

Surface Water Supply on a Tidally Influenced River in Southwest Florida



WUCA Training Case Study
Tampa, FL
May 30, 2019

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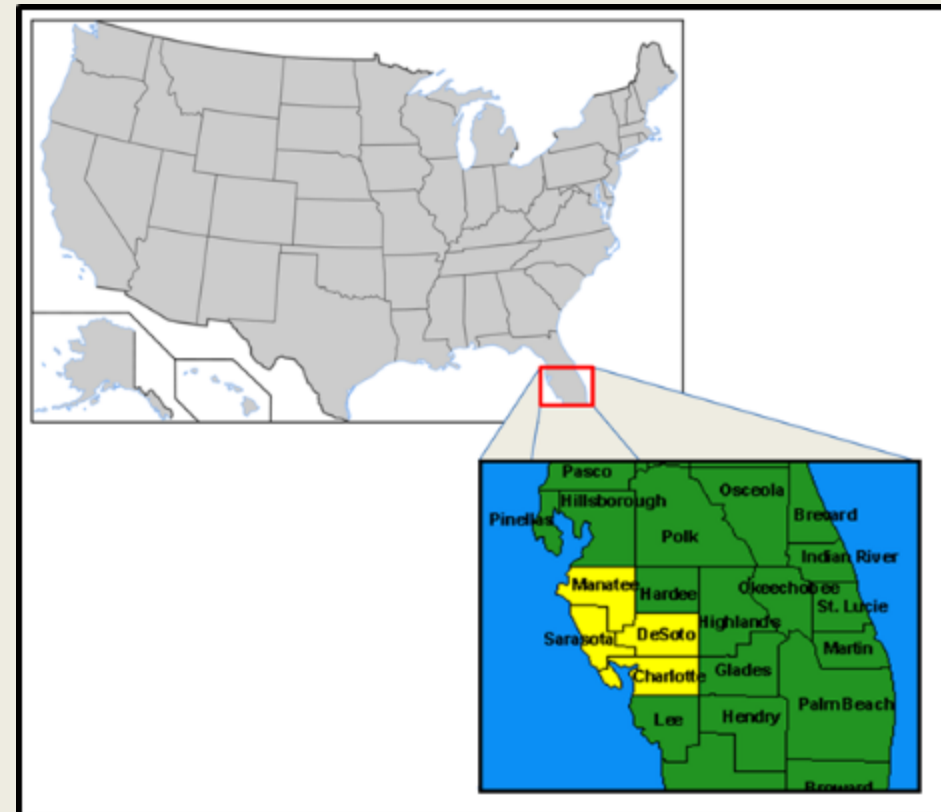
Special thanks to Kevin Morris, Peace River Manasota Regional Water Supply Authority

Introduction

Sequence



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

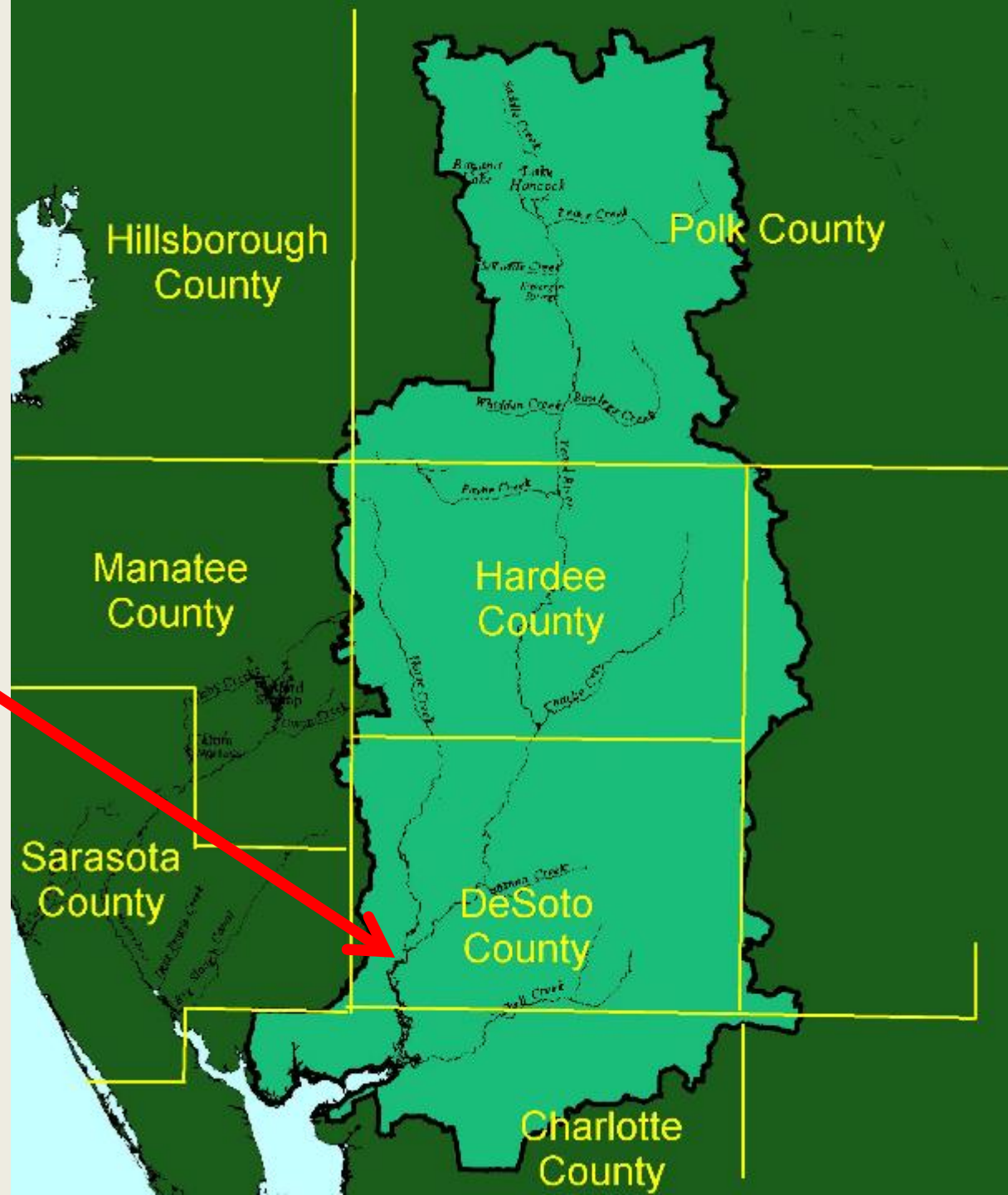


51 MGD Treatment Capacity



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

2019-Mar-30 08:53:53 AM (EDT)

