



# 2022 Stormwater Conference

INTEGRATIVE APPROACHES TO REGIONAL WATER RESOURCE MANAGEMENT

ANDREW N.S. ERNEST, PH.D., P.E., BCEE, D.WRE  
PRESIDENT & CEO

JAVIER GUERRERO, M.S., PH.D. CANDIDATE, EIT  
CHIEF PROJECT & COMMUNITY DEVELOPMENT OFFICER

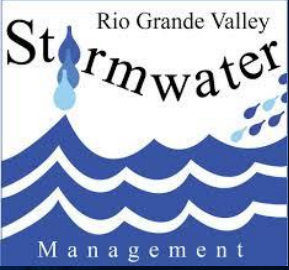
CHRISTOPHER FULLER, PH.D.  
CHIEF OPERATIONS OFFICER

WILLIAM KIRKEY, PH.D.  
CHIEF RESEARCH OFFICER



# The Lower Rio Grande Valley TPDES Stormwater Taskforce

A WORKING MODEL FOR REGIONAL COLLABORATION



# LRGV TPDES Stormwater Taskforce

## HISTORY

- Phase II TPDES Stormwater Rules
- Small Regulated LRGV Cities Support
- 1998: Founded @ TAMUK
- 2016: Transition to UTRGV
- 2018: Explosive Growth
  - Strains UTRGV Contracting Capacity
  - Legal Entity Formation
- Research Institute: RATES/RGV

## NOW

- Role
  - Stormwater Management
  - Watershed Management
  - Non Point Source Pollution Management
- RATES facilitates organization/operations
- Task Force supports
  - Research, Students
  - Community
- 30 Members & Growing



# Executive Committee

- Joe Hinojosa, Gen. Mgr., Santa Cruz Irrigation District #15
  - Chairperson, LRGV TPDES Stormwater Task Force
- Public Works Director, City of Mercedes
  - Vice-Chair, LRGV TPDES Stormwater Task Force
- Peter Hermida, Engineer I, City of Weslaco
  - Secretary, LRGV TPDES Stormwater Task Force
- Melisa Gonzales, Stormwater Manager, City of Alamo
  - Past Chairperson, LRGV TPDES Stormwater Task Force

\* Task Force Reps appointed by City Council, Board of Directors, Commissioners Court, etc. via interlocal agreements.



# Lower Rio Grande Stormwater Taskforce

<b>City of Brownsville</b> Carol Vasquez	<b>City of La Feria</b> Jaime Sandoval	<b>City of San Juan</b> Kimberly Diaz	<b>City of Donna</b> Roy Jimenez
<b>City of Alton</b> Jeff Underwood	<b>City of Edinburg</b> Robert Valenzuela, CSI, CEO	<b>City of San Benito</b> Bernard Rodriguez	<b>Cameron County DD#1</b> Albert Barreda
<b>City of Los Fresnos</b> Raul Garcia	<b>City of Weslaco</b> Peter Hermida, E.I.T.	<b>City of Mission</b> JP Terazzas, P.E.	<b>City of La Joya</b> Isidro Venecia
<b>City of La Villa</b> David Alaniz	<b>City of Primera</b> Celina Gonzales	<b>City of Alamo</b> Ernesto Solis	<b>City of SPI</b> Carlos Sanchez
<b>Cameron County</b> Augusto Sanchez	<b>City of Palmview</b> Rodolfo Flores	<b>City of Harlingen</b> Xavier Cervantes	<b>Hidalgo County Pct. #1</b> Saul Garcia
<b>City of Palmhurst</b> Lupe Garcia	<b>City of Mercedes</b> Jose Figueroa	<b>Willacy County</b> Eduardo Gonzales	<b>City of Edcouch</b> Hugo De La Cruz
<b>City of Elsa</b> J.J. Ybarra	<b>Town of Combes</b> Megan Meidel	<b>Hidalgo County Pct. #4</b> Velinda Reyes	<b>Santa Cruz Irrigation District #15</b> Joe Hinojosa, REM

## Taskforce Liaison

Javier Guerrero, M.S., E.I.T., Ph.D. Candidate



# Main Focus

- Stormwater Management Program (Compliance)
  - Develop new SWMP for new permit 2019-2024
  - Education, Outreach and Training
  - seek State and National conferences, events and initiatives; bring to the Valley
- Expanded focus to the Task Force to include solid waste, air quality, wastewater, planning and construction programs
- Non point source pollution programs
- Low Impact Development and Green Infrastructure Programs

# Stakeholder Legislative Technical Resource

- Flood Planning, Mitigation & Infrastructure Projects
- Phelan, Larson, Longoria, Guerra, Zerwas
- March 5<sup>th</sup> – LRGV Delegation Testimony Austin
- \$3.26B
- Through TWDB
- Regional Thrust: LRGVDC

By: Phelan, Larson, Longoria, Guerra, Zerwas H.B. No. 13

Substitute the following for H.B. No. 13:

By: Farrar

C.S.H.B. No. 13

## A BILL TO BE ENTITLED

### AN ACT

1 relating to flood planning, mitigation, and infrastructure  
2 projects; making an appropriation.

3 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

4 SECTION 1. The heading to Section 15.405, Water Code, is  
5 amended to read as follows:

6 Sec. 15.405. FLOOD CONTROL PLANNING CONTRACTS.

7 SECTION 2. Section 15.405, Water Code, is amended by  
8 amending Subsections (a), (f), and (g) and adding Subsection (a-1)  
9 to read as follows:

10 (a) In this section, "flood control planning" means any work  
11 related to:

12 (1) planning for flood protection;

13 (2) preparing applications for and obtaining  
14 regulatory approvals at the local, state, or federal level;

15 (3) activities associated with administrative or  
16 legal proceedings by regulatory agencies; and

17 (4) preparing engineering plans and specifications to  
18 provide structural or nonstructural flood mitigation and drainage.

19 (a-1) The board may enter into contracts with political  
20 subdivisions to pay from the research and planning fund all or part  
21 of the cost of [developing] flood control planning [plans] for the  
22 political subdivision.

23 (f) The board shall adopt rules establishing criteria of  
24



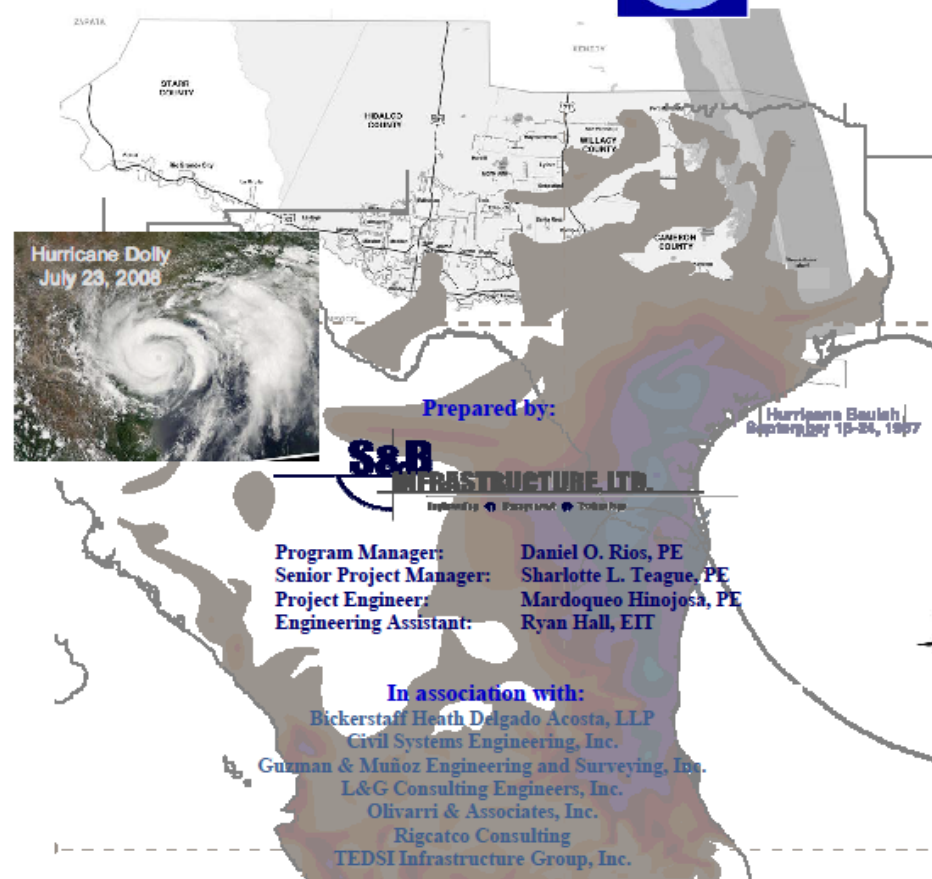
# Federal Funding Alignments

- Letter from Gov. Abbott to HUD Secy Carson
- \$370M
- Updated LRGV Strategic Plan

## Lower Rio Grande Valley Regional Economic Adjustment Plan For Building Disaster Resilient Communities

US Department of Commerce – Economic Development Administration  
Grant No. 08-79-04390

Prepared for:  
**Lower Rio Grande Valley  
Development Council**



September 28, 2012





# Regional Watershed Coordinator

LOWER LAGUNA MADRE WATERSHED



# Watershed Coordinator

- RATES EMPLOYEE
- STATIONED AT LRGVDC
- FUNDED BY:
  - RATES
  - COUNTY OF CAMERON
  - COUNTY OF HIDALGO
  - COUNTY OF WILLACY
  - LRGVDC
  - Grants
- OVERSEE 319 PROJECTS AND WATERSHED RELATED ACTIVITIES
- ROLE UNDER DEVELOPMENT

