



Sustainable
Water Initiative
for Tomorrow

Innovating for Resilience in an Uncertain Environment: The Role of Water Reuse

Ben Stanford | Hazen and Sawyer

Ted Henifin | HRSD

February 7, 2017



Hazen



- Primer on Water Reuse in the US
- Overview of HRSD SWIFT Program
- Key Elements of the 1 MGD Demonstration Facility

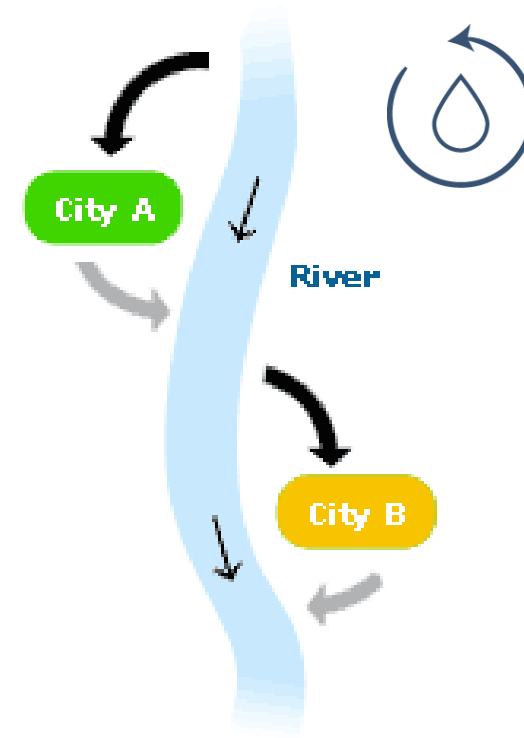
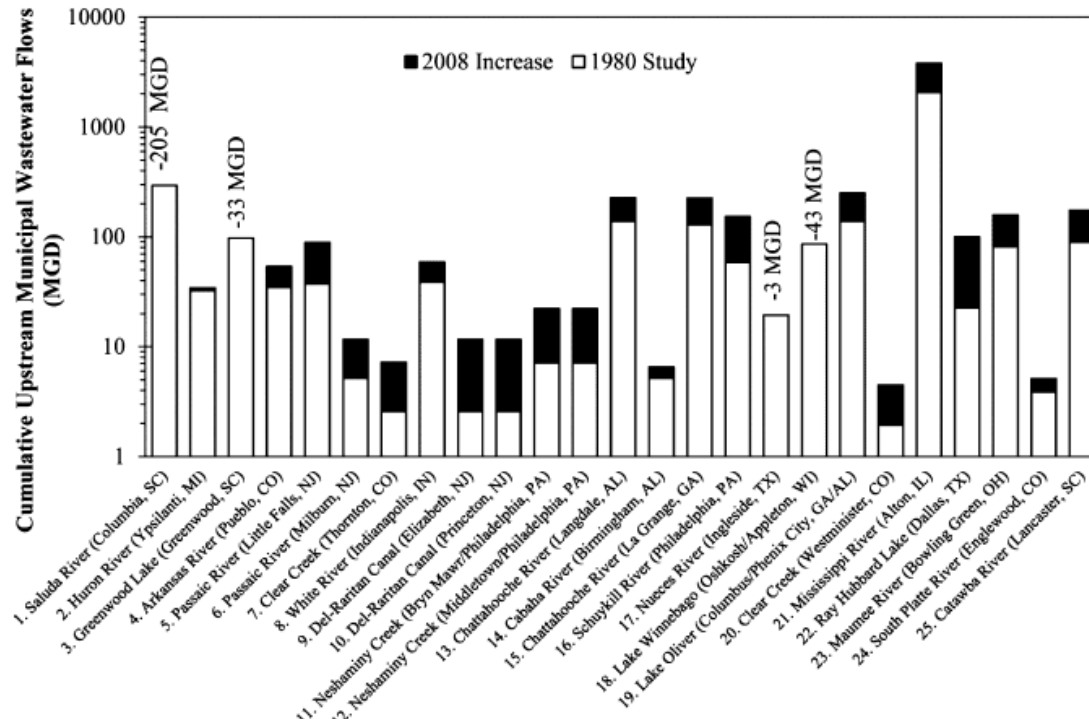
Potable Water Reuse Is Happening in the US and Abroad

The screenshot shows the GWR S (Groundwater Replenishment System) website. At the top, there is a navigation menu with links: About GWR S, The Process, Tours & Speakers, Media, H2O University, Keep Me Informed, and Languages. The main header features the GWR S logo and the text "New Water You Can Count On 120,725,353,600 GALLONS PRODUCED". Below this, there are three main content blocks: "The Process EXPLORE" with an image of a modern building, "GWR S Expansion WEBCAM & NEWS" with an image of blueprints, and "Stay Informed SIGN UP" with an image of two people. On the left side, there is a map of California with a red dot indicating the location of the GWR S facility in Southern California.



We Are Confronting the Reality of Rising De Facto Reuse

One Water: We Are All Connected



ENVIRONMENTAL
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Article

pubs.acs.org/est

Assessment of De Facto Wastewater Reuse across the U.S.: Trends between 1980 and 2008

Jacelyn Rice,^{†*} Amber Wutich,[‡] and Paul Westerhoff[†]

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10 of 25 Cities Had 100% De Facto Reuse in Low Flow

- One Water: We Are All Connected

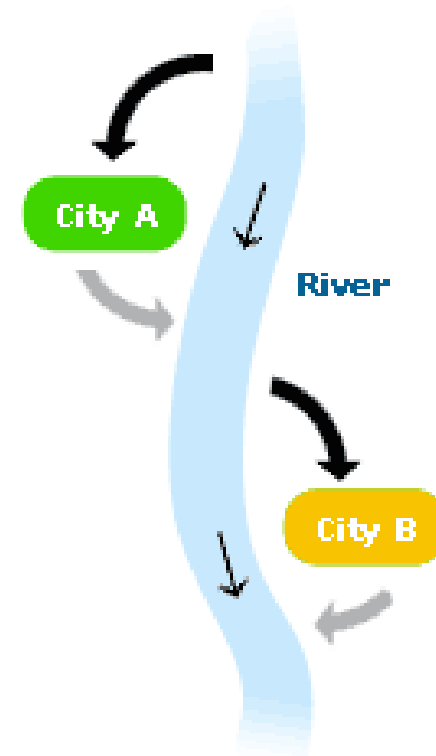
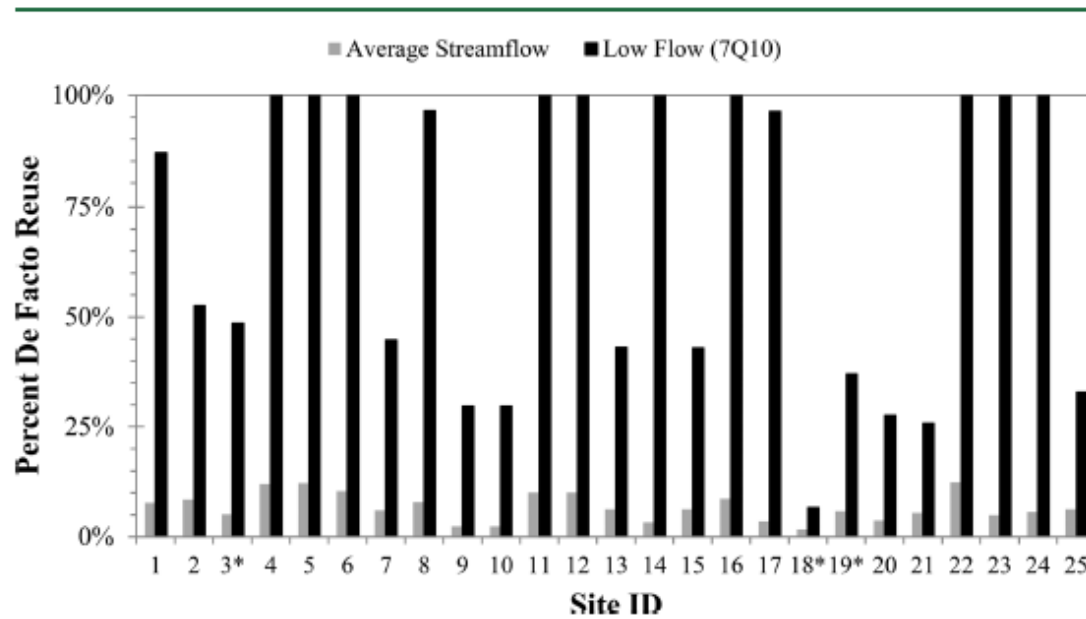


Figure 4. De facto reuse under average flow and low-flow conditions (modeled by 7Q10). Cities marked with an asterisk are calculated on the basis of 7Q10 streamflow values from the EPA 1980 study. (The x-axis gives same site IDs as in Figure 2.)