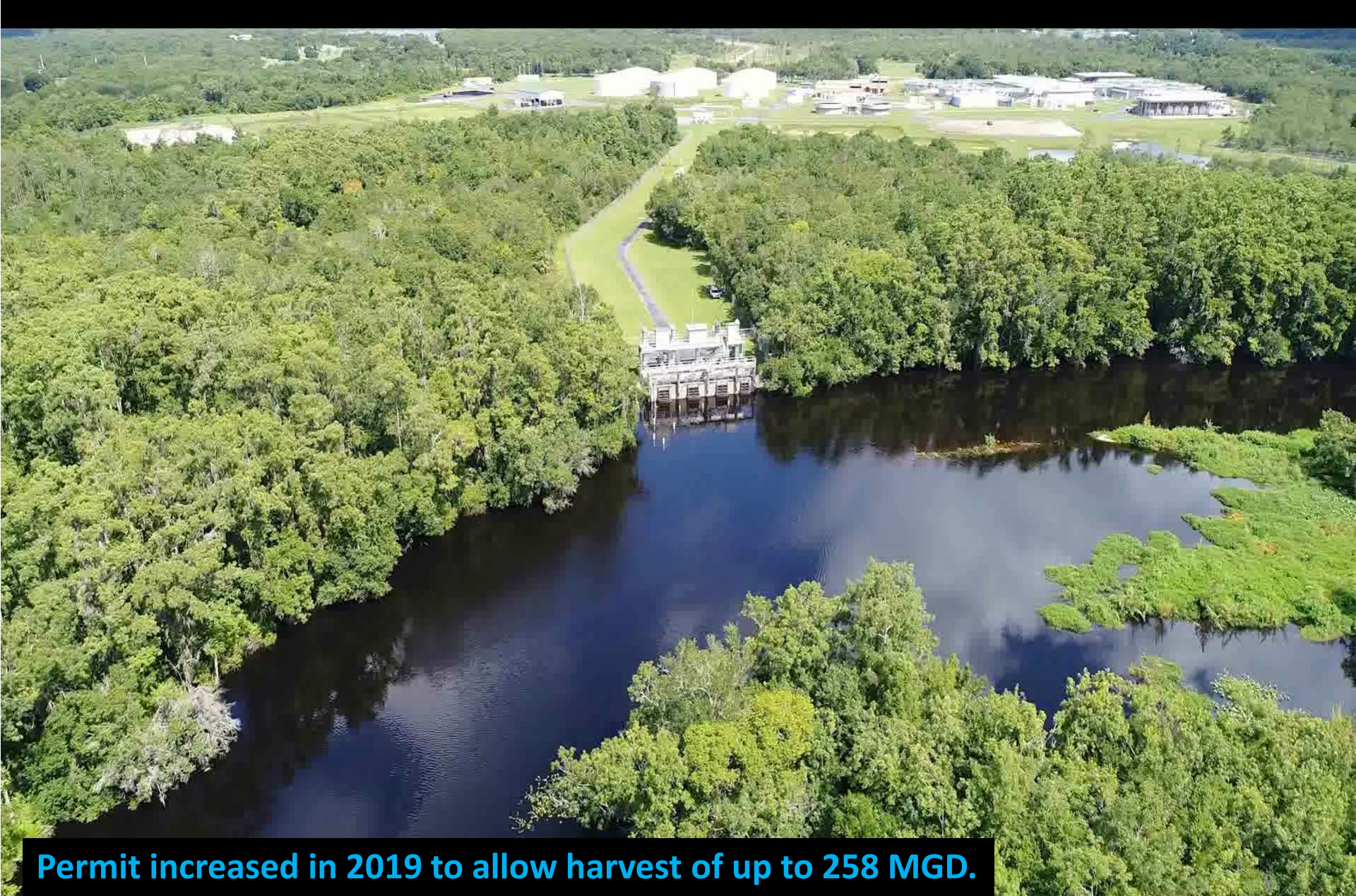


River Intake PTZ

Daily Tidal
Range
~ 2 feet



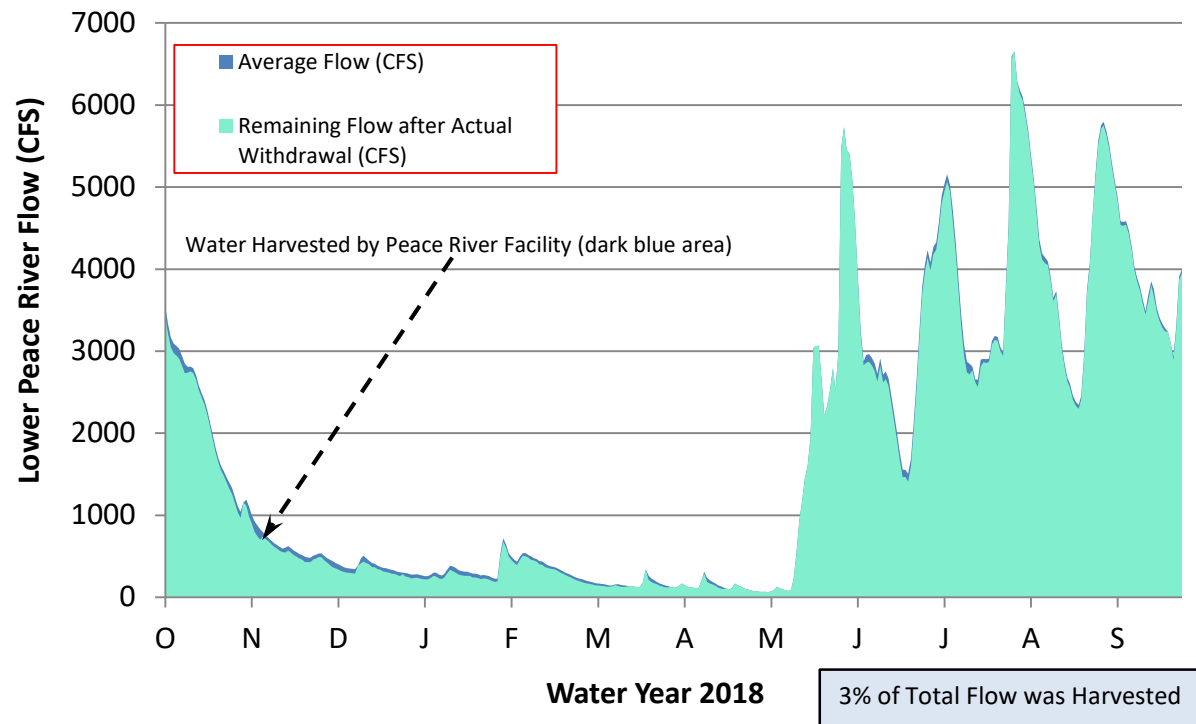
120 MGD River Intake Pump Station



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

Sustainable Withdrawals from Peace River

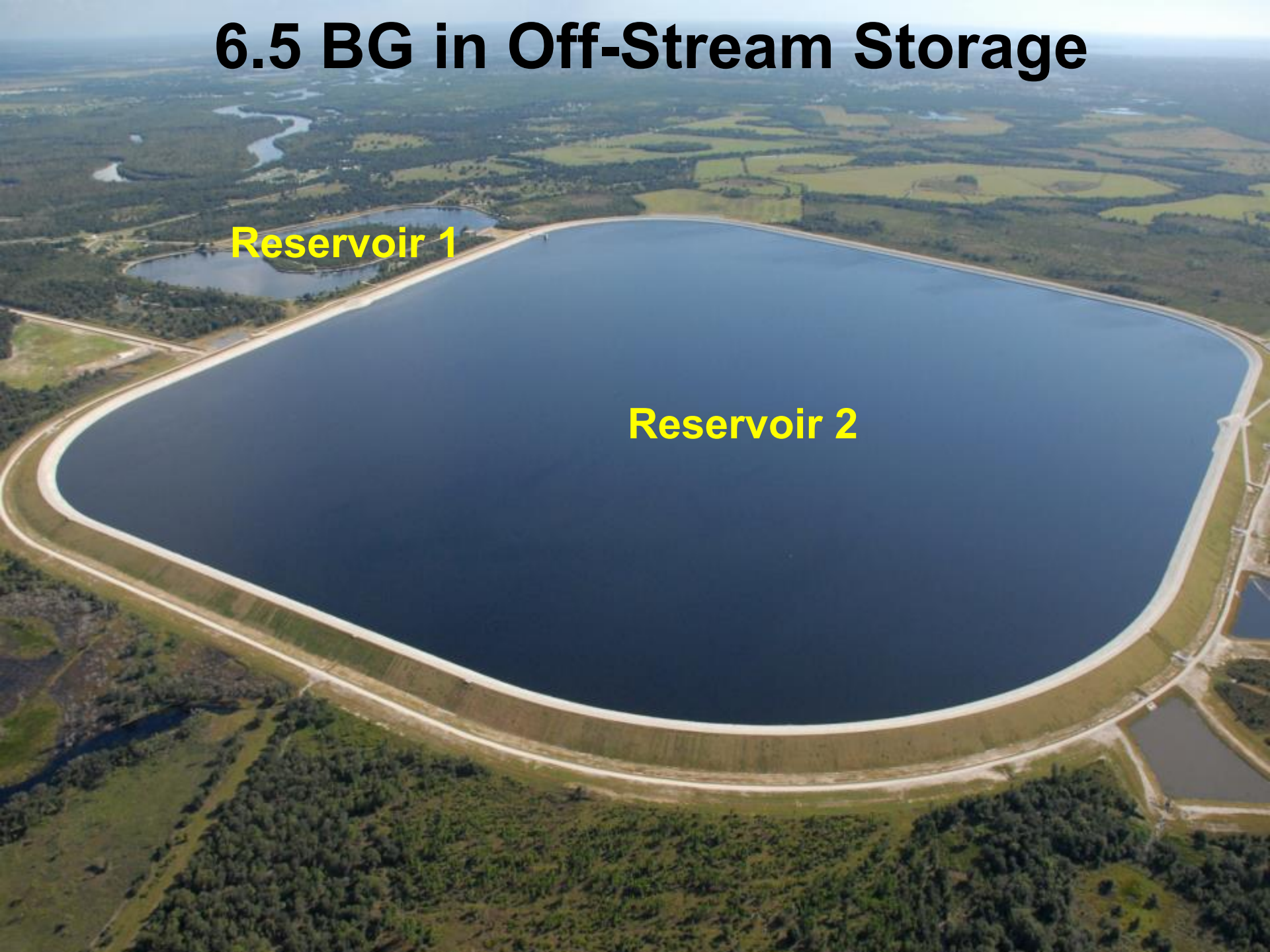
- Based on 2010 Minimum Flow & Levels
- Ties Diversions to Upstream Flow
- Preserves Natural Flow Character
- Harvest Average 3% of Flow since FY 2011



