

Sustainable Sanitation: the Engine of the Blue Economy

Global Reflections on the Sanitation/Marine Ecosystem Nexus

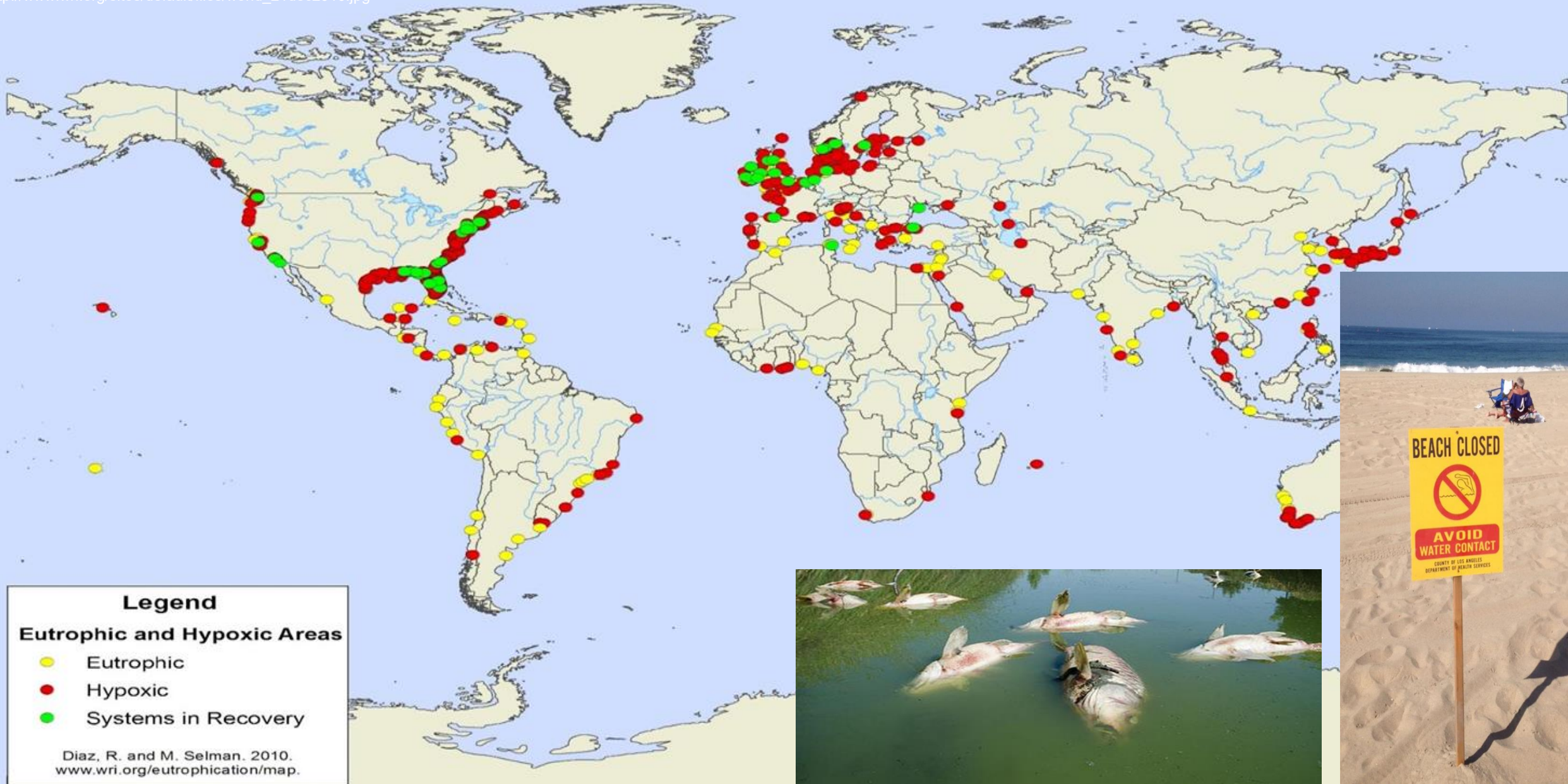
Dr. Martin Gambrill

Former World Bank Lead Water & Sanitation Specialist; Independent Consultant; Visiting Professor

