A Comprehensive Water Quality Study of Endocrine Disrupting Chemicals, Carcinogens, Pesticides, Pharmaceuticals, and Other Contaminants of Emerging Concern in the Florida Everglades: Condensed Version

About Save the Water™

Save the Water™ is a 501 (c)(3) non-profit organization dedicated to researching, identifying, and removing harmful contaminants in water. In addition, we work to raise public awareness about water contamination and its health impacts. Although Save the Water™ operates mainly in North America and follows scientific procedures established by the United States Environmental Protection Agency (U.S. EPA), the impact of our analytical research and water treatment technology is universally applicable. We value environmental stewardship through research, communication, community building, and integrity in all our actions. We value our planet and work to protect it for generations to come.

Contaminants are present in our water supplies. Our research team ensures that the chemicals present in the North American waters are identified and their effects documented. Then, we communicate this information in simple terms and share our knowledge so that every family in the United States and Canada is aware of the health impacts of water pollution. Our scientists and engineers have designed water treatment technologies to remove dangerous pollutants in water, making water cleaner for our families.

Introduction

The Everglades is a marsh of tropical vegetation, a particular water body asset to South Florida, and the most famous wetland on Earth. The diversity of native and invasive tropical aquatic life is thriving in this rare ecosystem. At least nine different habitats have been identified in the Everglades, including hardwood hammocks, pinelands, mangroves, coastal lowlands, freshwater slough, freshwater marl prairie, cypress, marine, and estuarine.[1] These widely varying habitats provide a home for a uniquely diverse array of plants and animals. This places the hydrology of the Everglades in a class of its own. When compared to other wetlands, the Everglades uniquely depend on a lake, rainfall, and groundwater for recharging its water, unlike other wetlands that depend on river flooding, such as the Pantanal of Brazil.[2]

The Everglades freshwater system begins near Orlando in the Kissimmee River, then moves to the shallow lake Okeechobee, covering 730 square miles. This ecosystem has an average depth of 3 feet with a flow of 34 meters per day and is susceptible to contamination and bioaccumulation.[3] The shallow, slow-moving waters provide the perfect conditions for settling contaminants.

As an oversimplification, the Everglades is a dissected water system. This is due to the construction of canals for flood control that deliver water to agricultural and urban lands. Some sections are more predisposed to agricultural runoff. That runoff includes several pesticides, some of which are known carcinogens. These sections are susceptible to nutrient loads that degrade the ecosystem. Thirty percent of what has remained from the Everglades' original region has been converted into water conservation areas. However, the issue is that urban and agricultural lands surround those areas.[4]

The increasing population and the accompanying environmental stress are impacting the Everglades. According to the 2021-2022 U.S. Census data and a report prepared by the Tampa Bay Economic Development Council, more than 1,200 people move daily into the State of Florida.[5] This then leads to a higher demand for water resources and more waste discharges into the environment. There is a lack of comprehensive monitoring of the only source of freshwater in South Florida for toxic substances such as carcinogens, and endocrine-disrupting chemicals such as pesticides, pharmaceuticals, and industrial chemicals. This can lead to acute and chronic health and environmental concerns. For example, endocrine-disrupting chemicals have been associated with health problems that impact fetal and brain development, thyroid function, infertility, obesity, prostate, breast cancer, and diabetes. Moreover, previous studies have confirmed that hazardous chemicals contribute to significant health effects on aquatic species, such as endocrine disruption in alligators.[6,7] More than eight million people depend on the Everglades water. Therefore, accurate information about toxic chemicals in the Everglades protects current and future generations.

The harmful effects of unaccounted Contaminants of Emerging Concern (CECs) combined with other CECs, exponentially increase their effect. This can happen either by synergy, additive impacts, or radiation actions.[8] The U.S. EPA identifies thousands of individual chemicals as CECs, including endocrine-disrupting chemicals. However, no organization has been testing these chemicals in the Everglades.[9] Thus, a planned monitoring and testing approach is needed to protect this natural ecosystem and public health.