ENVIRONMENTAL
Science & Technology

Article
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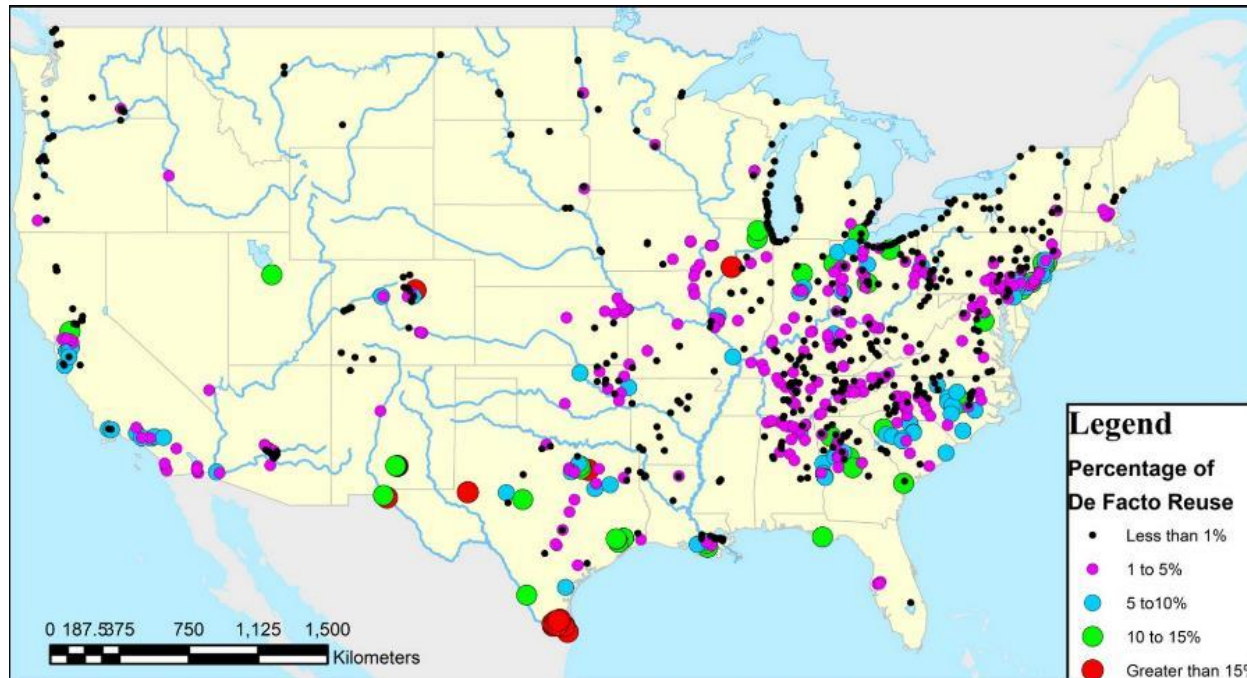
Assessment of De Facto Wastewater Reuse across the U.S.: Trends between 1980 and 2008

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Extent of *De Facto* Reuse Provides Opportunities and Challenges

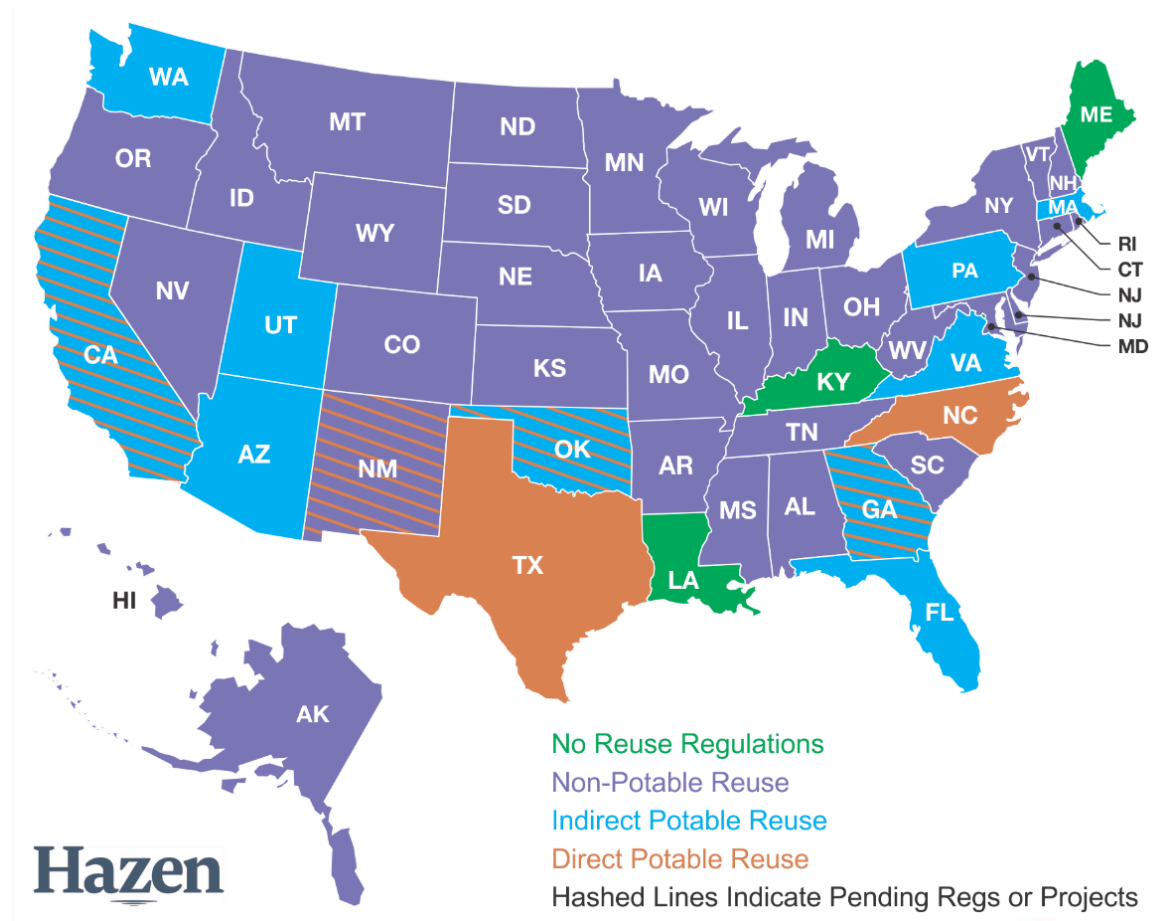
- People see that reuse is happening everywhere
- Potential for positive and negative impacts
 - Quantity – supply augmentation vs. diversion of flow from habitat/communities
 - Quality – source of contaminants vs. source of dilution
- Planned reuse allows for leveraging of positive impacts, guarding against negative impacts