LatinoSan, Punta Cana, June 3rd 2026

World Hypoxic and Eutrophic Coastal Areas

http://www.wri.org/sites/default/files/world_21dec2010.jpg



Increasing Risk

High Risk Zone

Increased Risk

Safe Operating Space

High Risk Line

Planetary Boundaries

Green Water
Blue Water



Stratospheric
Ozone Depletion



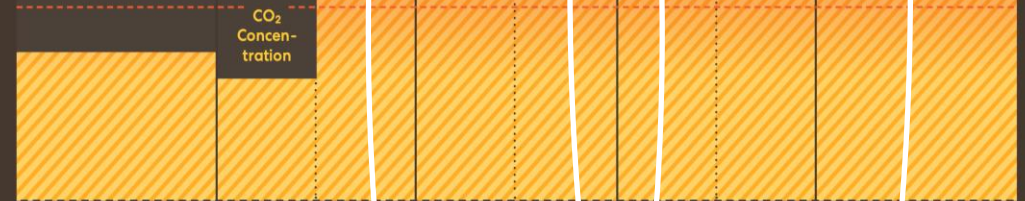
Atmospheric
Aerosol Loading



Ocean
Acidification



Freshwater
Change



CO₂
Concen-
tration

Radiative
Forcing

Phosphorus
Cycle

Nitrogen
Cycle

Functional
Integrity

Genetic
Diversity



Land System
Change



Climate
Change



Biogeochemical
Flows



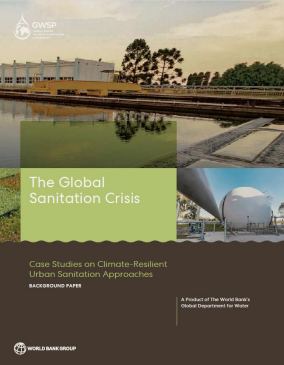
Biosphere
Integrity



Novel
Entities

Planetary Boundaries Impacted by Sanitation





Rethinking Sanitation for Resilience: Global Case Studies

WORLD BANK GROUP

CHECK² PROTECT



Properly Functioning Septic Systems
Save You Money and Protect Your
Property, Health & Our Environment!

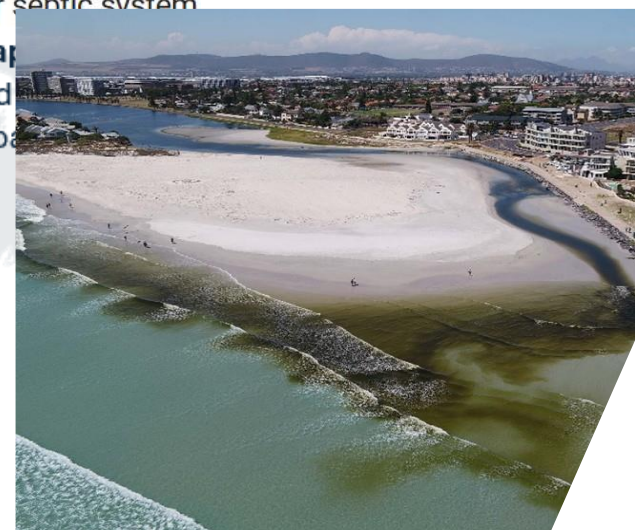
Climate Hazards

-  Drought
-  Flooding
-  Sea level rise
-  Increased temperature
-  Rainfall

... into local action

Get information on how to [Check to Protect](#) your septic system

Singapore
Island
approach



Cape Town (South Africa)
Creating a financially stable utility that can provide integrated services for a water-resilient city

Improving the climate resilience of low-income communities

Lusaka (Zambia)
Reducing climate change vulnerability through improved sanitation and active management in peri-urban areas

SANEPAR, Paraná State (Brazil)
Embedding climate risk management into utility planning & operation to tackle urban water crisis

San Francisco (USA)
Innovative financing for green capital infrastructure against stormwater overflows

Miami (USA)
Targeting septic tank connections to public sewer infrastructure to protect against sea level rise & groundwater intrusion

We flush nutrients every day...



