Environmental Plan for Kissimmee Okeechobee Everglades Tributaries (EPKOET)

Stephanie Bazan, Larissa Gaul, Vanessa Huber, Nicole Paladino, Emily Tulsky
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1. BACKGROUND AND HISTORY

The Kissimmee Okeechobee Everglades watershed is an area of about 9,000 sq. mi. located in south central Florida. In the northern part of this watershed, The Kissimmee River and other tributaries drain into Lake Okeechobee, the largest freshwater lake in the state of Florida, which periodically spills water into the Everglades to the south (USGS). The Kissimmee River is the largest water source for Lake Okeechobee, with 60% of Lake Okeechobee's water input coming from the Kissimmee River. The lake sits in the center of the Kissimmee Okeechobee Everglades watershed and provides recreational, economic, and environmental benefits to south Florida (Bengtsson et al.).

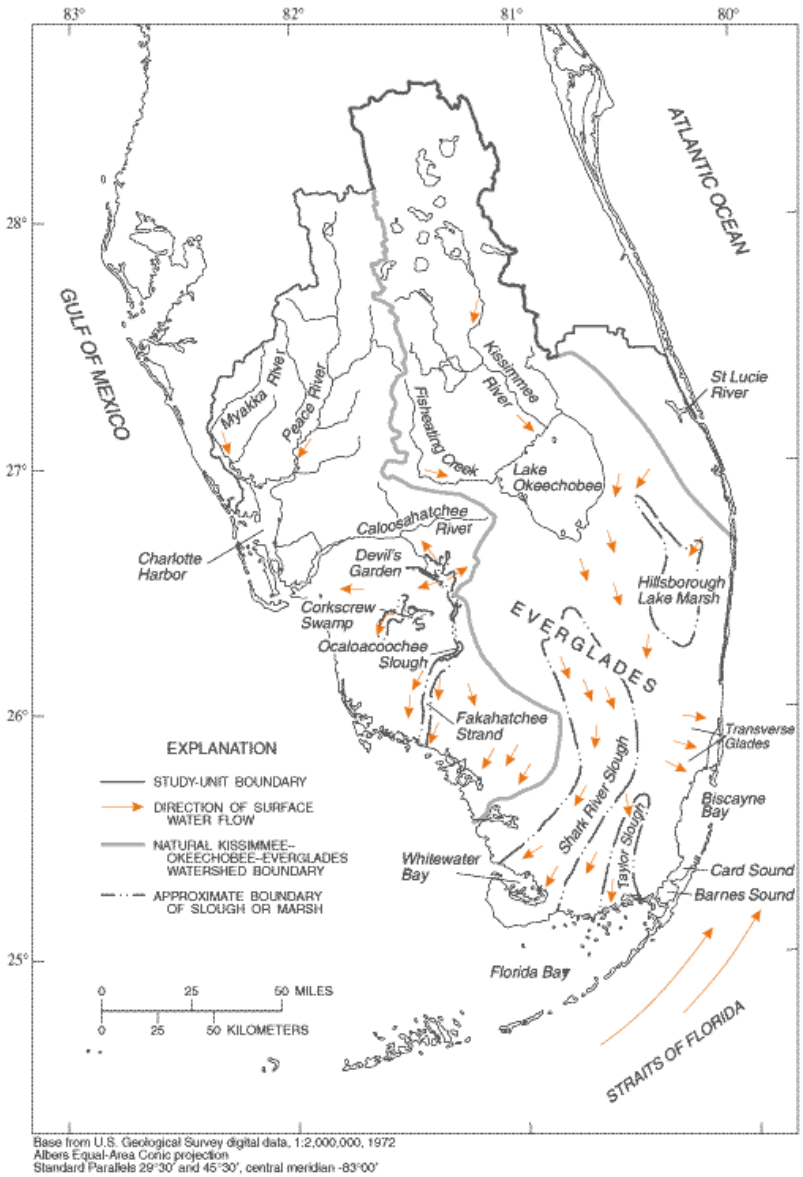

Figure A: Map of the Kissimmee Okeechobee Watershed with hydrologic features and water flow

History of the Kissimmee River and its Effects on the Watershed

Prior to construction in the 1950s, the 103-mile-long meandering Kissimmee river moved slowly through the wetlands of south-central Florida. Typical of South Florida, the Kissimmee River ecosystem was home to a diverse selection of fish, wildlife, and vegetation that flourished on the natural seasonally fluctuating water levels. The unique physical and chemical properties of the river allowed for such a diverse ecosystem. Mostly farmland and cattle ranching dominated the Kissimmee basin before World War II. After the war, however, rapid urbanization took place in the surrounding areas to account for the increase in south Florida's population (Woscyna).

