NC STATE UNIVERSITY

INNOVATIVE STORMWATER RETROFITS FOR BARRIER ISLAND APPLICATIONS: SEPTIC TANK CONVERSION IN HOLDEN BEACH, NC

Jason D. Wright, William F. Hunt, Jonathan T. Smith, Matthew Jones

Department of Biological and Agricultural Engineering

North Carolina State University

Economics On Coastal Tourism

- **180 million Americans vacation to coastal areas and the Great Lakes, spending ~ $44 billion/year**
  - ➢ 6.5 million tourists visit North Carolina's barrier island beaches each year, spending $2.9 billion/year*
- **Coastal tourism and recreation created 1.67 million jobs in the U.S., (44,800 in North Carolina) grossing $29.5 billion dollars****

*U.S. Environmental Protection Agency. 2000. *Liquid Assets 2000: America's Water Resources at a Turning Point.* EPA-840-B-00-001. Office of Water (4101), United States Environmental Protection Agency, Washington, DC

**Dorman Mark. "Testing the Waters: A Guide to Water Quality at Vacation Beaches." Natural Resources Defense Council, Aug. 2004

Coastal Population Increase

- Coastal areas contain over 50% of the total U.S. population within only 17% of the nation's land area*

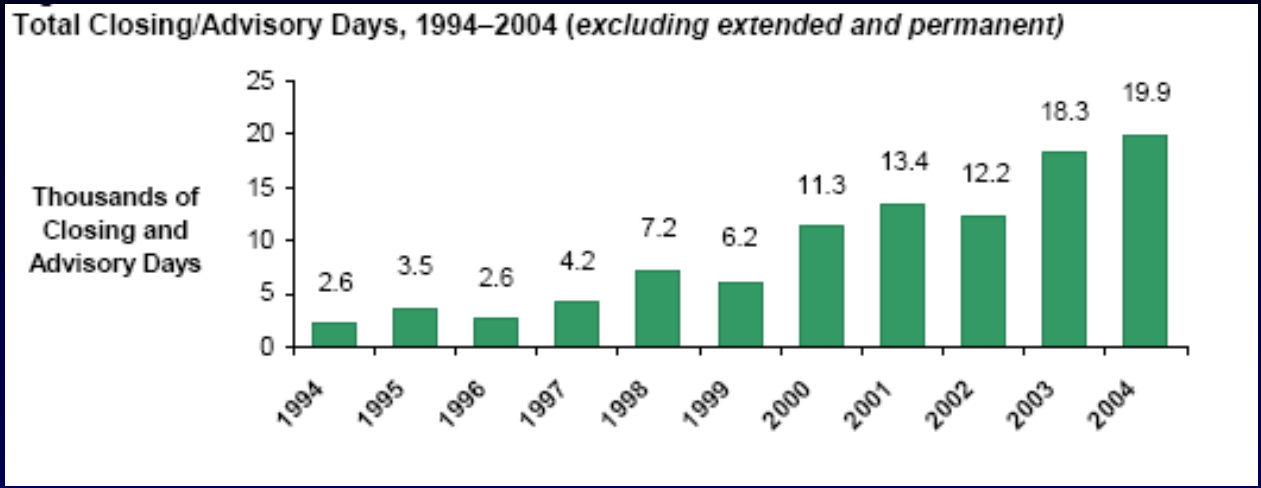
- Coastal populations grew by 37 million people between 1970 and 2000, projected to increase by another 21 million by 2015*

*Dorman Mark. "Testing the Waters: A Guide to Water Quality at Vacation Beaches." Natural Resources Defense Council, Aug. 2004

EPA Coastal Standards

- October 2000 Beach Environment Assessment and Coastal Health Act (BEACH Act)
- Bacteria Standards
  - Fecal Coliform standard Tier 1 Beach
    - > 200 CFU /100 mL single sample
  - *Enterococcus* standard Tier 1 Beach
    - > 104 CFU /100 mL single sample
- 26 of 35 coastal states adopted the EPA standards

