



Saltwater Interface Mapping Update

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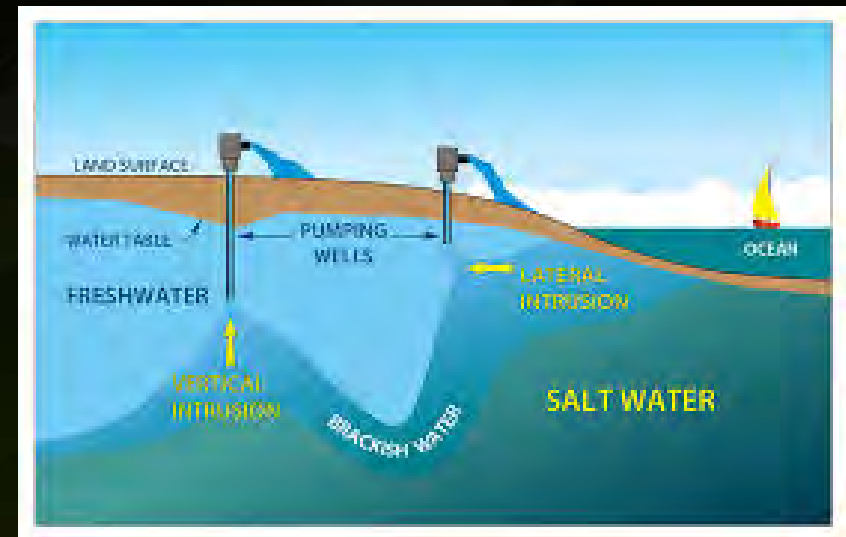
Big Cypress Basin Board Meeting
October 20, 2015
sfwmd.gov

Agenda

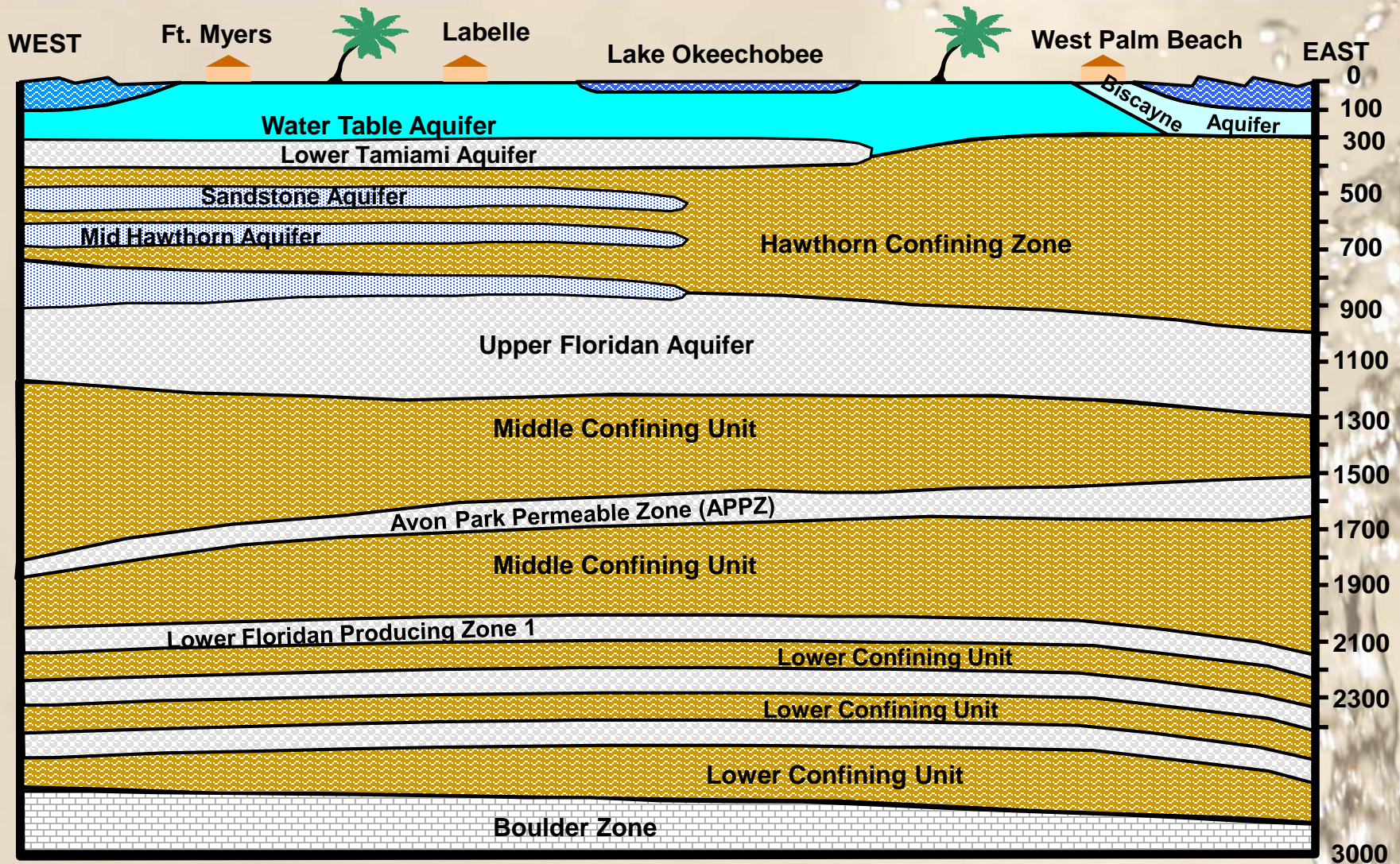
- Overview of Saltwater Intrusion and Aquifers
- Importance to Wellfields and Infrastructure
- Project Approach
- Results – Water Table and Lower Tamiami aquifers (2009 vs. 2014)
- Conclusions
- Next Steps