Image source:

https://www.google.com/url?sa=t&source=web&rct=j&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DwUhX_P1Z6bw&ved=0CBkQihxqFwoTCPIosbP2gZQDFQAAAAAdAAAAABAE&opi=89978449

and then use huge amounts of energy and chemicals to remove them.



Gotland, The Baltic Sea, Sweden

Gotland



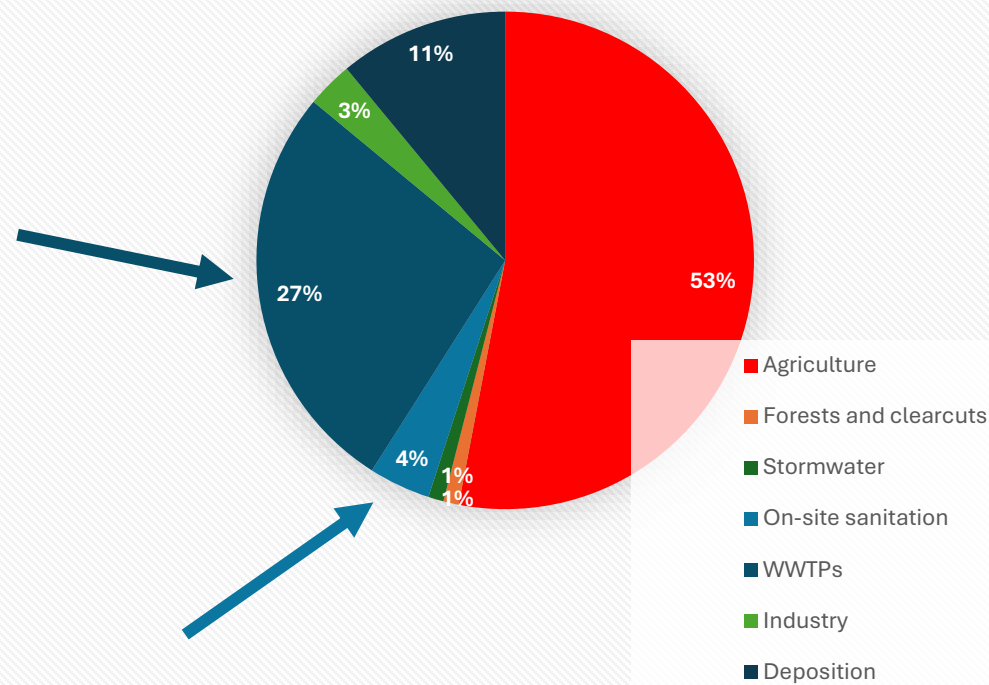
- **Swedish island** in the Baltic Sea
- **Resident population of 61,000 people; summer tourist visitors of 950,000 (> 15x increase)**
- **100% sanitation coverage:**
 - Sewers & wastewater management/treatment in dense urban areas
 - Onsite sanitation & septage management/treatment for dispersed rural areas

The background of the slide is an aerial photograph of a coastal area. On the left, a landmass with green and brown vegetation is visible. To the right of the land, a large, swirling mass of bright green water extends into the darker blue ocean, indicating a significant algal bloom or phytoplankton bloom. The water shows intricate swirling patterns, suggesting currents or wind-driven mixing.