Rice et al., ES&T,
2014

The “State” of Reuse

- Potable Water Reuse Is Rapidly Expanding as a Realistic Option in the US
- BUT...
- Uniform guidance and direction is needed



Numerous Resources Are Available to Assist with Obtaining Regulatory and Stakeholder Support

<https://watereuse.org/water-reuse-101/watereuse-videos/>

The Ways of Water



The Ways of Water (Spanish)



Downstream



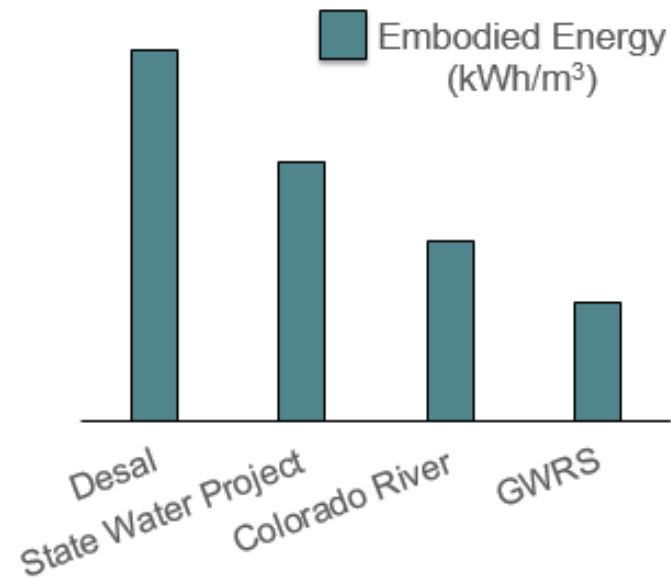
Rio Abajo (Downstream)



The Convergence of Water and WW Perspectives Enables Us to Address Multiple Community Challenges



- Energy footprint minimization
- Sustainable Supplies
- Climate Change
- Resiliency
- Resource recovery
 - Water
 - Nutrients
 - Energy
- ***Integrated water supply planning and management***



Energy required for water conveyance and treatment in Orange County, CA



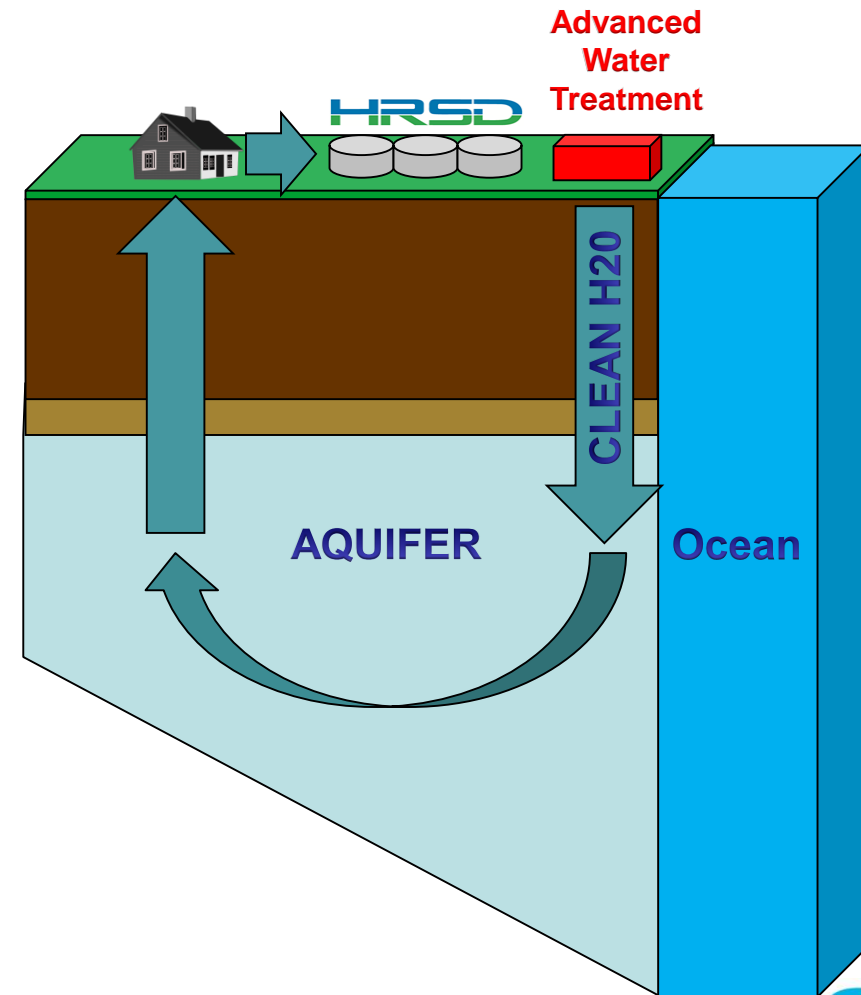
Overview of HRSD SWIFT Program

Water Issues Challenging Virginia and Hampton Roads

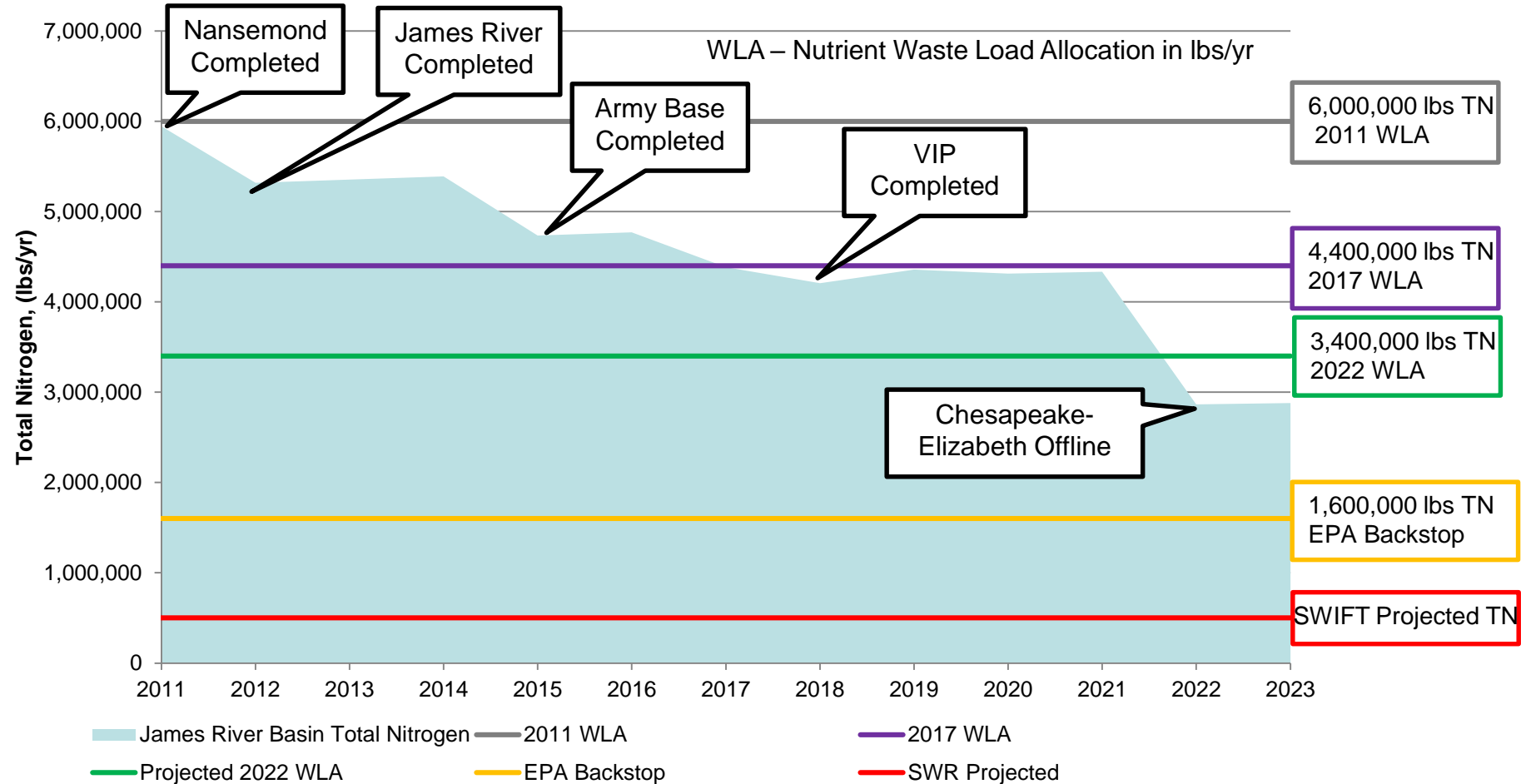
- Restoration of the Chesapeake Bay
 - Harmful Algal Blooms
 - Localized bacteria impairments
 - Urban stormwater retrofits (cost and complexity)
- Depletion of groundwater resources
 - Including protection from saltwater contamination
- Adaptation to sea level rise
 - Recurrent flooding
- Wet weather sewer overflows
 - Compliance with Federal enforcement action