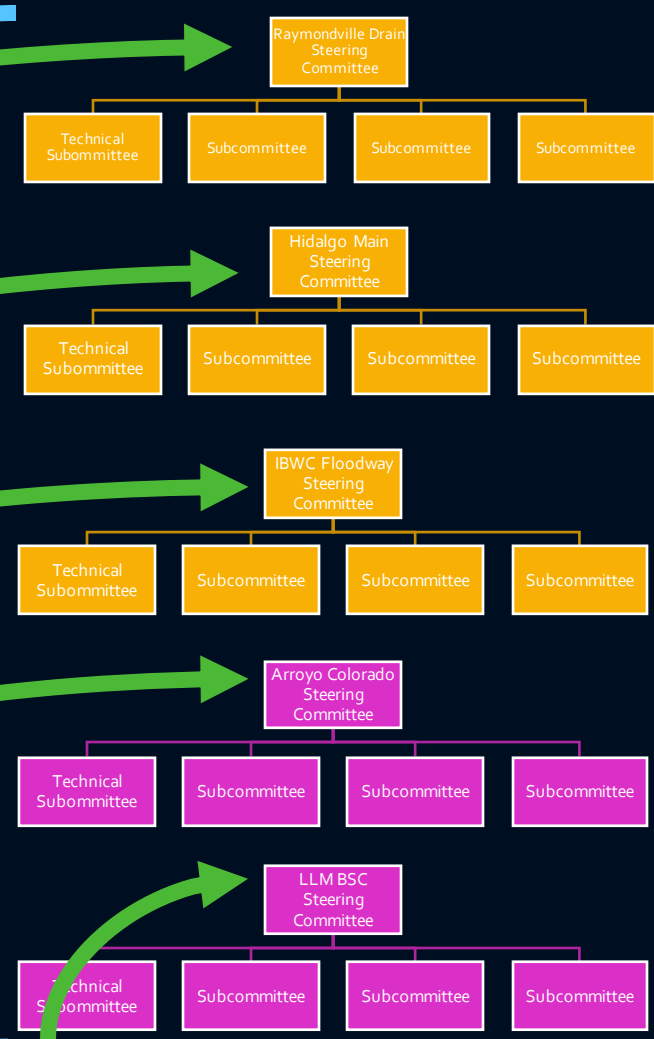


# Lower Laguna Madre Watershed-Based Planning



Watershed Coordinator

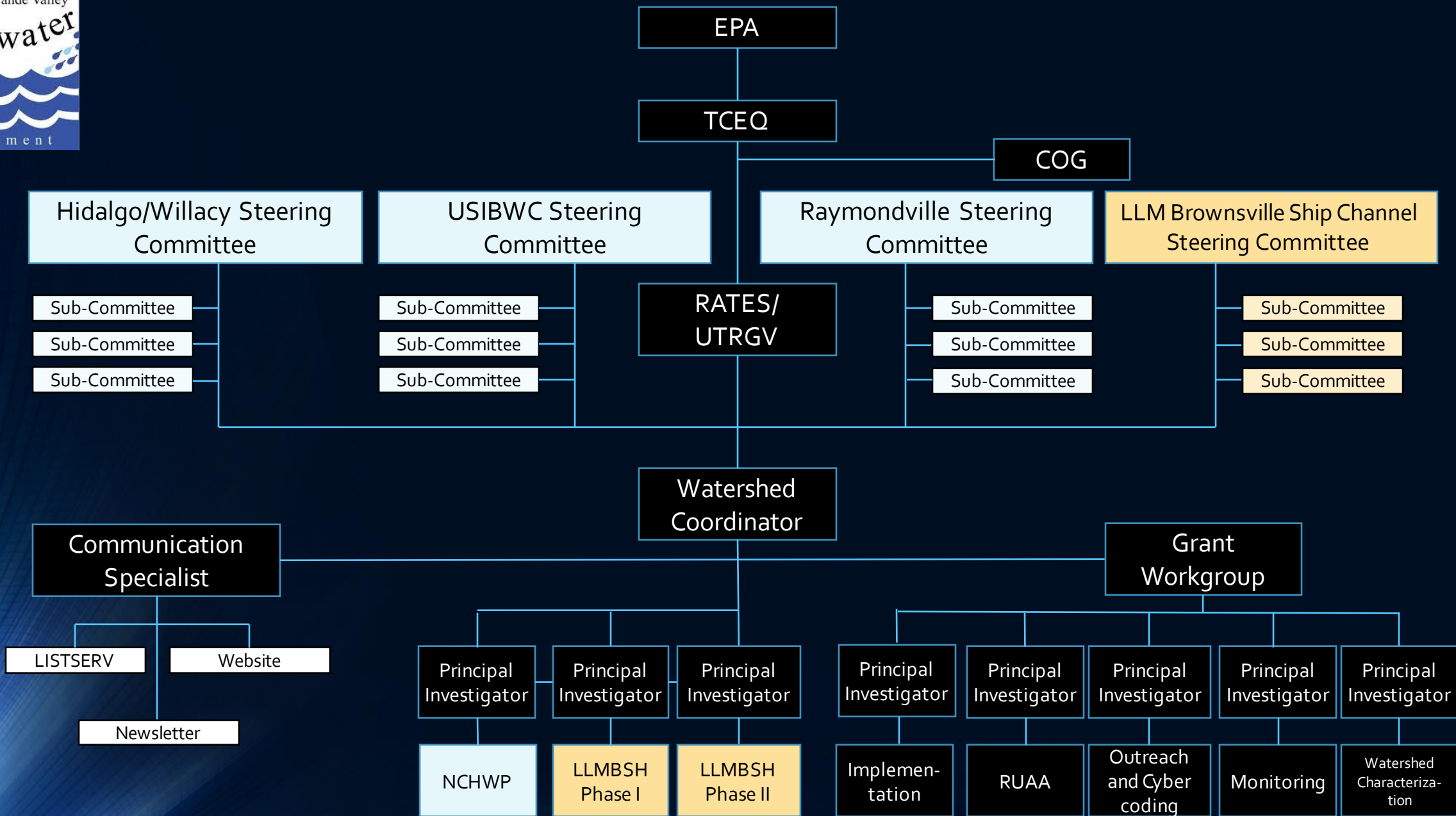
- Watershed Characterization
- Watershed Protection Plan
- Rio Grande Watershed Initiative



604(b)

Regional Water Resources Advisory Committee







# Lower Rio Grande Valley Development Council Regional Water Resource Advisory Committee

FOUNDED JANUARY 2019  
Planning and Development since October 2017



# Regional Water Resource Advisory Committee

- Established January 30, 2019
- Under LRGVDC Authority
- 15 Members
  - 3 Counties, Large & Small Cities, Special Purpose Districts, Stormwater Taskforce, UTRGV, IBWC, Region M
- Purpose
  - educate, promote, foster, and coordinate community and regional planning efforts on the environmental, economic, and other social impacts of existing, new or proposed regulations, policies, and control regarding water resources management



# Integrated Watershed Management

- Lower Laguna Madre Estuary Partnership
- Lower Laguna Madre/Brownsville Ship Channel Watershed Protection
- Raymondville Drain Watershed Characterization
- Hidalgo/Willacy Main Drain Watershed Characterization
- IBWC Floodway Watershed Characterization

Watershed Coordinator

Regional Water Resource  
Advisory Committee



# Watershed Coordinator

- Dr. Christopher Fuller
  - Chief Research & Technology Development Officer  
RATES, Inc.
- Stationed at LRGVDC
- Funded By:
  - RATES
  - County Of Cameron
  - County Of Hidalgo
  - County Of Willacy
  - LRGVDC
  - Grants
- Oversee 319 Projects And Watershed Related Activities
- Role Under Development





# Capital Projects Enhancement

## FACT SHEET Lower Rio Grande Valley Regional Water Management Project (Delta Watershed Project) Hidalgo County, Texas

### PROJECT BACKGROUND

- In 2008, Hidalgo County Drainage District #1 (HCDD1) contracted to perform a conceptual Regional Water Supply Facilities Plan to identify and evaluate potential project sites. Costs associated with this report (\$0.38 Million) were funded by Texas Water Development Board (TWDB).
- In 2012, Hidalgo County voters approved by a 75% margin, \$10 million through a bond referendum for the Lower Rio Grande Valley Regional Water Management (Delta Watershed) Project.

### PROJECT CONSTRUCTION COST

- Approximate estimated construction cost: **\$100,000,000**

### PROJECT SCHEDULE

- Contract Executed in April 2013
- Planning Studies, Legal Water Rights Issues and Permits, Environmental Documents, and Preliminary Engineering Report are currently being developed
- Final PER is due April 2015

### IMPORTANCE OF PROJECT

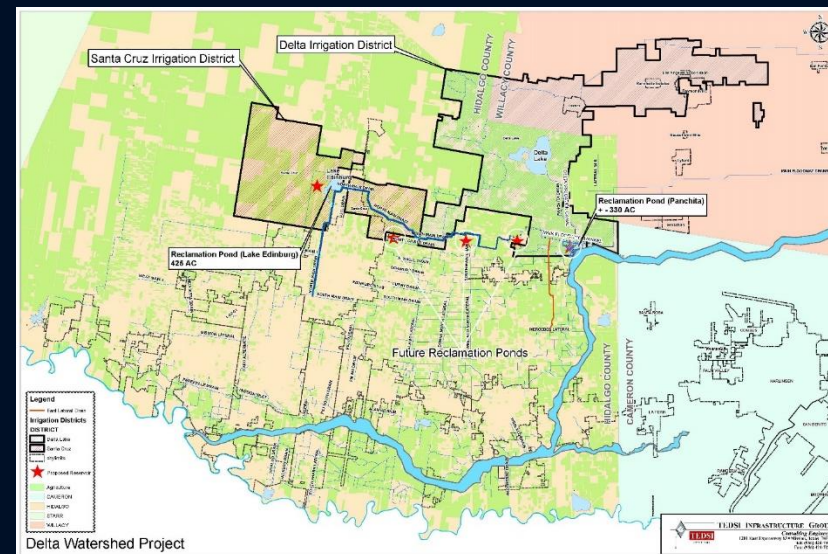
This project, once constructed, will play an important role in the following areas:

- Water Reclamation for agricultural and municipal use
- Raw Water Treatment
- Flood Protection
- MS4 Educational Area
- Economical Development Area
- Green Infrastructure

### PROJECT STATUS

- Environmental Impact statement is currently underway
- Legal aspects addressing water rights are currently being preformed for acceptance by Texas Commission on Environmental Quality (TCEQ). Also, an amendment has been filed with Rio Grande Regional Water Authority Region M (RGRWA) for inclusion of the project in the 2012 State Water Plan (SWP). An application has also been filed for this project in the 2017 SWP.
- Water Quality samples and depths are being collected on a quarterly time frame to determine quality analysis and flows in existing ditches.
- Preliminary Engineering Report is being developed for the total 450 Square Mile of delineated drainage area.

January 2014



## SMURRF: Santa Monica Urban Runoff Recycling Facility







# About RATES

RESEARCH, APPLIED TECHNOLOGY, EDUCATION & SERVICE, INC.

# Vision

## *Democratizing Water Intelligence for Knowledge-Enabled Policy & Decision Making*

- Mission: *“Make knowledge-based policy and decision making possible with regards to water resource management.”*
- **Data:** address monitoring needs of under-served areas to ensure technology and monitoring solutions are available to all
- **Information:** Translate water & environmental data into actionable intelligence
- **Knowledge:** Educate decision makers and elected officials to promote knowledge-based decision making
- **Wisdom:** Support implementation through facilitation of collaborative efforts between stakeholders such as municipalities, academic institutions, not-for-profits, conservancy & environmental groups as well as state and federal regulatory agencies