Common Sources of Saltwater Intrusion

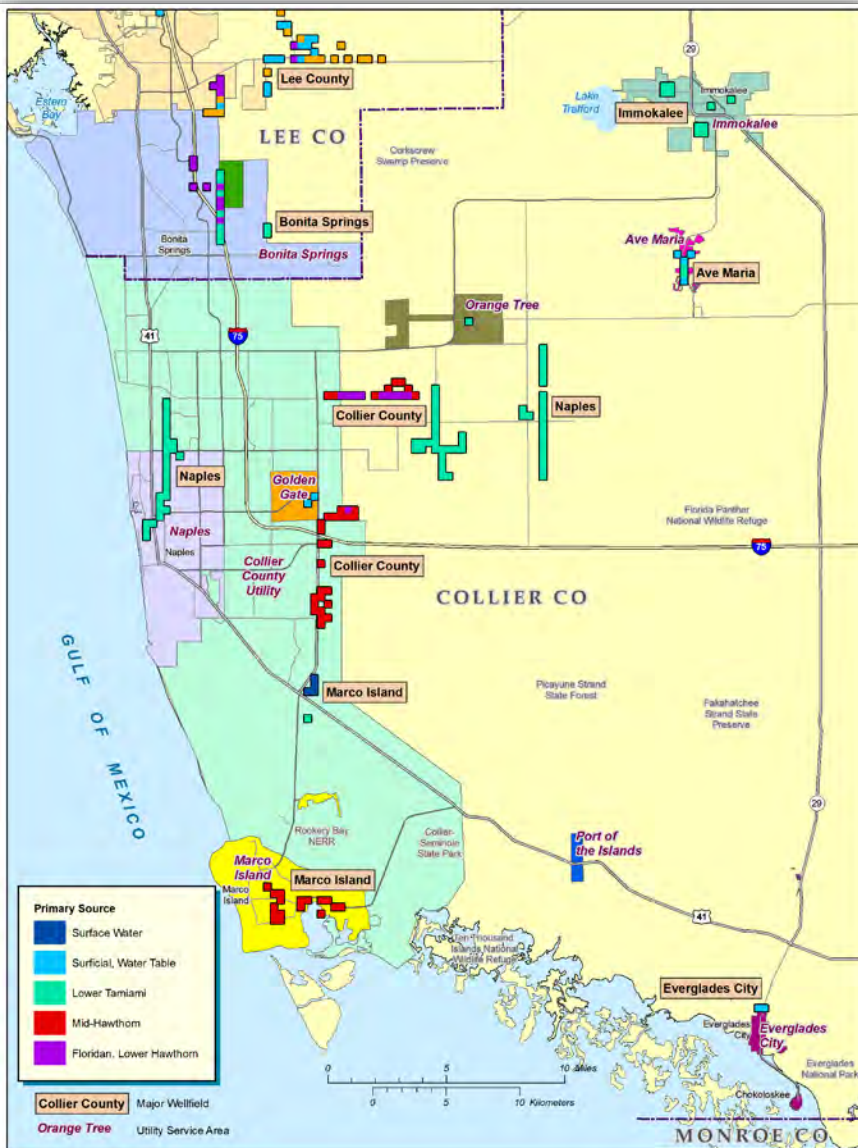
- Lateral intrusion from the coast
- Vertical intrusion (upconing) from saltwater below
- Surface Infiltration -- estuaries, boat basins, saltwater marshes, saltwater canals, etc.
- Ancient (relict) seawater trapped in low permeability aquifers



Generalized Hydrogeology of South Florida



Why is this Important?