SWIFT – Sustainable Water Initiative for Tomorrow

- Treat water to meet drinking water standards and replenish the aquifer with clean water to:
 - Provide regulatory stability for wastewater treatment
 - Reduce nutrient discharges to the Bay
 - Provide a sustainable supply of groundwater
 - Reduce the rate of land subsidence
 - Protect the groundwater from saltwater contamination



Impact on Nutrient Reductions

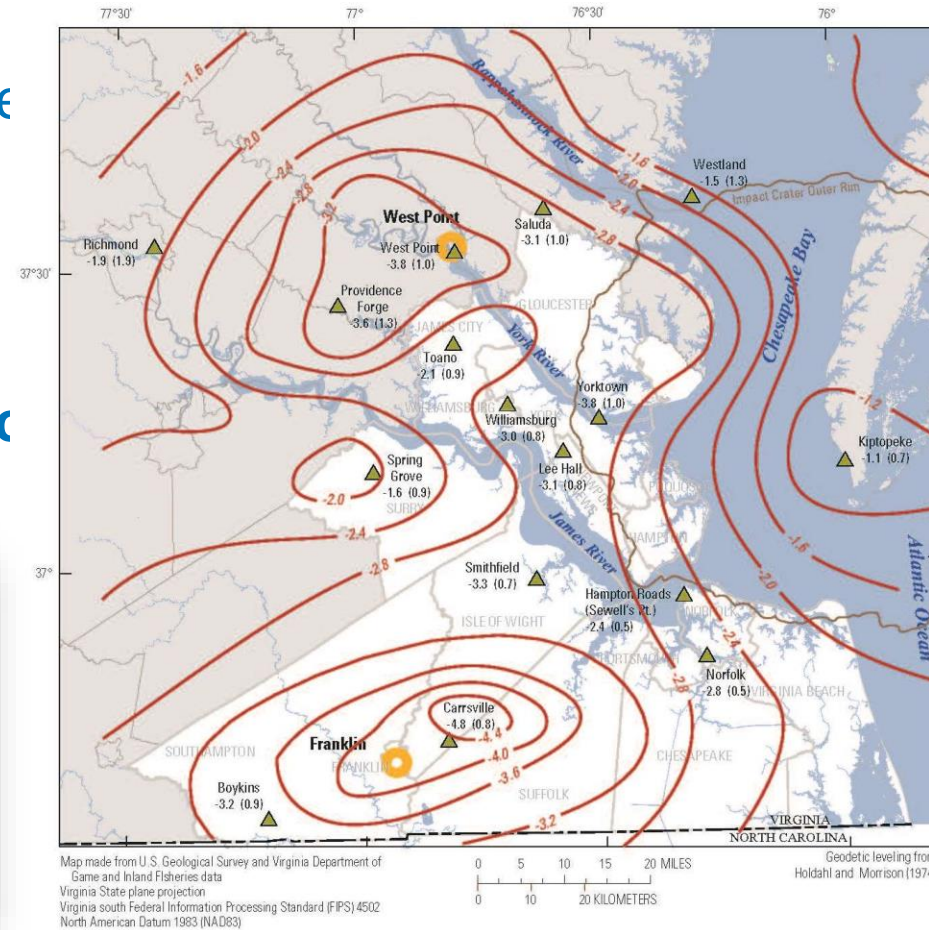
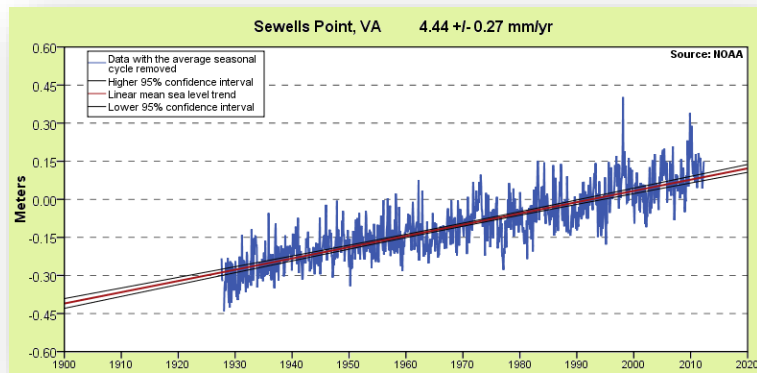


James River Basin – TN Similar results with TP and TSS and in other river basins.



Land Subsidence – We Are Sinking

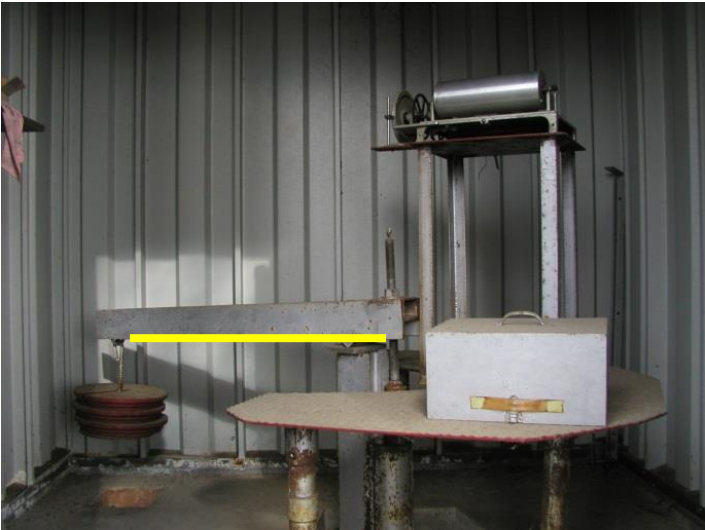
- According to USGS
 - Up to 50% of sea-level rise may be due to land subsidence
 - Up to 50% of land subsidence may be due to aquifer compaction