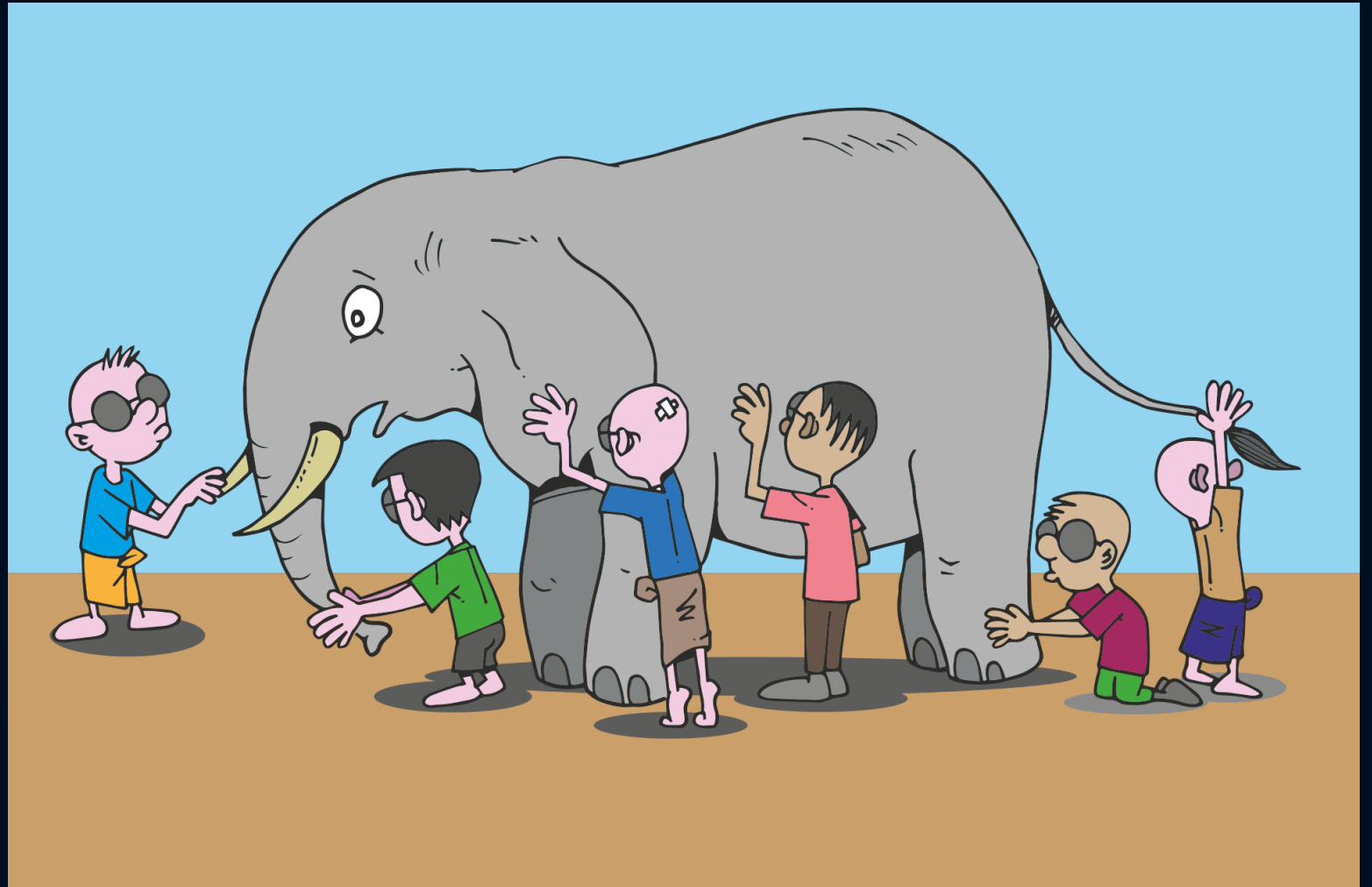


# Knowledge Enabled Decision Making

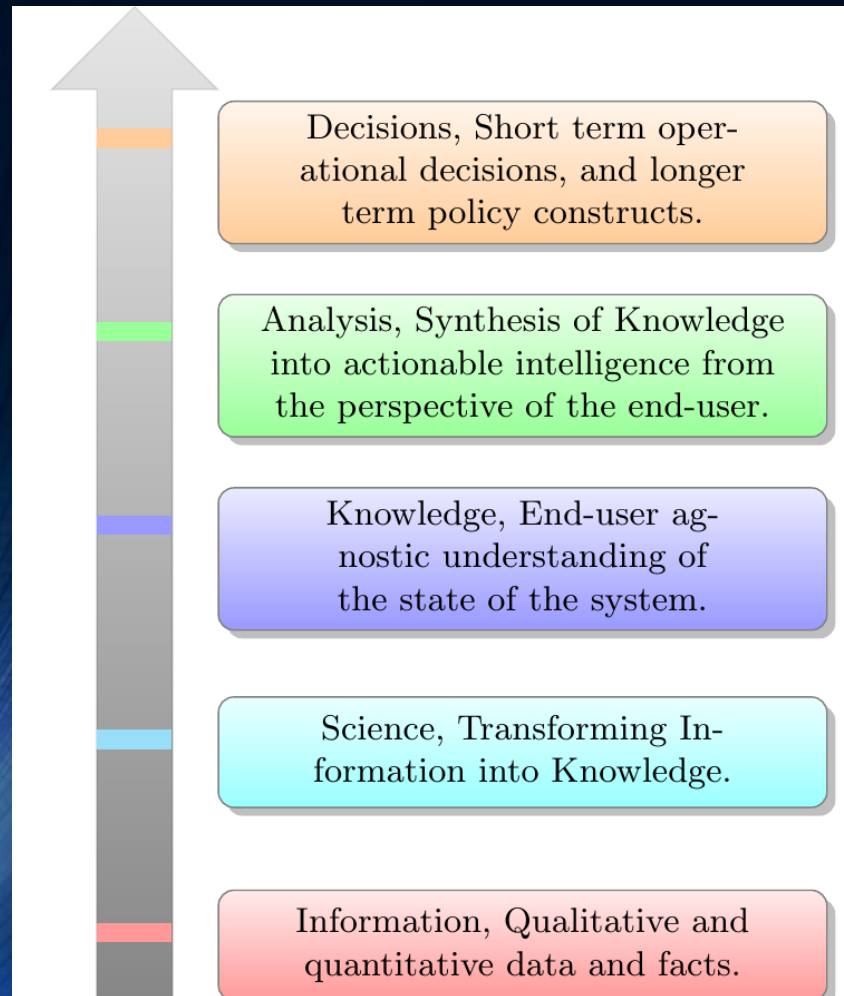
FOR REGIONAL WATER RESOURCE MANAGEMENT



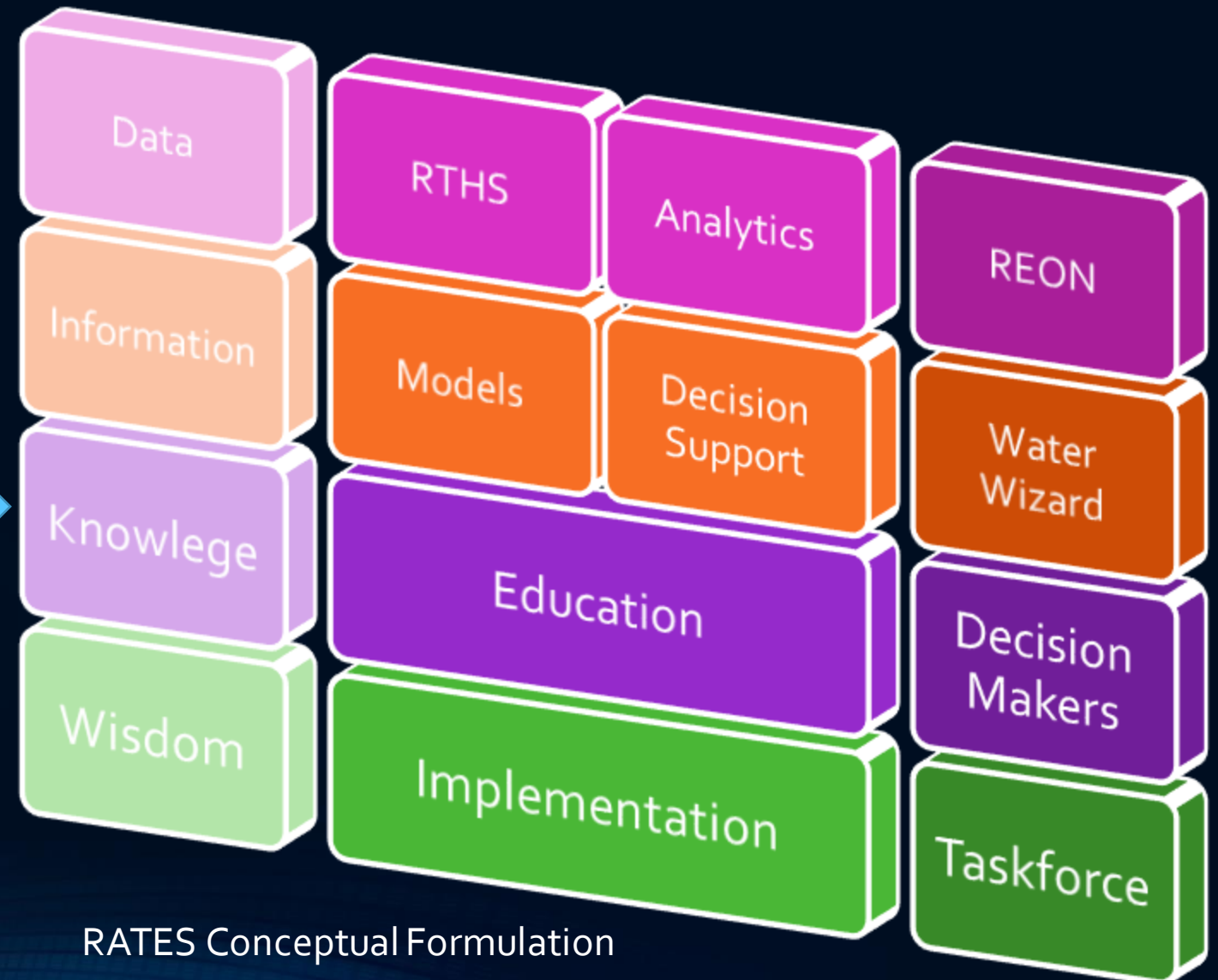
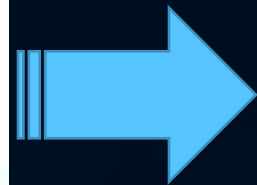
# The Fable of the Six Blind Men and the Elephant



# What's DIKW Got to Do with It?



# Organizing the Puzzle Pieces



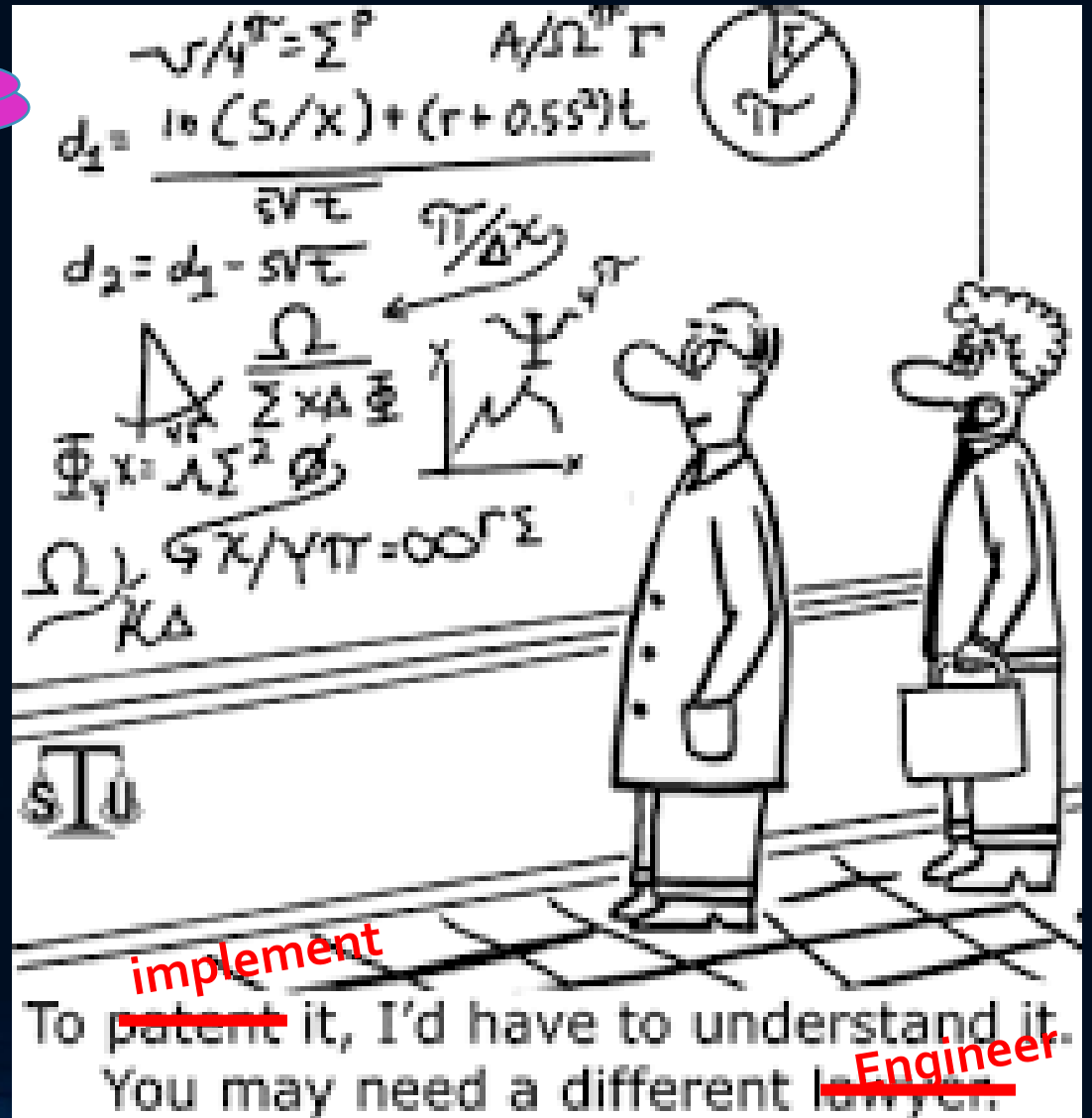
RATES Conceptual Formulation



# Bridging Data to Decisions

Results!

Data!



# Democratization of Water Intelligence

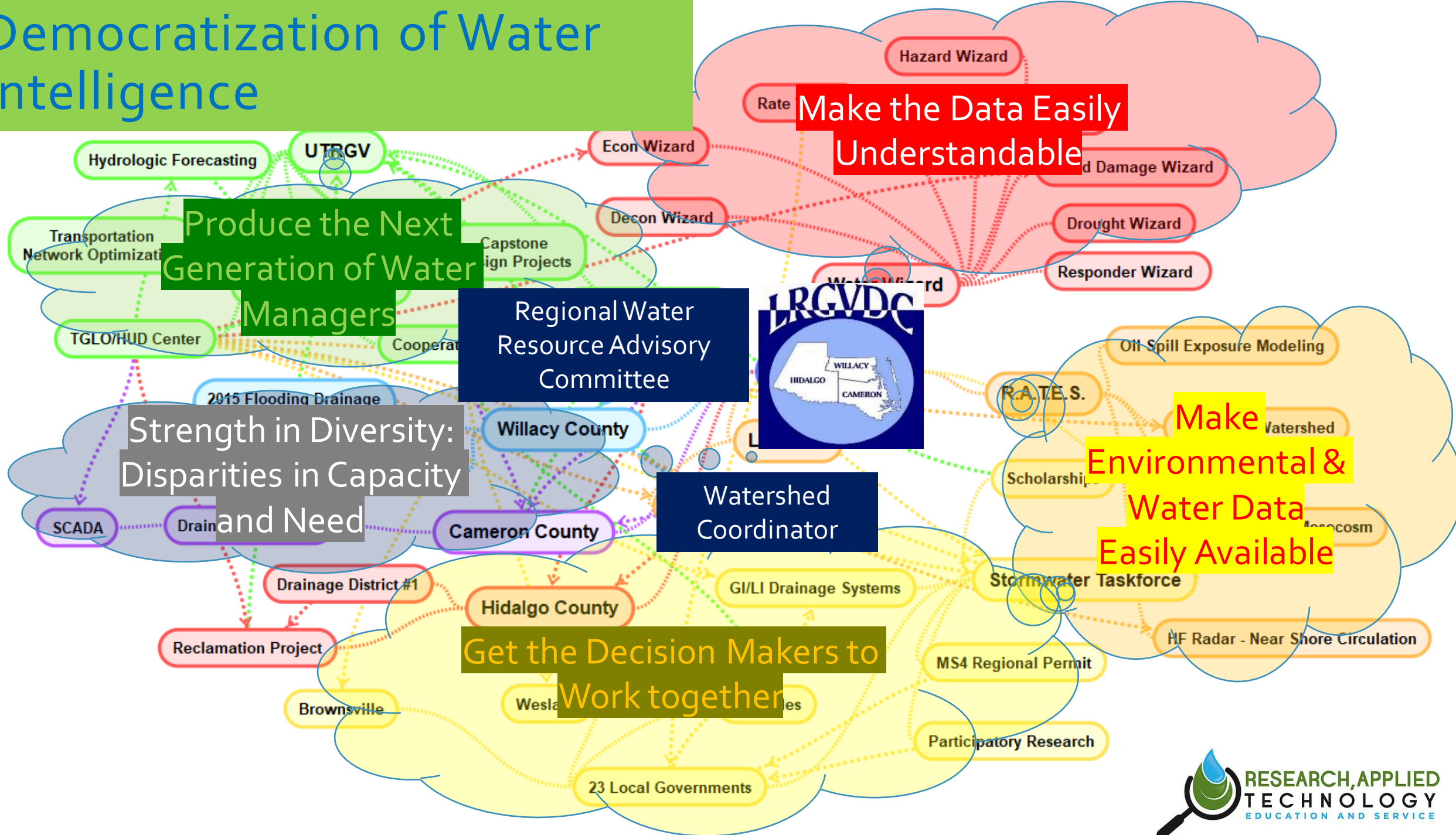
Produce the Next Generation of Water Managers

