The Central and Southern Florida Project Comprehensive Review Study: Restoring the Everglades

Michael Voss*

The Central and Southern Florida Project Comprehensive Review Study lays the blueprints for a massive ecological restoration of the Florida Everglades. The restoration's ambitious scope required the planning agencies to incorporate recent technological and managerial innovations into the plan. This Note summarizes those innovations and discusses the challenges and advantages that new technology and management styles will provide for Everglades restoration.

CONTENTS

Introduction .............................................................752
I. Background ..........................................................753
II. The Central and Southern Florida Comprehensive
    Review Study .....................................................757
    A. Basic Structure ............................................. 757
    B. Goals ......................................................... 757
    C. How the Restudy Works ................................. 758
    D. The Restudy's Management Approaches to
       Ecological Restoration .....................................760
       1. Ecosystem Management .................................760
       2. Adaptive Management ..................................761
III. The Suitability of the Restudy's Management Tools for
     Everglades Restoration .......................................762
     A. Ecosystem Management ..................................762
     B. Adaptive Management ...................................766
Conclusion .............................................................770

Copyright © 2000 by The Regents of the University of California
* J.D. candidate, University of California at Berkeley School of Law (Boalt Hall) 2001; B.A. and B.S., University of Utah, 1997.
INTRODUCTION

Just a century ago, the Everglades region of Southern Florida, an area covering almost nine million acres, was widely viewed as a mosquito-ridden, malaria-infested swamp. Public policies were oriented toward diverting water flows and converting this region to agricultural use. Over the past fifty years, this view has gradually changed as public values have come to recognize the great ecological importance of this unique region.

Section 208 of the Water Resources Development Act of 19991 authorizes the ambitious ecosystem restoration plans recommended by the Central and Southern Florida Project Comprehensive Review Study (Restudy).2 The Army Corps of Engineers, the lead agency for the Restudy, collaborated with dozens of scientists to create an innovative and experimental restoration plan for the Florida Everglades. The final Comprehensive Plan includes more than sixty water management projects at an estimated cost of $7.8 billion.3 The Army Corps hopes that the cumulative effects of the proposed projects and management practices will reverse the effects of a history of shortsighted management that has endangered the Everglades.

The Restudy embodies a paradigm mandated by the Clinton Administration for agency management of natural resources: ecosystem management.4 As scientists begin to understand the complex pattern of ecosystems more clearly, they have emphasized the importance of managing natural resources along watersheds and natural boundaries in order to promote system-wide health. The Restudy follows this mandate; its study area encompasses the greater part of the Everglades ecosystem, approximately 18,000 square miles, ranging from Orlando to the Florida Keys.5 In order to facilitate a project of this scale, the proposed plan requires significant changes in the allocation of

---

2. See U.S. ARMY CORPS OF ENGINEERS AND SOUTH FLORIDA WATER MANAGEMENT DIST., CENTRAL AND SOUTHERN FLORIDA PROJECT COMPREHENSIVE REVIEW STUDY, FINAL INTEGRATED FEASIBILITY REPORT AND PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (1999) [hereinafter RESTUDY].
3. See id. at vii.
5. See RESTUDY, supra note 2, ¶ 1.3, at 1-9.
water management responsibility in Southern and Central Florida.

The proposed increased federal role in Southern Florida's water management does not conform to the notion that "watershed management should be a flexible, responsive, 'bottom-up' consensus-building process...." Nevertheless, the novel challenges posed by the massive Everglades restoration may demand an alternative to "bottom-up" management. The Restudy team had to contend with the technical difficulties of altering South Florida's entire water management system to restore historic flows. The inadequacies of current systems will demand implementation of experimental water storage and retrieval technology. Another challenge facing the project is the pervasive scientific uncertainty regarding how ecological processes in the Everglades will respond to changing conditions.

To retain the flexibility and responsiveness necessary for ecosystem management, the Restudy adopted an adaptive management philosophy. Adaptive management provides a useful framework for management decisions under uncertain conditions. This management approach envisions projects as a series of experiments in which resource managers base later decisions on the results of earlier projects. Adaptive management appears to be a promising approach to decisionmaking in the Everglades restoration effort, uniquely equipped to deal with the limitations of the legal and political framework surrounding the Restudy.