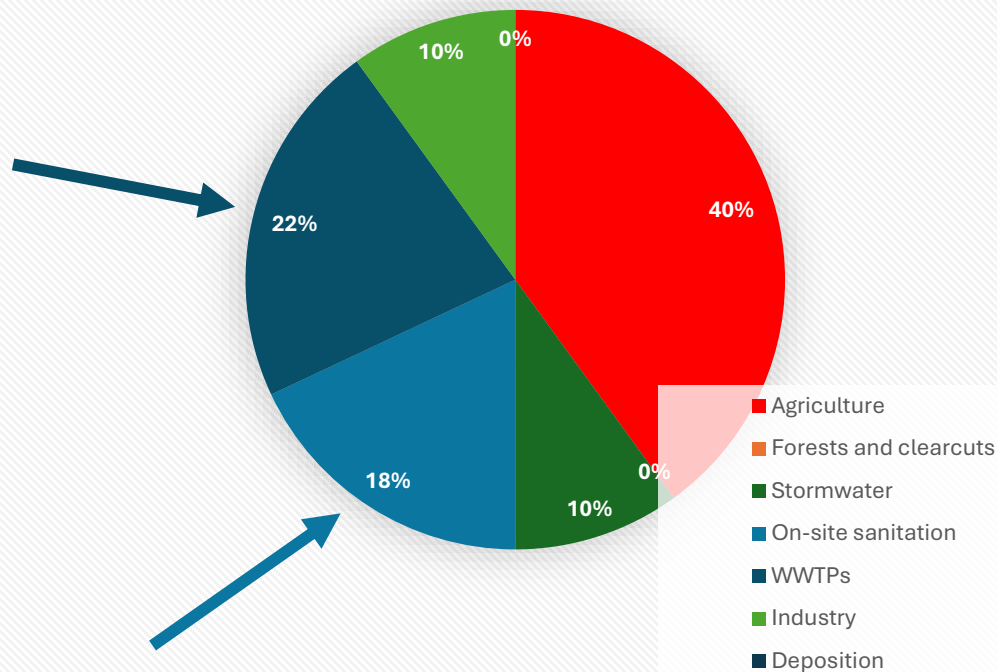
**When nutrients end up in water,
they're simply in the wrong place.**

Swedish Nitrogen & Phosphorus Release to the Baltic Sea

N (%)



P (%)



**Recycling urine is about putting
nutrients back where they belong —
in agriculture.**



Urine Diverting Toilets

Examples of our installations



Unisex dry urinal

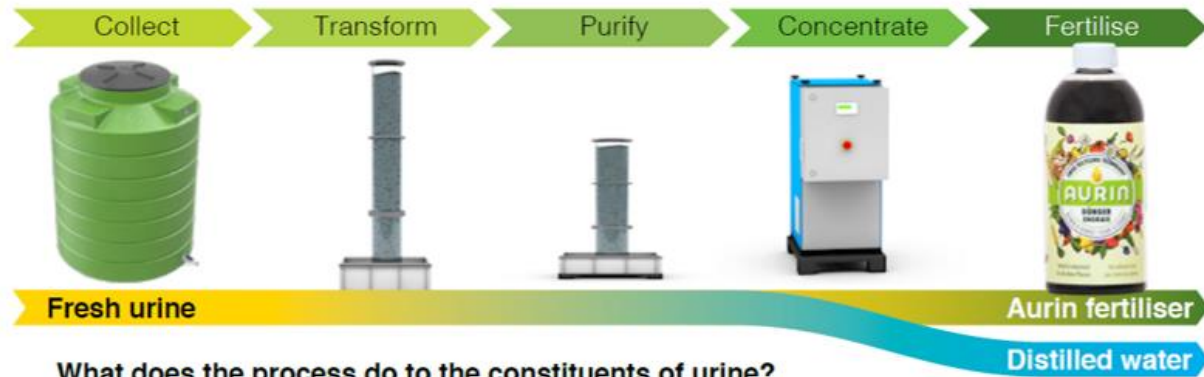


Urine diverting flush

Malmö Football Club video: <https://www.youtube.com/watch?v=4l1V1jiaPT4>

Our Solution:

We capture the **urine** and concentrate the nutrients into nutrient rich **fertiliser**.



What does the process do to the constituents of urine?

✗ Heavy metals – not present in urine

Bad smell & volatile ammonia

Pharmaceuticals & hormones

Pathogens

Primary nutrients (nitrogen, phosphorus, potassium etc.)

Trace elements (boron, iron, zinc etc.)