Problems

The Everglades faces an imminent and multifaceted water contamination crisis. This crisis has emerged due to inadequate water quality monitoring, exacerbated by many environmental stressors stemming from population growth, invasive species, agricultural activities, and catastrophic water discharges. These issues collectively pose a severe threat to the unique ecosystem of the Florida Everglades, its indigenous species, and the provision of clean drinking water to South Florida residents.

Contributing Issues

1. Cocktail of Unknown Chemicals: The surging population growth near the Everglades primarily drives environmental stress. This demographic expansion increases chemical usage, resulting in a dangerous cocktail of pollutants. The cumulative effects of these pollutants are further magnified due to synergistic reactions and interactions between chemicals, accentuating the pollution problem.

2. Invasion of Non-native Species: The relentless invasion of non-native species disrupts the delicate ecological balance of the Everglades. These invasive species outcompete native flora and fauna, compounding the ecosystem's vulnerability and exacerbating water quality issues.

3. Catastrophic Water Discharges: Hurricanes and heavy rainfall events release excessive water into the Gulf of Mexico and the Atlantic Ocean. These discharges, while aimed at mitigating flooding risks, inadvertently lead to adverse consequences. These include the depletion of oyster populations, increased bacterial contamination, and pollution of vital coastal fishing grounds. The continuation of these discharges poses a grave threat to the Everglades ecosystem.

Additional Issues

- Agricultural and Industrial Pollution: Florida's thriving agricultural and industrial sectors contribute significantly to water contamination. The discharge of millions of gallons of inadequately treated sewage and pollutants leaching from landfills further exacerbates the problem.[10] Agricultural practices, especially the use of fertilizers and pesticides, result in the discharge of over 45 pesticides into the ecosystem.[11] Some of these pesticides are considered likely carcinogens and endocrine-disrupting chemicals.[12, 13]

- Shortcomings in Water Treatment: Current drinking water treatment facilities in the region need to effectively remove many dangerous chemicals, including CECs, pesticides, endocrine-disrupting chemicals, and carcinogens. Additionally, the complex interactions, consequences of their mixture, and long-term impacts over a human's lifetime or on the ecosystem are not well known, even at low doses or exposures. A literature review of peer-reviewed articles focusing on insecticides concluded that agricultural insecticides threaten surface waters on a global scale.[14] The same literature review extrapolated data from other peer-reviewed studies, identifying parts of South Florida that regularly exceeded regulatory threshold levels for insecticides in crop areas. Current drinking water treatment facilities fall short of adequately removing numerous hazardous chemicals, including contaminants of emerging concern and pesticides. This inadequacy exposes the local population to potential health hazards through the consumption of tainted water.[19]

- Bioaccumulation of Persistent Organic Pollutants (POPs): The unique hydrogeology and characteristics of the Everglades, such as its shallow waters and slow flow, create ideal conditions for contaminants to precipitate and accumulate in sediment. The bioaccumulation of POPs in the ecosystem poses long-term challenges due to their slow biodegradation and potential harm to future generations.[15, 16]

- Alarming Scale of Pesticide Use: The widespread and persistent use of pesticides in the United States, exceeding one billion pounds annually, underscores the pervasive nature of chemical pollutants in our environment and their potential impact on ecosystems like the Everglades. Worldwide, the volume of pesticide use has jumped to 5.6 billion.[17]

- Runoff and Habitat Devastation: Nutrient runoff from neighboring agricultural regions poses a significant threat to the diverse habitats within the Everglades. Elevated phosphorus concentrations contribute to habitat degradation, particularly in the northern

Everglades.[9] The variability in total nitrogen load underscores the complexity of addressing nutrient-related challenges.[18]

The Everglades is in critical danger due to a perfect storm of environmental stressors. Urgent action is imperative to safeguard this natural treasure and ensure the well-being of the environment and the human population.