6.5 BG in Off-Stream Storage

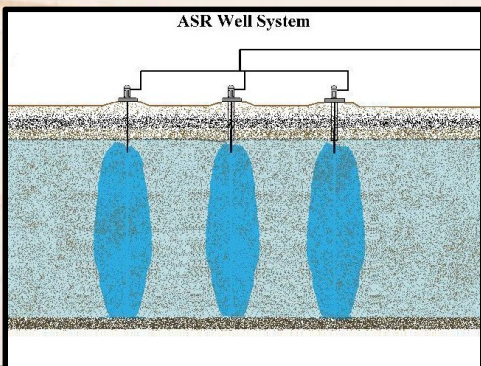
Reservoir 1

Reservoir 2



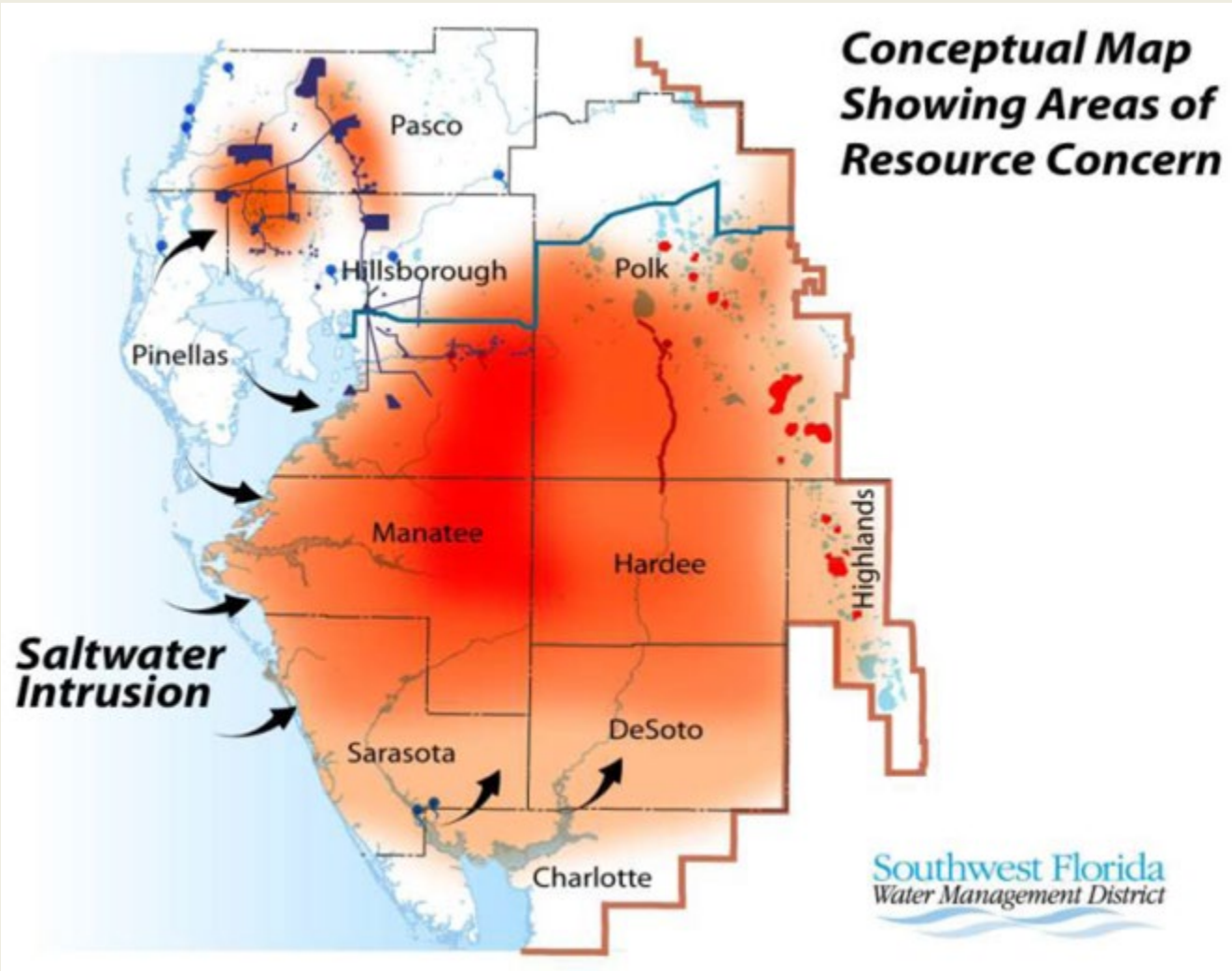
7 BG in Underground Storage

21 Finished Water ASR Wells

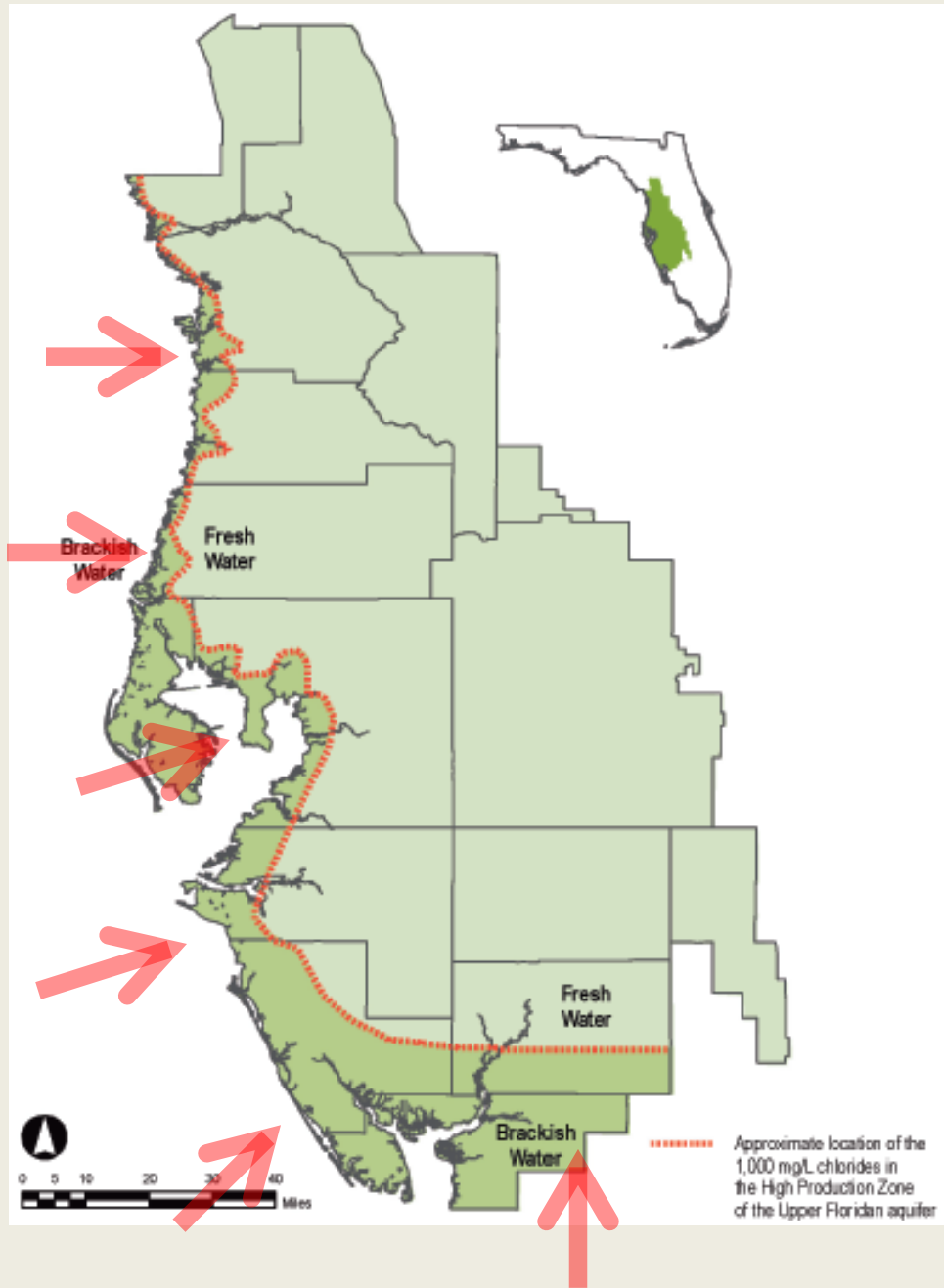


Impacts from Groundwater Pumping

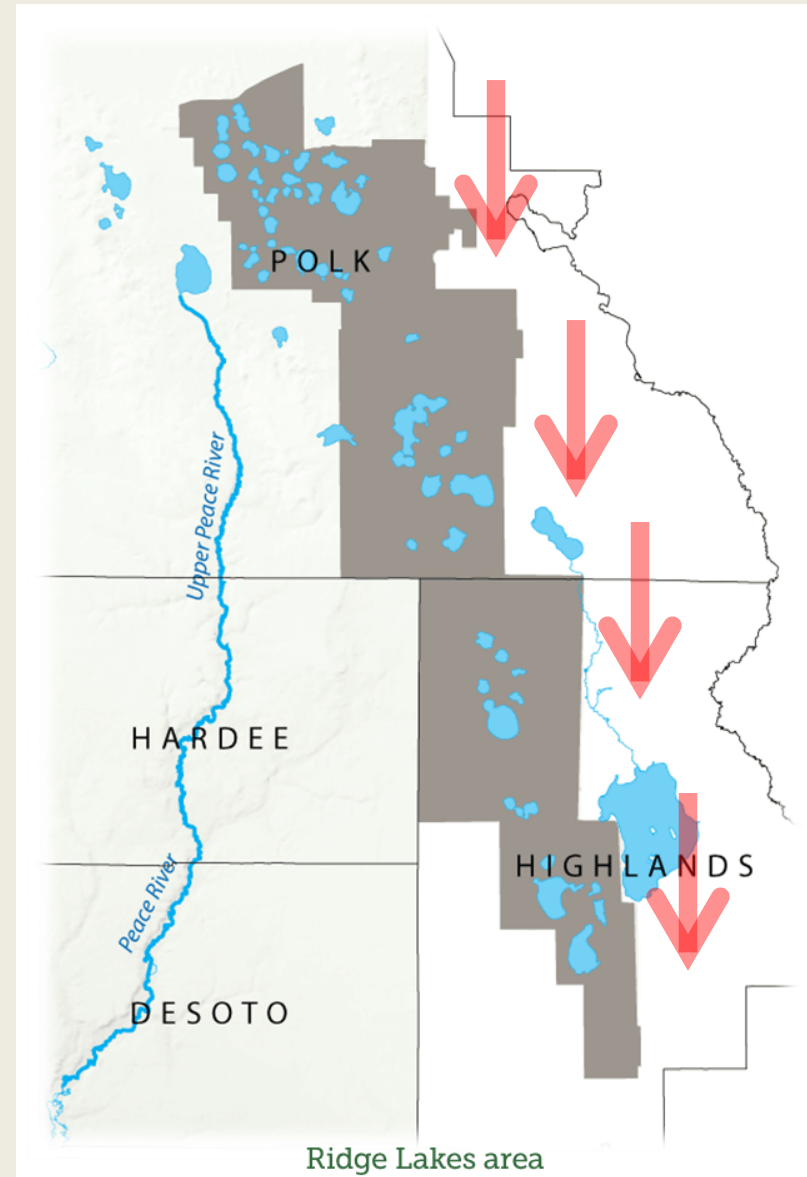
Southern Water Use Caution Area



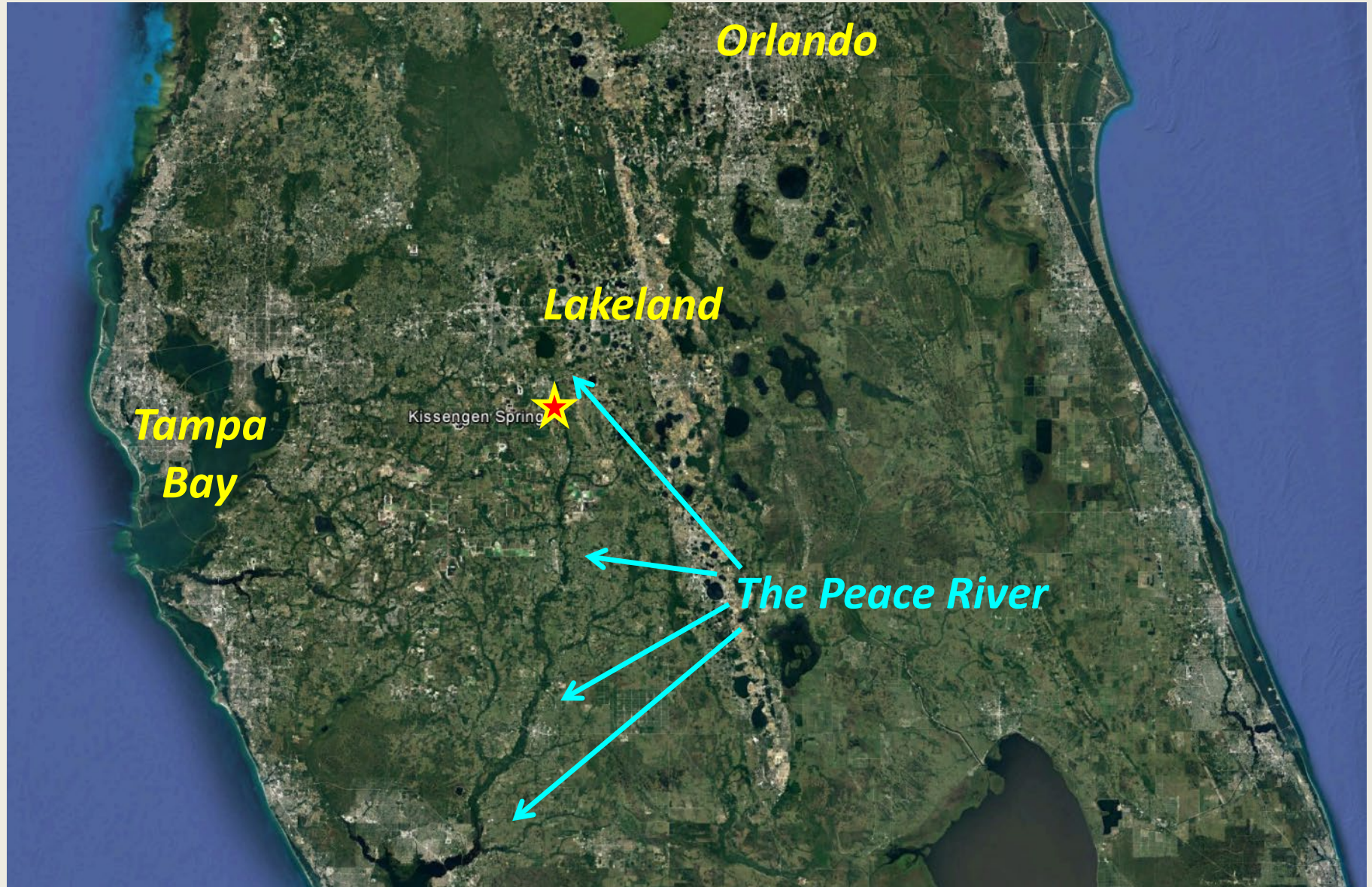
Coastal Salt Water Intrusion



Declining Lake Levels Inland



Kissengen Spring Used to Flow Into the Peace River



Kissingen Spring Bartow, FL



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



a corner of Kissingen Spring 1894

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.



The Upper Peace River Now can go Completely Dry



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



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

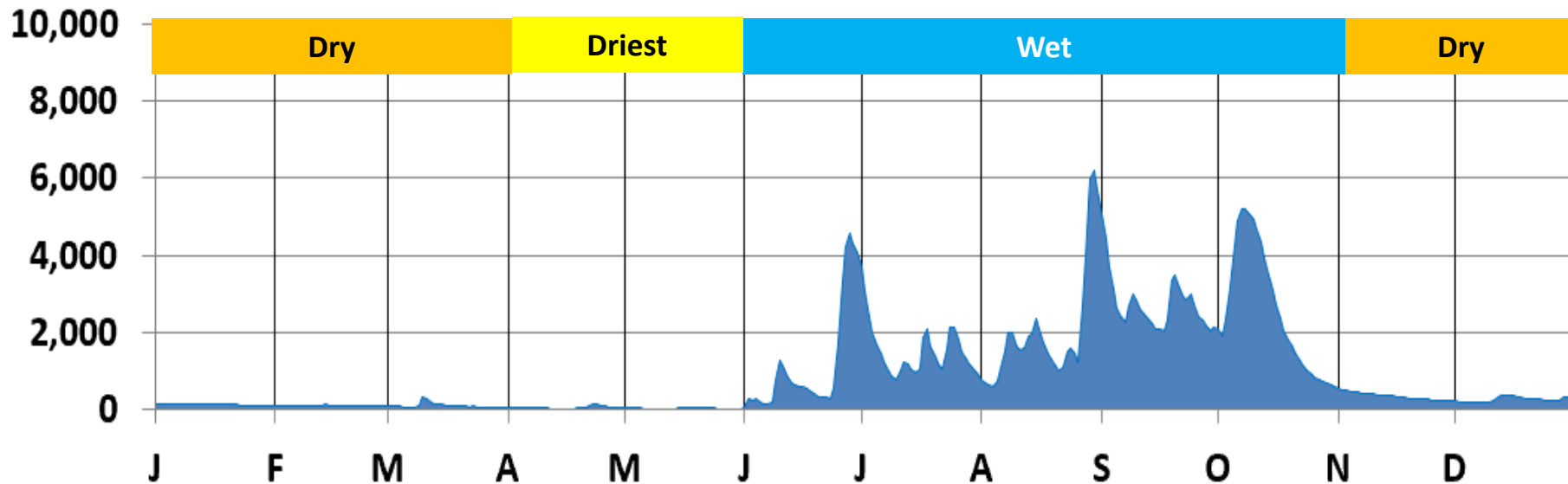
USGS Gauge Station # 2297310
- Horse Creek near Arcadia