Processed & preserved



Prototype installed at VA SYD's HQ

The Fertiliser



Fertiliser Treatment	N-P-K Content (%)	Mass fertilizer applied (kg/ha)	Barley Harvest (kg/ha)
S360 Fertilizer	15-2-4	567	6 500
NPK fertilizer	24-4-5	370	6 500
Fresh urine	0,6-0,07-0,2	14 167	5 500
Control	0-0-0	0	4 500



Combining sewered and non-sewered sanitation in Montero, Bolivia

Scaling up sustainably

SEI report
March 2022

Carla Liera¹

Mónica García²

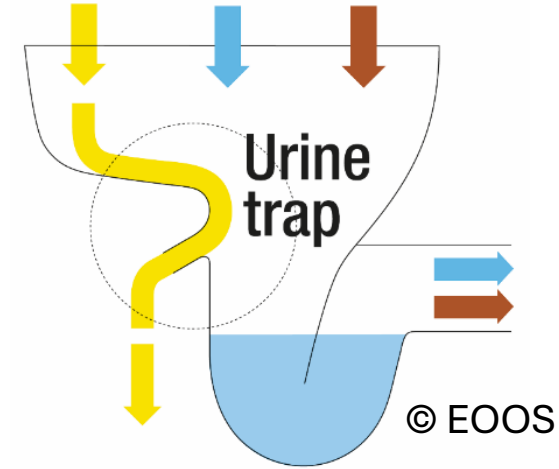
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²European Commission
³Research Institute of Sweden, RSI



For higher-income contexts



Laufen



...and for lower-income contexts

(© EOOS Next)