Solutions

The objective of this proposal is to set up a state-of-the-art water analytical laboratory to support the monitoring of the water and sediment quality in the Florida Everglades and ensure the future preservation of the ecosystem. The desired outcome is to protect the Florida Everglades from further contamination by monitoring water quality. This can be done by establishing a state-of-the-art water analytical laboratory that can financially support the Everglades Water Quality Study and is thus self-sustaining.

The proposed solution will be capable of analyzing parameters to comply with the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA). Quality assurance guidelines for laboratory and field operation procedures will be established under ISO 17025. The laboratory will conduct a comprehensive and continuous water quality study of the Florida Everglades to identify and monitor contaminants and provide accurate data to address the pollution problem. Additionally, the laboratory will offer analytical services for water, water extracts, and sediments to markets in Florida, the Caribbean, and Central and South America, generating funds to support the Everglades Water Quality Study.

The selection of sampling sites hinges on a dual criterion of priority and proximity. Priority is determined based on existing contamination levels of pesticides as officially documented by the South Florida Water Management District (SFWMD). In contrast, proximity is governed by locations suspected of releasing contaminants. Sites close to manufacturers that use hazardous chemicals and those associated with the ongoing Comprehensive Everglades Restoration Plan (CERP) initiative are shortlisted. The number of these sites will expand dynamically with the accumulation of data to optimize coverage across the Everglades region.

While STW™ intends to monitor the 26 sites already tested by SFWMD, our plan extends to encompass an additional 74 sites. This extension facilitates a comprehensive evaluation of pesticides and other toxic substances. The visualization in the figure below juxtaposes SFWMD's sampling locations with STW™'s proposed sites. They are strategically positioned based on potential pollution sources. The augmentation of sites arises from the necessity to monitor multiple contaminants, making the study more comprehensive and insightful.

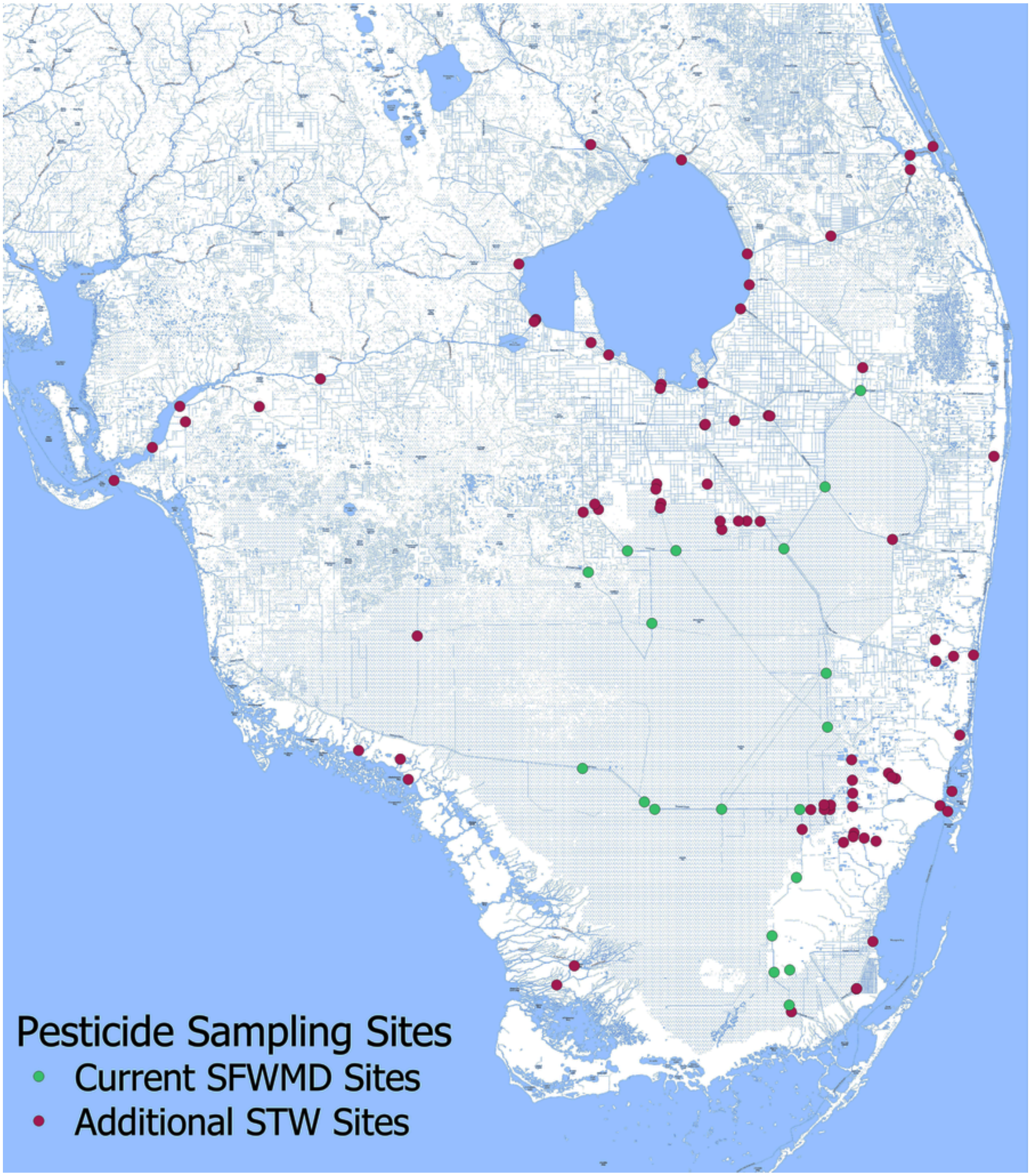
This augmentation of sites bears many benefits. It allows for a more nuanced understanding of contaminant distribution, sources, and potential impacts. Consequently, the insights gleaned from this expanded approach will empower informed decision-making, policy formulation, and intervention strategies.