USGS Gauge Station # 2297100
- Joshua Creek at Nocatee

Peace River Facility

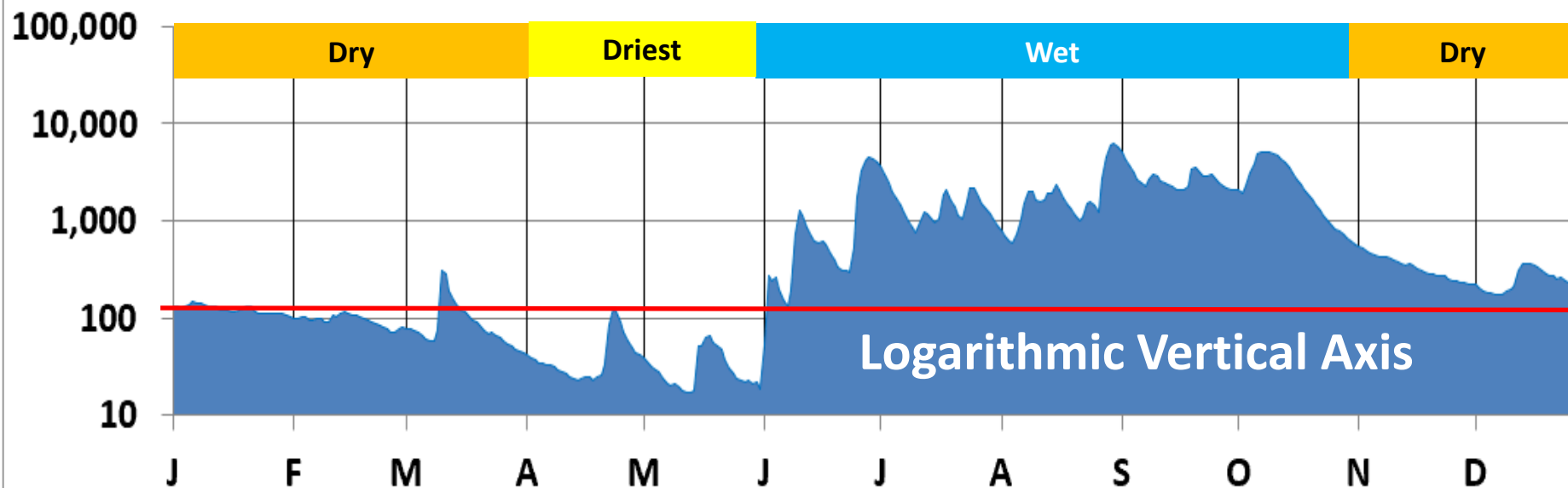
2012

Combined 3-Gauge Flow (cfs)

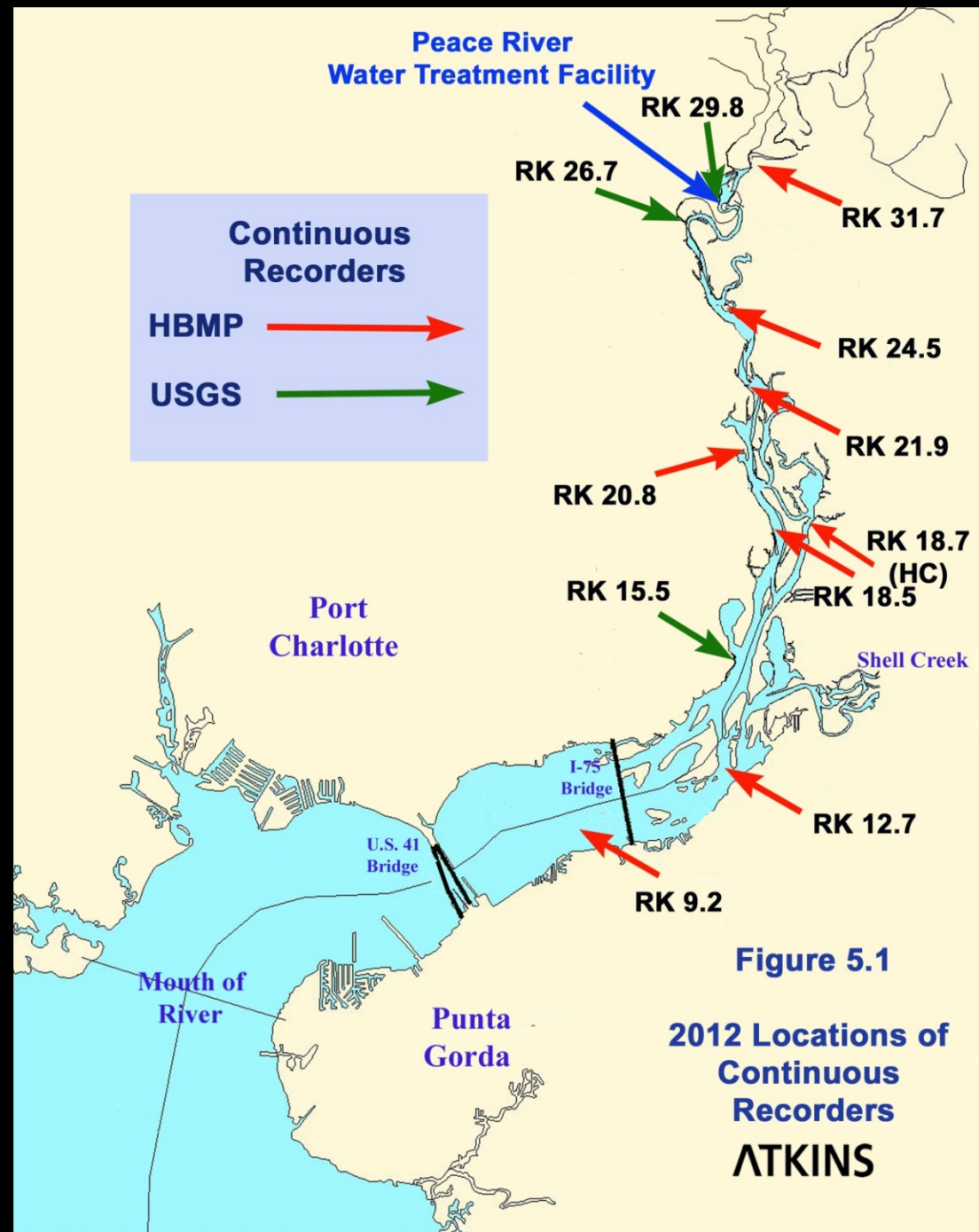


2012

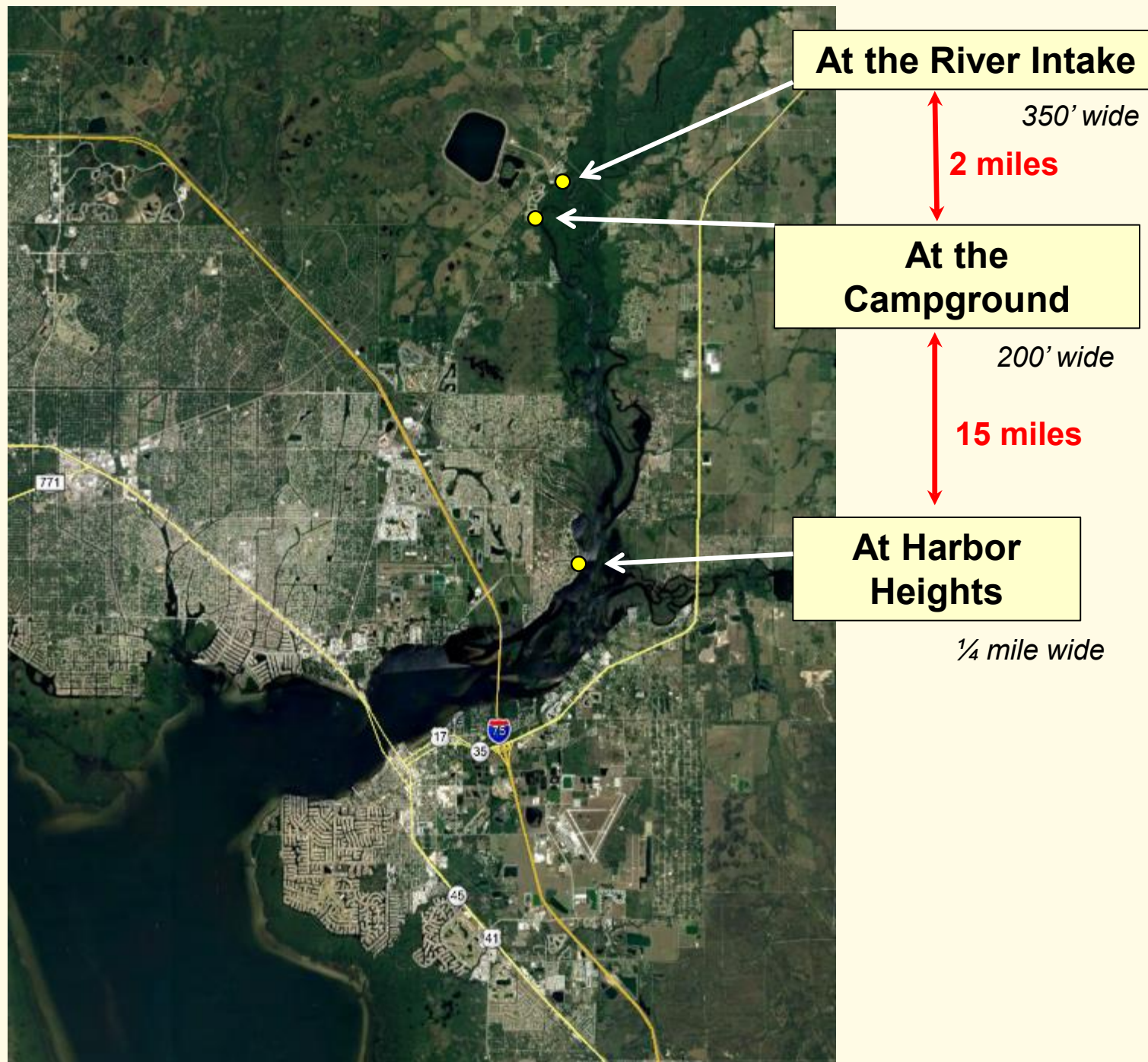
Combined 3-Gauge Flow (cfs)