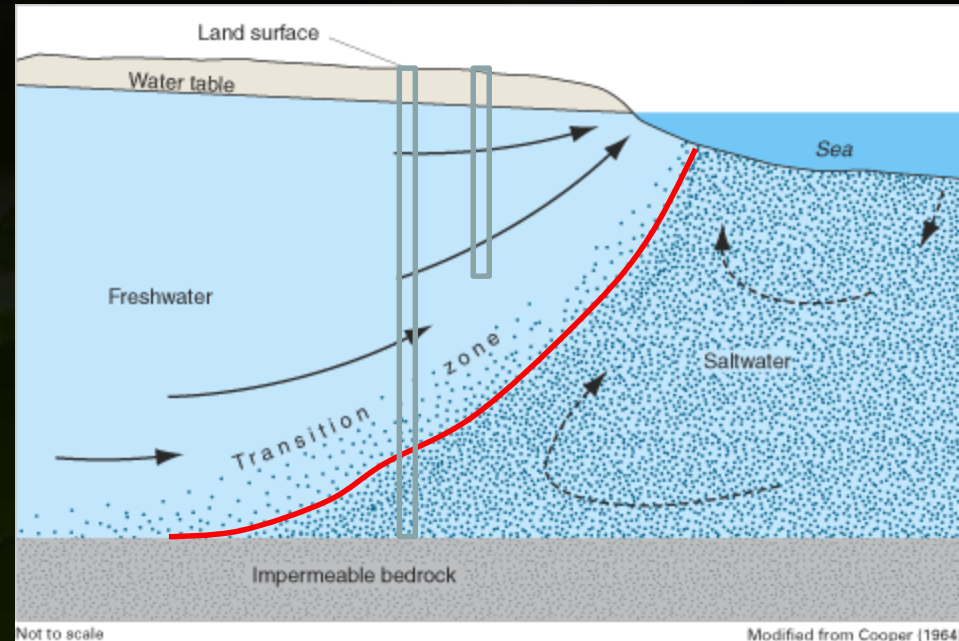
- Wellfields are a major water supply source – protect investment
- Once saltwater enters wells, very difficult – if not impossible -- to reverse
- Very expensive to relocate wellfields and associated infrastructure (pipelines, treatment plants and processes, etc.)
- Other sources of water more expensive to treat (e.g., Floridan aquifer – reverse osmosis)

SFWMD Saltwater Interface Mapping Project

- Strategy -- Compare maps (2009, 2014), note areas of concern, and adjust monitoring accordingly
- Update Maps Every 3 to 5 Years
- Use all available data (USGS, SFWMD, Counties, Water Use Permittees)
- Furthest Inland Extent – Dry Season
- 250 mg/L isochlor
- Coastal aquifers: Water Table, Lower Tamiami, Sandstone, Mid-Hawthorn

Mapping Challenges

- Representing a three-dimensional feature on a two dimensional map
- Representing a dynamic interface with fixed-time snapshots
- Representing a diffuse front with a single line
- Mapping from data that may represent one of several saltwater intrusion pathways
- Some wells used in 2009 not available in 2014 (e.g., wells abandoned, no longer required to be monitored, etc.)