Our approach to sample collection adheres to established protocols endorsed by the U.S. EPA, employing both grab samples and automated methods as appropriate. Ensuring the integrity of samples is paramount. To this end, primary equipment such as gas chromatographs, inductively-coupled argon plasma spectrometers, liquid chromatographs, and autoanalyzer spectrophotometers will be meticulously segregated and maintained in separate workspaces to preclude cross-contamination.

To initiate real sample analysis, STW™ will undergo rigorous performance demonstrations for equipment, personnel, and quality systems, gaining accreditation through NELAP by the Florida Department of Health. This accreditation necessitates ongoing quality compliance monitoring, both internally and externally. A key milestone is the ability to process 1,000 water samples weekly, demonstrating operational efficiency and capacity.

The core mission centers on conducting an exhaustive, continuous, and sustainable study of water quality in the Florida Everglades. This entails analyzing water, sediments, and selected biological samples for the presence of various emerging contaminants. Continuous monitoring facilitates the detection of shifts in contaminant concentrations, with prompt reporting to both authorities and the public through research papers disseminating study findings.

Adherence to stringent policies, standard operating procedures (SOPs), and an environment devoid of undue influences ensures technical integrity. The overarching goal is to establish a state-of-the-art water analytical laboratory that serves as a bulwark for preserving the Everglades ecosystem. This initiative envisions an empowered future where the laboratory sustains the study financially and contributes to the perpetual safeguarding of the Florida Everglades from contamination threats.



Actions

The foundation of our strategy rests on rigorous testing to validate our hypotheses. In this pursuit, we propose the establishment of a robust and sustainable laboratory equipped with cutting-edge water analytical chemistry technology. This facility will enable precise analysis of samples collected from numerous sites to identify and quantify CECs. This initiative encompasses two vital components: Program Implementation and Goals. It should be noted that the Program Implementation is an idealized goal but may be implemented in stages, depending on funding and logistical challenges.