In 1947, a series of hurricanes produced a significant amount of rainfall and flooding that affected south central Florida. To protect the growing population, the U.S. Congress authorized the U.S. Army Corps of Engineers to begin construction on the Central and South Florida Project. This project was to modify the natural properties of the river by making it straighter, wider, and deeper to prevent flooding. Throughout the 1960s, the U.S. Army Corps of Engineers constructed a canal, deemed the C-38 canal, that passed through the Kissimmee river which resulted in an altered flow that prevented water from passing through the original channel. The 103-mile-long Kissimmee River became just 56 miles long. Because of this, wildlife suffered as floodplains downstream of the canal dried out. Species of fish could no longer be supported as the oxygen levels in the water drastically decreased from making the channel deeper. Faster flowing water in the channel also created a pollution problem for Lake Okeechobee with increased phosphorus entering the Lake from agricultural runoff.

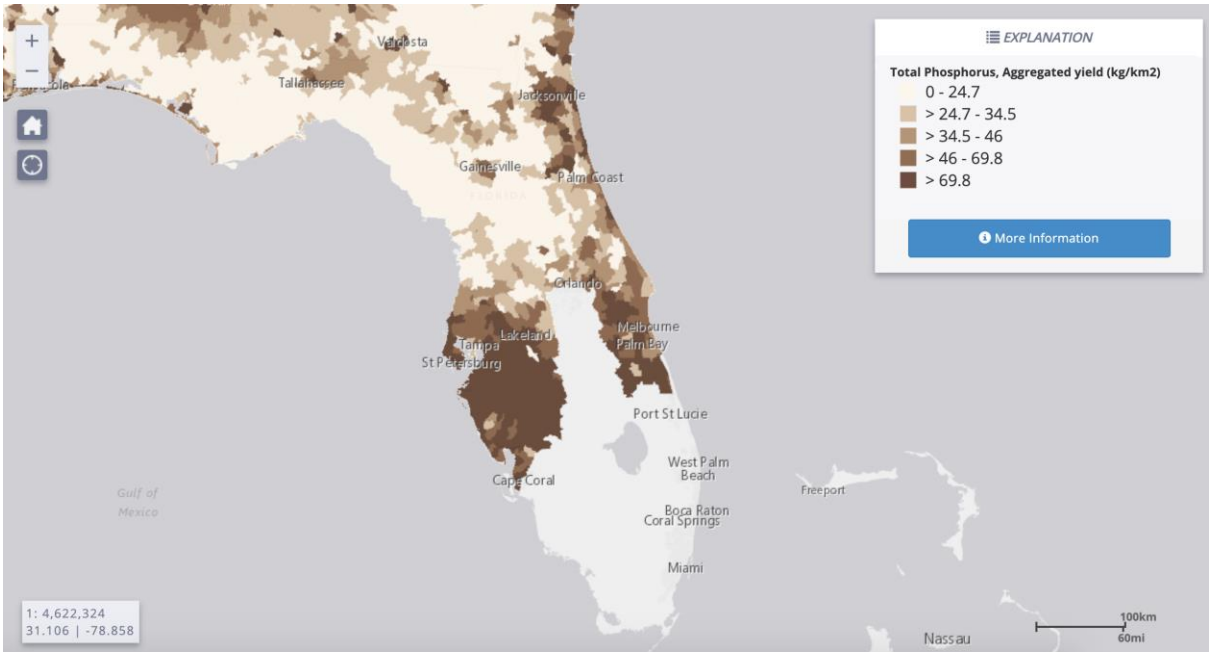

Figure B: Phosphorus levels in the areas surrounding the Kissimmee Okeechobee Everglades Watershed

Restoration processes of the Kissimmee River began in the late 1990s to restore water flow to 44 miles of the original Kissimmee river channel. Shown in figure C, backfilling of the C-38 canal restored the Kissimmee river to its natural flow. Limiting human disturbance has been the goal for the last 20 years, resulting in an improved habitat that has allowed wildlife to flourish and the gradual return of a diverse ecosystem.