Make the Data Easily Understandable

Strength in Diversity: Disparities in Capacity and Need

Make Environmental & Water Data Easily Available

Get the Decision Makers to Work together



# Higher Education Linkages





# Water IoT Vision

## Water Internet of Things

*The Water Internet of Things for Regional Economic Development*



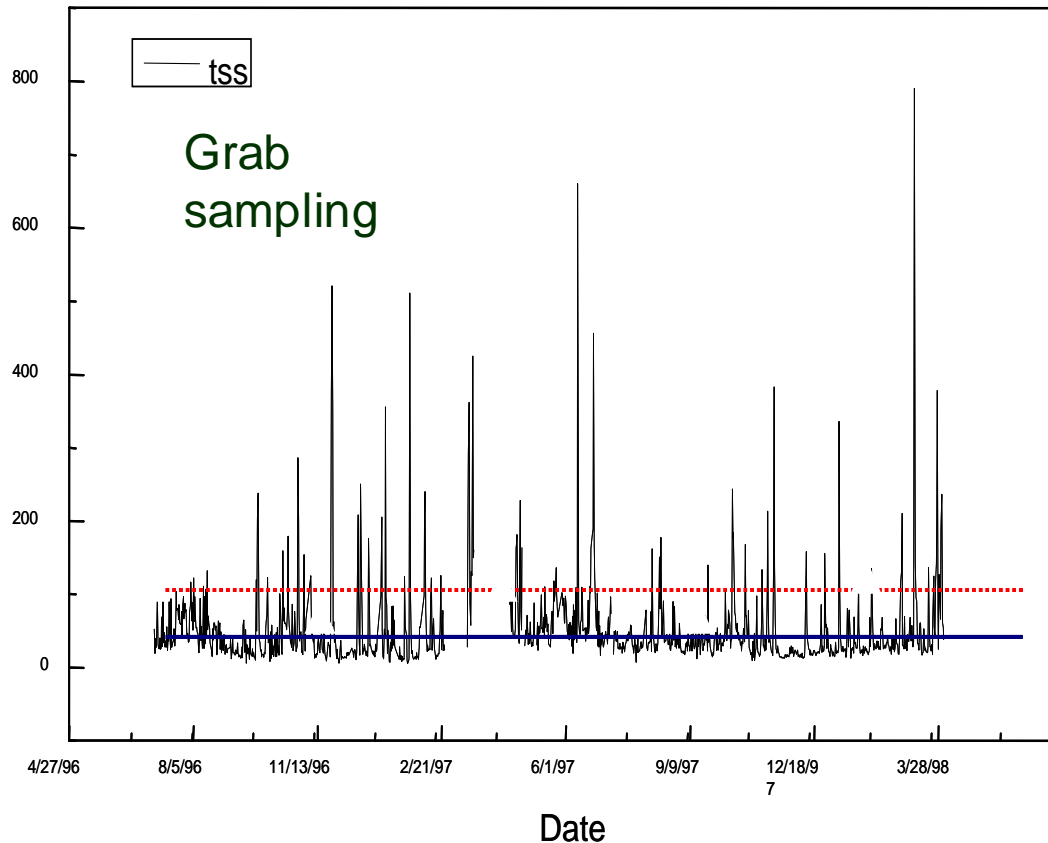


# Regional Need

REAL TIME SENSOR NETWORK

# Paradigm shift in Monitoring

Lavaca Bay  
Total Suspended Solids  
July 1996 to March 1998



“99% of environmental change occurs on the order of 1% of the time”

-- James S. Bonner, Ph.D.  
Founder, RATES

*in essence, If you didn't see it, it didn't happen*

Blue line represents the mean. Red line represents 1 standard deviation



# The Need for Community Sensor Networks

- Management Needs Data Outside Jurisdictional Boundaries
- COTS Sensor Costs are Exorbitant
- Sensor Placement Should Meet both LOCAL and REGIONAL Management Needs
- LOCAL Control Promotes Effective Local Decision Making
- Multi-Jurisdictional Sharing Promotes Regional Coordination

# Use Cases

- Flood Early Warning/Forecasting
- Flood Planning/Mitigation
- Stormwater Management (Compliance, IDDE, Performance Assessment)
- Water & Wastewater Treatment (Low-Cost SCADA, Industrial Dischargers)
- BMP Placement, Sizing, Performance Monitoring
  - Retention/Detention Ponds (Local)
  - Regional Detention Facilities (Multi-Jurisdictional)
  - Low Impact Development/Green Infrastructure



# Sensor Technology

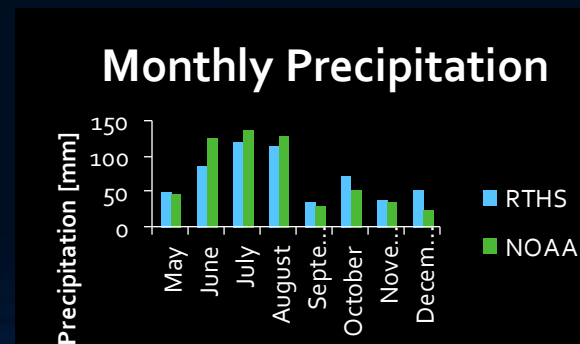
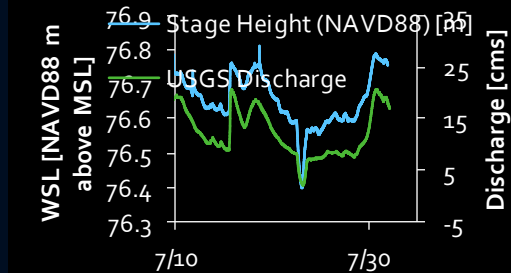
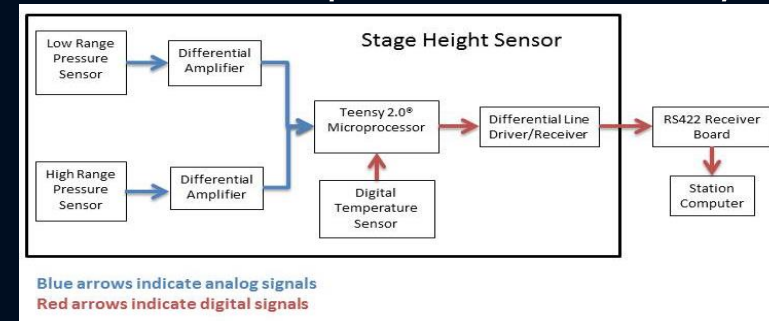
IN-HOUSE DESIGN



# Reduce Capital Cost

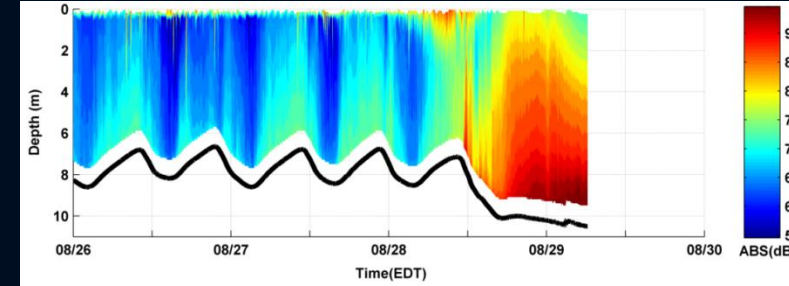
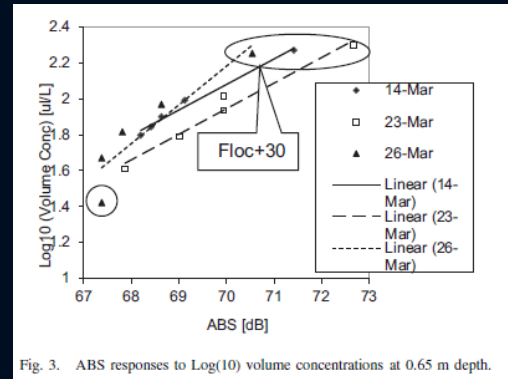
- Sensor technology.
  - Enabling technology borne through low-cost microprocessors (Teensy)
  - Incorporated into sensor designs.
    - Stage height
    - Precipitation
    - Water quality
    - Integrated network
  - Standardized/modular designs
  - Integrated systems

Developed water quality sonde can be built for approximately \$2,000. Comparable commercially available sonde ~\$20-25K with sufficient performance to characterize parameter variability and range.

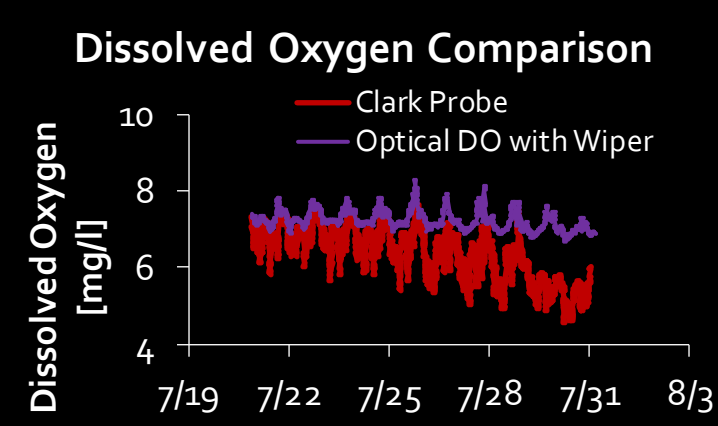


# Reduce Unit Data Costs

- Application of surrogate measurements



- Minimize service requirements through maximizing service intervals.



- Maximize parameter counts of developed sensors and sensor nodes (pH, DO, salinity, turbidity, chlorophyll, CDOM, atmospheric conditions, water level, water temp, etc.)



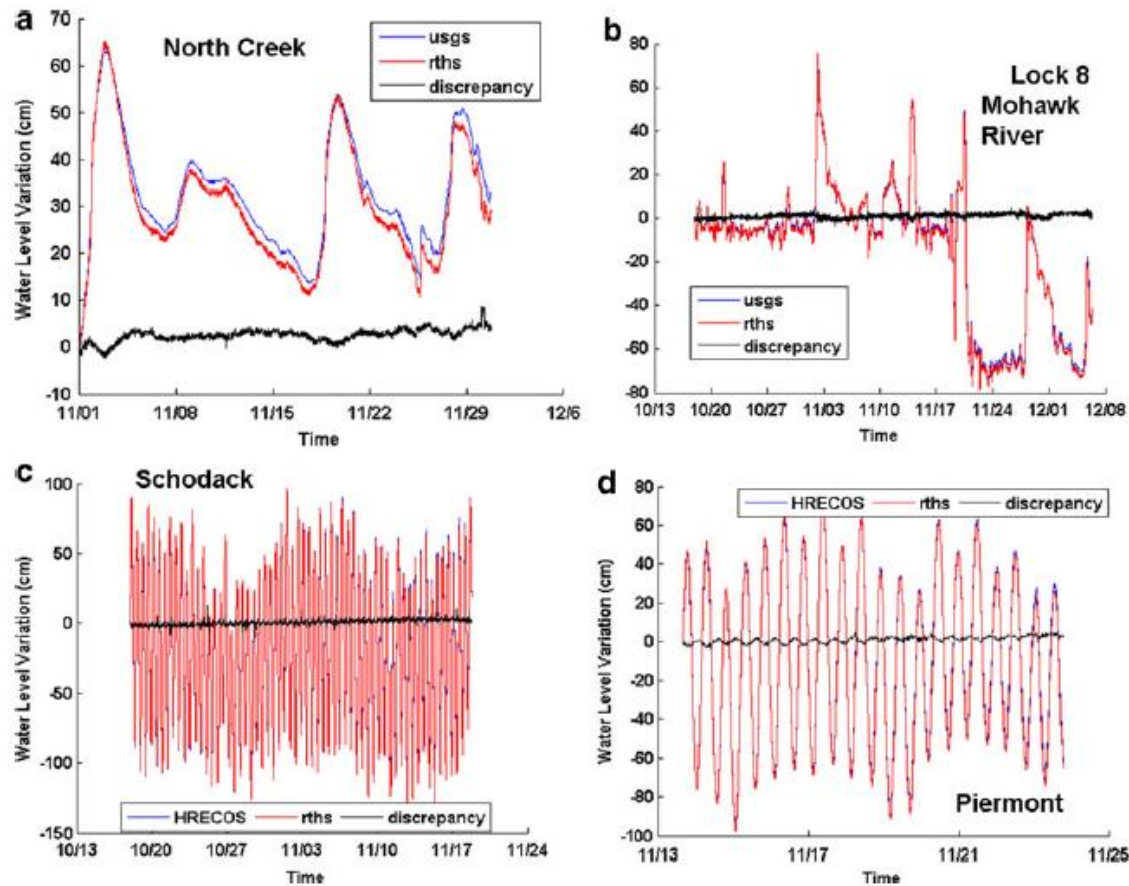
# Stage Height/Water Temp

- Low Power
- Easily deployed and maintained
- Small size makes them easily adaptable
- Durable
- Low Cost (~\$200.00)
- Real-Time
- Large Range/High Accuracy





# High Accuracy



**FIG. 6.** RTHS and reference sensor-measured water level variation and their discrepancies at four sites: (a) North Creek, (b) Lock 8 Mohawk River, (c) Schodack Island, and (d) Piermont. Note: blue, red, and black lines represent RTHS measurements, reference sensor measurements, and their discrepancies, respectively.