"Eazisplit" (insert)
Durban, SA



Indian squat pan
Coimbatore, IN



„better design“ squat pan
Bangalore, IN

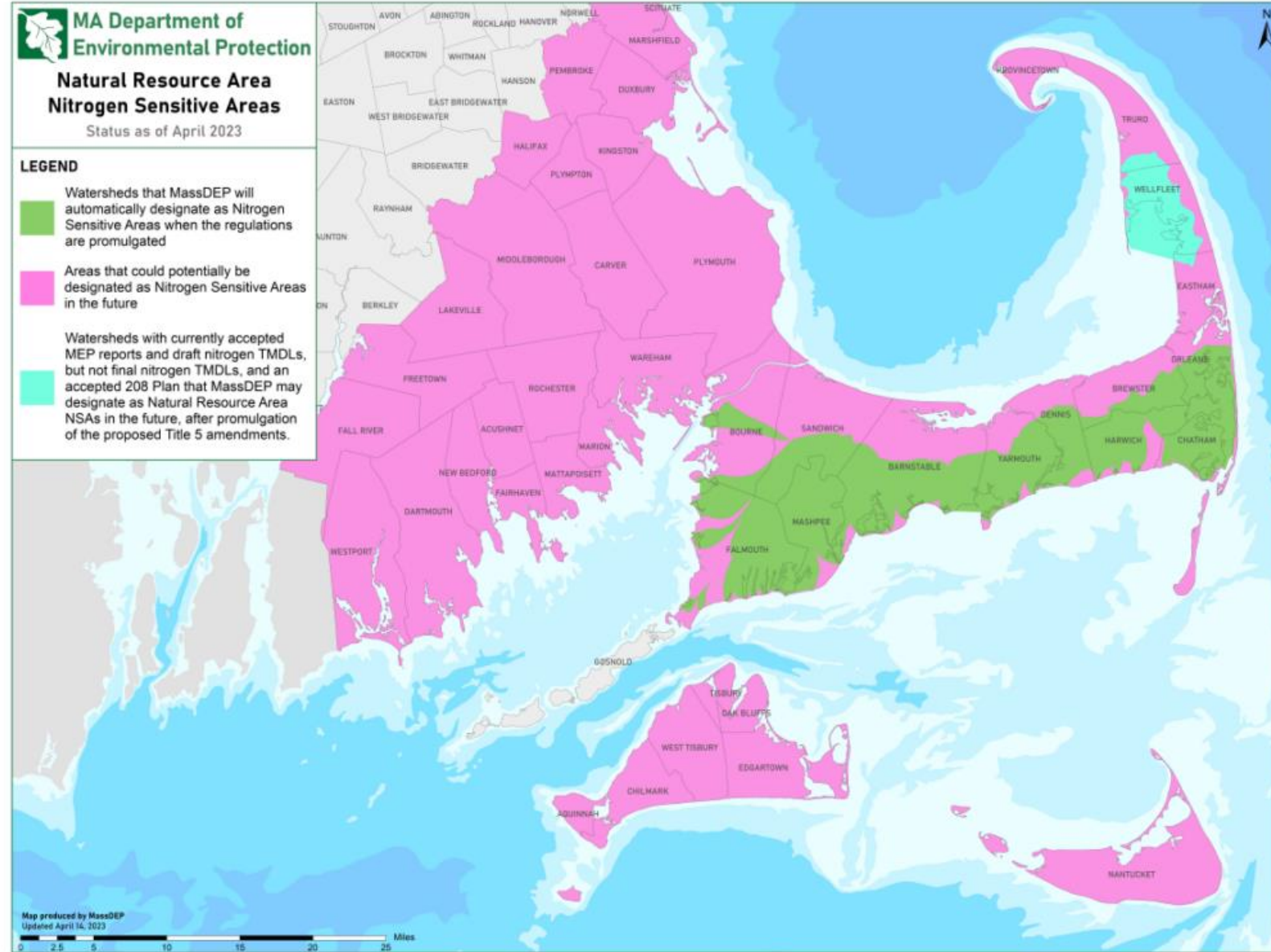


Open Design UDDT
Chitwan, NP

Cape Cod, USA: nitrogen polluting the marine environments



The Massachusetts Department of Environmental Protection requires that towns reduce nitrogen pollution in 'nitrogen sensitive areas' (green on map)





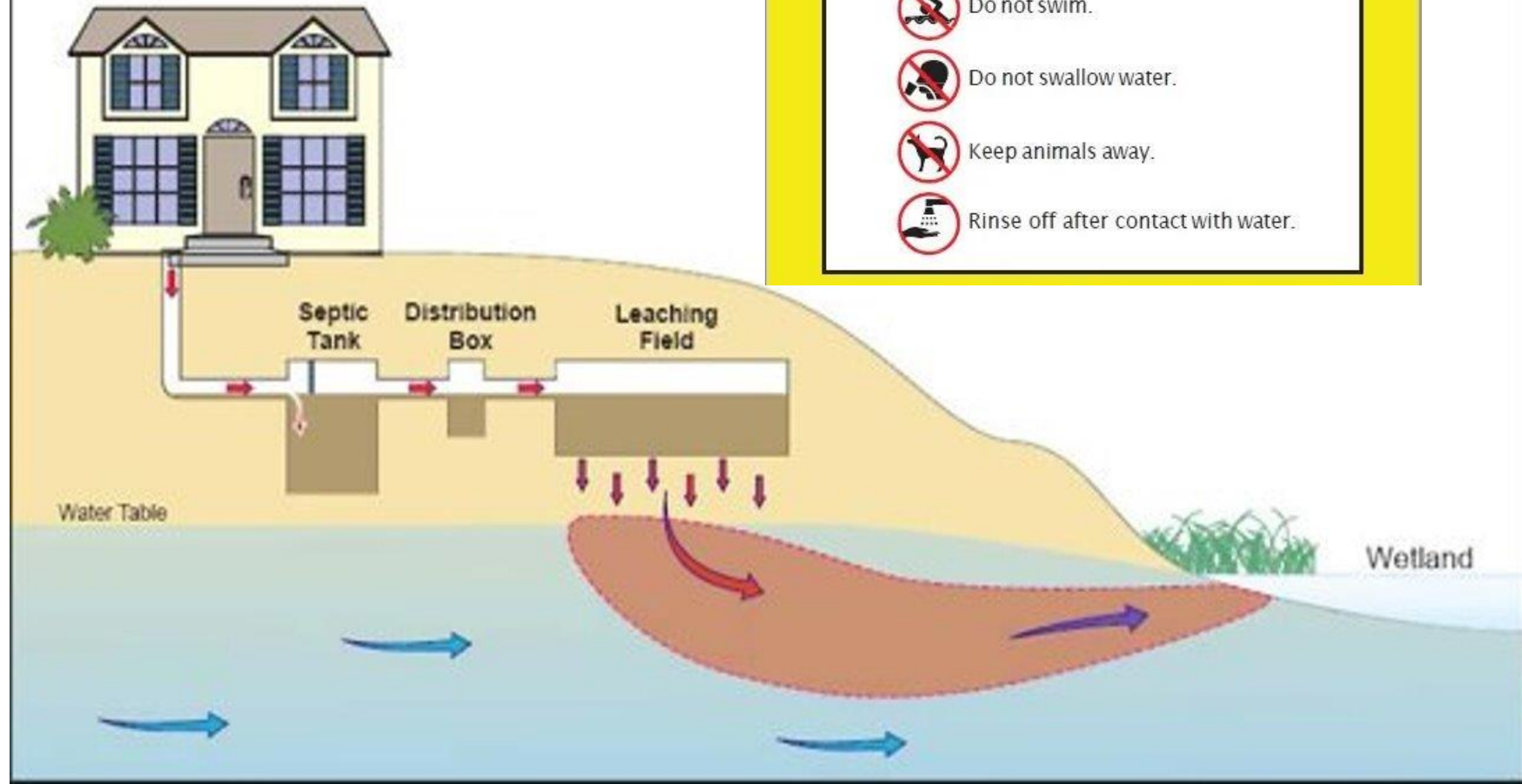
2022 Sewered Areas, Title 5 Septic System Areas, and Open Space



