

# Mitigating Saltwater Intrusion Through Everglades Restoration: A Policy Proposal for the Florida Legislature

## Executive Summary

*This brief examines the relationship between two distinct, contemporaneous issues—saltwater intrusion and Everglades degradation—and in doing so, proposes how addressing one will concurrently address the other. Conflicting interests of economic development and environmental conservation have undermined previous Everglades restoration efforts, and the bureaucratic process has stalled the passage and implementation of promising legislation. Furthermore, restoration attempts are geographically compartmentalized. This lack of coordination prevents successes within a county from benefiting the region at large. Combatting Everglades degradation has been approached most critically from a hydrological standpoint, since water quality is of critical importance to both the integrity of the ecosystem and of the people in surrounding areas. Through reengineering Everglades hydrology, we may combat the encroachment of saltwater to promote human and environmental health. The policy prescribed modifies and builds upon policies currently in place, and calls for a forward-thinking style of adaptive management that constantly takes new data, climate change, and the competing needs of stakeholders into consideration. The approach is new, but speaks to the ever-present importance of preserving the state's essential ecological functions for the purposes of maintaining and promoting a high quality of life, while concomitantly ensuring that future water supply demands are met.*

## Statement of the Problem

Due to lack of adequate infrastructure, saltwater intrusion is threatening both the natural habitats of the Everglades and urban water supply for surrounding regions.

## Background

- Home to 67 endangered plant and animal species, the Everglades is the largest subtropical wetland in the US, an International Biosphere Reserve, a World Heritage Site, and a National Park. Urban development, agriculture, population growth, and climate change within the last century has profoundly altered the landscape ([Everglades Foundation](#), 2014).
- Perhaps the most prominent threat to the Everglades' future comes from saltwater intrusion.
- Saltwater intrusion defined
  - The Biscayne aquifer, which has been seriously affected by saltwater intrusion, filters and replenishes the water supply for nearly 8 million Floridians. Human consumption demands exceed the Earth's natural ability to recharge the aquifer, and increasing temperatures hasten evaporation of freshwater. Seawater is denser than freshwater, and there

is more pressure forcing out of ground reserves, hence, its percolation into the aquifers.

- Sea level rise increases the amount of saltwater in the water table, making it harder for rainwater to percolate down.
  - Populations at risk include those in Broward, Palm Beach, and Dade Counties. Monroe and Collier counties, while not above the Biscayne aquifer, are impacted, as well.
- The threat of saltwater intrusion to the Everglades
    - Due to habitat migration and ecological shifts, freshwater marshes give way to saline mangroves, which are typically coastal but now found further inland due to saltwater encroachment.
    - Organic peat communities have collapsed under the weight of the sea.
    - As a result, certain habitats have become inhospitable/nonconductive to supporting wildlife, and new wildlife has encroached upon the indigenous wildlife (e.g., Crocodiles now live where in the natural habitat of alligators).
  - The vulnerability of the Everglades
    - Traditionally, water would move from the Kissimmee River to Lake Okeechobee, but drainage systems put into place in the mid 1800s (for flood control purposes rerouted the water, changed the flow rate, and artificially manipulated the soil chemistry and geographic distribution/displacement of flora and fauna
      - Less freshwater introduced back into the aquifer exacerbates a self-perpetuating problem of saltwater intrusion
    - Populations of one species are predator/prey for another, thus, alteration of one component disrupts the overall ecological balance
  - However, Everglades sheet flow restoration will promote the natural ecosystem functioning AND improve vital groundwater recharge, naturally mitigating problems of saltwater intrusion ([Arthur R Marshall Foundation](#), 2014).