Islam et al. (2016) Environmental Engineering Science, 33, DOI:  
10.1089/ees.2016.0106

# Water Quality Sonde

- Measured parameters
  - pH
  - Dissolved Oxygen
  - Conductivity/Salinity
  - Chlorophyll
  - Turbidity
- Low cost
- Good Field performance, comparable to YSI Multi-Parameter sonde
- Ambient light reduction
- Tested to 100 psi submersible depth



# Precipitation Gauge

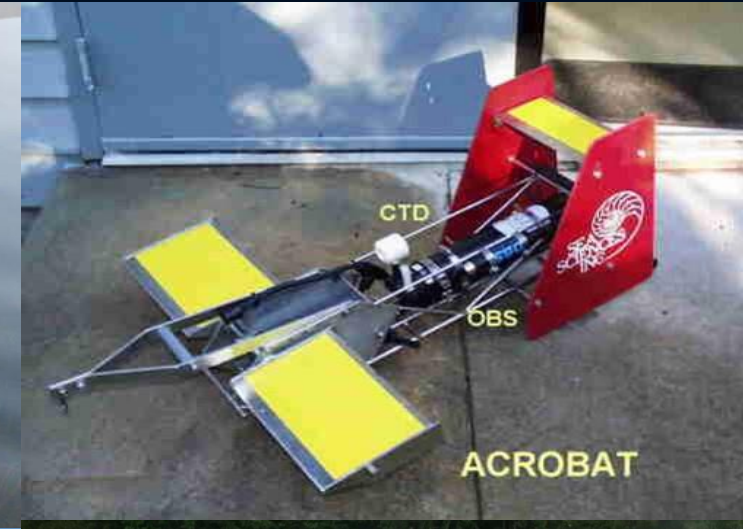
- Low power
- Extended duty life
- All season performance
- Results comparable to NOAA observations





# Instruments

- Ecomapper AUV
- Acoustic Doppler Current Profiler
- Acrobat Undulating Towbody
- StreamPro Shallow Water ADCP
- YSI Handheld Multi-Parameter Sondes
- YSI EXO Series Sondes
- Robotic Platforms
- Oxygen Optodes
- Fluorometers
- Conductivity/Temp/Depth
- pH/Redox
- Flow Probes
- Optical Backscatter Sensors





# Real-Time Hydrologic System

RTHS



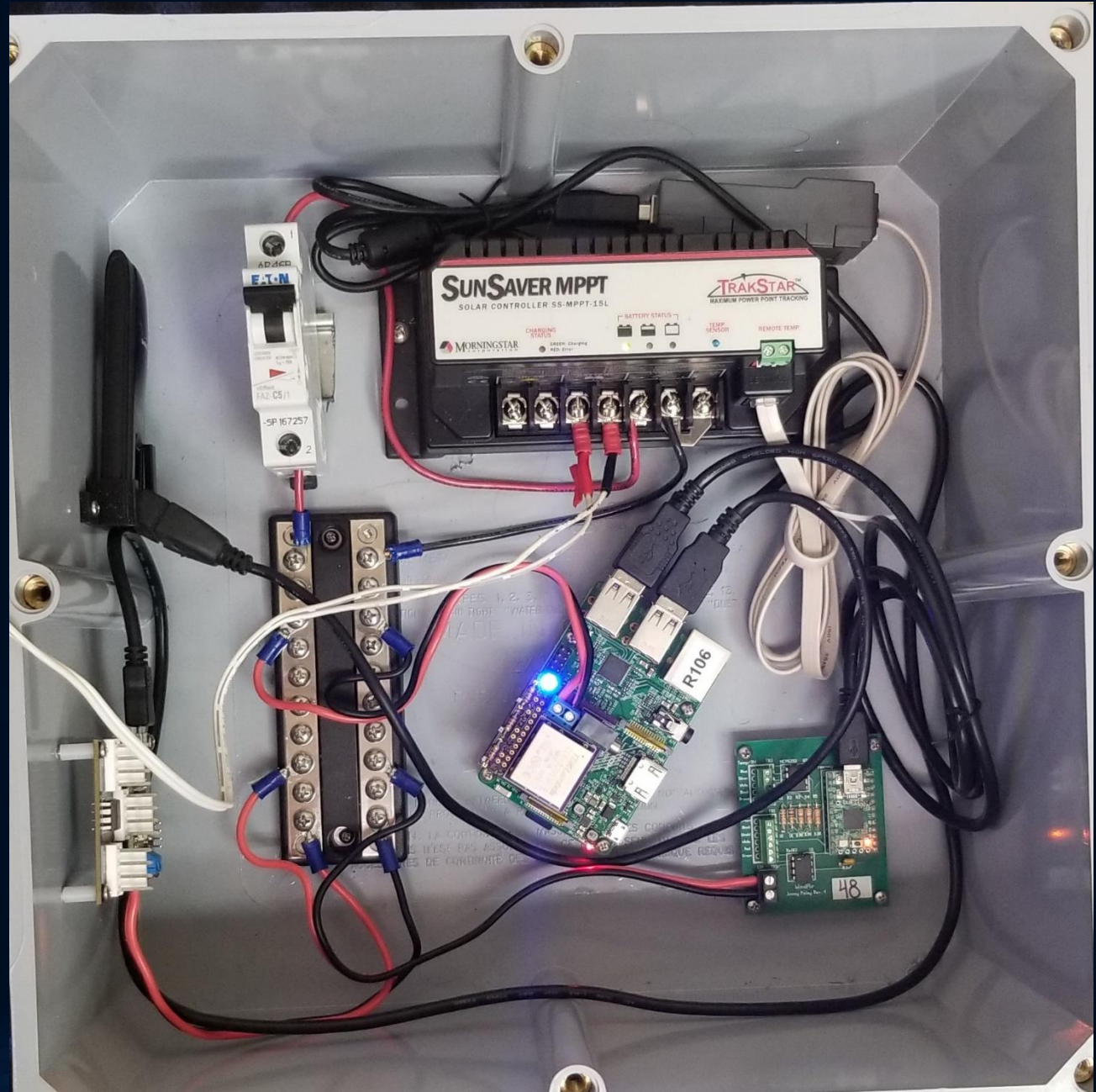
# Real-Time Hydrologic System (RTHS)

- COTS Meteorological Pole
  - Wind Speed/Direction
  - Relative Humidity
  - Air Temperature
  - Barometric Pressure
- Can be solar powered or grid tied
- Master control box
  - Raspberry Pi Microcomputer
  - Sensor Circuit Boards
  - Solar Controller
  - Cell Stick





# RTHS Brain





# RTHS Sensor Deployment

- Customizable sensor mounts all for installation in many different environments or conditions





# River & Estuary Observation Network (REON)

OPERATIONAL MODEL



# River and Estuary Observatory Network (REON)



1974



1994



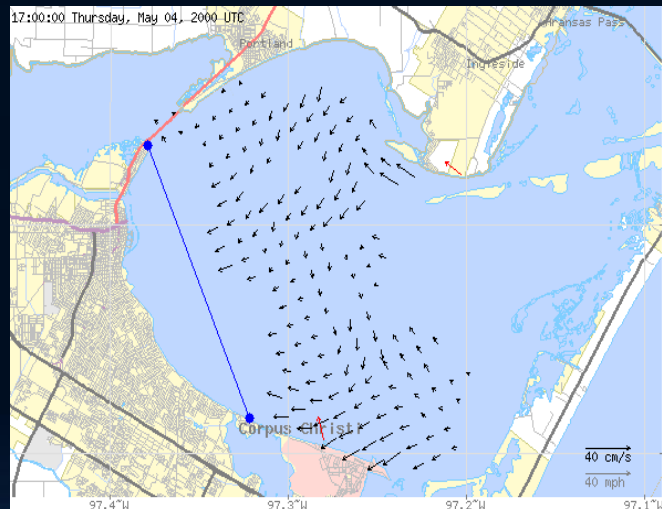
2002

2009



2009

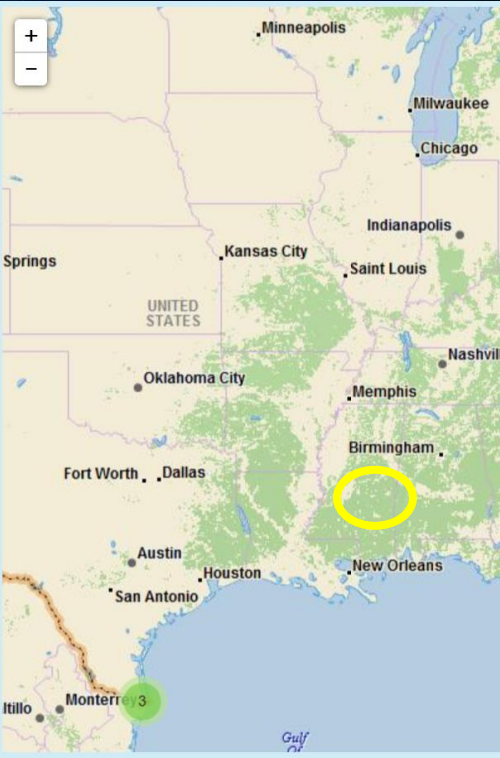
2014



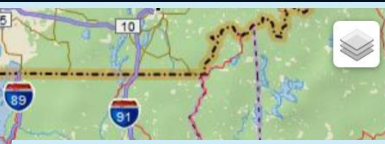
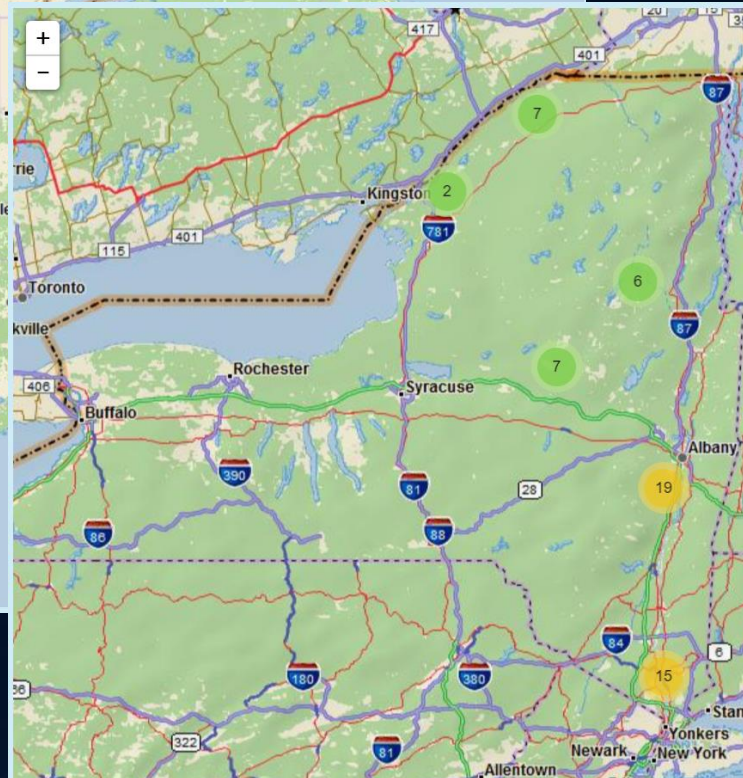


National (69...And Counting)

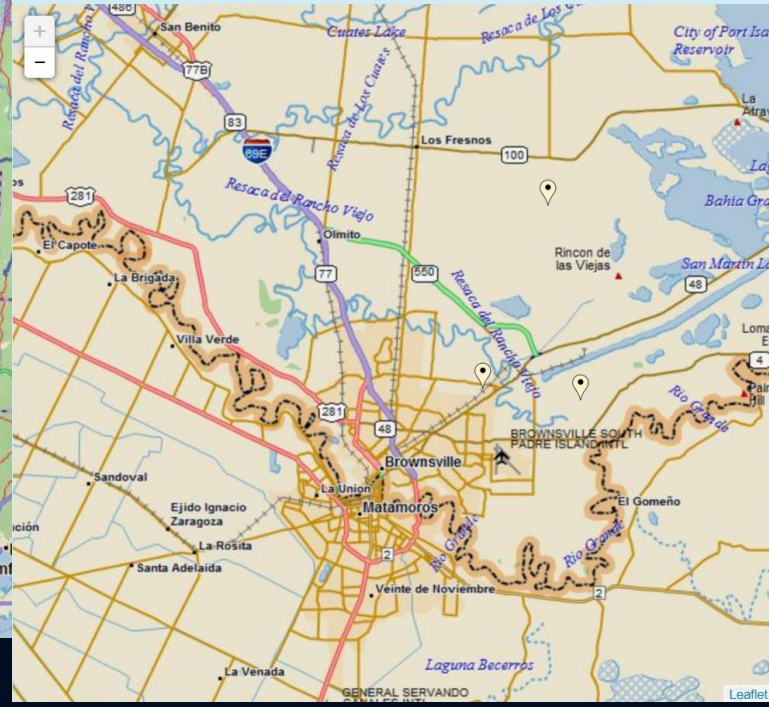
RE  
ON



New York (66)



South Texas (8+~70)