Water Table Aquifer, 2009 and 2014

- Added mangrove GIS coverage
- Added four new wells in 2014
- Relatively stable but dynamic interface from a regional perspective
- Inland movement observed in Bonita Springs
- Slight seaward and landward movement in Marco Lakes area



Structures	PWS [†] Chlorides	Non-PWS [†] Chlorides	Wellfields in the Water Table Aquifer
∅ Culvert	● ≤100 mg/L	○ ≤100 mg/L	Wellfields in Other Aquifers
⌘ Lock	◆ 101 - 250 mg/L	◇ 101 - 250 mg/L	Saline Water Bodies
⊠ Pump	■ 251 - 1,000 mg/L	▣ 251 - 1,000 mg/L	Freshwater Bodies
⊞ Spillway	▲ >1,000 mg/L	△ >1,000 mg/L	Mangrove and Saltwater Marsh
▽ Weir			Roads
	Wells		Estimated 250 mg/L isochlor, 2009 (updated)
	▲ 433 (3900)		Estimated 250 mg/L isochlor, 2014
	Map (chloride) Number		

Lower Tamiami Aquifer, 2009 and 2014

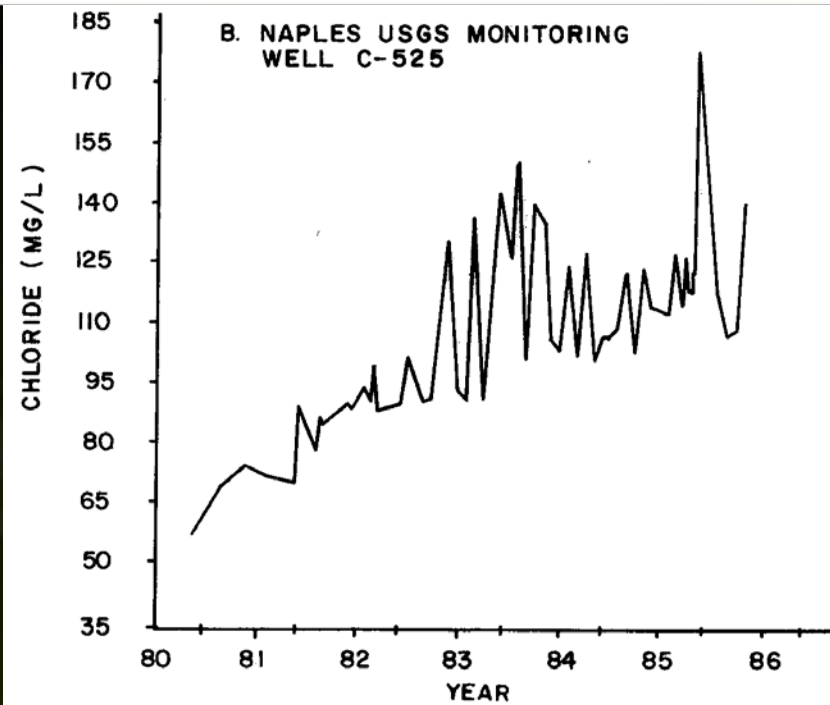
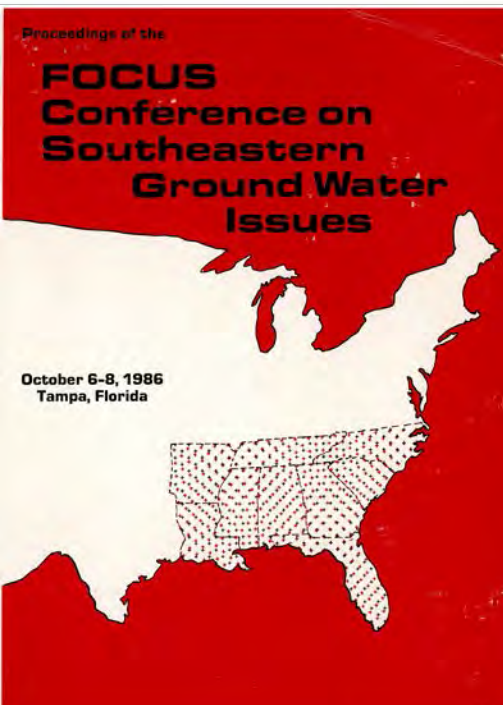
- Reinterpreted 2009 interface to be consistent with previous USGS interpretation (Schmerge, 2001)
- Relatively stable but dynamic interface from a regional perspective
- General seaward movement in Naples Coastal Ridge wellfield
- Slight seaward and landward movement in Bonita Springs area



