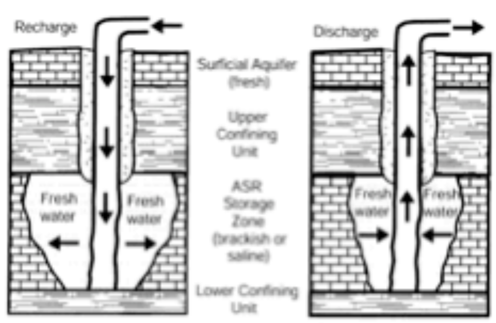
Adverse Environmental Impacts of Artificial Recharge Known As "Aquifer Storage and Recovery" (ASR) In Southern Florida: Implications for Everglades Restoration

Kissimmee River
channelized by USACOE in 1960s



Floridan Aquifer
channelized by USACOE in 2000s?

AQUIFER CHANNELIZATION

by
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Dedicated to the memory of Marjory Stoneman Douglas

Cover illustration of fictional aquifer cross-section/ASR well/bubble from: Corps' EIS, 2004
Cover photo/aerial view of channelized Kissimmee River from: Governor's "UPDATE" web site
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EXECUTIVE SUMMARY

Florida is experiencing a water crisis. Water shortages have been caused by excessive and increasing aquifer withdrawals combined with rapid decreases in natural aquifer recharge areas associated with construction of impervious (non-porous) surfaces such as buildings, highways, and paved parking lots. Discharges of pollutants to surface waters have increased with the increases in groundwater withdrawals and stormwater runoff from impervious surfaces. The water crisis has prompted widespread and large-scale expenditures of public funds to construct aquifer injection wells. More than 1,000 of these injection wells in southern Florida are ~60 feet (20 m) deep. Contaminated fluids such as sewage effluent injected into these wells and many deep wells in Florida are not intended to be recovered.

In an effort to recharge the aquifer artificially, an increasing number of injection wells are being proposed and constructed with the intent of withdrawing and using the injected fluids at a later date. In Florida, this process is referenced as "aquifer storage and recovery" (ASR).

Theoretically, ASR is a form of artificial aquifer "recharge" that consists of three components: aquifer injections of fluids, withdrawals of the injected fluids, and a period of time between the injections and withdrawals that is considered to be aquifer "storage" of the injected fluids. The injected fluids may include: (1) treated sewage effluent (also known as reclaimed, reuse, or bright water); (2) stormwater runoff pumped out of canals or pits; (3) surface waters from natural lakes and streams; or (4) ground water from different aquifer zones.

The US Army Corps of Engineers (Corps) and South Florida Water Management District (SFWMD) propose to construct more than 330 ASR wells in southern Florida at an estimated cost of $1.7 billion as the foundation of the more than $8 billion "Comprehensive Everglades Restoration Plan" (CERP). According to these agencies, the purported need for ASR by those agencies is to prevent "excess" waters from being "lost to tide" during the wet season, by reportedly injecting "approximately 1.7 billion gallons per day."

An evaluation of existing data from 87 tests throughout southern Florida was sufficient to show that less than 25% actual "recovery" has been achieved for fluids injected into the regional karst aquifer system via ASR wells. This low "recovery" occurred despite the fact that the longest "storage" period tested did not exceed 181 days and the majority of the "storage" periods were less than a month.

Those ASR test results constitute disposal, rather than "recovery" and function as artificial channelization of the aquifer system similar to the environmentally destructive and costly channelization of the Kissimmee River by the Corps in the 1960s. Those results also refute the theory accepted by funding and permitting agencies that injected fluids are retained as an intact "bubble" in the aquifer at the point of injection. Those brief "storage" periods also are insufficient to meet the stated agency objectives of retrieving the injected fluids during the dry season, more than six months after injection of "excess" water would occur.

Additional justification by various agencies for the use of ASR throughout Florida is the ability to avoid the loss of water to evapotranspiration (ET) that occurs when water is stored in surface "reservoirs" (mined/dredged pits). Existing data are sufficient to show that the failure to "recover" ~75% of the fluids injected into ASR wells in southern Florida greatly exceeds loss of water via ET in mined/dredged pits and impoundments.