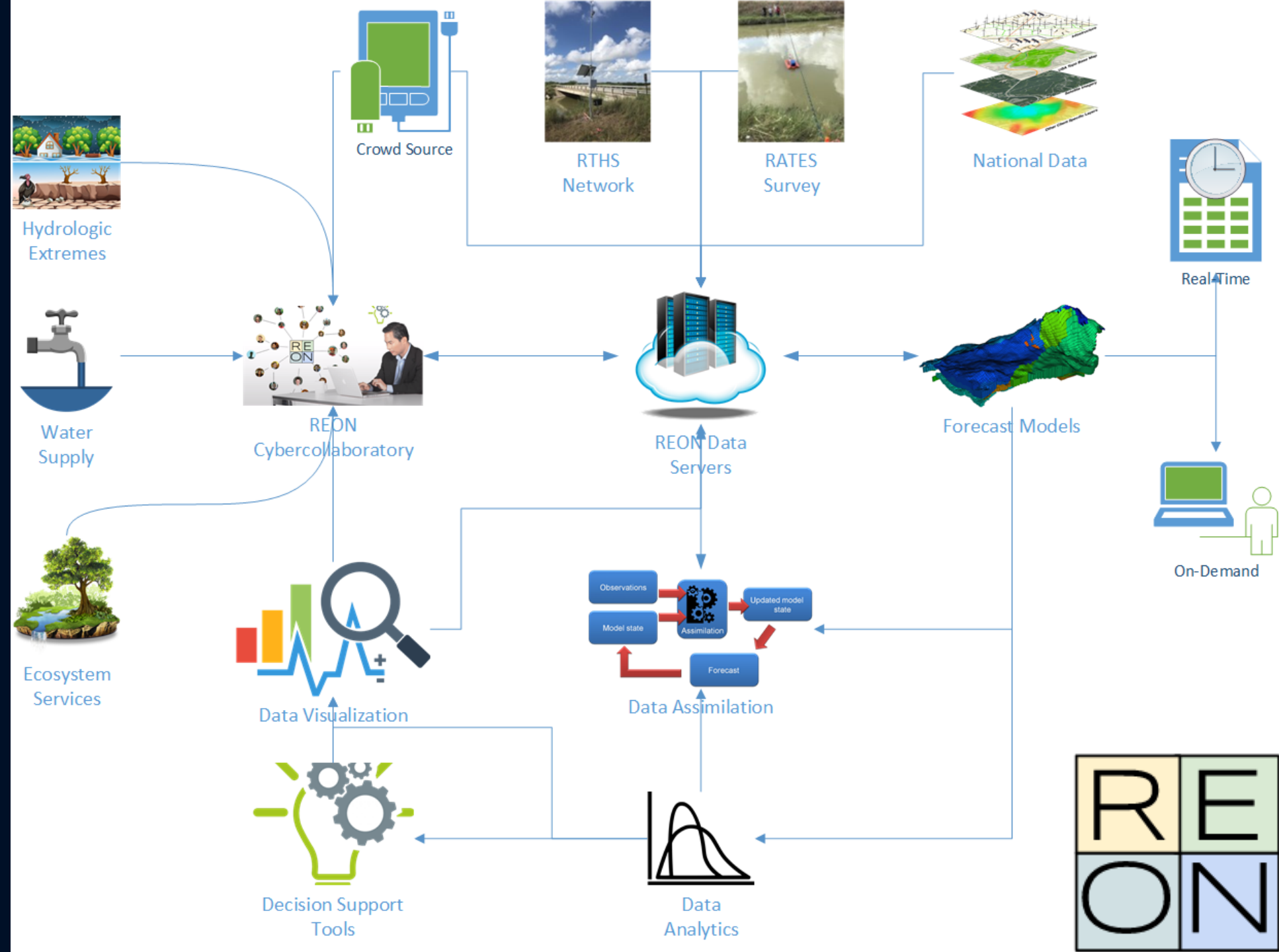
Alabama



The Growing REON Network

# River & Estuary Observation Network

## Operational Components







## Real Time Forecasting

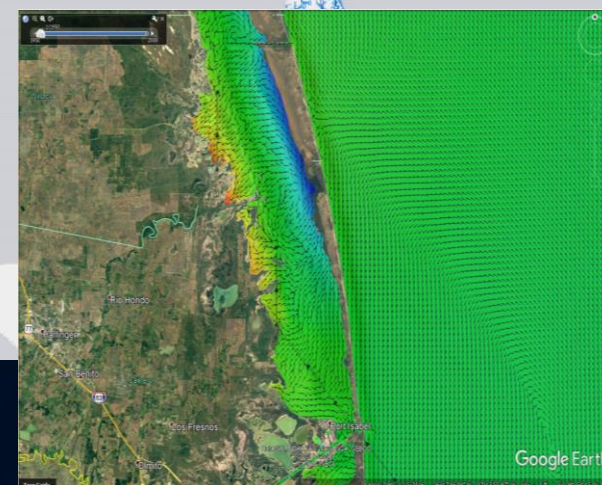
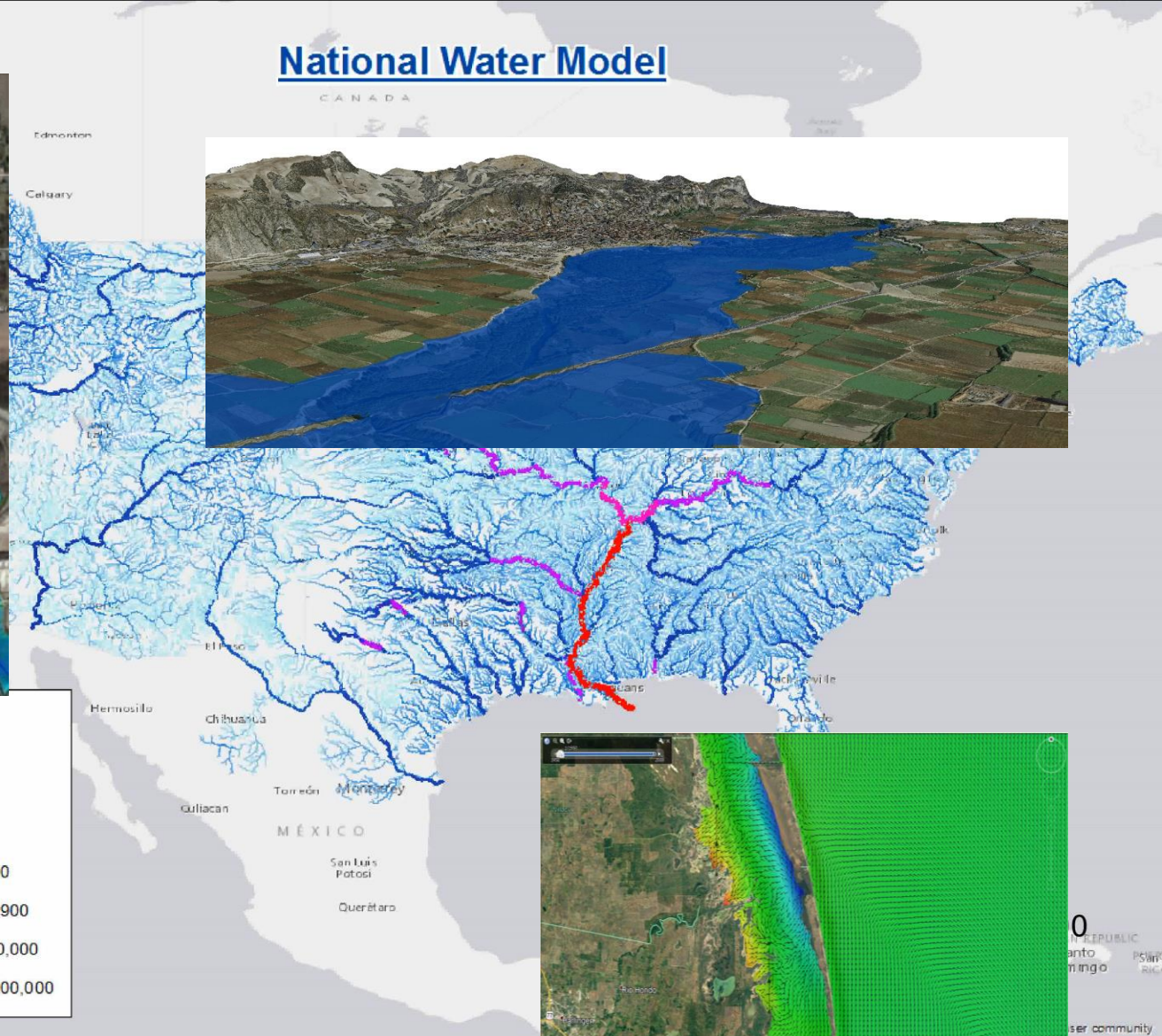
- Flood Warning
- Flood Planning
- Disaster Declaration
- Water Supply
- Ecosystem Services



### Legend

#### Streamflow (cfs)

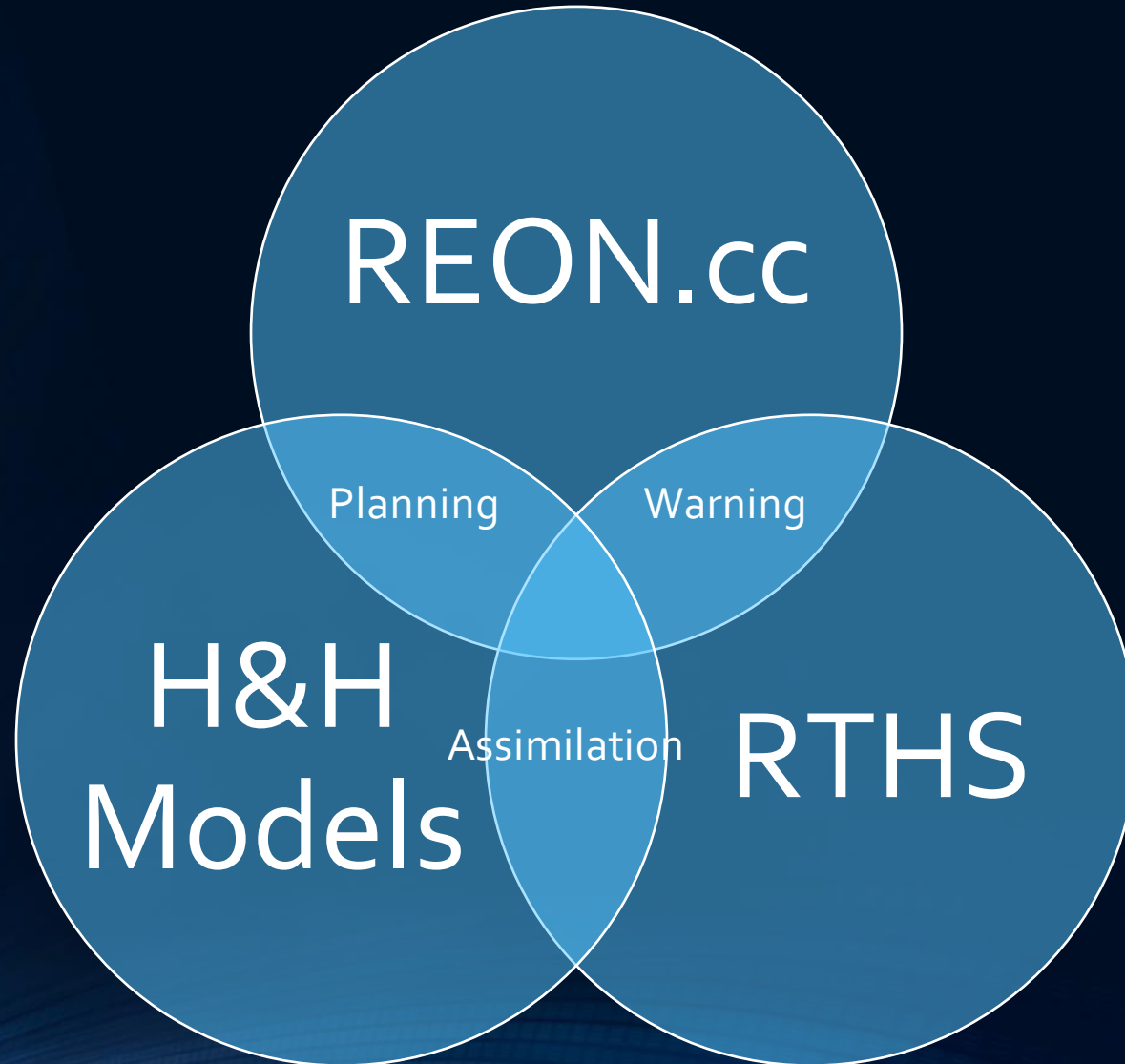
- 0 - 119
- 119 - 7,520
- 7,521 - 88,700
- 88,701 - 201,900
- 201,901 - 460,000
- 460,001 - 1,200,000







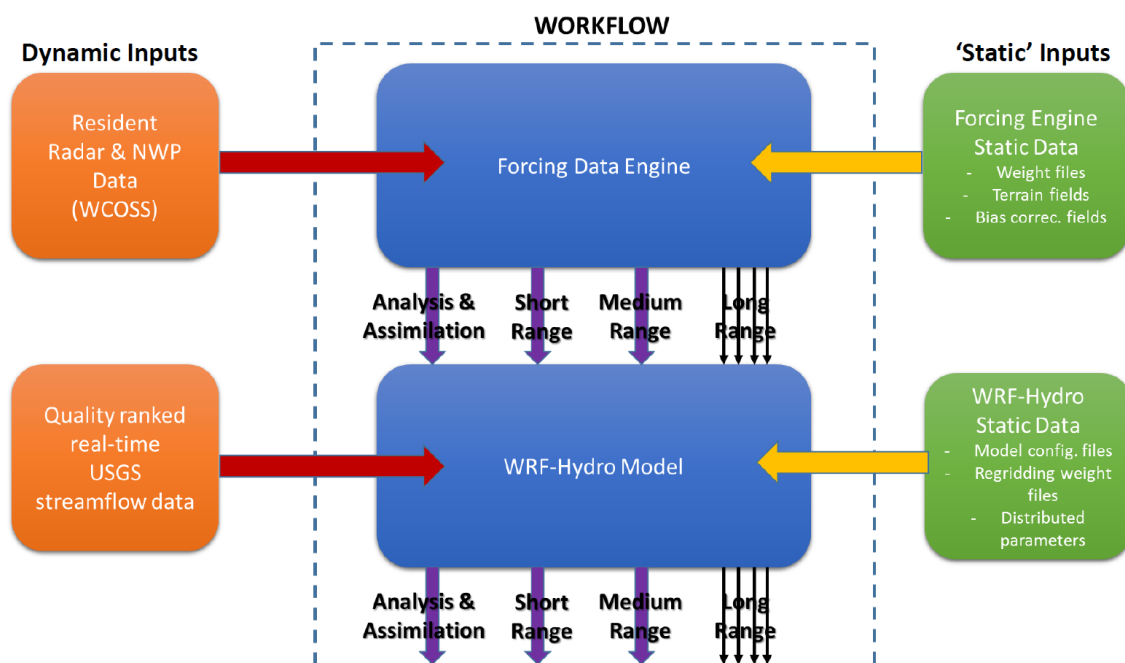
# Hydrologic & Hydraulic Assessment





# RTHS: Hydrologic Data Assimilation

## Operational Cycling of the National Water Model



Hydrologic Data Assimilation (RTHS) is Necessary to Overcome Gaps in Hydrography & Forcing

NCAR  
UCAR

**RAL**  
Research Applications Laboratory

science • serving • society

## Hydrologic Data Assimilation: The New Frontier of Hydrologic Prediction

'Hydrologic Data Assimilation' is the science of numerically optimizing the process through which hydrologic observations are integrated into simulation and prediction models. When done effectively, hydrologic data assimilation can add critical value to hydrologic predictions by increasing analysis and forecast accuracy and increasing skillful forecast lead times. NCAR/RAL is actively engaged in developing a host of new hydrologic data assimilation methods.

