Surface Water Supply on a Tidally Influenced River in Southwest Florida



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Introduction Sequence



Peace River Manasota Regional Water Supply Authority - a 4 County Special District formed in 1982



51 MGD Treatment Capacity



Drainage Basin & the Peace River Facility

- Location of Peace River Facility
- Ideally sited to take advantage of water quantity and quality



Location of the Peace River Facility

It is 37 miles from our river intake to the Gulf of Mexico but our river intake is located at sea level with no dam or salinity barrier to stop upstream migration of brackish water

> Image © 2016 TerraMetrics Ita SIO NOAA, U.S. Navy, NG6, GE © 2016 Gopple

Google earth



Daily Tidal Range ~ 2 feet



120 MGD River Intake Pump Station

Permit increased in 2019 to allow harvest of up to 258 MGD.

Sustainable Withdrawals from Peace River

- Based on 2010
 Minimum Flow & Levels
- Ties Diversions to Upstream Flow
- Preserves Natural Flow Character
- Harvest Average 3% of Flow since FY 2011





6.5 BG in Off-Stream Storage

Reservoir

Reservoir 2

7 BG in Underground Storage 21 Finished Water ASR Wells

ASR Well System



Impacts from Groundwater Pumping

Southern Water Use Caution Area





Coastal Salt Water Intrusion



Declining Lake Levels Inland



Kissengen Spring Used to Flow Into the Peace River





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Kissingen Spring Bartow, FL

- 2nd magnitude
- 200' wide pool
- 17' deep



HISTORIC KISSENGEN SPRING north million the strongest area of that this estabdepth powerful shows evidence who 1800s Americans late and Native the destination never springs. resort boats a as and dive sprind trolleys. floor. for rail lines. dance vere realized to exploit the spring for tourism. and a locals bathhouses were built, and thousands of was spring tourists visited over 75 years. In the 1930s the popular served the site of major political rallies. During World War it 11, as a rest and recuperation resort for members of the military based near Bartow. The spring ceased to be a tourist destination after its groundwater was captured for other uses.

> A FLORIDA HERITAGE SITE IN MEMORY OF THOMAS E. JACKSON SPONSORED BY THE POLK COUNTY HISTORICS

Kissingen Spring today

Karst Features Hydraulically Connect Surface and Ground Waters along the Peace River.



In the Past these Karst Features would supplement river flow during times of drought.





Picture from FDEP's "Florida's Water" webpage

The Upper Peace River Now can go Completely Dry



Picture by Sam Stone during 2000-1 drought

River Water Quality and Flow Depenancy

USGS Streamflow Gauge Stations

USGS Gauge Station # 2296750 - Peace River at Arcadia

USGS Gauge Station # 2297310 – Horse Creek near Arcadia

USGS Gauge Station # 2297100 – Joshua Creek at Nocatee

Peace River Facility

Data SIO NOAA S Navy NGA GEBCO



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Salinity Recorder Locations



Let's Focus on Water Quality at 3 Continuous Recorder Stations







Probability (%)	2025		2050		2075	
	ст	inches	ст	inches	cm	inches
90% (best case)	7	2.8	13	5.0	20	7.7
50% (median expected)	13	5.1	24	9.4	37	14.4
5% (worst case)	22	8.7	41	16.1	63	24.6

Projected potential probabilities of future increases in near future sea-level rise along southwest Florida coast (IPCC)

For this work, 5 Scenarios were selected and models developed to project a range of possible flow-dependent salinity relationships for the future.



Extreme **Conditions:** Flooding







September 9, 2017 at Noon

At this location the Peace River reached its highest stage on the 15th



September 15, 2017 at Noon



September 20, 2017 at Noon

Extreme **Conditions:** Drought

USGS Streamflow Gauge Stations

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Peace River Facility

Data SIO NOAA S Navy NGA GEBCO

Comparison of Normal Combined Streamflow to Actual Combined Streamflow This Periods Reflects the 1999-01 Drought Event



2000-01 Drought is Our Challenge Event And did not **Total River Flow Significantly Rise River flow fell** Above it Again for an below 500 cfs on extended period until **Christmas Eve** June 20, 2001 1999 Total Streamflow (cfs) 1,650 18 months 1,150 650 150 0.39 N.99 ್ರಿ

Building a System Model



System Reliability Modeling Starts by Defining Fundamental Solvent & Solute Mass Balance Relationships (Solute in this case is TDS)



System Model Details

- Excel-based, daily time step model:
- More than 170 Variables
- Neural Net Complex web of nested IF/THEN statements embedding logic to simulate decision making
- Operational Constructs:
 - Activation Trigger Points
 - Ramp Up Schedules
 - Rotational Management Philosophy
- 41 Years of streamflow (1975-2015) for 3 stream gauges.

So how do we measure success? We use a System Reliability Measure over the 41 Year model study period:

• Quantity Reliability Goal is 99.5%

(# days met full demands) (total days)

• Quality Reliability Goal is > 95%

(# days met full demands with TDS < 500 mg/L)

(total days)

Takeaway Messages (1 of 2)

- Over pumping of groundwater has profoundly impacted the resource
- The Peace River has a regular hydrologic pulse
- As flow 🖊 TDS 亣
- As flow \uparrow TDS 🦊
- Wet season is the prime window of opportunity for harvesting water for public supply





Takeaway Messages (2 of 2)

- System sustainability depends on:
 - diversion pumping capacity
 - off-stream storage volume
 - source availability (quantity & quality)
- Challenge events are droughts which extend 18 months (or longer)
- System models are helpful to frame and quantify uncertainties
- How will Sea Level Rise & Climate Shifts impact us?





