ADWR Groundwater Modeling & Data Collection Efforts within the Santa Cruz Active Management Area: Status Update and Future Work

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Talking Points

• Santa Cruz AMA Overview
  • History of AMA
  • Hydrology within Model Domain

• ADWR’s Hydrologic Models
  • Current Status & Recent Updates:
    • Micro-Basin model
    • Northern Santa Cruz Model

• Field Investigation

• Future Work
SCAMA History

1994 - Santa Cruz AMA established
- Formed from the southeastern portion of the Tucson AMA
- International nature of water management issues facing Upper Santa Cruz River Basin differed from other basins in Tucson AMA

Legislature sets AMA Goals § 45-562C
- “Maintain Safe-Yield Conditions”
- “Prevent local water tables from experiencing long-term declines”

1997 - ADWR begins long-term monitoring program in AMA
- Field monitoring combined with development of regional groundwater flow model(s)
SCAMA Hydrology

Inflows to the Santa Cruz AMA system

- Natural streamflow & WWTP effluent recharge along SCR
- Tributary and mountain front recharge
- Incidental agricultural recharge
- Subsurface groundwater inflow

Outflows

- Seasonal evapotranspiration
- Agricultural, municipal, industrial, domestic pumping
- Underflow to north (Tucson AMA)
- Seasonal groundwater discharge to SCR between NIWTP and Tubac
SCAMA Hydrologic Models Overview

The SCAMA model domain is split into 2 areas: the southern Micro-Basin model, and the northern SCAMA model

1. Micro-Basin Model (MB): ~ 14 river miles from Mexico-US border to NIWWTP
2. North SCAMA Model (NSCAMA): ~ 27 river miles from NIWWTP to Elephant Head bridge
1. **Micro-Basin Model**

- Four variable basins along a narrow valley from border to NIWTP
- No real steady-state observed on record
- Extremely fast response to flood pulses; highly dependent on flood recharge
- Modeled at tight spatial & temporal scales to capture fast aquifer response:
  - 1/8 mile x 1/8 mile model grid
  - Stress periods as short as 3 days
Hydrologic Models
Current Status & Updates

1. Micro-Basin Model
   • Updates through end of water year 2015 (in progress)
   • Calibration to follow model updates
     • PEST (Parameter Estimation)
     • Additional ~15 years of transient data expected to improve parameter fit
SCAMA Hydrologic Models Overview

Northern Santa Cruz AMA Model

- Inner valley opens up to a wider basin with deeper alluvial deposits at Amado
- Quasi-steady state conditions observed in winter, pre-2000 dry spell
- Flood pulses augmented by regular effluent discharges below Rio Rico
  - Since 1970s, nearly perennial flow between Rico Rico and Tubac due to releases from NIWTP
- Alternating gaining & losing reaches
- Modeled at a lower spatial & temporal resolution than micro-basin model:
  - 1/4 mile x 1/4 mile model grid
  - Longer stress periods

Elephant Head Well Hydrograph
Well Reg No: 55-623122
Northern Santa Cruz AMA Model

• Updates through end of water year 2015 complete
• Model refinement to better capture losing & gaining conditions along SCR:
  • In-stream conductance (kz)
  • Hydraulic conductivity of layers 1 & 2
• Calibration in progress
  • PEST (Parameter Estimation)
  • Additional ~15 years of transient data expected to improve parameter fit
Field Investigation

Groundwater (1997 – present)

• 24 index wells throughout SCAMA: depth to water sampled **quarterly**
• Data available
  • Publically accessible through ADWR’s Groundwater Site Inventory database (GWSI): [https://gisweb.azwater.gov/water resourcedata/GWSI.aspx](https://gisweb.azwater.gov/water resourcedata/GWSI.aspx)
Field Investigation

Surface Water (2007 – present)

• 7 Santa Cruz River cross sections: monitoring the interaction between the SCR and aquifer, flow sampled **quarterly**

• Data available
Future Model Activities

Short-Term
• Complete MB & NSCAMA model calibration using 20+ year record
• Input for Santa Cruz Active Management Area 4th Management Plan (projected release circa 2018)

Mid-Term
• Model expansion
  • Parametrize & include Potrero Canyon area within model domain

Long-Term
• Merge NSCAMA and Micro-Basin models
  • Advantages
    • Better management (more representative of AMA as a whole)
    • Better modeling (fluxes b/w MB and NSCAMA internalized)
  • Challenges
    • Resolving different temporal & spatial resolutions
    • Establishing steady-state for NSCAMA when fed into by dynamic MB model
Summary

• Field investigations ongoing: quarterly well depth to water measurements and stream flow gauging will continue

• Planned modeling updates:
  • Complete calibration of existing models using ~20 years of transient data
  • Merge Micro-Basins and NSCAMA Models; expand model domain to Potrero Canyon

• ADWR working towards releasing Santa Cruz AMA Fourth Management Plan
  • Fourth MP to cover period 2010 - 2025
  • Tentative internal draft date: late 2017 / early 2018
Thank You!
Questions?

Thanks to ADWR Basic Data & Survey Units
ADDITIONAL SLIDES
8.2mgd NIWTP constructed @ confluence of Nogales Wash & SCR; near-constant streamflow; biofilm clogging layer begins to form 1972.

Historically perennial surface flow along SCR from border to Tubac.

1940s
- Intensive pumping & land-use change lowers gw levels

1960 - 2001
- Major winter and fall-period flood events responsible for shallow water tables in SCR Valley

1982-2000
- Dynamic equilibrium (periodic gw fluctuations, but no extended trends)

1992
- NIWTP treatment upgrade

2002-2010
- Basin experiences significant dry period

2010
- El Niño temporarily raises gw levels

Present
- Clogging layer gone
SCAMA Hydrology

Models covers area between the Sonora-Arizona border and Elephant Head Bridge

- Bounded by Atascosa and Tumacacori Mountains to the west, + San Cayetano and Santa Rita Mountains to the east

- Models simulate groundwater flow in three units:
  - Younger Alluvium - floodplain aquifer adjacent to Santa Cruz River, most productive
  - Older Alluvium - upper basin-fill unit
  - Nogales Formation – oldest, least productive
Future Model Activities

Improved calibration using a number of potential water quality targets:

- Chemical markers of effluent vs. baseflow (e.g., detergents)
- Titrium (ADEQ wells)
- Water temperature

More user-friendly statistical and risk-analysis outputs