Figure C: Before and after backfilling of the C-38 canal in the Kissimmee River.

History and Modifications to Lake Okeechobee

Similarly to the Kissimmee River, Lake Okeechobee has undergone anthropogenic impacts due to human settlement in south Florida. In the 1880s, a series of projects created drainage canals to divert the flow of water from Lake Okeechobee to the east and west, away from the Everglades. This was done to prevent excess water flow to the Everglades, as they were being drained for property development. In the 1950s, flood control measures were taken and the levee surrounding almost all of Lake Okeechobee was finished being constructed and modified (Bengtsson et al.).

In the 1950s, the agricultural industry grew rapidly all over south Florida. Dairy farms, cattle ranches, and citrus groves covered the land surrounding Lake Okeechobee. As a result, nutrient runoff from these farms caused eutrophication of the lake. Increased phosphorus levels especially were a problem, and periodic cyanobacterial blooms, also known as blue-green algae, were common all throughout the lake. Rivers that stem from Lake Okeechobee, such as the St. Lucie River shown in Fig. D, that drain into the Atlantic and the Gulf have also been polluted and are a source of harmful algae blooms along Florida's coasts. Measures have been taken to reduce the addition of phosphorus into Lake Okeechobee, such as the implementation of best management practices and chemical treatment for farm runoff (Bengtsson et al.).

Figure D: Algae bloom along the St. Lucie River

However, pollution in Lake Okeechobee still remains a large problem today, and this pollution has created even more concerns for the Everglades. Strict state and federal programs are needed to restore the lake to pre-settlement conditions.

2. MISSION STATEMENT

EPKOET's mission is to achieve a 50% improvement in the restoration of the Kissimmee Okeechobee Everglades watershed in southern Florida by the year 2050.

3. GOVERNANCE

The state of Florida is composed of five water management districts that serve as the governing bodies for the state's watersheds. The South Florida Watershed Management District (SFWMD) is the largest of the five districts and manages the water resources spanning 16 different counties. The area of responsibility for the district ranges from the Florida Keys up to Orlando which encompasses the Okeechobee Basin and the Big Cypress Basin. This area comprises 8.7 million Florida residents who count on water for a variety of uses in their daily lives.

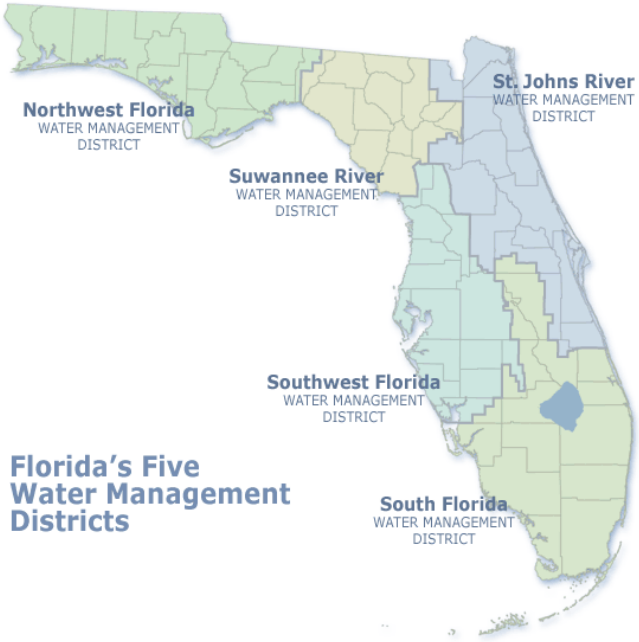

Figure E: Florida's Five Water Management Districts

The SFWMD is led by a Governing Board of nine members. The members are volunteers selected by the Governor and approved by the Florida Senate. They live within the district and bring a variety of interests to the board spanning various stakeholders. Once appointed, board members serve four-year terms and are responsible for creating policy for the district. The Governing Board is also responsible for appointing an Executive Director, to be confirmed by the state senate, to lead SFWMD activities. The current Governing Board consists of Chauncey Goss, Scott Wagner, Carlos E. Martinez, Cheryl Meads, Charlette Roman, Jay Steinle, Jacqui Thurlow-Lippisch, Ron Bergeron Sr., and Benjamin Butler.