- Despite efforts to expand sewer systems (black areas)
- Cape Cod is 85% reliant on onsite septic systems for wastewater management (brown areas)



- Onsite septic systems & WWTPs dispose of N into sandy soil where it travels into ground & surface waters causing harmful algal blooms & low oxygen when reaching the sea.
- Trying to introduce urine-diversion...
- ...but legislation/regulations don't recognize urine as a waste product to be managed!

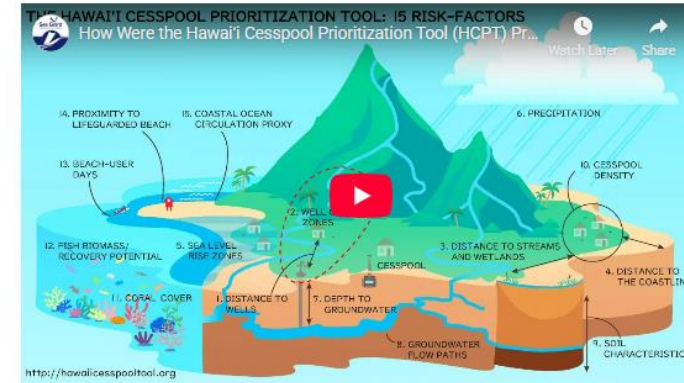




Hawai'i, USA: Cesspool Prioritization Tool

See Grant Hawai'i Cesspool Prioritization Tool ABOUT RESEARCH TOPICS RESOURCES NEWS & EVENTS DIRECTORY

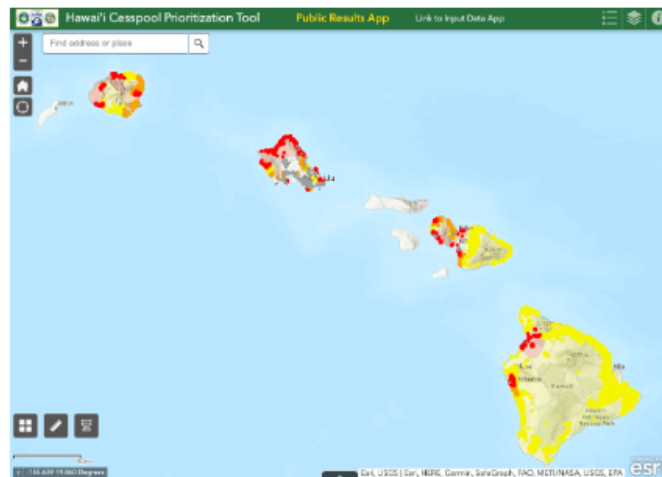
The HCPT's Priority Areas were determined through a data-driven process. Fifteen statewide data layers with relevance to cesspool hazards were overlain with cesspool locations in a code-based geospatial tool. With expert input, these factors were weighed according to the significance of their environmental and human impacts. These factors can be explored in the HCPT companion tool, the 'Input Data App'.