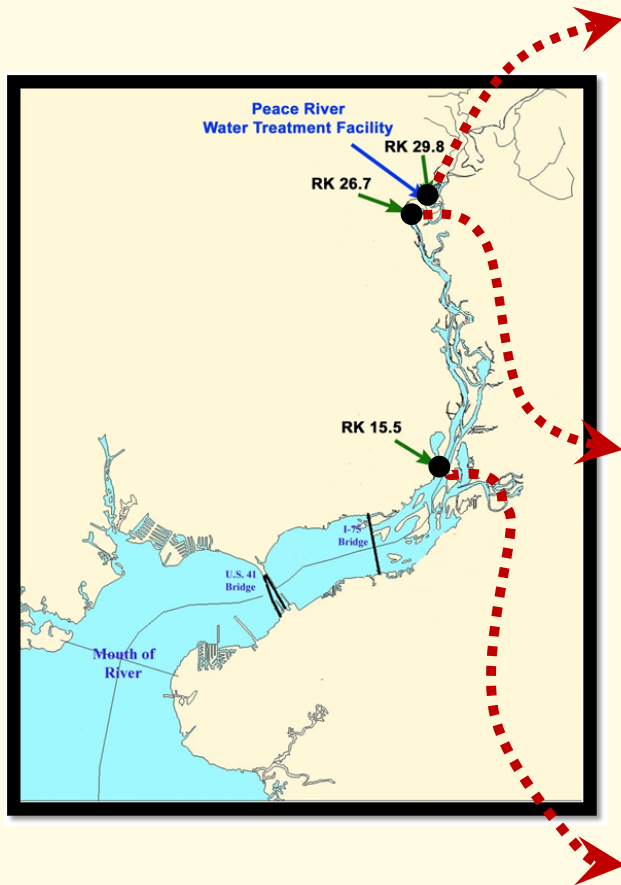
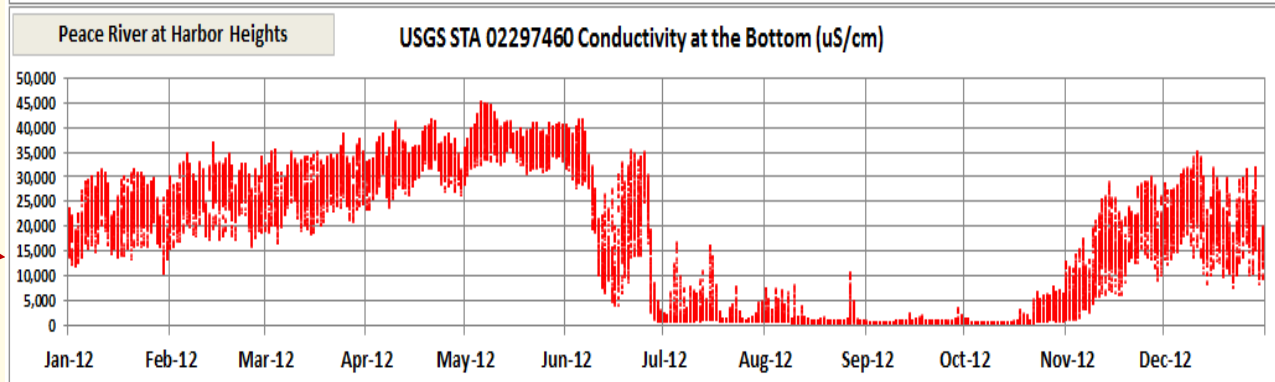
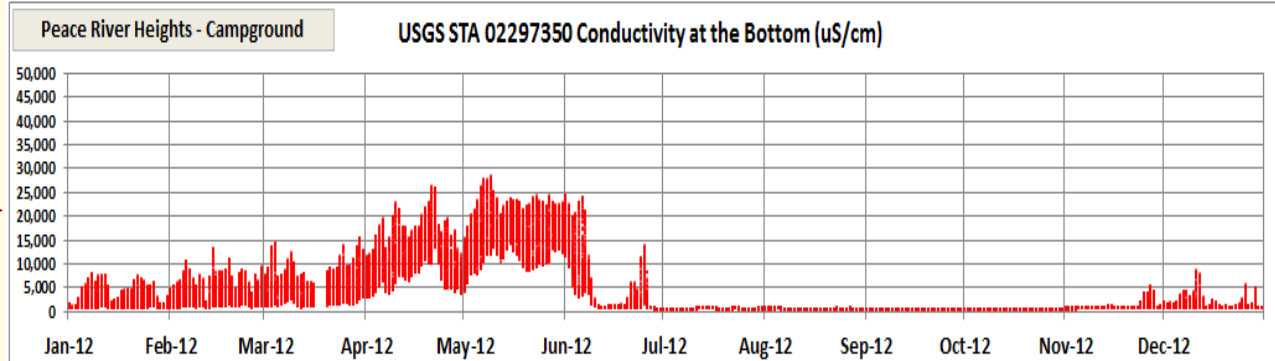
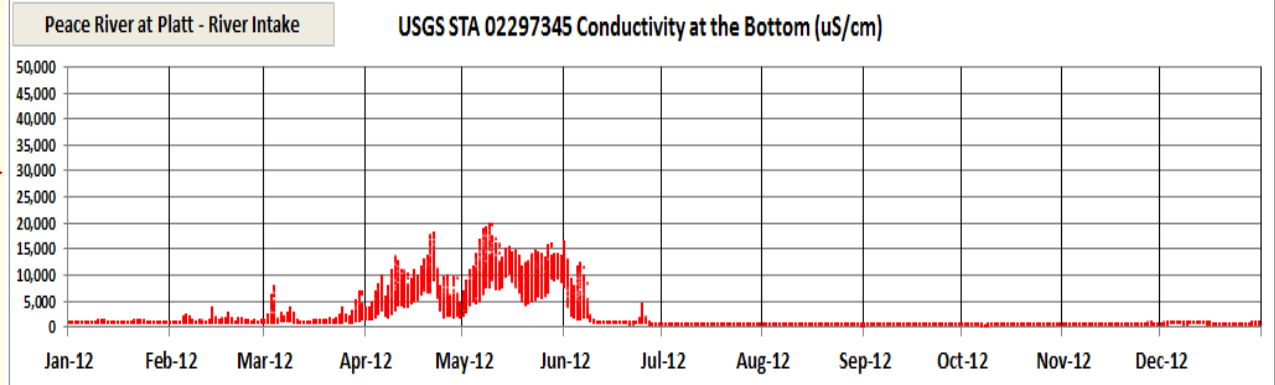
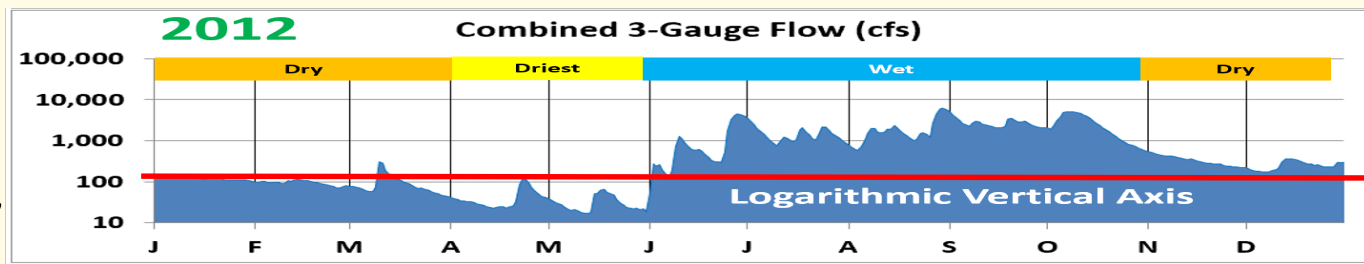
Salinity Recorder Locations



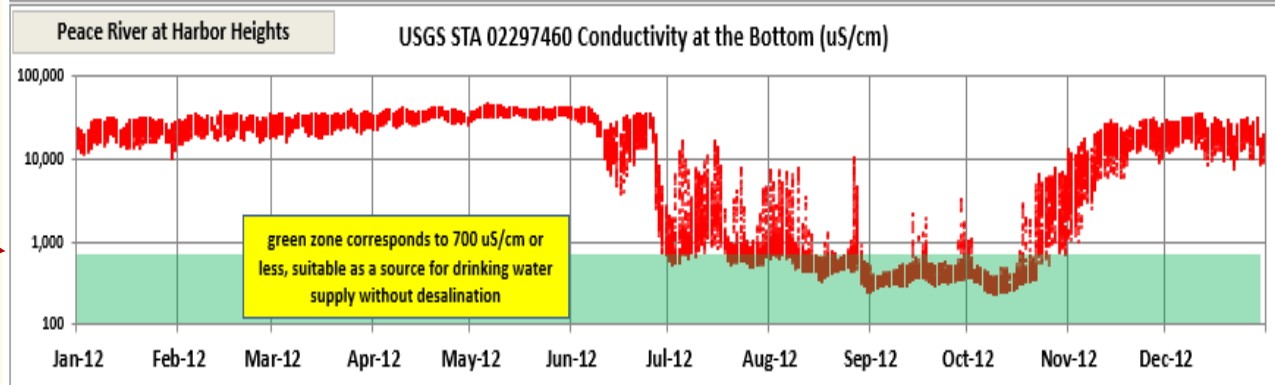
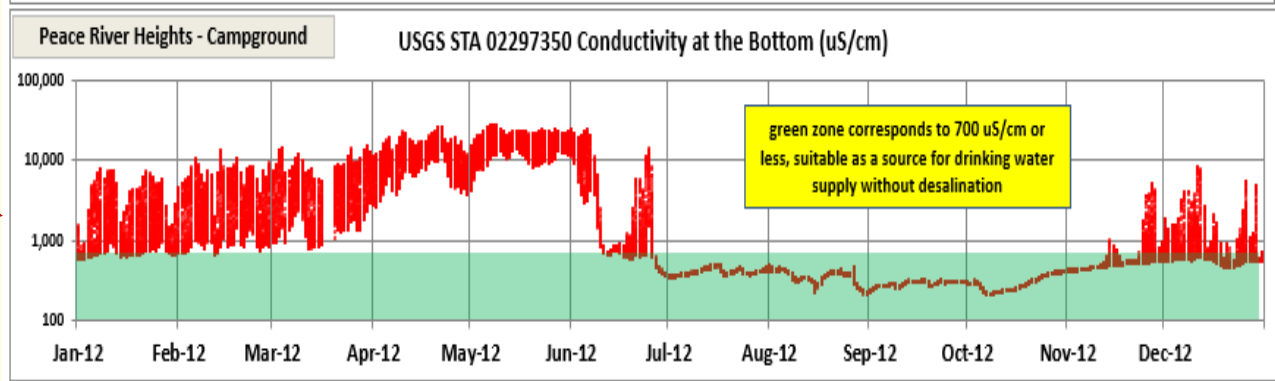
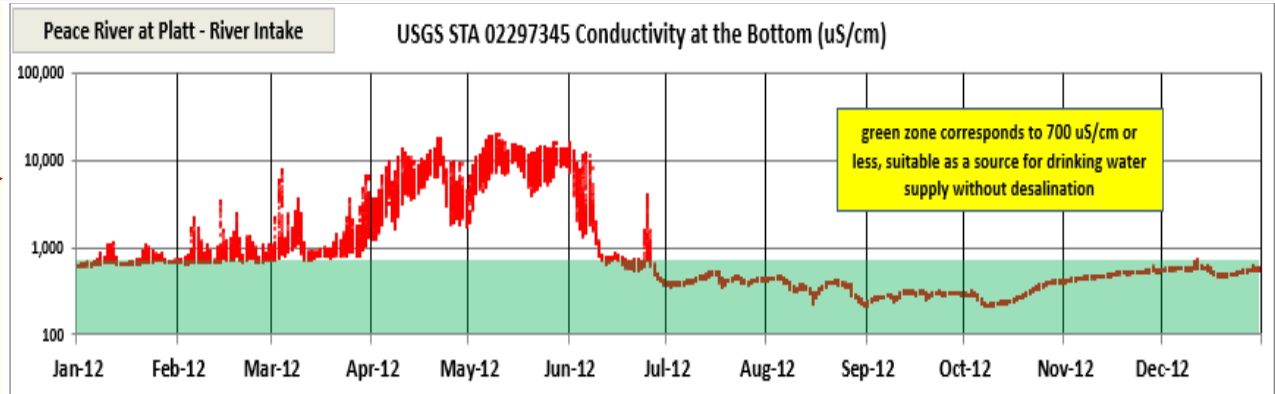
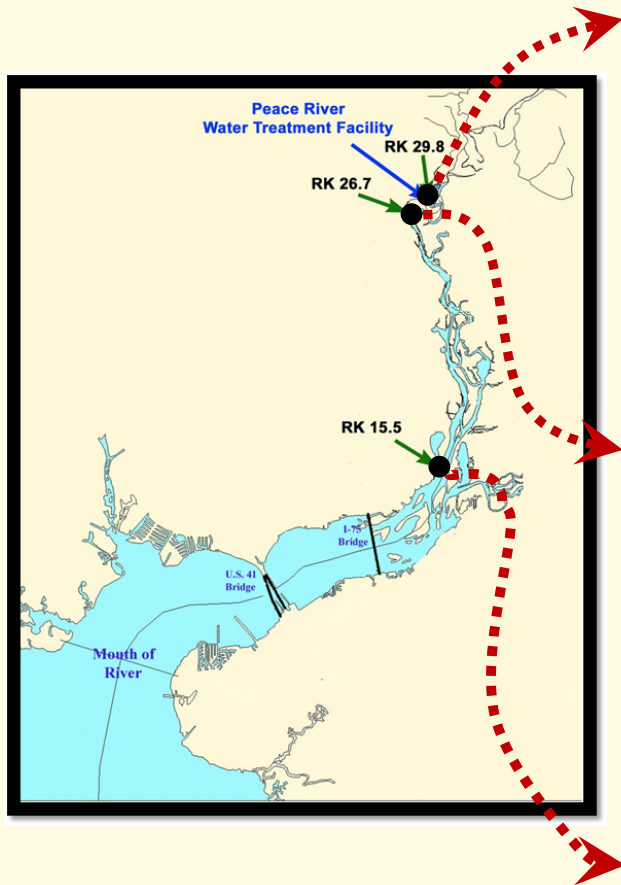
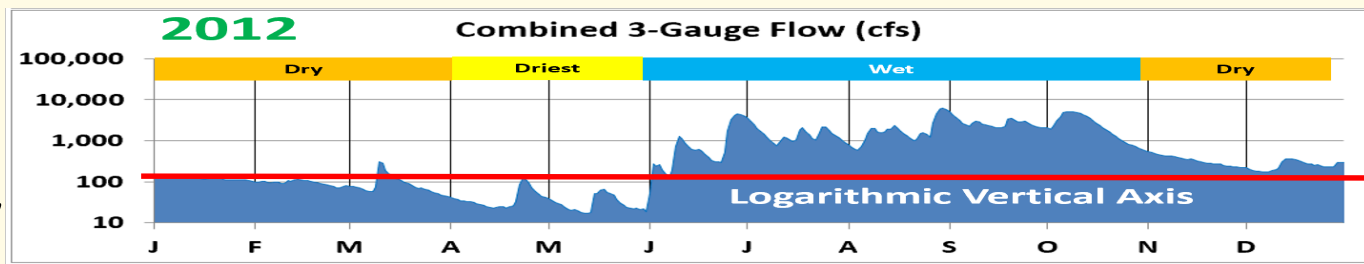
**Let's Focus
on Water
Quality at 3
Continuous
Recorder
Stations**