HAMPTON ROADS IS THE #2 LARGEST POPULATION CENTER AT RISK

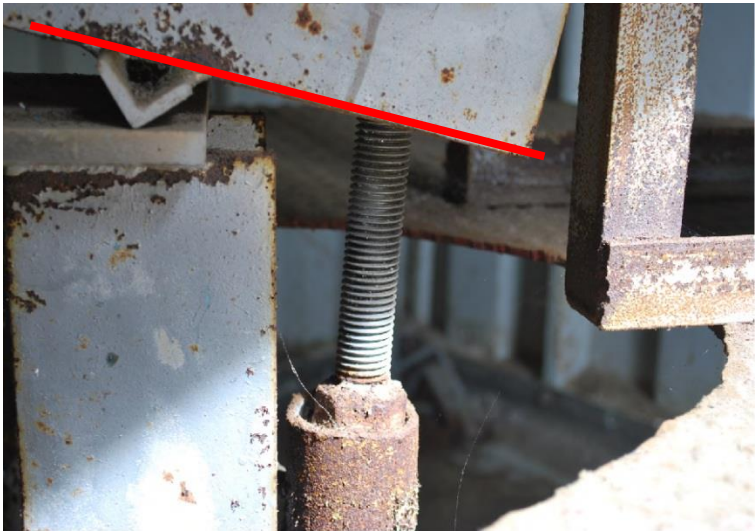
Evidence of Groundwater Impacts on Subsidence

2002



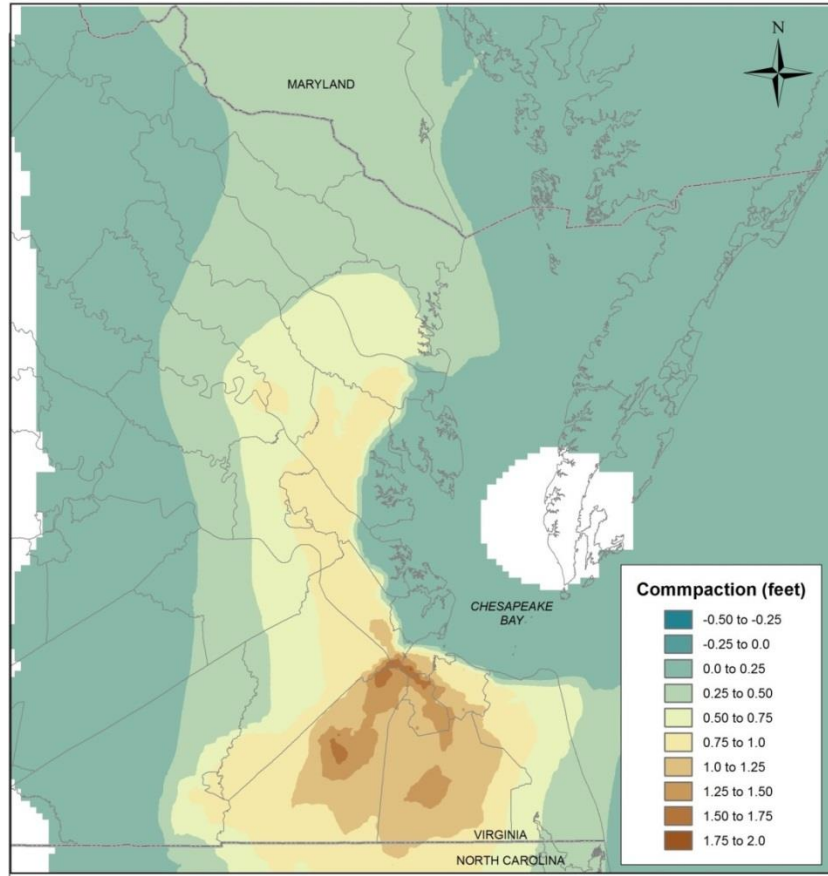
USGS found ground level rose 32 mm between 2002 and 2015 coinciding with reduced groundwater withdrawal by Franklin paper mill.

2015

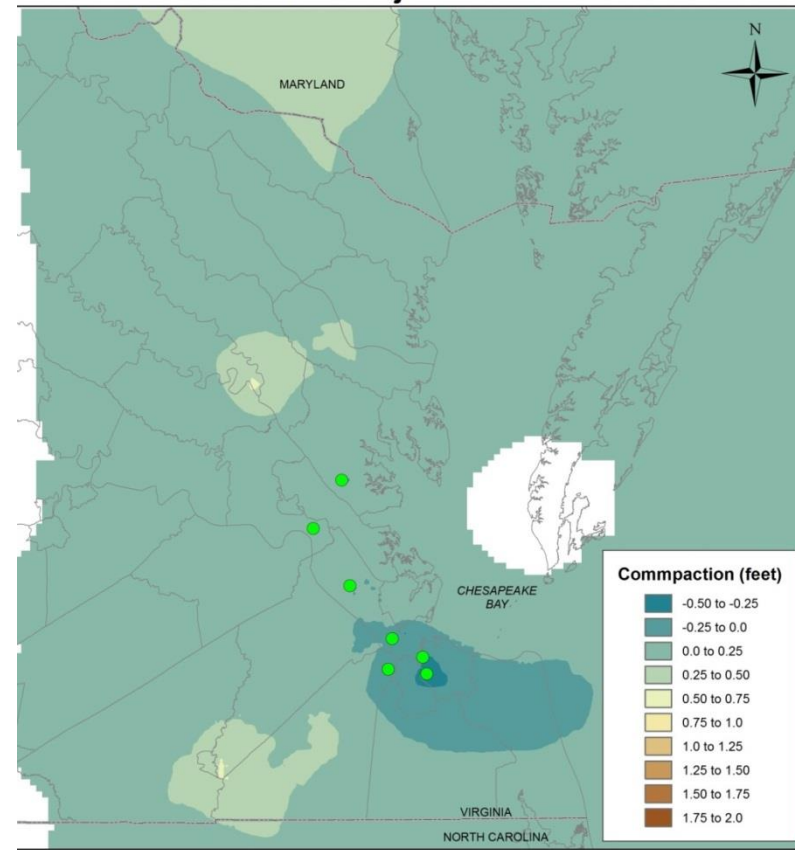


Aquifer Compaction Without and With SWIFT

Simulated Total Aquifer System Compaction
from 1890 to 2064 - Total Permitted



Simulated Total Aquifer System Compaction
from 1890 to 2064 - Total Permitted
with All Injection Wells



- SWIFT capitalizing on proven technologies
 - Messaging easier
 - Gain acceptance faster
- Still desire to prove concepts locally
 - Modeling and study
 - Pilot treatment processes
 - Larger scale demonstration – need enough water to make a difference
 - Full scale program
- Transparent and fully communicative along the way – building local trust and confidence

- Focus on multiple benefits
 - Well beyond agency's typical focus
 - Stormwater
 - Groundwater
 - Economic development
 - Sea level rise mitigation
- Integrate with Consent Decree
 - Allows funding within financial plan – independent of external funding sources

Congress of the United States
 Washington, DC 20510
 September 16, 2016

The Honorable Gina McCarthy
 Administrator
 Environmental Protection Agency
 1200 Pennsylvania Avenue, N. W.
 Washington, DC 20460

Dear Administrator McCarthy:

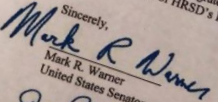
We were recently briefed on Hampton Roads Sanitation District's (HRSD) Integrated Plan to meet Clean Water Act obligations. We express our support for this plan, which addresses local waterways (and ultimately the Chesapeake Bay) and create a barrier to salt water intrusion.

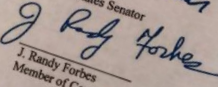
The HRSD Integrated Plan is a significant milestone in the effort to address the challenges of the eastern Virginia aquifer.

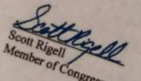
an aquifer has dropped over 100 feet in less than 100 years and is predicted to continue to drop unless withdrawals are drastically reduced or the aquifer can be recharged through artificial means. The HRSD Integrated Plan will add 120 million gallons of purified water daily to this productive confined aquifer, and modeled results show a positive impact on aquifer head pressures as far north as Maryland and south into North Carolina. Without a replenishment solution, groundwater supplies will be inadequate to support current trends in eastern Virginia by mid-century, and no new groundwater dependent development will be possible, effectively putting a significant portion of eastern Virginia at risk.