In addition to the board members, SFWMD also has approximately 1,500 worker staff members within the District. In addition, the board partners with various stakeholders including the Florida Department of Environmental Protection, the Florida Fish and Wildlife Commission, the US Army Corps of Engineers, and various state officials and representatives.

In July 2019, the Governing Board developed two Water Resources Accountability and Collaboration groups (WRAC). These groups are meant to encourage public and community involvement and meetings are available to be viewed live online along with open commentary and discussion. The WRAC also holds Public Forums in which various stakeholders are invited to participate and represent the interests of their communities. These stakeholders include businesses, agriculture, local governments, interest groups, environmental groups, etc. The WRAC Public Forums allow for open public discussion and comments from all parties.

SFWMD receives an annual budget from the state. The fiscal year for this budget begins on October 1 of every year and ends on September 30. The budget is sourced from property and agricultural taxes, federal, state, and local revenue, license and permit fees, grants, and investment income. SFWMD has the authority as a special taxing district to enforce property taxes for individuals and businesses within the district.

4. FEDERAL, STATE, AND LOCAL POLICIES

The Kissimmee Okeechobee Everglades watershed is influenced by policies and actions of different entities at multiple levels. This section is designed to provide a non-inclusive list of influential regulations and programs at federal, state, and local levels.

At the federal level, the Clean Water Act (CWA) specifies what water quality standards bodies of water must comply with to meet certain metrics, such as drinkable or swimmable. The CWA specifies limits for nitrogen, phosphorus, metals, and other contaminants. The Water Resources Development Act of 2000 authorizes water resources projects and is concerned with agricultural and urban flood protection as well as water supply. The rules of the National Pollutant Discharge Elimination System also apply to certain point sources within the watershed. Furthermore, National Park Service regulations will affect this watershed, as the Everglades National Park takes up a significant portion of its area. More specifically, the Comprehensive Everglades Restoration Plan (CERP) of 2000 is an $8-billion initiative to protect the south Florida ecosystem while providing for water needs, and thus, by extension, protects the watershed as a whole. A coalition of forty-five organizations from national to state level formed in response to CERP and its implementation issues. The coalition established several benchmarks that must be met for CERP to be achieved, including but not limited to restoration of historic sheet flow in various areas, restoration of specific water bodies like the Kissimmee River, a certain level of water quality and storage, and a return to the federal-state partnership.

The CWA is enforced through the Florida Department of Environmental Protection (DEP) at state level. Florida has six classifications for water quality, including potable, fishable for shellfish, swimmable, limited fishing or swimming, agricultural, and industrial. Mercury and nutrients are considered the worst pollutants for the South Florida region. If a water body does not meet CWA standards, the Florida DEP requires implementation of a Total Maximum Daily Load, or TMDL. This specifies the maximum amount of a given pollutant that can be discharged to a water body. BMAPs, or Basin Management Action Plans, are used to specify and guide actions needed to meet the TMDL within 20 years. Point sources must restrict their discharge to a certain limit, while nonpoint sources must use best management practices (BMPs), like rain gardens or swales, to limit discharge. Unfortunately, BMPs have not proven to be enough. Efforts by members of the Florida House of Representatives to ban fracking and extreme well simulation within Florida displays another state level policy initiative.

On the local level, municipalities, counties, and specific polluters must comply with TMDLs. Municipalities can also voluntarily adopt stricter regulations, like fertilizer ordinances. The city of Marco Island has a fertilizer ordinance that specifies where, when, and how fertilizer should be applied, as well as the nitrogen and phosphorous content for certain uses. On a regional level, entities like the Conservancy of Southwest Florida are heavily involved with the policy process, including recommending fertilizer ordinances, stormwater regulations, BMPs, and land use

planning and tracking to various cities and counties. The Conservancy also lobbies for stricter environmental protection as high as the state and national level and helps identify water bodies that do not comply with CWA standards. Another example of a regional policy entity is the South Florida Water Management District, which may, among other items, help regulate Lake Okeechobee water levels and releases when levels are low or normal. During high water conditions, water releases are mostly controlled by the U.S. Army Corps of Engineers, which is a federal entity. This is an example of federal and regional entities working collaboratively on a watershed program.

5. PROBLEMS AND GOALS

EPKOET has identified three primary problems that have resulted from anthropogenic influences on the Kissimmee Okeechobee Everglades watershed.