I
BACKGROUND

The Everglades ecosystem of a century ago featured a unique combination of climate and rare hydrological flows. Historically, rains falling on Central Florida began slowly filtering south toward the Everglades through the Kissimmee River. Rivers flowing into Lake Okeechobee drained the northern watersheds

7. See RESTUDY, supra note 2, Introduction at 4.
8. See RESTUDY, supra note 2, ¶ 5.6.5, at 5-32.
10. See LODGE, supra note 9, at 10.
and collected the runoff. As water spilled over the southern edge of Lake Okeechobee, it spread out into a sheet sixty miles wide. This "sheet flow" could take over a year to reach the ocean, insulating the Everglades from the floods and droughts so common in Southern Florida. The slow pace of the water contributed to its high quality because the wetlands' vegetation acted as a natural filter as the water passed through it. Estuaries formed where the sheet flow met with the ocean, providing a rich environment for marine life and estuarine species. Because of this unique hydrological pattern and the great biological diversity that it spawned, three different international environmental organizations have designated Southern Florida a biological area of importance, one of only three sites in the world to receive this recognition.

Early Florida settlers, however, did not appreciate the intrinsic value of the Everglades. At the turn of the century, settlers characterized the Everglades as valuable only if drained. The 1905 Florida gubernatorial election became a referendum on the fate of the Everglades. The eventual winner, Napoleon Broward, ran on the promise of draining the Everglades and putting it to beneficial use. As Florida's population grew, settlers began making inroads into the Everglades by draining small sections and claiming land for agriculture and communities.

In the twentieth century, the Army Corps of Engineers achieved what the early settlers could not: large-scale drainage of the Everglades. The Corps began construction on the Central and Southern Florida Project (C & SF Project) in response to serious hurricane flooding in the late 1940s. The C & SF Project increased the level of flood protection for South Florida and drained many of the Everglades' wetlands for agricultural uses and development by means of an elaborate system of levees and canals that channeled most of the sheet flow and diverted it

11. See id. at 14.
12. See id.
13. See MCCALLY. supra note 9, at 26-27.
14. See id.
15. See RESTUDY, supra note 2, I 2.5, at 2-5.
16. The Everglades have been designated an International Biosphere Reserve, a World Heritage Site, and a Ramsar Convention Wetland of International Importance. See DAVIS & OGDEN, supra note 9, at 3.
17. See MCCALLY, supra note 9, at 86.
19. See MCCALLY, supra note 9, at 140-45.
east into the Atlantic Ocean.\textsuperscript{20} Construction of the Tamiami Trail, the first road to cross the Everglades from east to west, further contributed to the decline in the southward flow of water.\textsuperscript{21} As the canals funneled the water east, the sheet flow dwindled.

The toll that development and flood control were taking on the Everglades did not go unnoticed. In 1934, Congress passed an act authorizing Everglades National Park.\textsuperscript{22} Everglades was the first national park preserved primarily for maintaining biodiversity rather than scenic or historic values.\textsuperscript{23} Conservationists began to document the problems arising in the Everglades and citizens groups began working for its protection. However, an enormous amount of damage had already been done.

The original C & SF Project caused a widespread environmental crisis in the Everglades. The project converted nearly half of the Everglades into plantations and developments,\textsuperscript{24} and the systematic deprivation of water compromised the integrity of the remaining ecosystem.\textsuperscript{25} Reduced southward flows caused hypersalinity in the southern estuaries while the enormous quantities of waters diverted east poisoned the estuaries on the Atlantic coast with fresh water.\textsuperscript{26} These dramatic changes in salinity concentrations have devastated valuable fisheries and marine breeding grounds. As aquifer levels drop in southern counties in response to diminishing water flows, saltwater incursion is becoming a serious threat to urban water supplies.\textsuperscript{27} Other factors have exacerbated the ecological deterioration caused by diminished water flows. Widespread agricultural runoff has contaminated the once pristine water with foreign nutrients.\textsuperscript{28} As a result of excess quantities of nutrients in the water, exotic species have proliferated at the expense of formerly abundant populations of indigenous species, and significant environmental damage has

\textsuperscript{20} See Stephen S. Light et al., The Everglades: Evolution of Management in a Turbulent Ecosystem, in BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS 103, 125-32 (Lance H. Gunderson et al. eds., 1995).