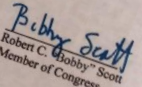
HRSD believes this project would not be possible without the integrated planning framework EPA developed in 2012. The region does not have the financial capacity to implement the groundwater replenishment work (estimated at \$2.2 billion) as required by a traditional approach to compliance with the consent decree. By integrating these water related issues, the Hampton Roads region can prioritize efforts to address the region's most critical and time sensitive environmental issues and realize so many more significant environmental benefits than with wet weather work alone. The HRSD Integrated Plan shows what is possible when local, regional, state and federal entities work together to find innovative solutions to the challenging environmental problems of today.

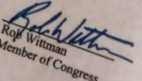
We appreciate EPA's leadership and willingness to think beyond traditional solutions by supporting HRSD's Integrated Plan and look forward to securing eastern Virginia's water future as a result of HRSD's Integrated Plan.


Sincerely,

 Mark R. Warner
 United States Senator


 J. Randy Forbes
 Member of Congress


 Scott Rigell
 Member of Congress


 Bobby Scott
 Robert C. "Bobby" Scott
 Member of Congress


 Roy Wittman
 Member of Congress


COMMONWEALTH of VIRGINIA
 Office of the Governor
 September 13, 2016

Terence R. McAuliffe
 Governor

The Honorable Gina McCarthy
 Office of the Administrator
 U. S. Environmental Protection Agency
 Mail Code: 1101A
 1200 Rios Building
 1200 Pennsylvania Avenue, NW
 Washington, DC 20460

RE: Support for Hampton Roads Sanitation District's Integrated Plan

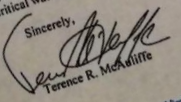
Dear Administrator McCarthy:

I write to encourage you to support the Hampton Roads Sanitation District's (HRSD) Integrated Plan to meet their Clean Water Act obligations under their Sanitary Sewer Overflow (SSO) federal consent decree with the U.S. Environmental Protection Agency.

The Potomac Aquifer in eastern Virginia is a principal groundwater source for eastern Virginia and part of northern Virginia. The Virginia Department of Environmental Quality (DEQ) has monitored the water withdrawal from this aquifer for decades and has grown increasingly concerned over the aquifer's sustainability. In addition, over withdrawal of the aquifer contributes to both land subsidence and salt water contamination. If not corrected, these issues present significant environmental, public health, and economic challenges in the years ahead.

HRSD's proposed Integrated Plan would enable the agency to include an aquifer replenishment project that would add 120 million gallons per day of purified water to the aquifer. This would have a number of benefits: within a few decades it would begin to stabilize and return the aquifer to a sustainable groundwater source, reduce the rate of land subsidence by as much as 50%, create a barrier to salt water intrusion, and would reduce HRSD's pollutant loads on the Chesapeake Bay by nearly 90%.

It is my hope that you and your staff also will continue to collaborate with HRSD and DEQ, and that you will support HRSD's Integrated Plan. We believe it holds great promise to address a number of eastern Virginia's most critical water quality and quantity challenges.

Sincerely,

 Terence R. McAuliffe

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Can your sinks and toilets fight sea-level rise?

Virginia GOP asks state to cancel "loyalty oath"

SEAFORD
recycled
 Ted Henfin crouched next to a floor drain at the Hampton Roads Sanitation District's York County treatment plant. Into his palm ran a soft stream of clear water — clean enough, probably, to drink. But the lab results aren't back to confirm that. So, Henfin will hold off before he sips. Waiting isn't exactly Henfin's style these days. He has dived into a project to prove that HRSD can turn what Hampton Roads flushes down

See WASTE, PAGE 10

Daily Press
 SUNDAY, OCTOBER 11, 2009

GROUNDWATER DRAIN: A BIG-DOLLAR DILEMMA

Groundwater water level decreases from 1900 to 2008

Decreases, in meters: 0, -0.5, -1.0, -1.5, -2.0

Groundwater withdrawal center, U.S. Geological Survey station

PENINSULA CITIES IN ECONOMIC DOLDRUMS
 Facing sluggish job growth, defense cuts, region fares poorly in national rankings

By J. EDGAR O'NEAL



NO WASTING WATER

Following the lead of other regions, local plant tries treating wastewater

By Dave Reed
 reed@dailypress.com

SEAFORD — With a sip of specially treated wastewater, the Hampton Roads Sanitation District general manager Ted Henfin put his mouth where his money is — what could be a \$1 billion effort to replenish eastern Virginia's rapidly shrinking pool of groundwater.

A pilot program at the agency's York River Treatment Plant shows it is possible to clean the water Hampton Roads residents flush out of past century.

Virginia dropping 200 feet over the century.

See more photos and video at dailypress.com

gathering of state and local officials. Not that he expects anyone will be drinking it any time soon. The plan is to eventually inject 180 million gallons a day of treated water deep underground to begin replenishing the wedge of waterlogged sand tapped by wells that serve hundreds of thousands of people and businesses.

They're currently drawing about 100 million gallons a day from those wells, resulting in groundwater levels in parts of eastern Virginia dropping 200 feet over the century.

See WATER/PAGE 8



Top: Process engineering and research manager Chris Wilson is reflected in a window displaying the first step of the carbon-based advanced water treatment process at a conference at the York River Treatment Plant Thursday. Above: HRSD general manager Ted Henfin holds a glass of purified water during the conference at the plant.

Sip shape

Hampton Roads Sanitation District's treated sewage water tastes great, say officials, and could shore up the area's sea level rise and bay cleanup issues

By Dave Mayfield
 The Virginian-Pilot

YORK COUNTY
 Earlier this year, as the Hampton Roads Sanitation District ramped up plans to make its wastewater clean enough to drink, general manager Ted Henfin vowed he'd take the first gulp.

On Thursday at the HRSD's York County treatment plant, Henfin made good on the promise, leading dozens of employees and invited guests in downing glasses of wastewater that came from a sewer and toilets.

"Great!" he proclaimed after his first sip. "Ahhh." To Henfin, it was no mere stunt. It was an early demonstration of the potential for an ambitious initiative to turn what goes down Hampton Roads'

See HRSD, BACK PAGE



Ted Henfin, Hampton Roads Sanitation District general manager, vowed to take the first gulp of HRSD's treated wastewater. He made good on his promise Thursday.

STEVE EARLEY | THE VIRGINIAN-PILOT

Hopes that wastewater can conserve land in coastal Va.

BY DARRYL FEARS

SEAFORD, VA. — It looks like a mad scientist's lab, something straight out of a sci-fi novel. Valves turn in every direction. Tubes are stacked halfway to the ceiling. Tiny bubbles dance in large vats of water.

But what's happening in a hangar of the York River Treatment Plant is real, part of a grand experiment that could help keep this coastal region from continuing to subside and eventually being claimed by the rising sea. Over the next 15 months, tests will determine whether millions of gallons of wastewater can be purified to drinking water quality and injected into the ground.

If successful, the project of the Hampton Roads Sanitation District could start to replenish a giant aquifer that thousands of industries and half a million households in the area are sucking dry. Over the past five decades, they have collectively pumped out so much water that land here is falling 4 millimeters a year — or more than 1½ inches by 2026.

Ted Henfin's jaw-dropping, eyebrow-raising idea was proposed in 2015, and last month the sanitation district general manager kicked off the pilot phase to stop what some scientists have called a nightmare in super slow motion.