Structures	PWS [†] Chlorides	Non-PWS [†] Chlorides	Wellfields in the Water Table Aquifer
<ul style="list-style-type: none"> Culvert Lock Pump Spillway Weir 	<ul style="list-style-type: none"> ≤100 mg/L 101 - 250 mg/L 251 - 1,000 mg/L >1,000 mg/L 	<ul style="list-style-type: none"> ≤100 mg/L 101 - 250 mg/L 251 - 1,000 mg/L >1,000 mg/L 	<ul style="list-style-type: none"> Wellfields in the Water Table Aquifer Wellfields in Other Aquifers Saline Water Bodies Freshwater Bodies Mangrove and Saltwater Marsh
	Wells		Roads
	<ul style="list-style-type: none"> 433 (3900) 		<ul style="list-style-type: none"> Estimated 250 mg/L isochlor, 2009 (up) Estimated 250 mg/L isochlor, 2014
	Map Number (chloride)		

[†] PWS = Public Water Supply

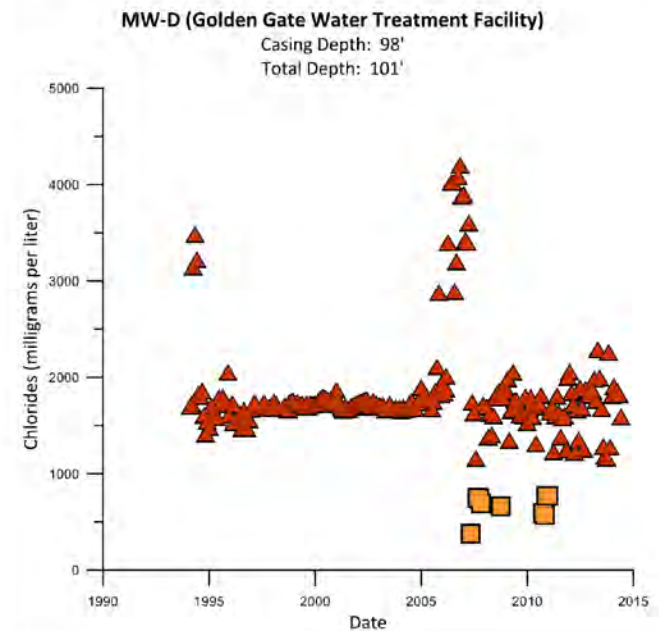
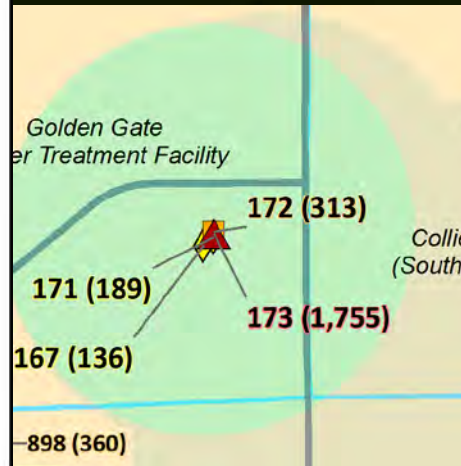
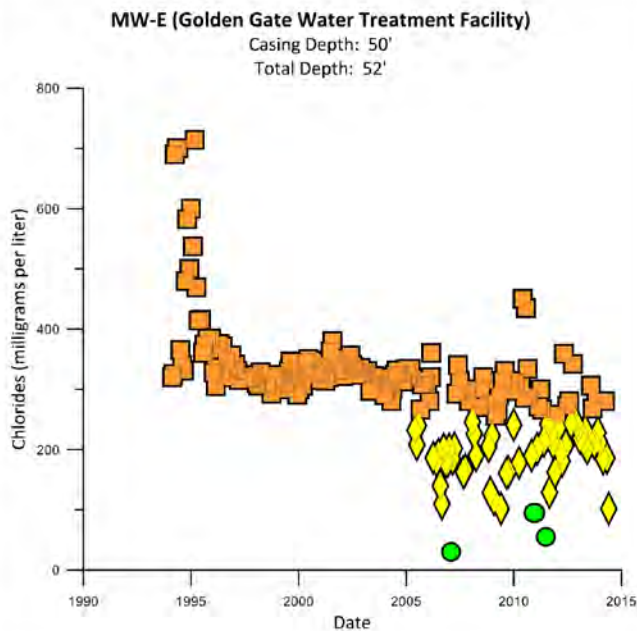
Saltwater Intrusion – Then and Now



- Gleason, Proffitt, and Anderson – The Status of Saltwater Intrusion in South Florida
- USGS Monitor Well C-525 (Map Number 147); Screened Interval 63 to 83 feet bls
- Naples Coastal Ridge Wellfield – Lower Tamiami aquifer
- Chloride Concentrations: 1986 (140 mg/L); 2009 (1,120 mg/L) and 2014 (1,400 mg/L)

Upconing of saltwater from below....