\textsuperscript{21} See id.


\textsuperscript{25} See LODGE, supra note 9 at 186.

\textsuperscript{26} See RESTUDY, supra note 2, at iii-iv.

\textsuperscript{27} See id.

\textsuperscript{28} See id. ¶ 3.19, at 3-19.
occurred. The Fish and Wildlife Service has identified 18 different threatened or endangered plant and animal species within the study area, indicating the grave problems confronting Everglades restoration.

Florida has been aware of the need to address water management issues for quite some time. In 1985, Florida's five water management districts entered into an interagency agreement "to conduct a comprehensive review of water resource policies." One of the report's conclusions was that water management policies in place were not sustainable. A lack of strong state leadership, however, has created a system of regionalized and disjointed policy decisions that has plagued Florida's efforts to establish a workable state water plan. A notable turning point in Florida water management occurred in 1991, when newly elected Governor Lawton Chiles settled an action brought by the federal government over deteriorating water quality in Everglades National Park. Nutrient pollution released by agricultural development was threatening the Park, and the Southern Florida Water Management District (SFWMD) was not responsive to the water quality issues. In the settlement, Florida agreed to create 35,000 acres of water treatment marshes designed to improve the quality of water flows into the park. Shortly after that agreement, the Florida legislature openly recognized the severity of the problems facing the Southern Florida ecosystem by passing the Save the Everglades Act, a comprehensive bill calling for measures to increase the quantity and quality of water flows into Everglades National Park. The Restudy represents Congress' recognition of the problems in the Everglades.

29. See id.
30. See RESTUDY, supra note 2, at tbl. 3-1.
32. See id. at 16.
35. See id.; see generally Hinrichsen, supra note 18.
36. FLA. STAT. ANN. § 373.4592 (West 1999).
A. Basic Structure

Congress addressed the problem of the Everglades' deterioration in the Water Resources Development Act of 1992. The Act commissioned the Restudy in order to restore the South Florida ecosystem, to modify water management, and to address dwindling urban water supplies, deteriorating water quality, and other water usage problems. Congress continued to support the Restudy by passing the Water Resources Development Act of 1996. President Clinton signed the bill authorizing the final plan on August 17, 1999. In compliance with the Administrative Procedures Act, the Corps analyzed more than 10 alternate courses of actions before recommending the initial draft plan in 1998. In addition to an updated water management plan, the Restudy includes a Programmatic Environmental Impact Statement that addresses the environmental effects of the project. Because of the size of the project and the inherent uncertainties involved in the planning, the final report deals with proposed actions on a conceptual level.

B. Goals

Scientists studying the ecology of the Everglades have concluded that because of widespread, permanent habitat loss, the Everglades cannot be restored to its historical state. These findings raise the question of when the ecosystem “restoration” will be complete. The Restudy defers this issue, preferring to conceive of the restoration as an open-ended process. It asserts that as resource specialists amass data, a notion of what the revitalized Everglades should look like will emerge. The Restudy team concluded that if it altered flows to approximate historical levels, the slow flows through wetlands and estuaries would insulate the Everglades from the variable floods and droughts.

38. See id.
40. See RESTUDY, supra note 2, at vii.
41. See id. ¶ 1.4, at 1-22.
42. See id. ¶ 5.7, at 5-36.
43. See id. ¶ 5.7, at 5-37.
that characterize Florida weather patterns. These flows would stabilize the habitat for threatened and endangered species and revitalize the remaining Everglades. The Restudy team listed indicators that would measure the degree of ecosystem restoration occurring; these indicators include the recovery of endangered species, the return of large nesting rookeries, the improvement of water quality in wetlands and estuaries, the emergence of wetland functions that mimic pre-drainage conditions, and the improvement of the Lake Okeechobee fishery.