Aquifers big and small exist under Hampton Roads in muddy
AQUIFER CONTINUED ON A16



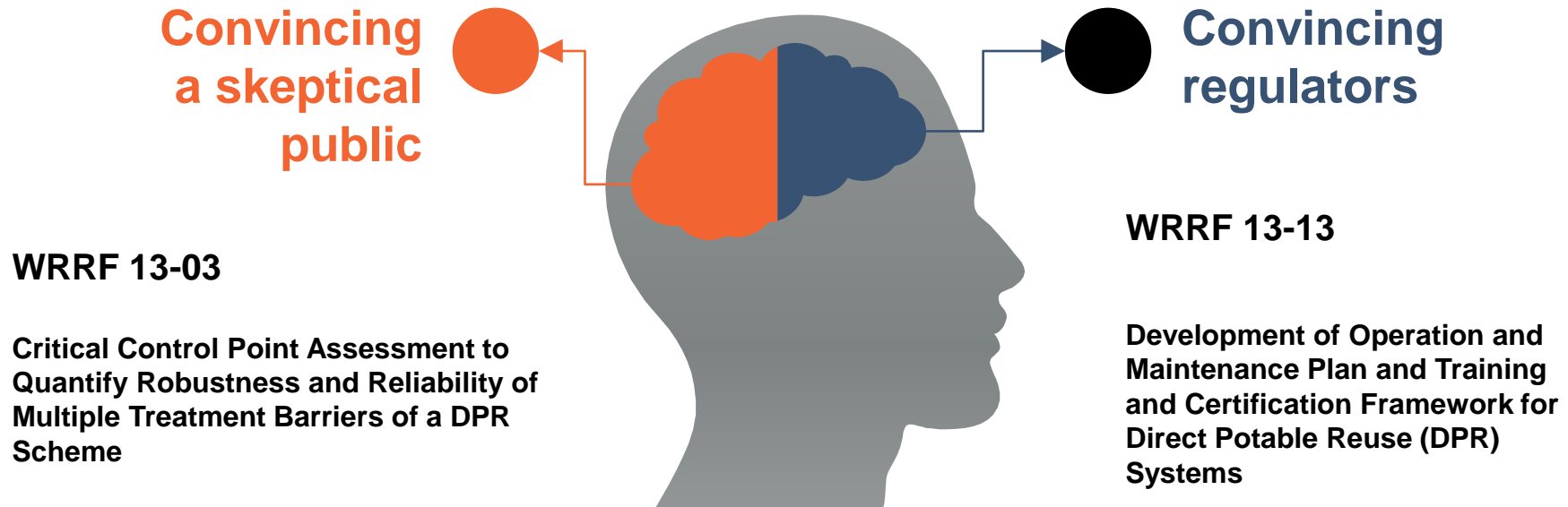


Key Elements of Demonstration Facility Design

Theme: Building Confidence & Trust in Water Reuse



Building a Safe, Reliable, High Quality Advanced Purification Facility



Critical Control Point Assessment to Quantify Robustness and Reliability of Multiple Treatment Barriers of a DPR Scheme

Development of Operation and Maintenance Plan and Training and Certification Framework for Direct Potable Reuse (DPR) Systems

“Eighty per cent of the failures he recorded were not due to failures of technology ... but were due to human error”



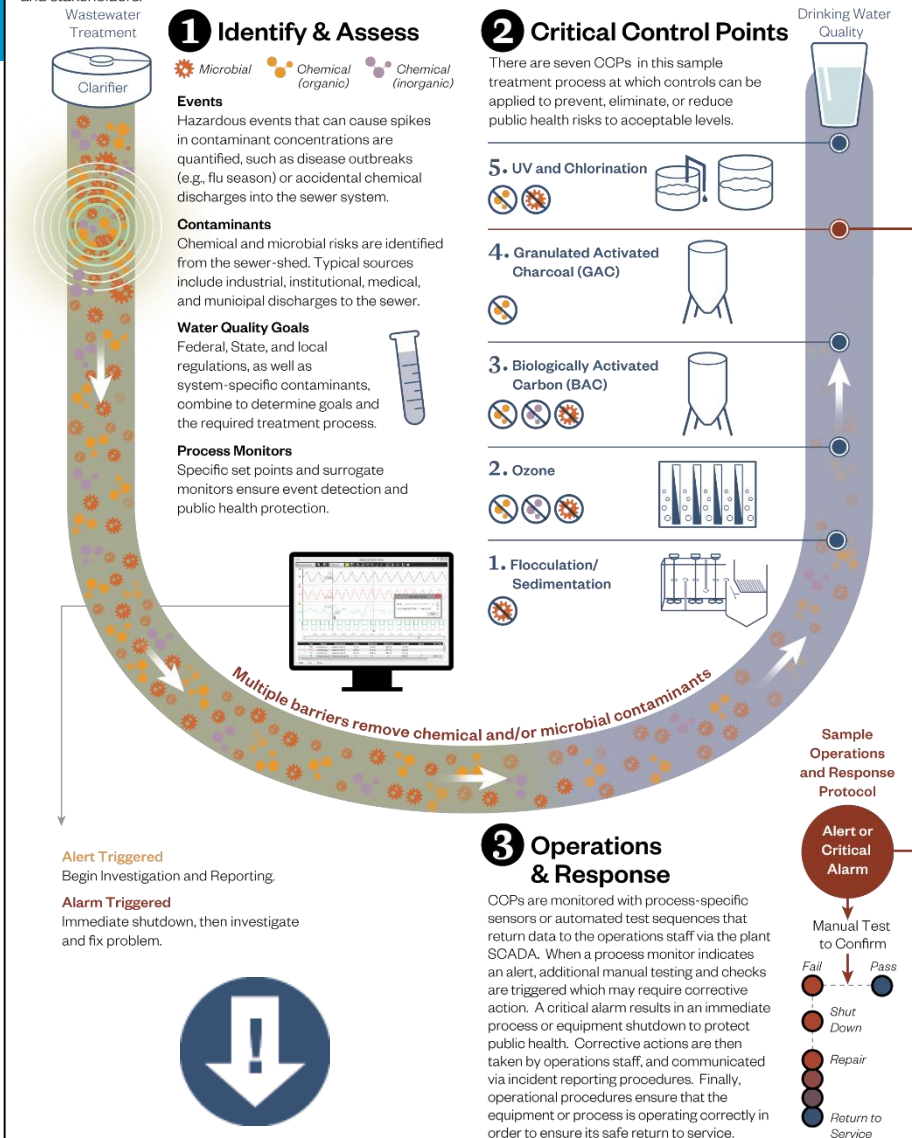
Professor Don Bursill, the CEO of the Cooperative Research Centre for Water Quality and Treatment, Australia 2007 (The Age June 5, 2007).

