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

Bill Lewelling/Carol Kraft

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

Joshua Creek Watershed
WUP 5060 - Well DID 13

Back-Plugged 3/17/03

Groundwater Quality

Conductivity uS/cm  | TDS mg/L  | Chloride mg/L  | Sulfate mg/L

Jan-03  | Apr-03  | Jul-03  | Nov-03  | Feb-04  | May-04  | Jul-04  | Oct-04  | Feb-05  | Apr-05  | Oct-05  | Jan-06  | Apr-06

0  | 500  | 1,000  | 1,500  | 2,000  | 2,500  | 3,000  | 3,500  | 0  | 500  | 1,000  | 1,500  | 2,000  | 2,500  | 3,000  |

Back-Plugged 3/17/03
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.
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.
Results of Lower Horse Creek Surface-Water Sulfate Reconnaissance Sampling
January 29-30, June 6, and September 17, 2008

Horse Creek Main Channel Sampling

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<tr>
<th>Location</th>
<th>Jan</th>
<th>June</th>
<th>Sept</th>
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<td>Horse Creek at Pine Level Road</td>
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<td>Horse Creek below SR 70</td>
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Tributary Sampling

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<tr>
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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.
## South West Florida Water Management District

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

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\[ y = 1.3047x + 563.6 \]

\[ R^2 = 0.9702 \]