### **Why This Matters?**

- The ecological health of the water supply is vital to the health of Florida's economy: tourism, agriculture, golf courses, plant nurseries, and resorts all rely on fresh water stores
- 1 in 3 Floridians rely on the Biscayne aquifer for their drinking water supply, plus farms and businesses. Accounting for projected population growth, thousands of new residents will only increase the demand for fresh water.
  - ([Everglades Coalition](#)).
  - ([South Florida Water Management District](#)).
- Endangered wildlife (Florida Panther and Bald Eagle)

- The Everglades supports tourism, boating, and fishing industries, as well as a host of recreational activities (camping, hunting, stargazing, nature study); its survival is essential to maintaining the quality of life for natives and experience for visitors
- Overdevelopment has already cut the size of the Everglades in half since the early 1900s. Further destruction of the Everglades, which would seem like an “investment” in urban development, would actually increase the region’s vulnerability to saltwater intrusion, and increase demand for fresh water resources. In this sense, development as an economic pursuit would be counterintuitive.

### Pre-existing Policies

- The **Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project)** was authorized in 1948 to provide flood control and water supply to urban/agricultural areas by diverting vast quantities of fresh water away from wetlands and southern estuaries. It built the levees, pumps, and canals in place today, but these artificial connections only limit the movement of energy within the ecosystem and exacerbate problems of fresh water loss in South Florida ([IFAS Extension](#), 2013).
- The **Tamiami Trail** is a 275-mile high-speed road built in 1928 that cuts across the Everglades from Tampa to Miami. Initially hailed as a feat of modern engineering that would accommodate modern traffic, but its unintended consequences are alarming. It has prevented fresh water from flowing south, so salt water seeps further inland, upsetting the balance necessary for vegetation and animal populations to thrive and endangering aquifer wells ([Everglades Foundation](#), 2013).
- The **Everglades Skyway** is an initiative to provide road elevation along the Tamiami Trail. This will allow restore the flow of freshwater to the main artery of the Everglades, and allow hydration of the Biscayne Aquifer and Everglades soil. It started with the one-mile bridge, but is currently undergoing extension with the addition of another 5.5 miles. Designed by NPS, it seems promising, but construction is slow and climate change is fast ([Everglades Foundation](#), 2013).
- The **Comprehensive Everglades Restoration Plan (CERP)** is a 2000 project co-sponsored by US Army Corps of Engineers and South Florida Water Management District as a federal-state partnership. It consists of 68 projects throughout South Florida to achieve natural water flow while maintaining flood control and supply. The budget is supposed to be shared 50-50, but state budget cuts have caused feds to outspend by a large gap, so they, in turn, have had to reduce the amount of funding they offer ([Central Everglades Planning Project](#), 2013).

- The Central Everglades Planning Project (CEPP) was launched in October 2011, and bundles a subset of high impact CERP projects on a strict timeline (18 months versus 6-7 years). It has been expedited, but with little consideration to ecological conditions. CEPP increases the environment's capacity to re-direct water back to the central Everglades (that would otherwise go to St Lucie and Caloosahatchee Estuaries), which delivers an average of 200,000 acre-feet of clean freshwater annually. In 2014, the project did not receive approval for state budget consideration, so funding was delayed another year ([Central Everglades Planning Project](#), 2013).
- The **River of Grass Acquisition Project** represents a strategy of the South Florida Water Management District (SFWMD) to acquire land south of Lake Okeechobee, from the US Sugar Corporation. This would allow for continued operation of US Sugar Mill and refinery, keeping 1700 jobs for another decade but would improve flow of freshwater into the Everglades from Lake Okeechobee. Proposed in 2008, but amended in 2010 in light of changing economic conditions, this project expands storm water treatment areas and increases water quality. Due to a decline in district revenues, SFWMD would only take ownership of 26,8000 acres (as opposed to initial 180,000). Officials decided on this smaller scale plan. SFWMD still has ability to buy 100% of US Sugar's land through October 2020 ([South Florida Water Management District](#), 2009).
- Problems:
  - The Florida Department of Economic Opportunity raised objections to acquisition of land in Hendry county: development plans could be more prosperous and provide residential, commercial, and industrial capacity ([Florida Department of Economic Opportunity](#), 2013).
  - The option for FL to acquire 47,000 acres expires in October 2015. The state has already invested \$197 million in the first purchase of parcels. Considering the alternative: where will the water supply come from to support urban development? The land is already located on flood zones, so flood control measures would be needed, as well ([Sanibel-Captiva Conservation Foundation](#), 2014).