Problem	Description	Causes
P1: Saltwater Intrusion	Sea levels are rising and extensive pumping at this aquifer is causing a pressure difference that percolates the seawater into the freshwater (because seawater is denser) which contaminates the drinking water supply.	● Canals dump freshwater onto salt tides ● Islands are drained - saltwater intrudes ● Irregular water flow ● Building of drainage works
P2: Extreme Water Level Fluctuation	During the rainy season, the watershed experiences high water levels. In contrast, the dry period brings droughts that lower water levels to below the land surface, making the area vulnerable to pollution, saltwater intrusion, and fires.	● Heavy rainfall and runoff during the summer period ● Dry periods during the winter months ● Disruption of natural drainage and meanders by drainage works and canals
P3: Pollution	Due to current water flow to and through the Everglades, canals bring pollutants from agricultural & urban areas that disrupt the balance and harm wildlife.	● Canals bring freshwater pulses with agricultural and urban runoff ● No gradual sheet flow - nutrients not removed ● Building in the floodplain ● Runoff with sulfur from sugar fields helps form toxic mercury which bioaccumulates

Table 1. Primary Problems in the Kissimmee Okeechobee Everglades watershed.

Problems:

P1: Saltwater Intrusion

As the sea level rises, saltwater from the ocean moves inland and infiltrates the bedrock underlying the Kissimmee Okeechobee Everglades watershed. The bedrock in this area is limestone which is a very porous geologic material. Freshwater naturally flows into the Everglades, but in recent decades this water has been diverted to irrigate agricultural fields. This exacerbates the effect of the lack of freshwater in the system. The saltwater in the watershed is destroying plant structure and root networks which adversely impacts the entire ecosystem. This watershed naturally feeds off of the Biscayne aquifer which is a large store of freshwater that lies underneath the land. However, due to the increasing salinity of the watershed, seawater is seeping into this aquifer which provides 90% of the drinking water to millions of people in southern Florida.

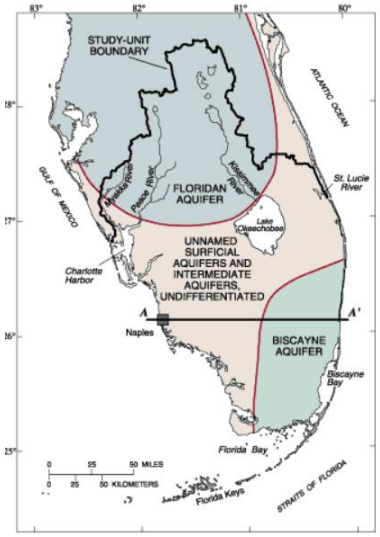

Figure F. Three main aquifer systems in southern Florida.

P2: Extreme Flooding and Water Level Fluctuation

Due to poor water distribution, water levels are often too high or too low during the wrong seasons of the year. Various species found in the Everglades rely on certain water depth during certain seasons for breeding, habitat and other functions. Therefore, irregular and extreme water levels harm many of these species.

During the 20th century, many water-control measures were taken that altered the hydrologically connected landscapes of the watershed. The sawgrass plains, prairies, and mangrove swamps were all shaped by the steady south/southwestward flow of water. However, anthropogenic alterations disrupted this hydrology for the purpose of agricultural and urban development. Major drainage canals and levees were built which significantly lowered the water levels in the watershed and altered the natural hydrologic flow pattern. Figure 2 conveys the adverse effects

that levees have had on this watershed. The levees create deep, unnatural pools on one side which are unable to support the historically diverse plant communities.

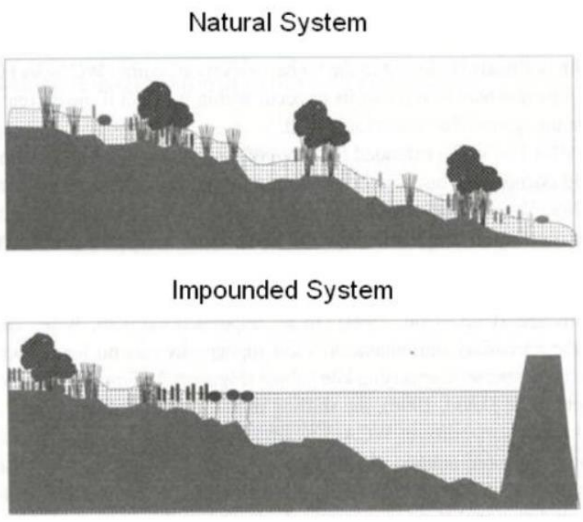

Figure G. Effect of levees on the watershed.