Bottom Conductivity (2012)



Bottom Conductivity (2012)

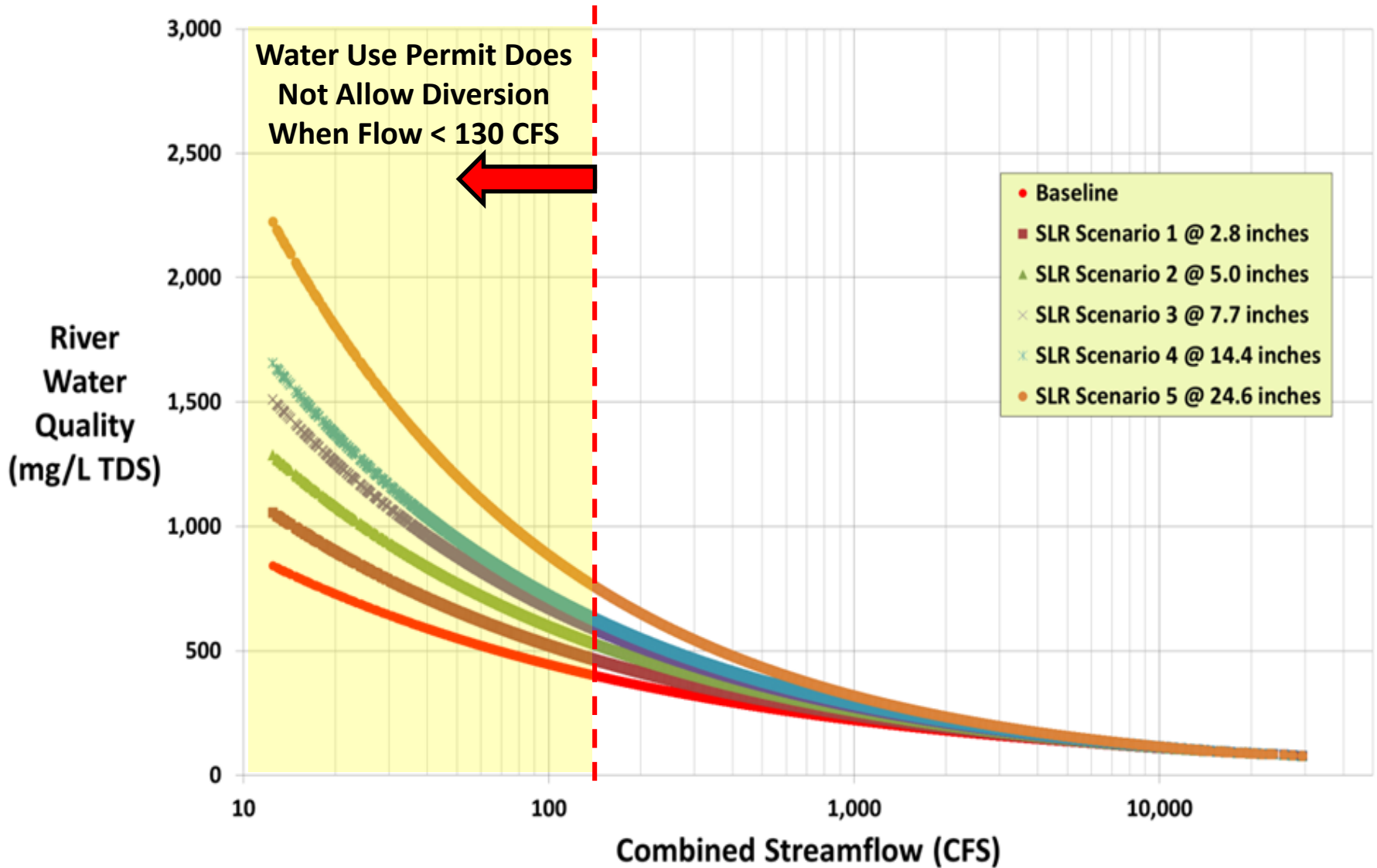


| Probability (%) | 2025 | | 2050 | | 2075 | |
|-----------------------|------|--------|------|--------|------|--------|
| | cm | inches | cm | inches | cm | inches |
| 90% (best case) | 7 | 2.8 | 13 | 5.0 | 20 | 7.7 |
| 50% (median expected) | 13 | 5.1 | 24 | 9.4 | 37 | 14.4 |
| 5% (worst case) | 22 | 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.

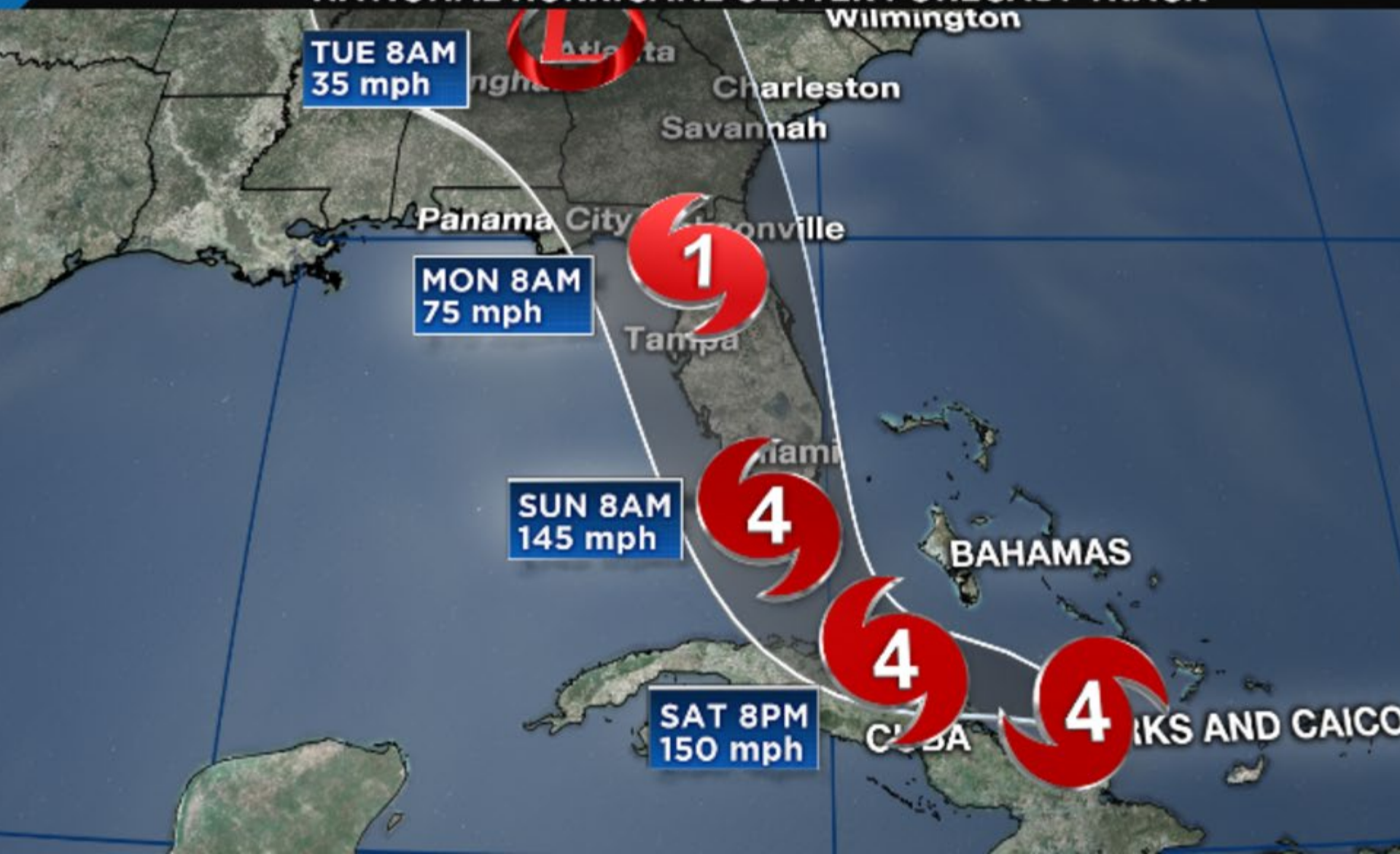
Estimated Total Dissolved Solids of River Water as a Function of Combined StreamFlow