### Policy Options

- Restore the flow of freshwater and slow pace of landscape transition, allow for more natural transition of habitats that give at-risk species an opportunity to adjust (rather than just rapidly changing from marshes to mangroves ([Everglades Foundation](#), 2014).
- Eliminate canals: an extensive network of canals was constructed during the early 20<sup>th</sup> century to prompt land development and alleviate drainage concerns. By artificially diverting the water supply, however, they have interrupted the

natural flow of freshwater, exacerbating flooding in wet years and drought in dry years.

- Advantages
  - Would prevent lowering of water tables and resulting saline infiltration into the aquifer
- Disadvantages
  - Would eliminate a crucial mechanism for flood control and recreational vessel for fishers and hunters
- Extend/build more bridges over the Tamiami Trail
  - Advantages
    - Will increase flow from Okeechobee River back into the Everglades
    - Will create thousands of jobs through spurred construction and tourism activity
  - Disadvantages
    - Given past delay and disputes, feasibility of adding more is questionable
    - Funding: the next 2.6 miles are estimated to cost \$180 million
- Restore natural functioning of the everglades as a water filtration system. use reclaimed water and rain, increase surface water storage, diversify water storage
  - Allow more water to flow south from lake Okeechobee to Everglades national park instead of being dumped into the sea through FL's canal/levy system
- Acquisition of sugar lands to prevent further development and install infrastructural control
  - Advantages
    - Healthy ecosystems would absorb wave energy, hold sediment in place, and increases a drag on water motions/acts as a buffer zone that limits saltwater intrusion
    - Limited burden on taxpayers
  - Disadvantages
    - Competing goals of federal-state government; would result in job loss for many farmers
    - Fragmentation of land parcels would make it difficult to implement overall broader objectives
    - Linkage between land acquisition and CERP projects unclear; could create funding shortfall for CERP restoration activities ([Congressional Research Service](#), 2010).
- Store seeds to rare, endemic, endangered species/relocate these species to more adjacent and coastal areas

- Advantages
    - Prevents species from extinction and maintains quality of life for animals
  - Disadvantages
    - Removes the species from their natural habitat
    - Does not restore, merely preserves
- Road removal: like canals, a number of roads have been erected across South Florida to facilitate traffic across the state. This has backed up the flow of surface water and contaminated water quality. To construct a compromise route, that runs North through less sensitive lands, would be too costly.
    - Advantages
      - Would prevent lowering of water tables and resulting saline infiltration into the aquifer
    - Disadvantages
      - Closing campgrounds
      - Restricting access to a huge swath of forest/temporarily disrupting ecosystems
      - Conflict with county building permits
  - Crystallization technology ([SMAP Clearing House](#), 2008).
    - Advantages
      - Artificially introduces a crystallized solution that develops a seal that changes porosity and permeability of rock formations to prevent saltwater from seeping into aquifer
    - Disadvantages
      - Could prevent recharge of freshwater, and is therefore unsustainable
      - Alters the geology of the region

## Recommendations

- **Modify CERP so that its implementation style reflects a form of adaptive management; one sensitive to changing climatic and economic conditions.**
  - One of the most notorious mistakes of previous Everglades restoration efforts has been reliance on historic data. Today, there are different climatic factors (such as rainfall projections and sea-level rise), invasive species, and urban and agricultural demands that must be incorporated into models for infrastructural planning. Additionally, with the impending threat of sea level rise, it is crucial that policies are not only implemented immediately, but that their projected consequences are sustainable.