P3: Pollution

Human impacts in the Kissimmee Okeechobee Everglades watershed have increased water contaminant concentrations. Urban/suburban stormwater runoff and agricultural runoff containing fertilizer and manure are the causes of this significant pollution. The polluted runoff is carried by the canal system into this watershed, resulting in harmful anthropogenic nutrient loadings. Specifically, phosphorus and nitrogen are the key nutrient contaminants that cause eutrophication and harmful algal blooms.

Figure H. Algal bloom in the KOE watershed.

The excessive nutrient loadings due to anthropogenic inputs result in the overproduction of algae in the system. When this algae dies, the microbes that decompose it deplete the oxygen from the

system. This creates hypoxic zones that are not suitable for the plants and animals that comprise this ecosystem. This algae can also be toxic and form what are known as harmful algal blooms (HABs). Figure 3 shows how the algal blooms can interfere with the natural system. Sulfur and mercury also threaten species in the area.

The effects of nutrient runoff from surrounding agriculture affects Lake Okeechobee and the surrounding waters. This pollution from the lake directly causes the harmful algal blooms that plague the coasts of Florida. Figure 4 illustrates the canal systems that drain water from Lake Okeechobee into the Everglades and to the east coast of Florida.

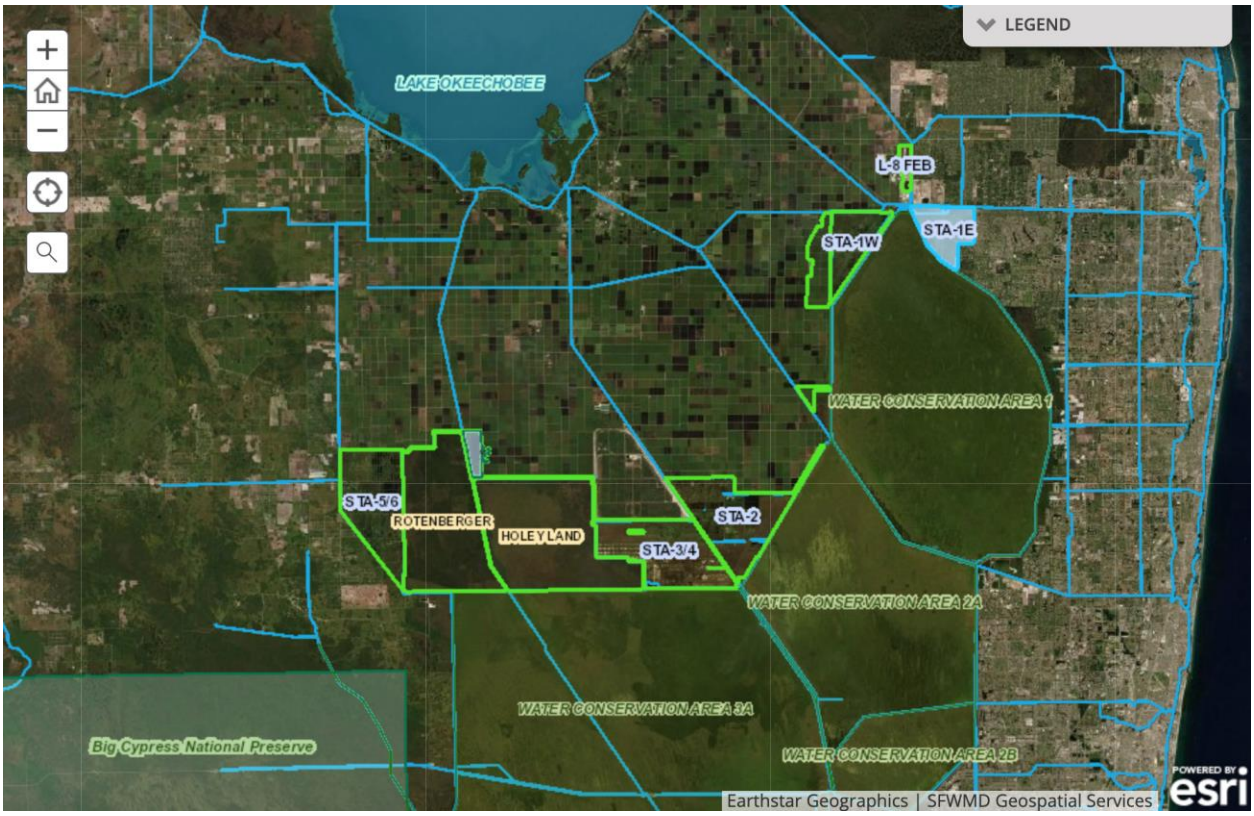

Figure I: The system of Canals that stem south from Lake Okeechobee

Goals:

G1: Remove impervious surfaces and buy lands

The first goal that EPKOET has developed is to remove several impervious roads that have backed up surface water and contaminated water quality. This would prevent the lowering of the water table and the resulting saline infiltration. With this goal, EPKOET also aims to buy "sugar lands" to use as storage for replenishing the Everglades. The purchasing of said lands would not only prevent the construction of additional impervious roads, it would also hold sediment in place as the ecosystem absorbs the wave energy. Gaining this land will also increase the drag on water motions and act as a buffer zone to limit saltwater intrusion.

G2: Decrease channelization

The second goal of EPKOET is to create more consistent water levels. This will be done by decreasing the amount of channels, levees, drainage works, and canals along tributaries of this basin. By restoring some of the basin's natural conditions, the irregular flooding and water level fluctuation may be restored to the natural cycle. Shallow sheet flow will operate more closely to natural conditions if barriers like levees are removed. Additional water storage reservoirs and wells will also improve water level regulation. Other actions, such as water delivery scheduling, may be altered to mimic more natural patterns. In addition, as the natural hydrological flow patterns are restored, the native plants and animals will also thrive, building up the ecosystem that is currently very limited by anthropogenic influences.