Program Implementation

1. Hiring Key Personnel: Within the initial three months of operation, we will onboard a Laboratory Manager and Quality Assurance Officer, who will spearhead hiring section chemists and pivotal lab staff. Ensuring personnel qualifications, training, and continuous evaluation is central to our approach, aligning with NELAP requirements.

2. Quality Manual and Standard Operating Procedures (SOPs): A comprehensive Quality Assurance Manual will guide our operations, setting the standards for consistent quality. SOPs will codify methods for reproducible processes, and fostering accuracy.

3. Equipment and Supplies: Selection of supplies and equipment from approved sources, maintaining equipment functionality, and adhering to environmental test methods will be pivotal. Segregation of primary equipment will ensure precision.

4. Lab Setup: The laboratory layout will prioritize minimizing cross-contamination risks with vigilant door access and external monitoring. Adequate climate control and ventilation will maintain optimal conditions, safeguarding equipment and sample integrity.

5. Methods Development: All procedures will undergo rigorous validation before deployment. Our methods will adhere to industry standards and documented protocols, ensuring data generation with acceptable accuracy and precision.

6. Accreditation under Florida NELAP: Our accreditation process aligns with the National Environmental Laboratory Accreditation Program (NELAP) administered by The NELAC Institute (TNI). This accreditation underscores our commitment to meeting recognized standards and producing legally defensible data.

7. Sample Analysis and Quality Compliance: Analysis of real environmental samples will commence only after securing NELAP acceptance. We will uphold continuous quality compliance through internal and external monitoring, with an initial capability to analyze at least 1,000 water samples weekly.

8. Acquiring Commercial Clients: Our Sales and Marketing teams will employ a multifaceted approach to attract diverse clients, leveraging omnichannel campaigns tailored to regional market demands and our laboratory's capabilities. These campaigns will harness digital tools and direct interactions to maximize outreach.

Operational Goals and Objectives

Our trajectory spans multiple years, marked by progressive objectives.

1. First-Year Goals: In the first year, the laboratory's establishment, equipment procurement, personnel hiring, and initial accreditation work will be paramount. Over three planning years, we'll develop field operations and logistics for efficient sample collection while motivating broader water quality research.

2. Second-Year Focus: Our second-year goals are to commence sampling and analytical work, map contaminating chemicals, and establish present-day baseline contaminants. The monitoring will encompass a wide array of parameters specified by regulations, offering a comprehensive view.

3. Third-Year Expansion: In the third year, our focus intensifies on categorizing chemicals by toxicity and health effects while expanding into research for more sensitive detection methods. Collaborations with universities will enrich our toxicology studies, enhancing our understanding of contaminant impacts.

4. Financial Goals: Our financial goals align with our sustainability mission. We intend to begin marketing and selling analytical services in the first year, aiming to accumulate $2,300,000 from services provided to NPDES permit holders by the third year. These funds, combined with the fourth-year cash flow, will support the lab's financial independence from the fifth year onwards.

5. Ultimate Operational and Financial Goals: By the fourth year, our lab will operate at full capacity, serving many clients and maintaining continuous water research. Financial autonomy will be achieved, covering all expenses through client services. This financial independence will empower us to initiate self-funded research and humanitarian endeavors, exemplified by implementing our patented FloNox™ technology for water treatment in underserved regions.

Significant starting and operating capital will be needed for the first three years, approximately $1.6 million per quarter for 12 quarters, to achieve these goals. With this budget, pressure can be taken off projected sales to allow the team to focus on setting up processes and providing high-quality services. As such, we seek to raise these initial funds primarily through donations. The co-naming of the Everglades proposal is an option for a substantial donor.

The central essence of our approach revolves around establishing this state-of-the-art laboratory that serves as an epicenter for generating high-quality, actionable data. Through meticulous planning, adherence to rigorous standards, and a vision of self-sufficiency, we aim to contribute substantially to safeguarding water quality, enhancing public health, and preserving invaluable ecosystems like the Florida Everglades.

For full project details, please contact researchandengineering@savethewater.org info@savethewater.org;

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