- Past shortcomings of CERP could be attributed to poor planning. In a rush to implement CERP, money was authorized by Congress before the project was completely designed. This time, devise a payment plan that is more economically conservative, but maintains the 50-50 state/federal funding partnership. Set goals and earmark a smaller annual budget to leave room for economic fluctuation; it can always be increased.
  - Understand ecological tradeoffs will have to be made, and do not let this stall progress. Restoring freshwater flow to the Everglades may mean the flourishing of one species at the expense of another; incorporate this understanding into performance measures. For example, set restoration targets that indicate overall ecosystem health such as patterns of native species diversity, rather than unachievable targets that focus on restoration of a single species.
  - Consult National Academies in the process, a non-profit that provides government and public institutions with independent analysis and public policy recommendations
- **Acquire some sugar lands**
    - Acquisition of some sugar lands provides a more economically feasible alternative; 50,000 acres will cost \$400 million, as opposed to the government's plan for urban development that would run taxpayers \$16 billion. These lands, south of Lake Okeechobee, could be the ones outfitted with the main infrastructural mechanisms for restoring water flow into Southern estuaries ([Woolfenden](#), 2013).
- **Restore hydrology on acquired sugar lands via canal plugs and pumping stations**
    - Canal plugs and pumping stations would restore flow-ways by redirecting water that would otherwise be diverted to the St Lucie and Caloosahatchee estuaries, and sending it to the Everglades. Here, it would not only revive the ecosystem, but percolate into the aquifer and recharge the water table below. It has already been implemented as part of the Picayune Strand Project, but, this only operates in Southwest Florida. Granted Lake Okeechobee is one of the largest freshwater replenishers of the central Everglades, building similar infrastructural controls on acquired sugar lands just South of it could benefit a broader portion of the Everglades, and provide a uniform solution that is more cost-effective and bureaucratically efficient for all regions in South Florida to adopt (The South Florida...Biennial Report, 2014).

### **Annotated Bibliography**

Crider, Mary, Paul Boynton, Jessica Huffman, Janna Kepley, Cheng-Tung Liu, Morgan Mooney, and Nigel Woodfork. "[Employment of Proactive Mitigation Strategies in Combination with Reactive Barriers to Counteract Sea Level Rise in South Florida.](#)"

*Academia.edu*. Arthur R. Marshall Foundation for the Everglades, 1 Aug. 2014. Web. 7 Jan. 2015.

This academic paper notes how, in environmental context, sea level rise is a pressing concern for Floridians. It proposes strategies that prevent, mitigate, and counteract sea level rise and associated environmental damage, but largely focuses on how utilizing the Everglades has the dual benefit of ecological enhancement. Solutions are divided into two approaches: employing natural methods of Everglades restoration, and implementing man-made, structural barriers. Statistics, diagrams, cost comparisons, and prototypes illustrate points made so that readers without technical background can comprehend the nature of these strategies.

Davis, Stephen. "[Everglades Restoration and Sea Level Rise](#)." *Everglades Foundation*. 9 June 2014. Web. 7 Jan. 2015.

Dr. Stephen Davis acknowledges how sea level rise is posing a threat to the Everglades, but, more importantly, why we, as citizens, should continue to invest in Everglades restoration. It is only to our own benefit that we do so, he asserts, and identifies how the quality and quantity of water in aquifers affects residents, visitors, the economy, and ecological balance.

"[Everglades Restoration Works! Creating Jobs, Protecting Water Supply](#)." *Everglades Coalition*. Web. 7 Jan. 2015.

This flyer asserts that Everglades restoration is a sound investment both economically and environmentally. It supplies a list of private sector jobs and mean salaries that the infrastructural and bureaucratic demands restoration efforts create, and use numerical data from the past to project future estimates. Sections that highlight different restoration projects, including the Tamiami Trail, Kissimmee River, and Picayune Strand, illustrate the scope of revitalization. With environmental thriving comes thriving tourism, real estate, commerce, and recreation industries.