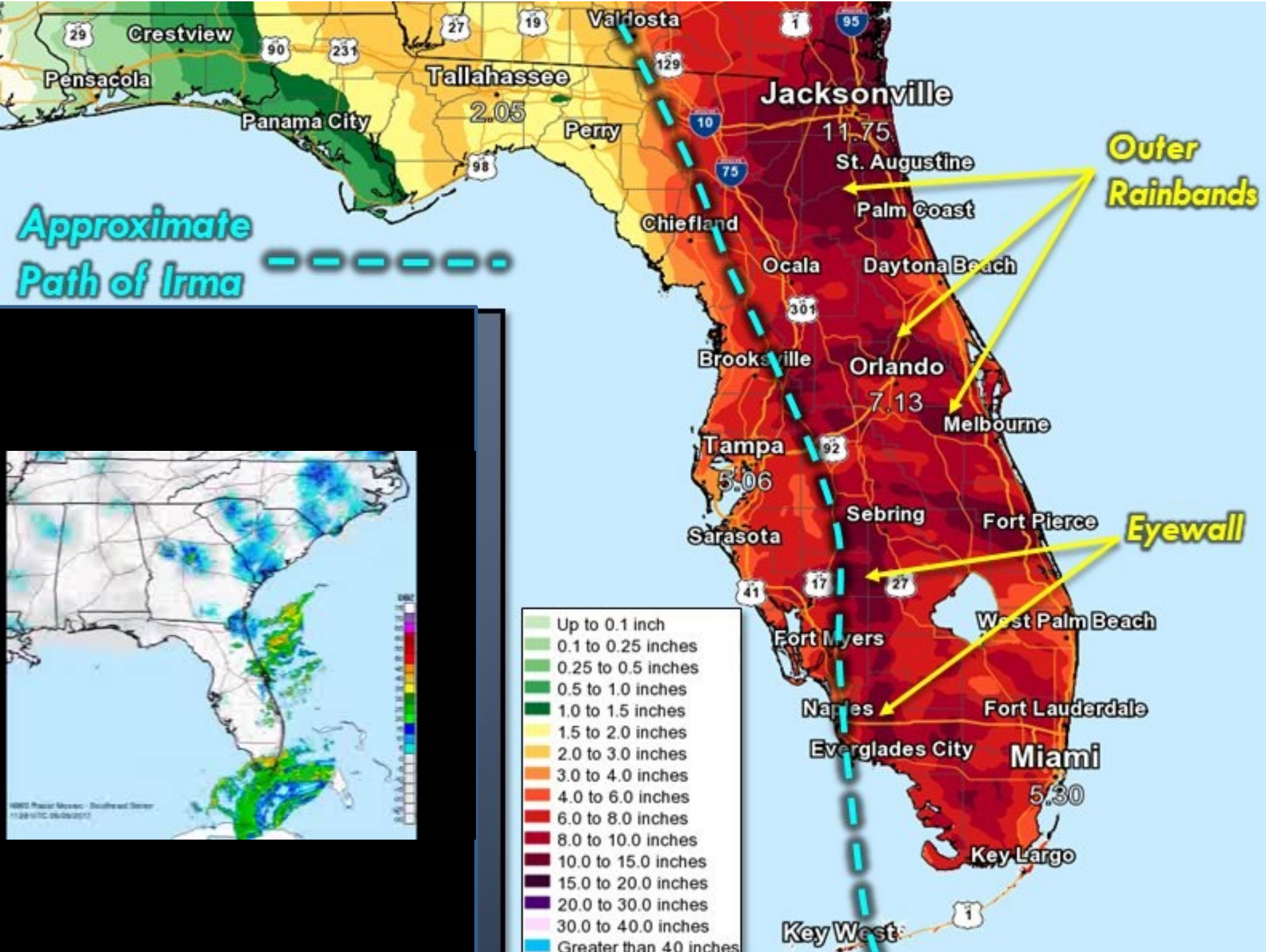


Extreme Conditions: Flooding

HURRICANE IRMA

NATIONAL HURRICANE CENTER FORECAST TRACK







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



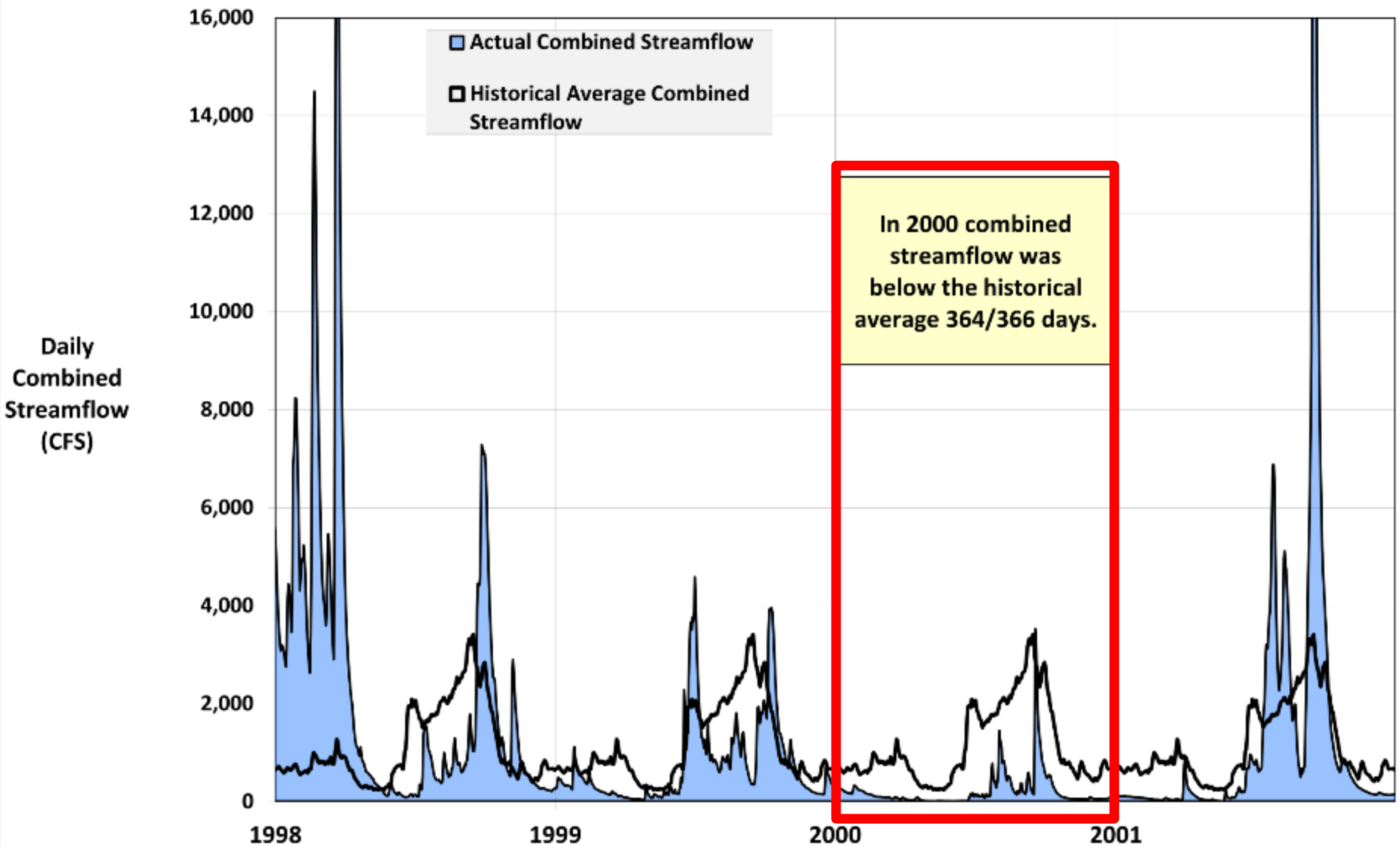
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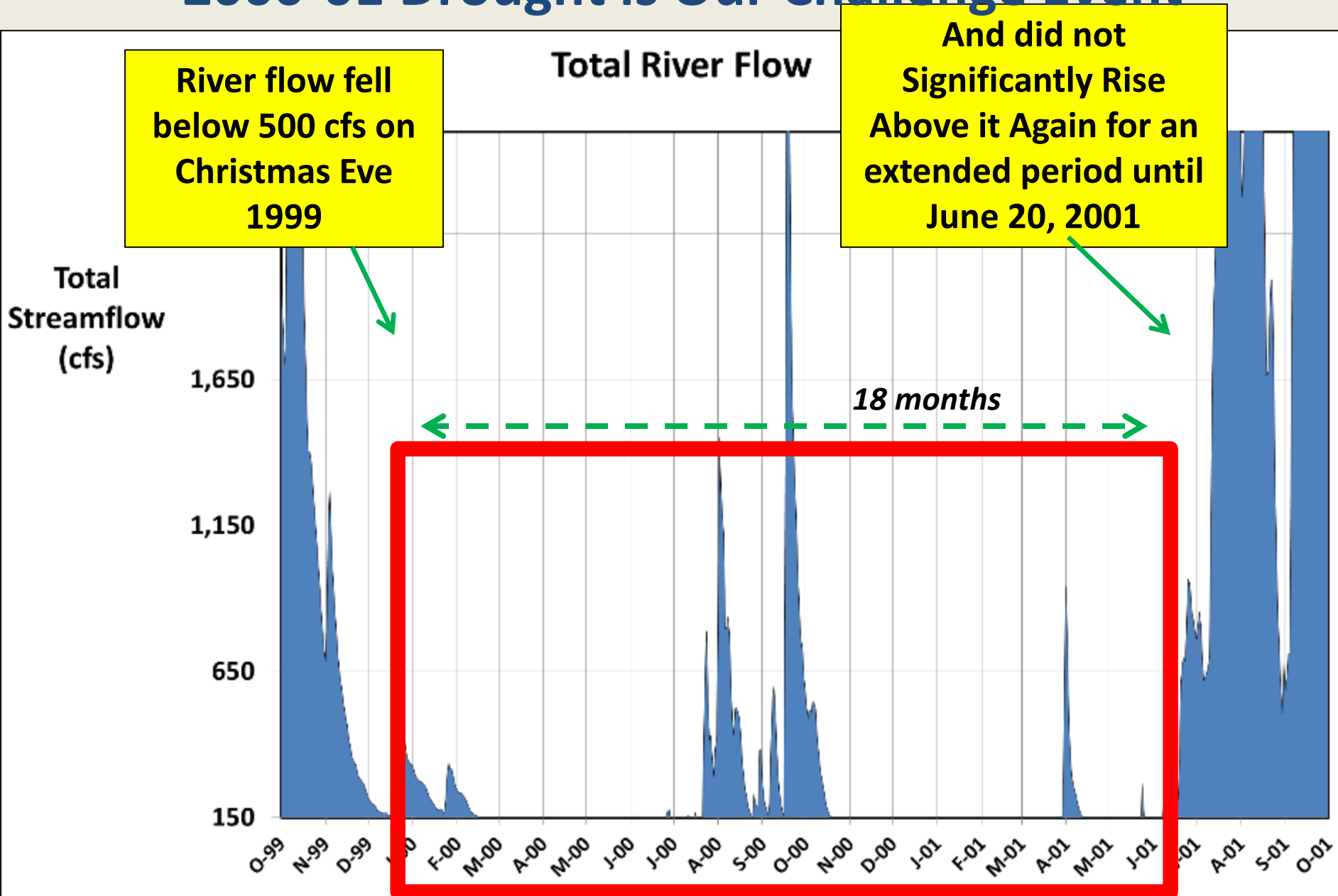
USGS Gauge Station # 2297100
- Joshua Creek at Nocatee