G3: Decrease pollution

The third and final goal of EPKOET is to treat or remove pollutants in runoff from agricultural and urban areas before it enters the Everglades. This will also include discouraging further development in the floodplain as well as prohibiting the draining of existing Everglades for agriculture. Contaminants of interest include nitrogen, phosphorus, and sulfur. Additional constructed wetlands may be a viable option for nutrient removal. EPKOET will also support groups like Friends of the Everglades in their efforts to prevent untreated agricultural discharge into the Everglades via policy action. EPKOET will work to form policies that require agriculturalists to test their soil for phosphorus and nitrogen so that they only add an amount of fertilizer or manure that will be utilized by the crops. This will limit the amount of nutrient loading into the watershed, minimizing the growth of algae and eutrophic conditions.

6. SCHEDULE

Schedule (years all follow January 1)										
Tasks	2022	2024	2025	2026	2028	2030	2035	2040	2045	2050
Research on roads near Water sources										
Apply to purchase "sugar lands"										
Purchase Sugar lands										
Deconstruction of the roads										
Deconstruction of leeves, drainage works, and canals										
Stormwater Permit (SW Florida Water Management District)										
Rain Garden constuction										
Wetland Construction										
Form agricultural policies for fertilizer testing										
BMAP to meet TMDL (pollutant load reductions)										
EPKOET completes project and reopens the watershed										

Table 2: Schedule for EPKOET

7. CONCLUSIONS AND RECOMMENDATIONS

The Kissimmee Okeechobee Everglades watershed suffers from saltwater intrusion, extreme water level fluctuation, and pollution caused by runoff from agricultural and urban areas. These three issues affect Florida's drinking water quality, ecosystems' habitats, and create hypoxic algae blooms. EPKOET has three goals to address these problems. The first goal is to remove impervious surfaces that lower the water table and increase saltwater intrusion and buy "sugar lands" to use as storage for replenishing the Everglades. EPKOET's second goal to address the issues is to decrease channelization and get rid of man-made infrastructure that hinders the natural flow of the water body. Our third goal is to decrease pollution from agricultural and urban areas by managing the discharge and where the contaminated flow enters. EPKOET will complete the project design by 2050. It is recommended that the EPKOET program and goals be led and managed by the existing water governance in southern Florida, the South Florida Watershed Management District. Collaboration and frequent communication with the Everglades Coalition and the Conservancy of Southwest Florida is also strongly encouraged, as their goals align with the goals of this document.

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