The tool creation process and methodology is detailed in the report, 'Hawai'i Cesspool Hazard Assessment & Prioritization Tool: Updated Report & Technical Appendices' (2022). For a deeper dive into the 15 risk-factors, explore the Storymap, 'Understanding the Priority Areas' and view the video below, 'How were the HCPT Priority Areas Determined?'.

Launch the HCPT Input Data App

What are the Priority Areas?



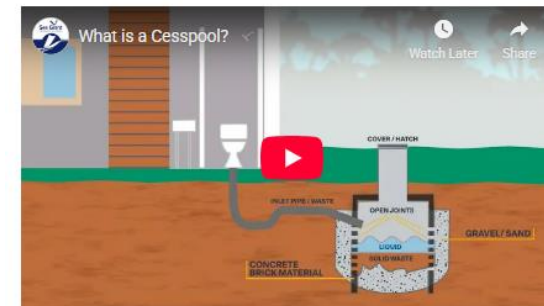
The HCPT prioritization method places each geographic area into three prioritization categories:

Priority Level 1: These cesspools have the greatest potential to impact human well-being and the environment and are directly adjacent to sensitive environmental assets like coral reefs or drinking water aquifers (map color red).

Priority Level 2: These cesspools rank behind Priority 1, but still pose a significant hazard to human well-being and the environment. Priority 2 cesspools may be close to sensitive environmental assets like streams or drinking water aquifers (map color orange).

Priority Level 3: These cesspools still have an impact on human well-being and the environment but may be further away from sensitive environmental assets or areas that may directly impact human well-being (map color yellow).

Explore Further



HCPT video #1 => <https://youtu.be/5pSOUm8taNY?si=6TU2mGeY-NjMn75y>

HCPT video #2 => https://youtu.be/1mnjh4C_SSo?si=NSr7t8IU6lmjF72B



Hawai'i, USA: cesspool prioritization tool:

Cesspool Conversion Revolving Fund



HB1618 HD1 SD1 CD1



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Submit Testimony

Measure Title: RELATING TO CESSPOOL CONVERSIONS.

Report Title: HGIA; Cesspool Conversion Financing Program; Cesspool Conversion Revolving Loan Fund; Hawai'i Green Infrastructure Special Fund; Appropriation (\$)

Description: Establishes a Cesspool Conversion Revolving Loan Fund, to be administered by the Hawai'i Green Infrastructure Authority, to provide financial assistance, including low-interest or forgivable loans, to eligible homeowners for the upgrade, conversion, or connection of cesspools. Appropriates funds for the establishment and hiring of a program management position and for the purposes of the Cesspool Conversion Revolving Loan Fund. (CD1)

All Versions of this Measure

[HB1618_CD1](#)



[HB1618_SD1](#)



[HB1618_HD1](#)



[HB1618](#)



Committee Reports

[HB1618_HD1_HSCR388-26](#)



[HB1618_HD1_HSCR874-26](#)



[HB1618_SD1_SSCR3726](#)



[HB1618_CD1_CCR164-26](#)



Testimony

Take-aways

- ***Inadequate sanitation has a critical interface with our seas & with the blue economy***, which we need to understand to effectively plan & design our sanitation systems.
- ***Nutrients contained in wastewater/blackwater/urine have significant negative impacts on marine ecosystems***, which circular economy approaches can combat.
- ***Countries & cities globally are rethinking their sanitation systems*** given the challenges of too little, too much and/or too polluted water – resilient sanitation systems contribute to city resilience and to urban water resilience, as well as to marine resilience.
- It is not a question of ***either sewers or onsite systems*** but of ***understanding the flow of nutrients, organic material & pathogens*** from our sanitation systems and their impacts on the receiving environment, so that we design sanitation interventions appropriately.
- We should understand & embrace ***sanitation systems thinking & enabling environment*** factors that allow us to ***rethink our approach to sanitation services***.

Thank you