- Golden Gate WTF Monitor Wells E (50 to 52 feet bls; Chloride = 189 mg/L) and D (98 to 101 feet bls; Chloride = 1,755 mg/L) at same location, different depths, in Lower Tamiami aquifer
- Highlights the importance of monitoring both laterally and vertically and wellfield management to prevent upconing of poor quality water



Conclusions

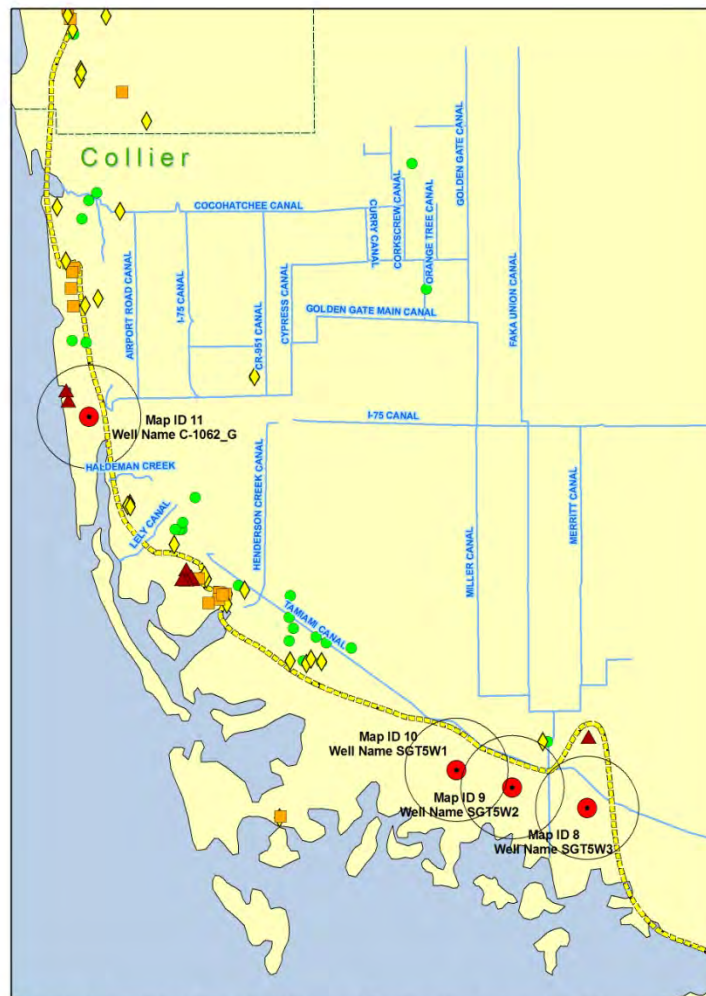
- Regional perspective – No major changes in saltwater interface position from 2009 to 2014
- Interface is dynamic – general inland (WTA – Bonita Springs) and seaward (LTA – Naples Coastal Ridge) movement observed
- Saltwater intrusion is occurring, emphasizing the importance of continued monitoring (laterally and vertically) and wellfield management
- Additional, localized monitoring may be required at select wellfields to protect water supplies

Next Steps

- Continue coordination with other Water Management Districts and the Department of Environmental Protection
- Work with local governments and permittees to:
 - Identify wells from 2009 -- not available in 2014 – and secure their use for 2019 maps
 - Identify other existing or new wells to increase mapping accuracy for future maps
 - evaluate need for increased monitoring
- Explore funding opportunities to investigate saltwater intrusion in coastal areas of concern within BCB
- Where appropriate, consider implementing recommendations from USGS (Prinos, et.al., 2013) report



Questions and Discussion



Wells Identified For Additional Saltwater Intrusion Monitoring

- Proposed Additional Well
- Isoclinal Line Apr-May 2009
- County lines
- 2 mile radius

- Existing Saltwater Wells Chlorides
- <100 mg/L
 - 100-250 mg/L
 - 250-1000 mg/L
 - >1000 mg/L



Prepared by: Resource Evaluation
 Date: 04/03/2012
 Map Doc: hsd.sfwmd.gov/infodata/wsd/GIS/REGIONAL/
 Well_Inventory_Analysis/Map8/
 Wells_identified_Saltwater_inclusion_04022012_CJB_Ver2.1.mxd