Existing evidence also supports the conclusion that the injected fluids rapidly discharge to nearshore coastal waters and other surface waters via conduit flow through the aquifer. Those subsurface discharges are similar to current stormwater discharges via canals that result in contamination of surface waters and massive fish kills. These subsurface discharges are proposed as one of the significant factors in the increased frequency, intensity and duration of harmful algal blooms (*e.g.,* red tide) occurring throughout Florida's coastal waters. Therefore, those aquifer injections do not constitute significant artificial aquifer recharge and are harmful in ways that are addressed in the ensuing chapters.

Recent reports have documented that ASR in southern Florida increases arsenic levels in excess of 100 mg/L - more than 10 times the current EPA standard for drinking water. Despite the failure of ASR in southern Florida to meet any of the stated agency objectives and the recent documentation that ASR mobilizes arsenic and other contaminants present in the aquifer formations, the Corps continues to promote the use of ASR in the Everglades watershed.

The final Environmental Impact Statement (EIS) for these proposed ASR wells (released by the Corps in September 2004) proposed to fund the estimated $45 million construction/operation for up to seven ASR wells in the Everglades watershed. While numerous ASR wells exist in southern Florida and actual "recovery" from these existing wells has been low, these proposed actions under CERP are being referenced as "pilot projects." These "pilot projects" represent the initial step in the agencies' proposed aquifer injections and withdrawals of a reported 1.7 billion gallons per day via the more than 330 new ASR wells proposed under CERP.

Existing aquifer injections and withdrawals that are orders of magnitude less than those proposed for ASR under CERP are known to have resulted in significant adverse environmental impacts, including induced (forced) recharge from wetlands, other surface waters, and the surficial aquifer, downward to the underlying zone during the withdrawal ("recovery") period of ASR. Induced recharge from the surficial aquifer results in altered hydroperiods and subsequent loss of wildlife habitat.

The ASR injections and withdrawals proposed under CERP will result in adverse direct, indirect, and cumulative impacts to at least 10 federally listed species, including the endangered Florida panther, Florida manatee, and wood stork. Adverse impacts also would occur to an additional 17 state-listed species, for a total of nine listed bird species subjected to jeopardized survival and recovery.

The National Environmental Policy Act (NEPA) requires federal agencies to consider alternatives to the proposed action. Also required under NEPA is consideration of all of the adverse direct, indirect, and cumulative impacts of a proposed project such as all adverse environmental impacts. Those adverse environmental impacts include the nonsustainable consumption of nonrenewable sources of energy that are intended to be used for the ASR projects. The final EIS failed to meet those requirements, or to consider new information on the harm from ASR injections and withdrawals.

The final EIS released by the Corps for these proposed ASR wells failed to consider any alternatives to ASR, any adverse environmental impacts of repeated large-scale injections and withdrawals, or the adverse impacts of energy use for the proposed ASR projects. Examples of sustainable, cost-effective alternatives to ASR include: (1) removal of existing impervious (non-porous) surfaces that prevent natural recharge; (2) mandatory water conservation; (3) land purchase for natural overland flow (rather than dredged and filled impoundments); and (4) closed-loop water use systems. The agency's failure to consider these alternatives and new information regarding environmental damage caused by these extremely costly aquifer injections and withdrawals is increasing the extent and severity of damage to the greater Everglades ecosystem while providing no discernible benefits to those ecosystems.

The objectives of this scientific review and analysis were to evaluate relevant published literature and agency documents to determine: (1) the types of adverse environmental impacts predicted to be associated with these aquifer injections in southern Florida and (2) the implications of these adverse impacts for the Everglades "restoration" effort. Therefore, the focus of this review and analysis was directed by considering provisions of the NEPA, Clean Water Act (CWA), and Endangered Species Act (ESA).

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In preparation for her doctoral degree from the University of Georgia's Institute of Ecology Dr. Bacchus' curriculum included graduate-level courses in Hydrology, Groundwater Seepage, Forest Hydrology, Forest Pathology, Tree Physiology, Hydrogeology, Geochemistry, Water Quality, Soil Physics and various aspects of Ecology at universities in both Florida and Georgia. She also served as the Hydroecologist for the Region IV US Environmental Protection Agency Lab for ~6 years and completed a phytoremediation Internship and Fellowship with that agency's National Exposure Research Laboratory.

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