Beach Closures and Advisories



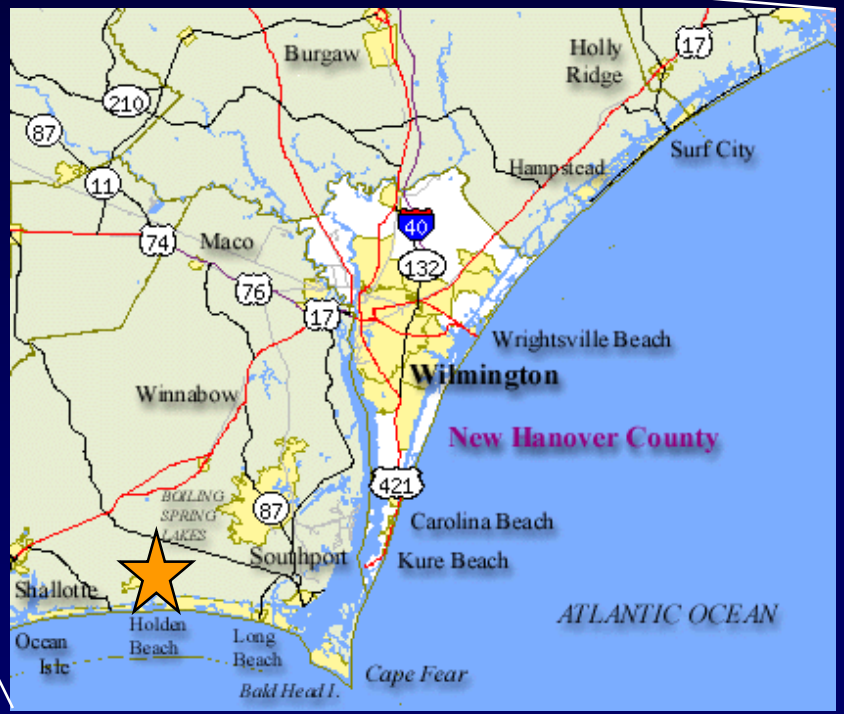
Major Pollution Sources Causing Beach Closings/Advisories in 2005

Pollution Source	Number of Closings/Advisories*
Elevated bacteria levels of unknown origin	14,602 days plus 69 extended and 39 permanent events
Stormwater runoff	5,333 days plus 26 extended and 2 permanent events
Rain or preemptive††	5,213 days plus 23 extended and 9 permanent events
Sewage spills and overflows†	898 days plus 2 extended and 7 permanent events
Other (algal blooms, dredging, wildlife, etc.)	333 days plus 1 extended and 3 permanent events

*Total exceeds national total because more than one source may apply to a given closing/advisory.
†Includes sewage overflows from combined and sanitary sewers, malfunctioning sewage treatment plants and pump stations, sewage spills, and sewer-line breaks.
††Usually due to stormwater or sewer overflows.
Extended: closings of 7 to 13 weeks.
Permanent: closings of more than 13 weeks.

Holden Beach

(Tier 1 beach)



NC STATE UNIVERSITY

Town Of Holden Beach

- 900 Full Time Residents
- 10,000 in the summer
- Approximately 3,150 parcels with 2,400 Homes
- Currently One Septic Tank for Each Parcel
- Installed Regional Sewer System
  - Was operational in early 2006
  - All Structures Must Connect to Sewer System within 1 year of operation

Project Scope

- Harvested Rain Water in Unused Septic Tanks
  - Connected Down Spouts to Septic Tank
  - Installed Sump Pump For Irrigation
  - Allowed the Water to Infiltrate
    - Punched Hole in the Bottom of the Tank


