 665	439	--	-- mg/L
• Brandy Branch	--	726	115 mg/L
• Buzzard Roost at SR 70	852	--	-- mg/L
• Buzzard Roost at Pine Level Road	410	--	54 mg/L



### Surface-Water Sulfate Concentrations are Inversely Related to Streamflow Volume

*-Moderate-to-high flows flush and dilute sulfate concentrations, whereas low-flows, which are largely shallow groundwater discharge (base flow), can have higher concentrations of mineralized agricultural irrigation groundwater*



**Results of Prior Sulfate Sampling--Horse Creek Stewardship Program, 2003-2007**  
*Increasing sulfate concentration trend during drought low-flow period.*

Sites	SO4	TDS	Si	Cond	Alk	pH	Ca	Fe	Mg	K	Na	Sr	Cl
Sunny South	1510	2320	19.89	2440	125.8	7.48	429	73.2	146	2.88	12.2	12.3	21.6
Lily Grove	1427	2380	20.77	2500	125.5	7.51							15.7
Bethel 10	1500	2380	20.4	2460	128.4	7.59	464	79.7	171	3.86	13.4	12.3	20
Bethel 2	1080	1800	22.7	1980	137.7	7.57		48.4	129	3.45	14.9	13.5	19.7
Bethel 3	1350	2150	20.9	2300	134.2	7.56		51.5	155	3.75	12.8	12.7	21.2
VCH 1	764	1310	24.4	1600	164.9	7.64		18.3	99.7	3.25	19.3	12.4	33.4
VCH 3	812	1350	23.9	1650	159.8	7.60	224	13.7	103	3.26	19.1	12.4	30.7
Horse 663	133	313	5.32	449	40.4	7.23	42.4	43.4	20	6.56	10.1	0.81	26.2
Brandy 70	726	1130	4.98	1420	42.2		178	92.9	82.6	21.2	17	3.94	39
Horse 70	222	459	1.79	668	45.7	7.09	68.8	74	31.3	5.52	17.8	0.99	38.8
Mosaic 7	58.9	450	24.6	763	247	7.91	64.3	51	38.5	1.87	32.7	1.25	60
Mosaic 13	93.2	452	23.6	776	232.9	7.82	64.8	17.8	40.7	1.94	31.7	1.49	55.5
Mosaic 39	819	1430	24.9	1720	157	7.71	217	135	110	3.56	18.9	16	27.2
Mosaic 54	683	1270	26.5	1580	181	7.6	211	81.1	99	2.63	23.7	9.6	28.3
Mosaic 60	222	652	24	983	208	7.75	94.9	23.7	54.2	2.24	29.8	3.99	48.4
Mosaic 61	1110	1810	22.9	2050	142	7.61	305	213	130	3.72	16.7	12.9	22.1

Reconnaissance specific conductance measurements can be useful in determining relative sulfate concentrations