As a multi-use project, the Restudy addresses many other water-related concerns in Southern Florida. The new water projects will ensure more plentiful, better quality water for urban South Florida. Florida's population is projected to grow to nearly 15 million by 2000; current water delivery will not be able to fulfill the future needs of urban water users. Florida planners believe that the Restudy will address the possibility of future water supply shortages more cost effectively than desalination plants or other exotic technology. The Restudy also recognizes the necessity of the continued existence of the C & SF Project as a means of controlling flood damage. The Corps will face the challenge of restoring more natural flows to the whole system while maintaining safeguards against heavy floods. Finally, the Restudy includes projects addressing the problem of water contamination from agricultural runoff and providing better quality water to users and natural systems downstream.

C. How the Restudy Works

The Restudy team proposes an elaborate system of water management that will closely mimic historical water flows through the Everglades. It assumes that the ecosystem will heal if the water management systems can deliver the right amount of water, of the right quality, to the right place, at the right time. The Comprehensive Plan will build new reservoirs, wetlands-based treatment areas, and underground aquifer

44. See id. ¶ 8.3, at 8-3.
45. See Restudy Summary, supra note 24, at 17.
46. See RESTUDY, supra note 2, ¶ 6.4.6, at 6-23.
47. See Christaldi, supra note 33, at 1063-64.
48. See Water Bill Will be High, but Waiting Won't Help, PALM BEACH POST, Aug. 24, 1999, Opinion, at 1A.
49. See RESTUDY, supra note 2, ¶ 6.4.6, at 6-23.
50. See id. introduction at 2.
51. See id. ¶ 7.3.2, at 7-15.
storage and recovery wells in order to capture water that canals discharge to the Atlantic coast. Water managers will use the re-diverted water to augment urban water supplies, agricultural users, and environmental restoration. New techniques for wastewater reuse will supplement urban water supplies. In an effort to restore sheet flow to the Everglades, the Restudy proposes removal of over 240 miles of dikes and levees and redesign of structures that impede flows. In conjunction with increased flows, the Restudy team envisions shifting to a style of water management that duplicates natural variations in flows and returns releases to less harmful water levels. The Restudy addresses water quality issues primarily by diverting degraded runoff from agricultural areas into stormwater treatment areas and restored natural wetlands, which will biologically filter the water.

The Restudy team envisions the project as a series of experiments carried out over a long period of time. This structure enables the implementing agency to analyze the effects of earlier projects and adjust subsequent projects based on the results. For example, in an attempt to address questions about the effectiveness of new technologies, the Restudy has slated six pilot projects for immediate implementation that will test the effectiveness of water storage and delivery devices. These pilot projects will provide accurate data for future management decisions and dictate to what extent the new technologies will be used. Another advantage to this structure is that by proceeding slowly, the implementing agencies minimize the chances of irretrievably committing resources to unworkable projects.

Agencies must conduct baseline projects in order for scientists to evaluate the computer models that anchor the water management decisions. In the process of laying the groundwork for ecosystem restoration, the Restudy team brought together resource specialists to create conceptual models of the conditions of the Everglades. Based on computer models such as the Natural Systems Model that simulate the complex

---

52. See Restudy Summary, supra note 24, at 9.
53. See id.
54. See Restudy, supra note 2, ¶ 8.9, at 8-6 to 8-7.
56. See Restudy, supra note 2, at 6.
57. See id. ¶ 6.41, at 6-12.
58. See id. ¶ 5.6.5, at 5-33.
60. See id. ¶ 5.6.5.2, at 5-34.
variables that comprise the Everglades water flows, the scientists developed causal hypotheses about how hydrological conditions would influence ecosystem restoration. Using these hypotheses, the Restudy team designed projects to create flows that would closely approximate these hydrological conditions. In the process of implementing the Restudy, the agencies will evaluate the effectiveness of the models at predicting system reactions and then adjust models in response to new data. The agencies also used the models to set indicators of success for different facets of the ecosystem restoration.

These models have provoked controversy because of their theoretical nature. The U.S. Geological Survey has questioned the effectiveness of the Natural Systems Model, one of the central models for understanding Everglades' hydrology, in simulating historic flows through the Everglades because of the limited knowledge available to scientists. The Restudy team recognizes that these models may not be accurate, but it maintains that scientists should be able to recognize and correct for major flaws early in the process by noting the discrepancies between the models and the baseline data. The Restudy team also points out that the models provide important starting points for the restoration and will demarcate measurable progress in a nebulous process.