Peace River Facility

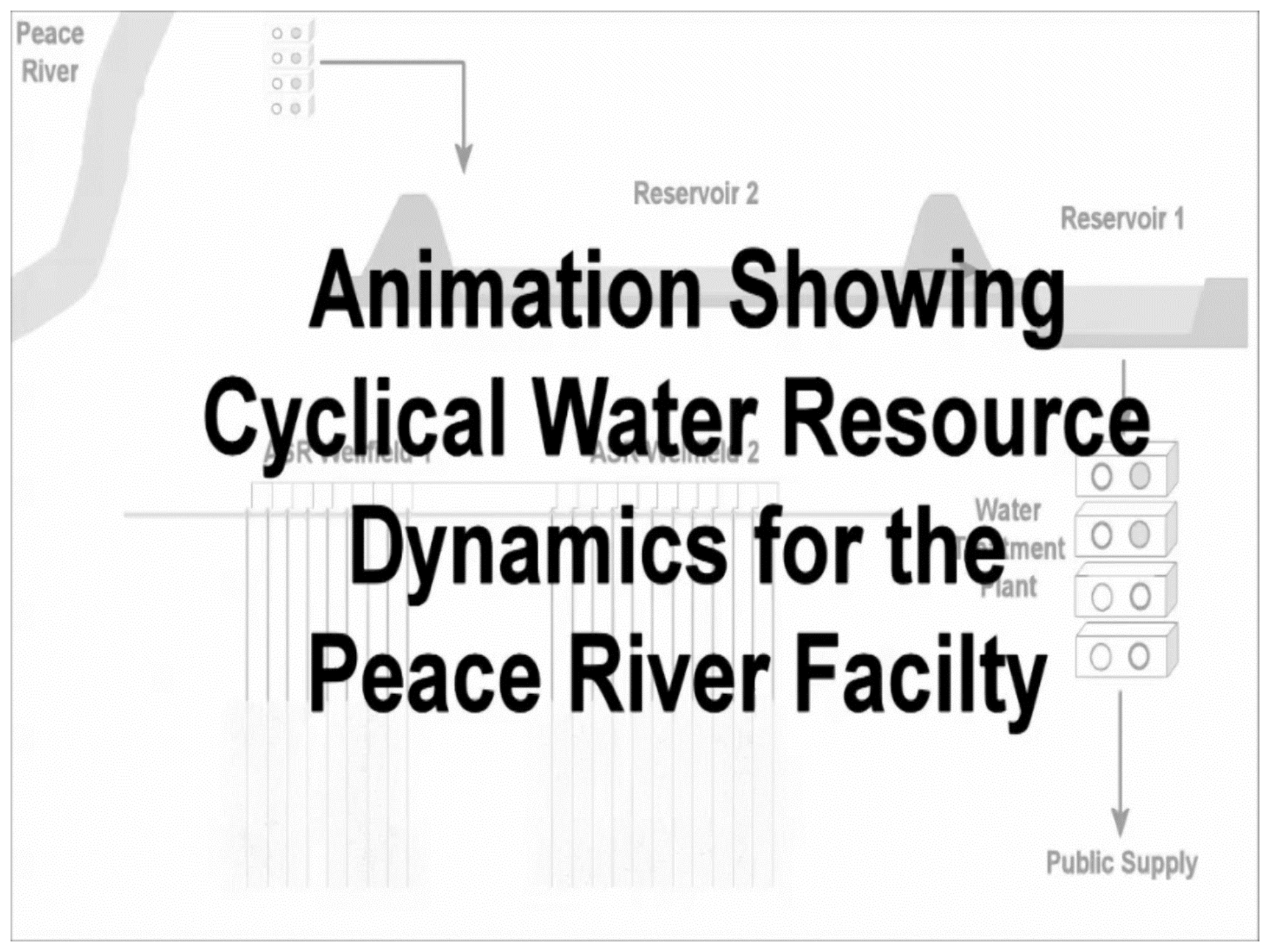
Comparison of Normal Combined Streamflow to Actual Combined Streamflow This Periods Reflects the 1999-01 Drought Event



2000-01 Drought is Our Challenge Event



Building a System Model

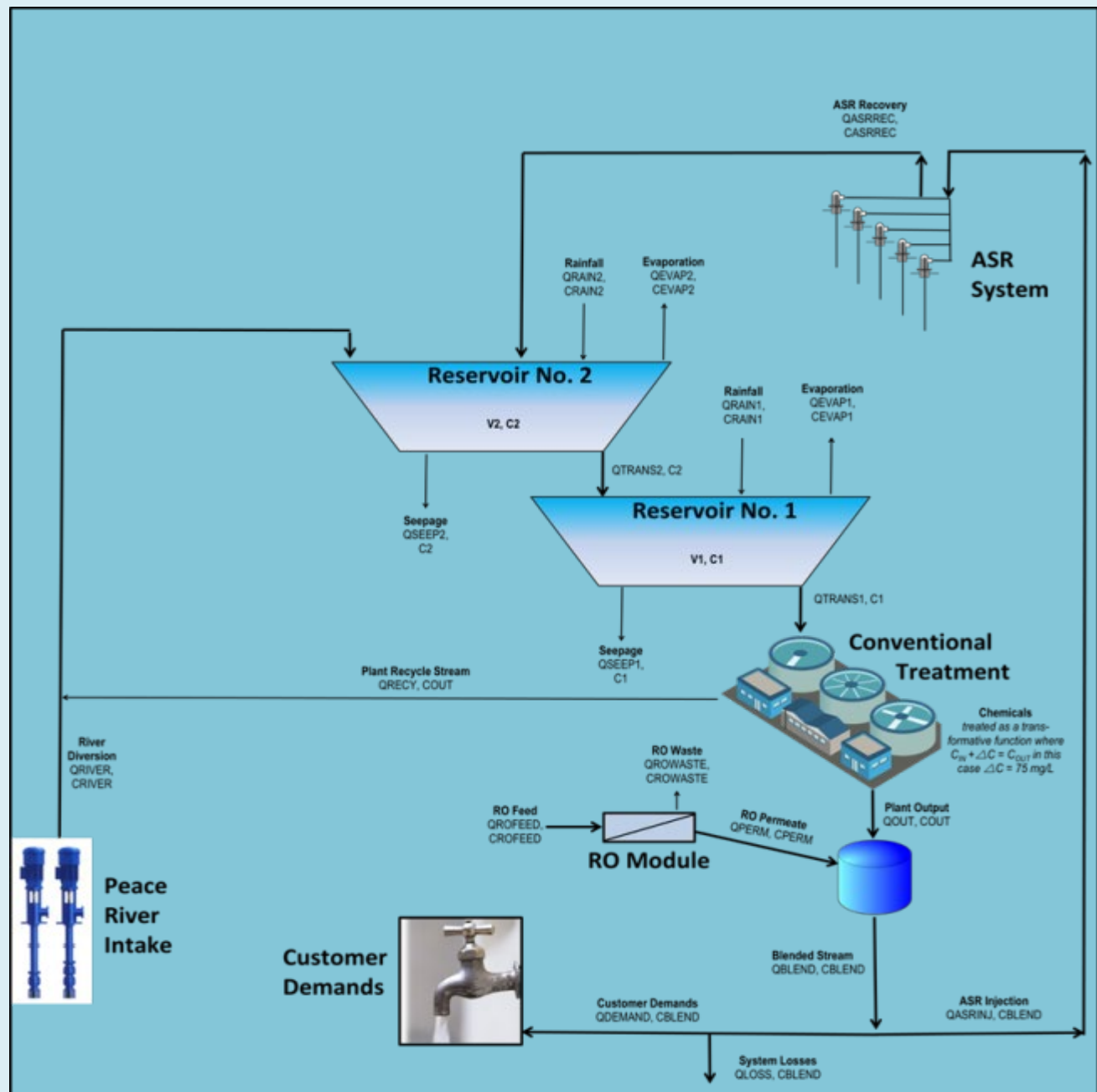


The diagram illustrates the water resource dynamics for the Peace River Facility. It shows the Peace River on the left, with an arrow indicating flow into Reservoir 2. Reservoir 2 is connected to Reservoir 1 by a horizontal line. Below the reservoirs, there are two ASR Wellfields (ASR Wellfield 1 and ASR Wellfield 2) represented by vertical lines. To the right of the wellfields is the Water Treatment Plant, represented by a stack of four rectangular units. An arrow points from the Water Treatment Plant to the Public Supply. The title 'Animation Showing Cyclical Water Resource Dynamics for the Peace River Facility' is centered over the diagram.

Animation Showing Cyclical Water Resource Dynamics for the Peace River Facility

Public Supply

**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%**

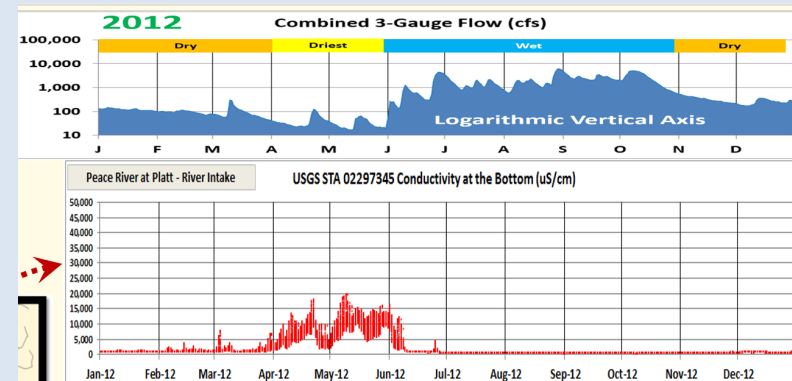
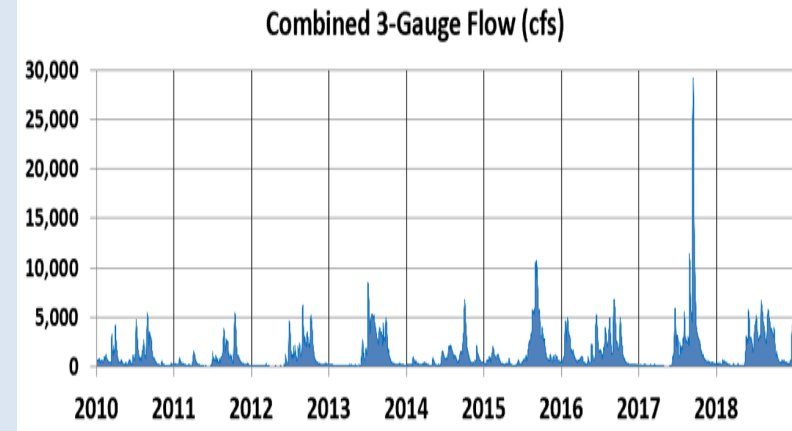
$$\frac{(\# \text{ days met full demands})}{(\text{total days})}$$

- **Quality Reliability** **Goal is > 95%**

$$\frac{(\# \text{ days met full demands with TDS} < 500 \text{ mg/L})}{(\text{total days})}$$

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 
- As flow  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?



An aerial photograph of a large, kidney-shaped reservoir with a dark blue surface. The reservoir is surrounded by a light-colored earthen embankment. The surrounding landscape is a mix of green fields, dense forests, and smaller bodies of water. In the far distance, a city skyline is visible under a hazy sky. The word "End" is written in a large, white, sans-serif font in the center of the reservoir.

End