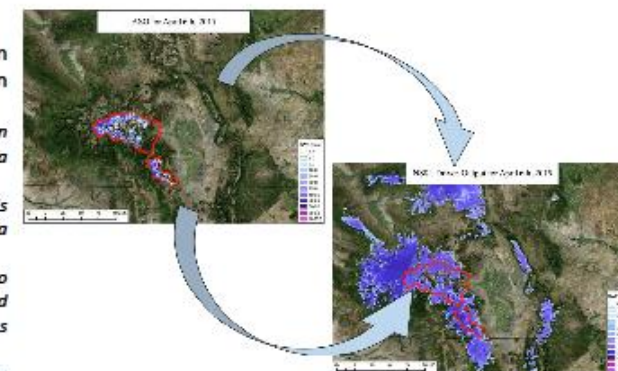
### Problem Statement:

Hydrologic models suffer from numerous sources of error such as, errors in meteorological forcing, hydrologic process representation uncertainty, model parameter uncertainty and errors in the characterization of initial hydrologic conditions at the start of a simulation or forecast. As new measurement methods emerge and new sensor networks are deployed there exist new opportunities to fuse these observations into numerical models using data assimilation. However, hydrologic data assimilation is still in its infancy and there are many challenges to making the most use of newly available, real-time observations.

### Research Questions:

Key research questions in hydrologic data assimilation include:

1. How representative is a given measurement with respect to a simulated model state or flux?
2. What level observation quality is necessary to make effective use of a given observation?
3. Are there optimal ways to assimilate point and/or gridded observations that preserve mass balances within models?
4. How do we minimize the computational demand added by performing data assimilation into global and continental domain, high-resolution hydrologic models?



Assimilation of NASA airborne lidar snowpack estimates into a radar-driven, WRF-Hydro simulation of snowpack in the Upper Rio Grande river basin.

Contact Information: WRF-Hydro Website: <https://www.ral.ucar.edu/projects/wrf-hydro>  
James McCreight ([jamesmcc@ucar.edu](mailto:jamesmcc@ucar.edu)), David Cochis ([dcocis@ucar.edu](mailto:dcocis@ucar.edu))



# Welcome

The River and Estuary Observation Network (REON) is a community network of real-time data providers and users committed to the philosophy of enabling local and regional water resource management through sharing of water data and open exchange of water information.

Get Started

Search for Data.

Search

Advanced Search



322 Layers



Maps



REON.cc is Designed for:

- Regional Decision Making
- Preventing Duplication

River & Estuary Observation Network  
Cybercollaboratory

Search



Andrew Ernest

People  
Groups  
Group Categories  
Announcements

Invite Users  
Add User  
Create Group

Search by location name

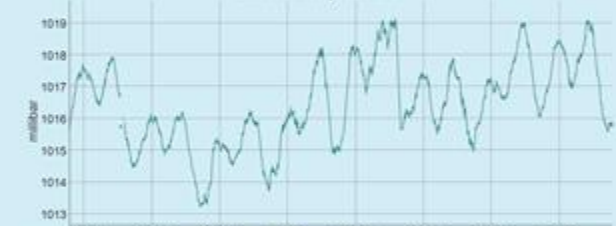


Real-Time Hydrologic System

Site: Brownsville Public Works County: Cameron

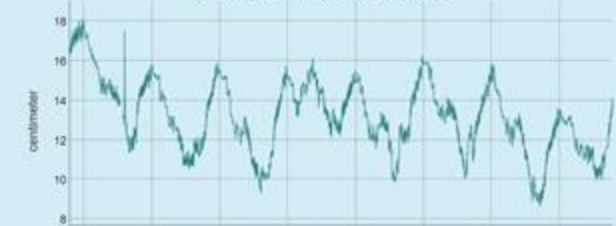


Barometric pressure

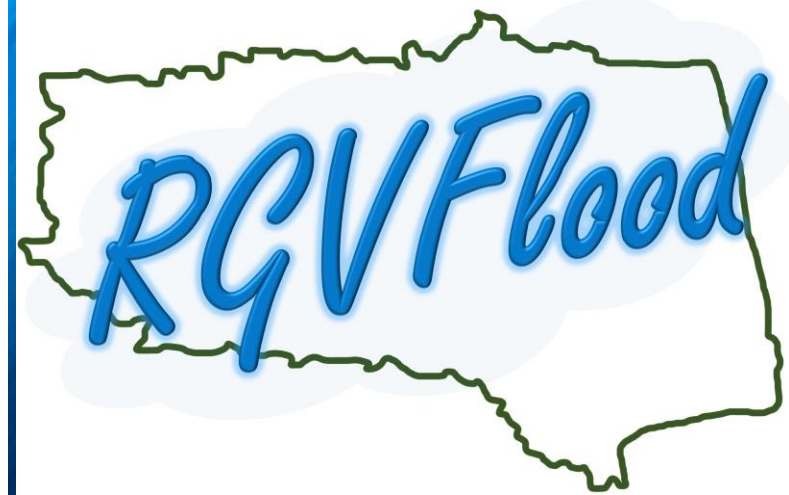


You can also download this data in [standard CSV](#) format or [Excel CSV](#) with UTC times. All plots are in your browser's timezone.

Stage height using Large range



You can also download this data in [standard CSV](#) format or [Excel CSV](#) with UTC times. All plots are in your browser's timezone.



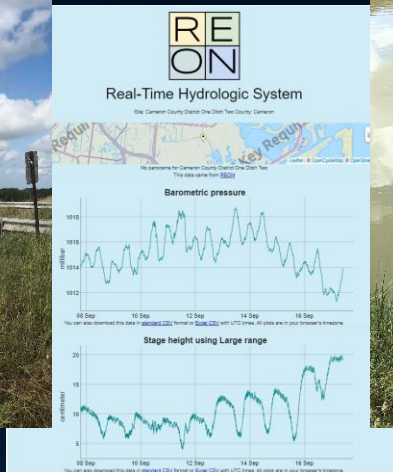
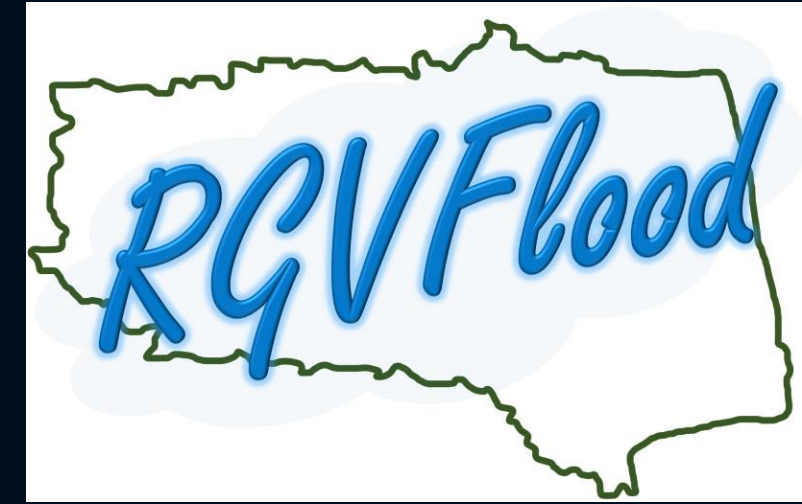
# RGVFlood

REON RIO GRANDE VALLEY



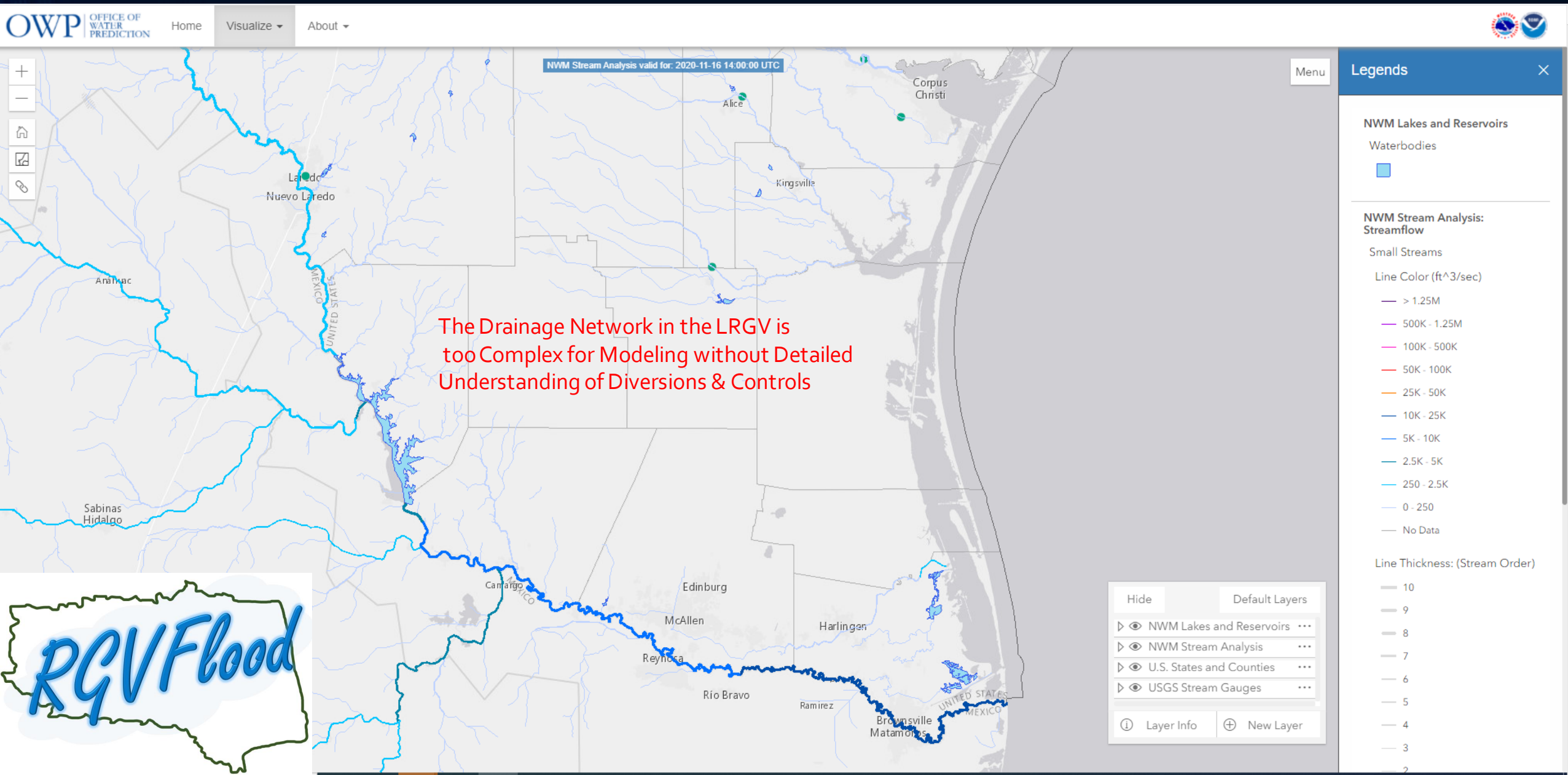
# RGVFlood: An Affordable Real-Time Sensor Network for Regional Water Resource Management

- Proposed commissioning of ~70-RTHS at strategic locations
  - Promote inter-jurisdictional engagement and collaborative decision making
  - Stream gauging for discharge rating curves