Harvey, Rebecca, William Loftus, Jennifer Rehage, and Frank Mazzotti. "[Effects of Canals and Levees on Everglades Ecosystems](#): Circular." *EDIS New Publications RSS*. University of Florida IFAS Extension, 1 Dec. 2010. Web. 7 Jan. 2015.

This academic paper, authored by professors from University of Florida's IFAS/Extension program, explores hydrologic control of the South Florida Landscape throughout history, and how infrastructure put in place centuries ago has altered the ecology today. While canals and levees have potentially damaging effects in the way of freshwater flow, habitat dispersal, drought, and soil loss, the landscape can still be re-engineered to undo much of the damage. Illustrations and maps provide models of how hydrologic restoration may be achieved, and an accompanying section on "Mitigating the Impacts of Everglades Canals and Levees" delineate the benefits of their removal.

Scott, Rick, and Jesse Pannuchio. "[Objections, Recommendations, and Comments Report for Hendry County](#)." *Department of Economic Opportunity*. Division of Community Development, 1 Nov. 2014. Web. 7 Jan. 2015.

This letter to the Hendry County Commissioner Chair, on behalf of the Florida Department of Economic Opportunity, reviews a proposed amendment seeking to

convert sugarland in Hendry County to an area for urban planning. While it raises objections and provides recommendations on multiple dimensions of the plan (transportation, farmworker housing, natural resource protection, water supply), it requires a lot of cross-referencing and is not easy to identify the pros and cons of each option. An end summary, however, urges the Commissioners to consider their responsibility to preserve the Everglades for future generations, and to be forward-thinking in making decisions.

Stern, Charles, Pervaze Sheikh, and Remy Jurenas. "[Everglades Restoration and the River of Grass Land Acquisition](#)." *CRS Reports for Congress*. Congressional Research Service, 25 Aug. 2010. Web. 7 Jan. 2015.

This report was prepared by policy specialists for members and committees of Congress to educate them on the potential consequences of different components of the River of Grass Acquisition. It assumes these committees do not possess the specialized knowledge and provides a background to the issue of Everglades degradation, then proceeds to briefly analyze how land purchase, other CERP projects, and phosphorus reduction would be affected. The chronology at the end is helpful in recognizing how delays in the bureaucratic process would be critical to the success of the plan.

"[US Sugar Planned Development Conflicts with Restoration](#)." *Sanibel-Captiva Conservation Foundation*. SCCF, 1 Nov. 2014. Web. 7 Jan. 2015.

Two maps indicate two conflicting priorities: land acquisition for urban development, and land acquisition for Everglades restoration. A concise list states the reasons why opting for Everglades restoration would be more beneficial than the "Sugar Hill Sector Plan", and provides an argument that is as economical as it is environmental. A disclaimer at the end summarizes how these efforts in Hendry County represent a national interest at large to promote smart, sustainable growth.

"[Water Supply Planning](#)." *SFWMD.gov*. South Florida Water Management District. Web. 7 Jan. 2015.

The South Florida Water Management District not only provides a basic overview as to why water supply planning is important, and includes related links to different plans throughout the region. News articles, multimedia presentations, and online archives serve as valuable ancillary resources, and sections of the website cater to different audiences: residents, visitors, business, engineers, and educators. Its comprehensive nature demonstrates that sound water supply planning is crucial, because its effect is not limited in scope to anyone.

Woolfenden, Tricia. "[Why Everglades Restoration Really Needs To Be About Adapting To](#)

[Climate Change.](#)" *Everglades Restoration and Climate Change*. WLRN South Florida. Web. 7 Jan. 2015.

This refreshing article points out a significant shortcoming of CERP—its inflexible framework. While the plan to “restore, protect, and preserve” water in South/Central Florida was approved in 2000, it has not produced sustainable results because of its failure to account for climate change. Woolfenden promotes the importance of adaptive management, invoking support from nonprofit think tanks, President Bush, government agencies, and scientific experts.