Tank 2
Tank 1
Tank 3
MARSH WALK
BY THE SEA
FRIGATE
SEA GULL
DEAL
SEA SIDE
OCEAN

NC STATE UNIVERSITY

NC STATE UNIVERSITY

NC STATE UNIVERSITY


Tank 2
Tank 1
Tank 3
MARSH WALK
BY THE SEA
FRIGATE
SEA GULL
DEAL
SEA SIDE
OCEAN


Tank 2
Tank 1
Tank 3
MARSH WALK
BY THE SEA
FRIGATE
SEA GULL
DEAL
SEA SIDE
OCEAN

Drainage Areas

- Tank 1
  - 845 Ft^2
- Tank 2
  - 370 Ft^2
- Tank 3
  - 790 Ft^2

Tank 3

Tank 2

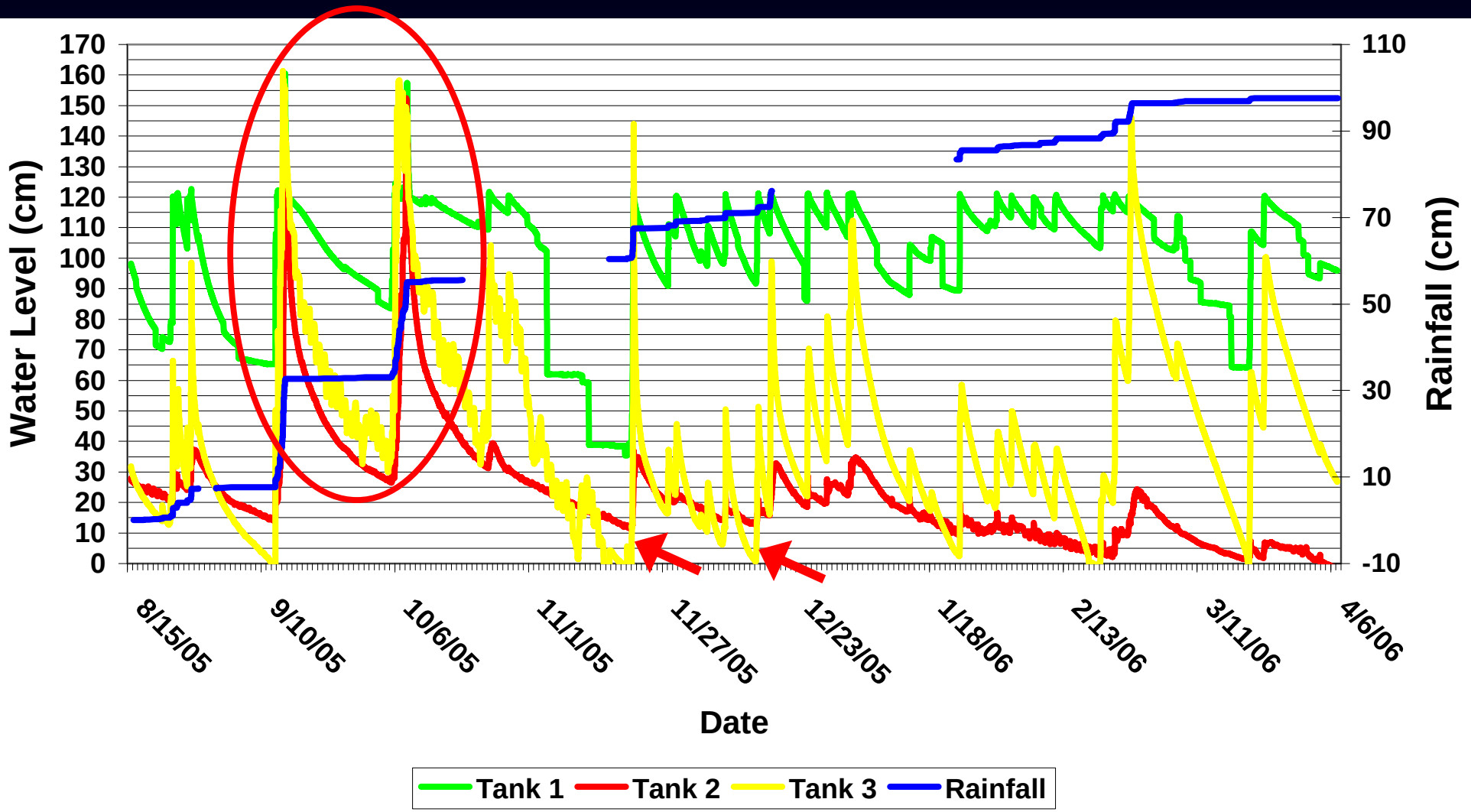
Conversion Costs

- Connecting The Downspouts ~$65
  - Plastic Corrugated Pipe
    - average of $38 for 100 ft
    - Connect 2 downspouts ~100 ft
  - ~ 5 fittings average of $3 each
  - Other materials (PVC glue etc) ~ $10
- ¼ horse power pump for irrigation = $85
- Installation Time
  - 23 man hours for Tank 1
  - 16 man hours for Tank 2 and Tank 3