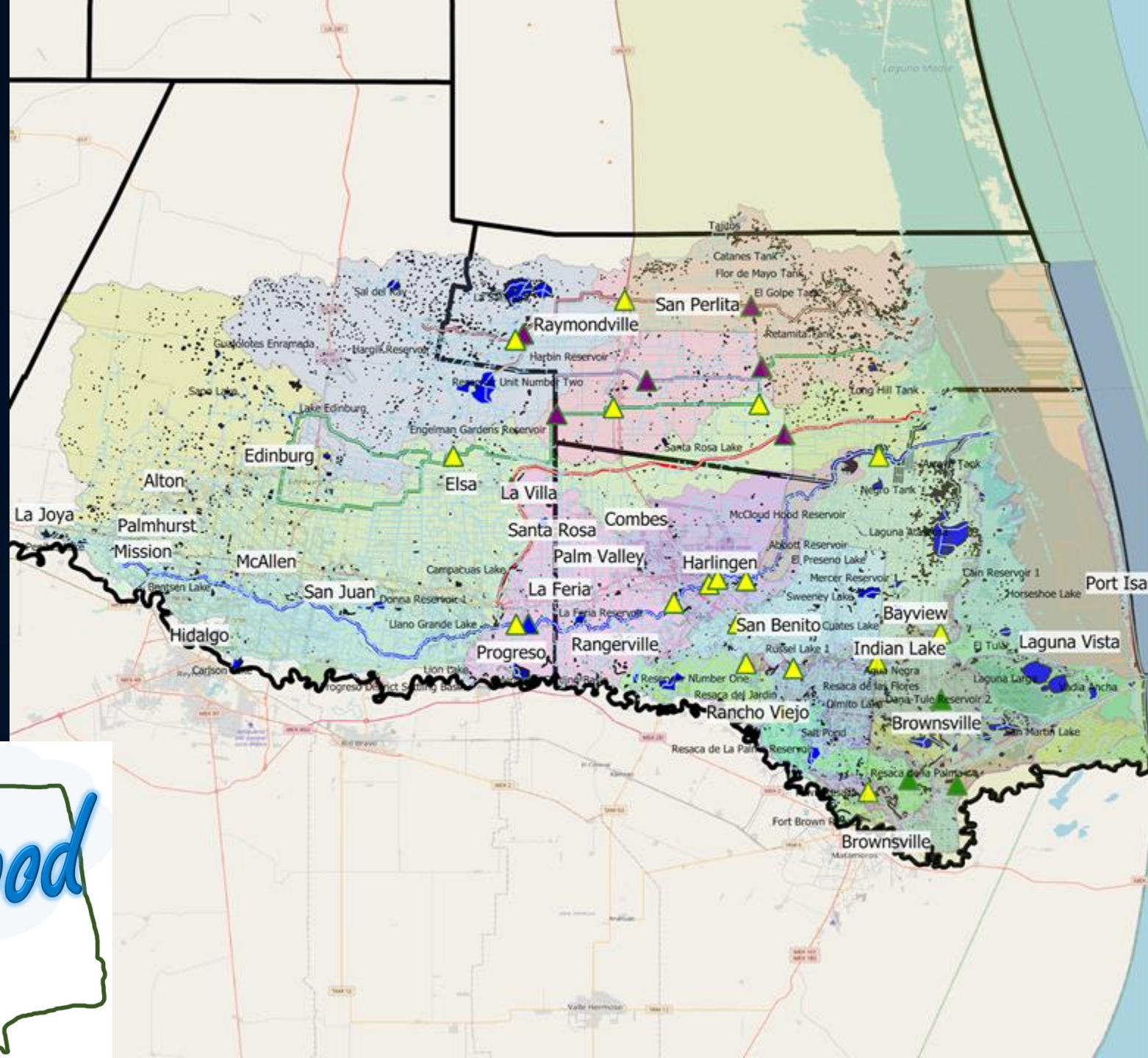


# National Water Model: LRGV Gaps



# Real Time Hydrologic System Network

- Data Democratization
- Local Ownership
- Regional Integration
- Regional
- Basin Management
- Flood Planning
- Local
- Flood Warning
- Design Development



## REON/RTHS

- ▲ Active
- ▲ Committed
- ▲ Contracted
- ▲ Proposed

## National Hydrography Dataset

- Flowlines
- Waterbodies

## LRGV Major Drains

- Raymondville Drain East
- Raymondville Drain West
- Willacy Main Drain
- HCDD1 North Main Drain
- IBWC Floodway
- Arroyo Colorado East (Tidal)
- Arroyo Colorado West-Central

## River & Estuary Observation Network

Rio Grande Valley

Map of Current, Contracted and Proposed Real Time Hydrologic Stations, overlaid on HUC12 Subwatersheds





# LRGVDC Flood Study

- 44 Real Time Hydrologic Stations
- LRGV Regional Real Time Hydrologic Model
- On-Demand Sub-Regional Hydraulic Models
- Selected Urban Stormwater Models
- River & Estuary Observation Network Cyber infrastructure
- Coordination of Regional Projects
- Selected Feasibility Assessments

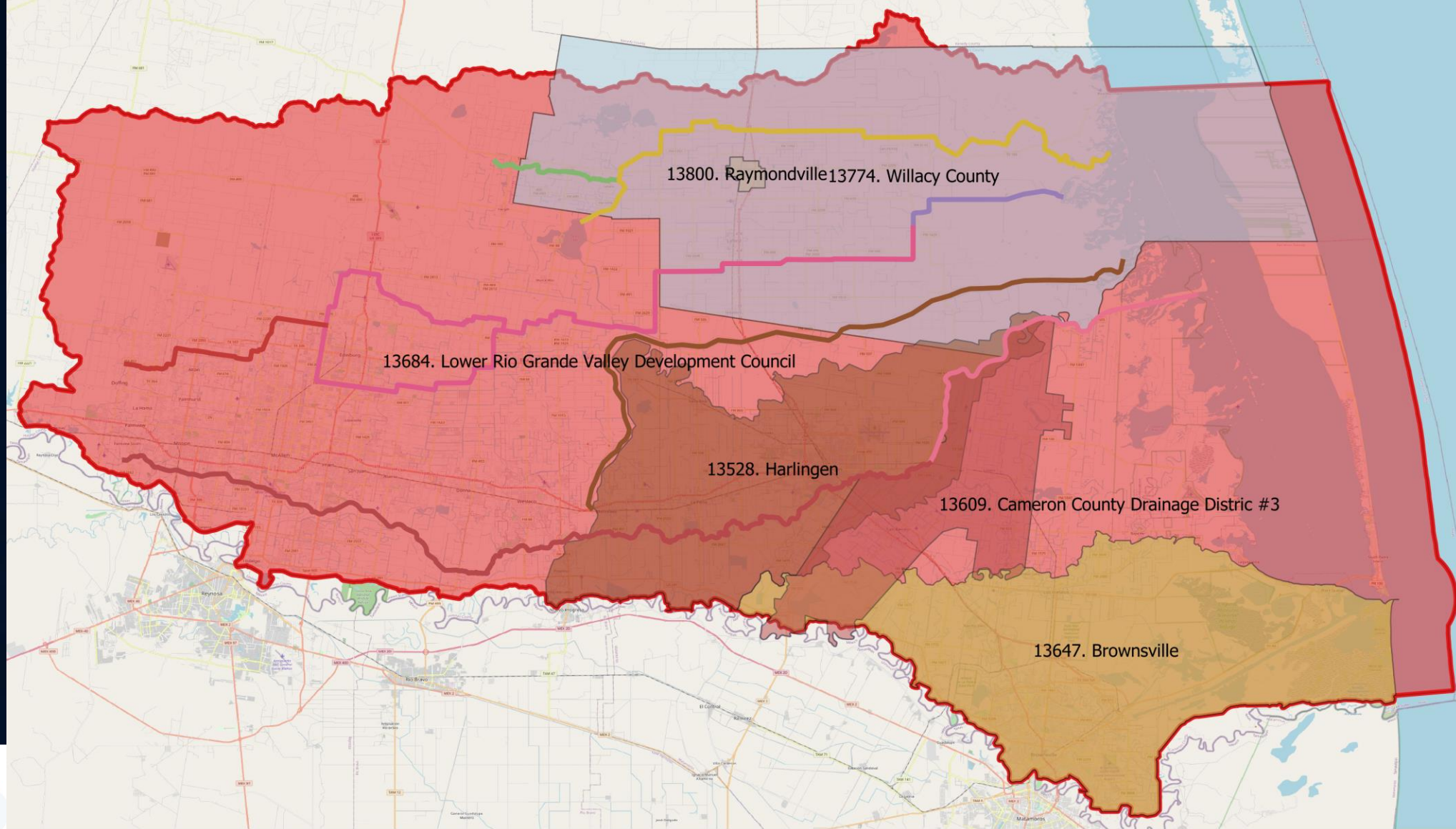
Total	\$8.9M
Grant	\$7.9M
Cost-Share (Counties)	\$1.0M
LRGVDC	\$0.4M
RATES	\$5.5M
Cameron County	\$1.0M
Hidalgo County	\$1.0M





# TWDB FIF Cat 1 Projects

Brownsville	\$1.2M
CCDD#3	\$1.5M
Harlingen	\$5.6M
LRGVDC	\$7.9M
Raymondville	\$400K
Willacy County	\$1.6M



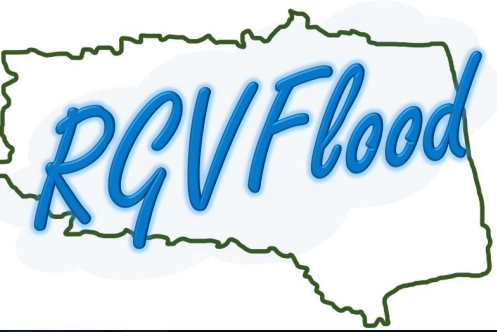
Lower Rio Grande Valley TWDB-FIF Category 1 Applications

Main Drains	IBWC Floodway	HCDD1 NMD	Category 1 Applications	Raymondville	LRGVDC
Raymondville Drain	Hidalgo-Willacy W Spur	Arroyo Colorado West-Central	CCDD3	Harlingen	
Raymondville Drain II	Hidalgo-Willacy	Arroyo Colorado East (Tidal)	Brownsville	Willacy	



Regional Water Resource Advisory Committee





# Coherent Project Goals

Lower Rio Grande Valley

Harlingen

Willacy County

CCDD#3

## Objective 1 REON/RGV

*the establishment of a **regional coordination and decision making** network, along with the assimilation of hydrologic and hydraulic knowledge to support science-driven policy and decision making*

## Objective 2 CIP Identification

*the identification of local and regional **capital improvement projects** that support **regional flood management***





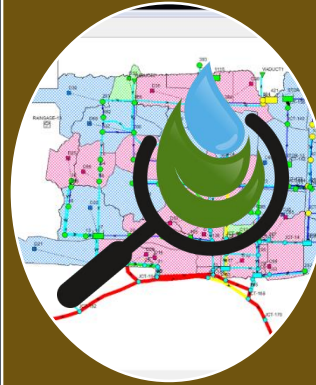
Regional  
Coordination  
&  
Technical  
Infrastructure



Tier 1  
Real-Time  
Regional  
Hydrology  
  
RATES



Tier 2  
On-Demand  
Sub-Regional  
Hydraulics  
  
RATES



Tier 3  
Needs-Based  
Urban Stormwater  
  
RATES  
Harlingen  
Willacy County  
CCDD#3



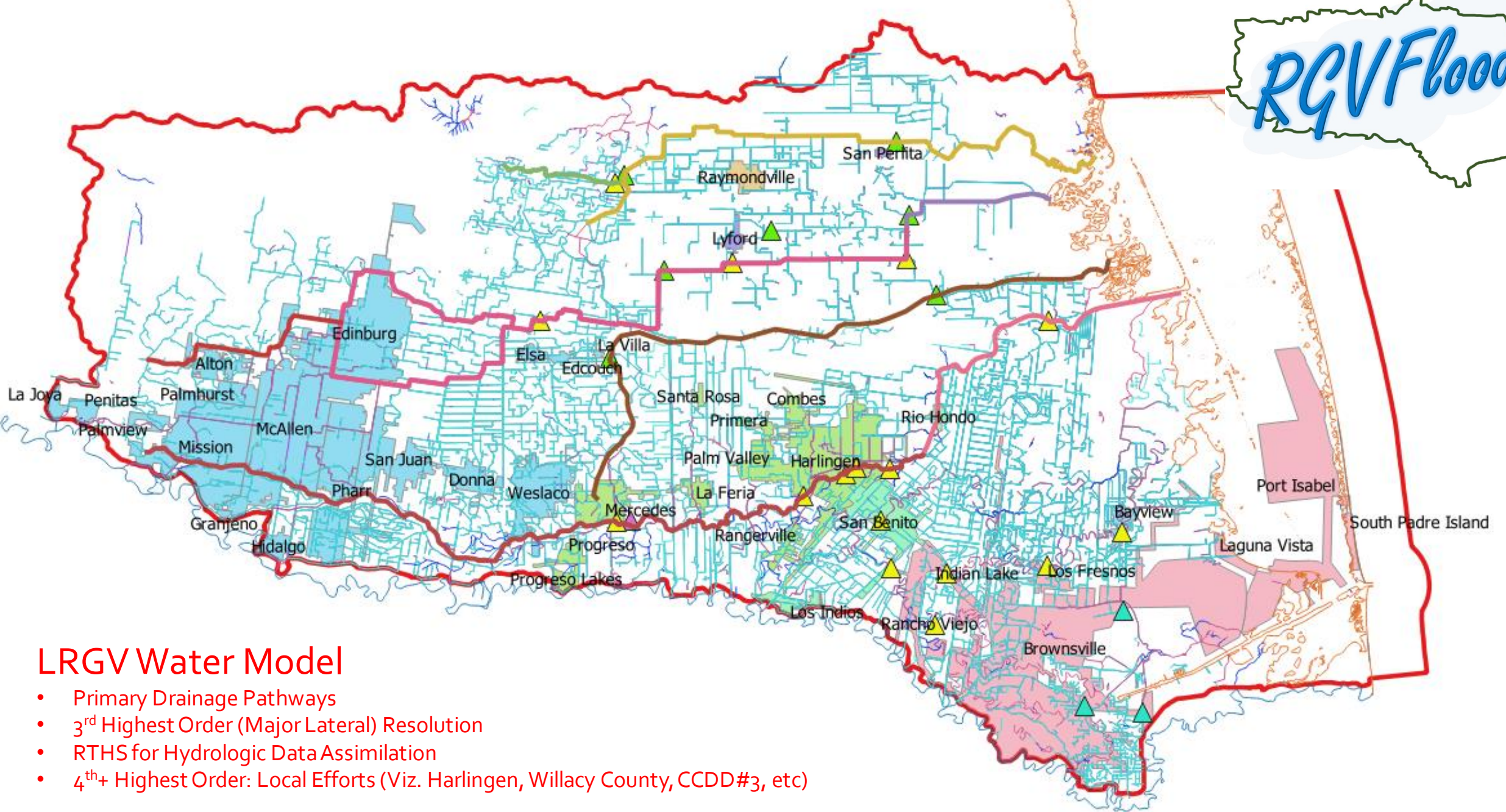
Tier 4  
Capital  
Improvement  
Project Specific  
  
Contractors



LRGV Hydrologic & Hydraulic Modeling: Adaptive Resolution



RGV Flood







# A Public/Private Partnership Serving The Lower Rio Grande Valley



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