Critical Control Point Process Carries Through All Phases

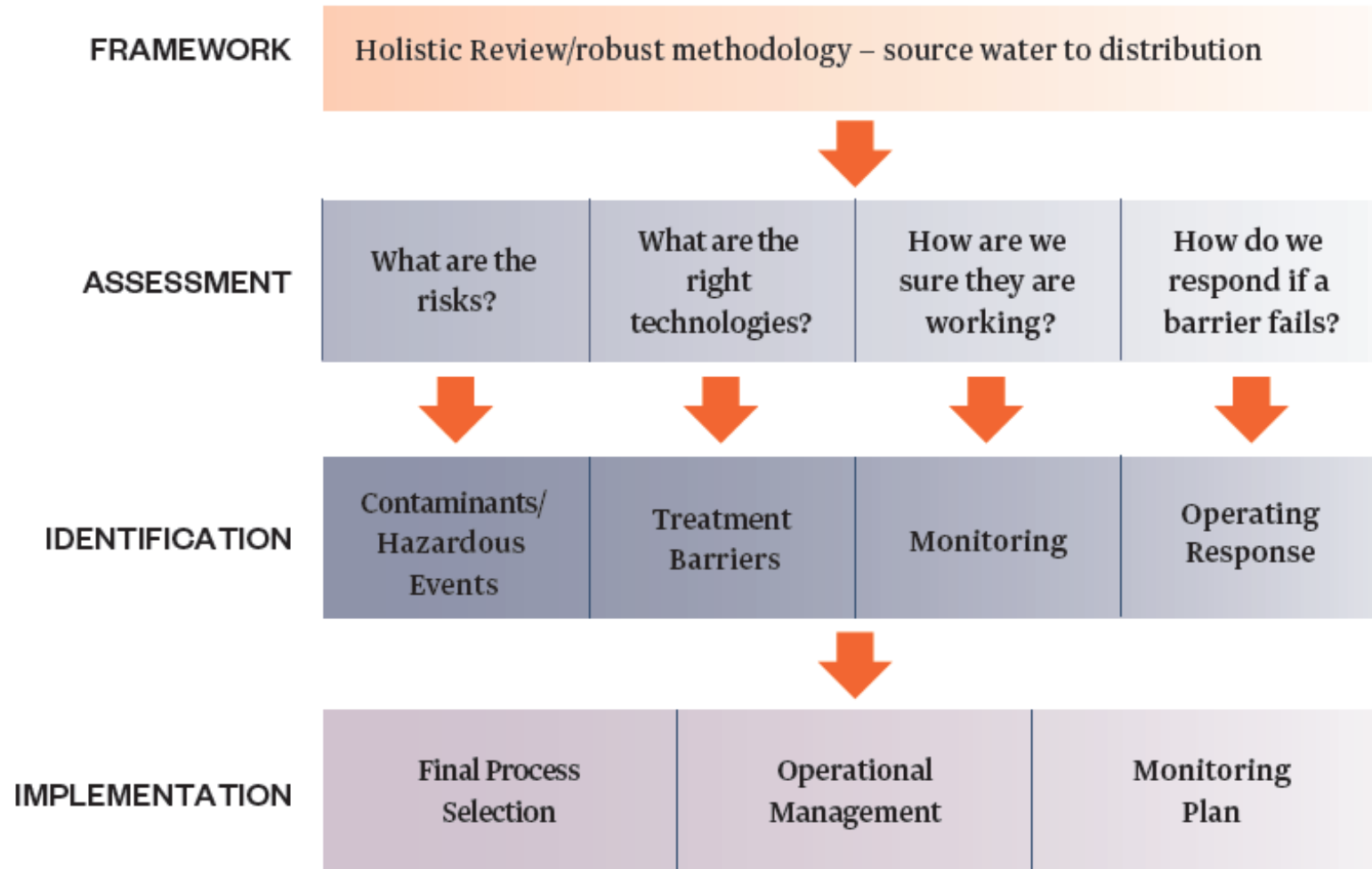
- Based on a data-driven design process
- Forward thinking about operations
- Ensures facilities achieve water quality goals, are operable, and are maintainable
- Prepares operations teams
- WE&RF 15-05 Implementation

Engineering Trust in Potable Reuse

Advanced treatment for potable reuse applications requires processes that are designed properly to achieve the desired function and public health protection goals, that are reliable and operable from commissioning through the life of the facility, and that are maintainable with minimal impact on operator teams and budget. The Hazen team uses the Hazard Analysis and Critical Control Point (HACCP) process as the core of our approach to potable reuse project. This approach provides a framework that ensures proper design, function, monitoring, and response in potable reuse projects and maximizes the return on investment for the utility and stakeholders.

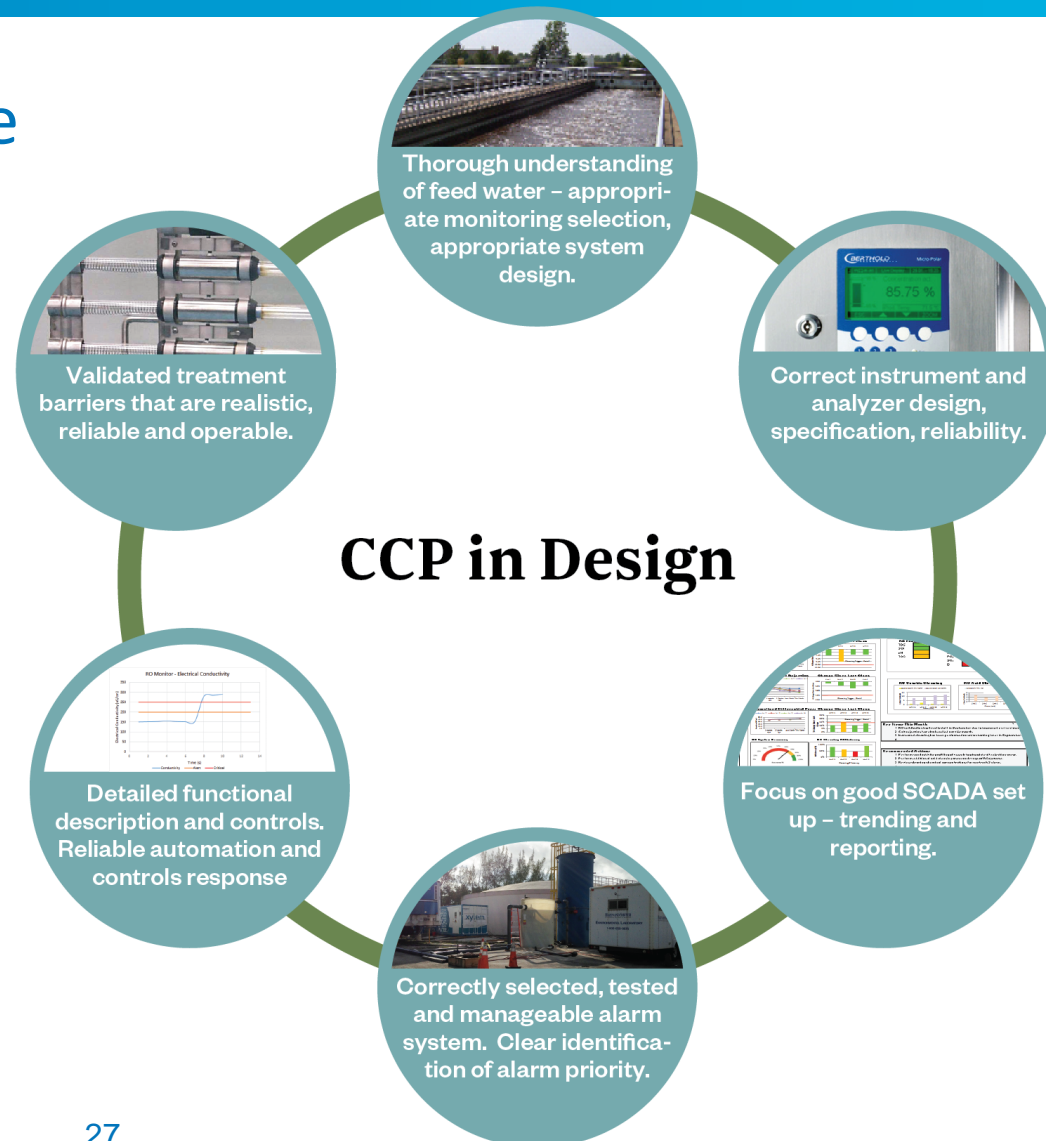


What Does the CCP Approach Provide?



Critical Control Point Process Drives Design

- The process ensures we have the right:
 - Processes
 - Monitors
 - Controls
 - Response Procedures
 - Operating Guidelines
 - Operator Training



Flexible Architecture Achieves Multiple Objectives

- Sustainability
 - Accessibility
 - Constructability
 - Visibility
 - Functionality
-
- Design-Build
 - 14 month schedule
 - \$25 million



- Interstate exposure
- Easy access at front of plant
- Multi-purpose room and visitors gallery
- Linear process flow
- Tasting opportunity



Questions?