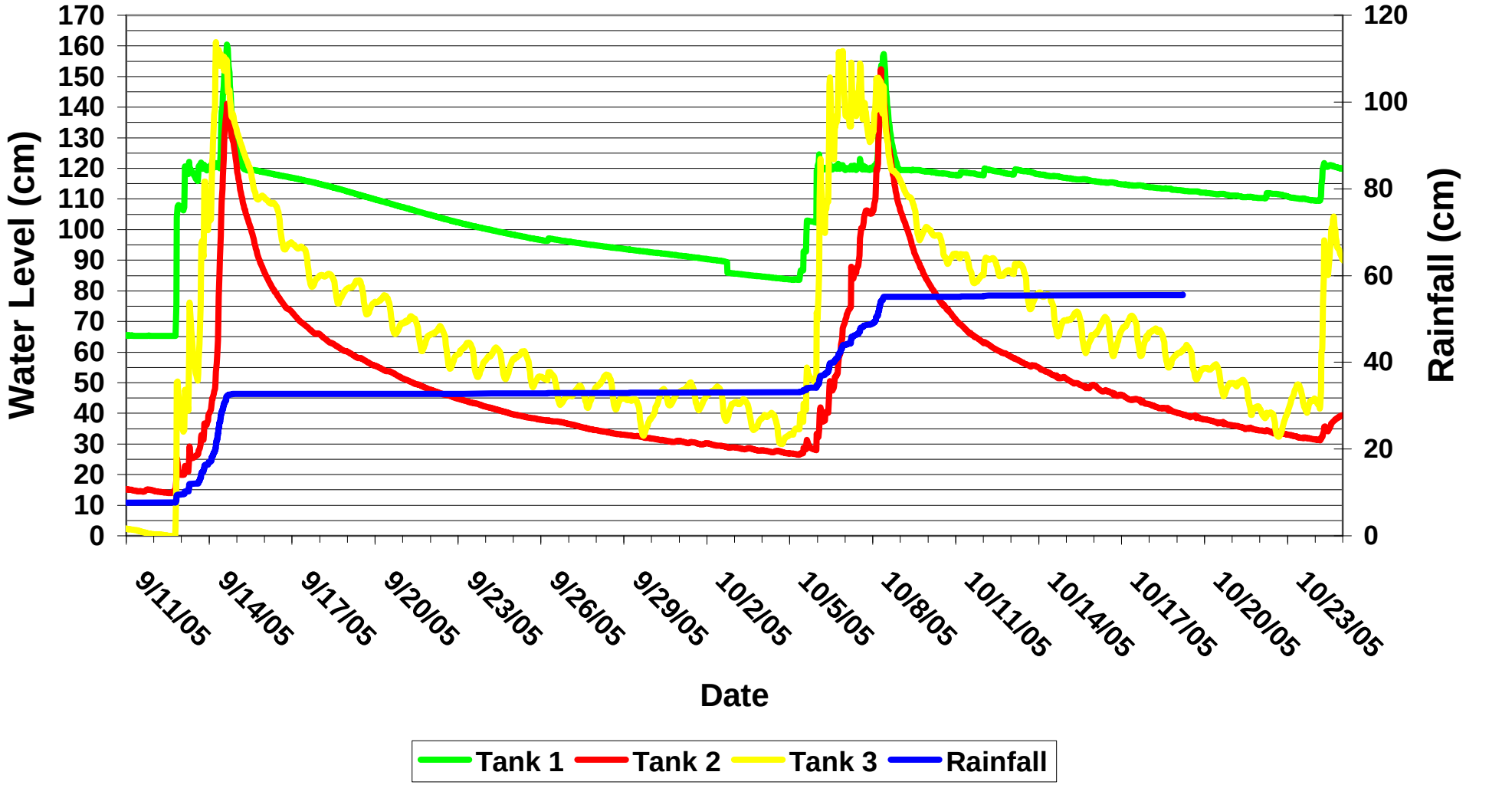
Monitoring Results


Tank 2
Tank 1
Tank 3
MARSH WALK
BY THE SEA
FRIGATE
SEA GULL
OCEAN
DEAL
SEA SIDE

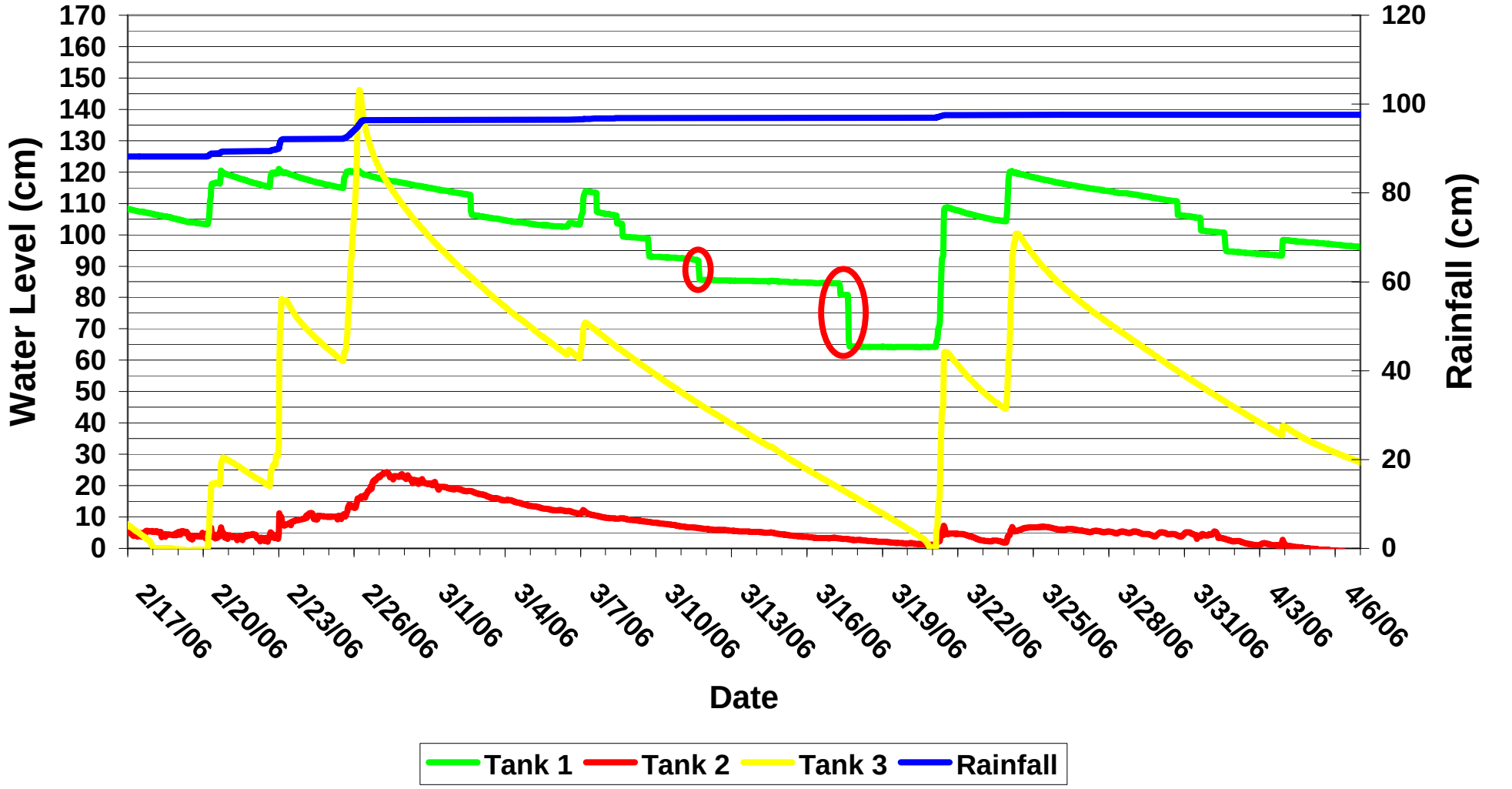
Water Level and Rainfall



Water Level and Rainfall During Hurricane Ophelia (~25.5 cm) and Tropical Storm Tammy (~20 cm)



Infiltration and Irrigation



Holden Beach Conclusions

- A basic spreadsheet based model was calibrated from the observed data
  - Tank 2 captured and infiltrated 78% of the rainfall
  - Tank 3 captured and infiltrated 87% of the rainfall
  - The remaining rainfall was assumed to have passed into the drain field
- Position in the landscape effects infiltration
- Irrigation did not utilize all harvested water
  - Recommend hybrid approach
- Further research will determine the island wide run off reduction associated with septic tank conversion

Conclusions

- **The Septic Tank Conversion project is an effective low impact solution to coastal stormwater management**

- **More research is needed to determine the effects of the systems on the watersheds where they are installed.**

Questions