D. The Restudy's Management Approaches to Ecological Restoration

1. Ecosystem Management

As environmental protection becomes a more important public value, agencies have increasingly emphasized ecosystem management as the preferred natural resources management policy. This policy focuses management on entire ecosystems

61. See id. ¶ 5.6.2, at 5-29.
62. See id. ¶ 10.6.3, at 10-64.
63. See id. ¶ 5.6.5.2, at 5-35.
64. See Jerad D. Bales et al., Review of Selected Features of the Natural Systems Model and Suggestions for its Applications in South Florida, WATER RESOURCES INVESTIGATIVE REPORT 97-4039, 6 (1997).
65. See RESTUDY, supra note 2, ¶ 5.6.5.1, at 5-33 to 5-35.
66. See id.
rather than individual resources or distinct goals such as flood control and water quality. Proponents of ecosystem management suggest that it effectively maintains and restores natural processes, conserves biological diversity, and ensures sustainable use for the managed ecosystem. As shrinking water flows threaten the viability of the Everglades ecosystem, the need to address its problems on a widespread basis has become apparent. Although many smaller projects have been undertaken to mitigate environmental damage, they have failed to materially improve the ecosystem's health. The Restudy recognizes the positive steps taken by the prior projects but suggests that, because the ecosystem is fundamentally unhealthy, smaller projects will not effectively address the underlying causes.

2. Adaptive Management

While all planning involves accounting for routine uncertainties, the Restudy faces challenges that, to some extent, will confront many future ecosystem restoration efforts. Conditions have changed considerably from the historical Everglades ecosystem, so scientists are unsure how their ecological indicators of success and computer models will respond to changing hydrological conditions. The task of making an accurate prediction is complicated by the theoretical nature of the models; many parameters such as input data (for example, topography), model assumptions (for example, rainfall), and model discretization simply cannot be quantified accurately. The Restudy also faces questions about new techniques for water storage and delivery, including aquifer storage and recovery, seepage management, and wastewater reuse. While these technologies have been successful in limited applications, they have not been proven on a scale approaching that required by the Restudy. Finally, implementation of the Comprehensive Plan carries serious risks such as flooding, water shortages, and water degradation that could drastically affect millions of people. When projects operate on an ecosystem scale, they have the

68. See Kelter, supra note 67, at 302.
69. Current projects include the Lake Okeechobee clean up, water quality restoration for Everglades National Park, and the Kissimee River restoration. See RESTUDY, supra note 2, ¶ 10.3.3, at 10-22.
70. See RESTUDY, supra note 2, ¶ 10.3.3, at 10-22.
71. See McCALLY, supra note 9, at 14.
72. See RESTUDY, supra note 2, ¶ 8.9, at 8-6, ¶ 10.7, at 10-70.
potential to create much more significant impacts to natural systems.

Adaptive management represents one of the most recent approaches to making natural resource management decisions in the face of scientific uncertainty. The Northwest Power Planning Council pioneered the adaptive management approach in response to the problem of how to promote salmon recovery in the Pacific Northwest. The dilemma facing the Council was that recovery efforts could not succeed unless they were based on sound science, but scientifically-sound salmon measures could not be implemented unless they were politically acceptable. The Council decided to pursue a management policy that integrated scientific, economic, and social concerns by using computer modeling and simulation that demonstrates the potential effects of alternative management.

III
THE SUITABILITY OF THE RESTUDY'S MANAGEMENT TOOLS FOR EVERGLADES RESTORATION

A. Ecosystem Management

Ecosystem management offers several obvious advantages for the Everglades restoration effort. Most importantly, resource managers will be able to address the effect that water management decisions upstream have on resources in different areas. While scientists generally tend to view ecosystems as interconnected, this perception is particularly true of the Everglades ecosystem because of its reliance on water flows throughout the system. Managing the system as an integrated whole will preclude addressing one goal at the expense of other concerns such as managing for flood control to the detriment of the environment, water supply, and water quality. As a result of this wider focus, the Everglades restoration project may also receive more resources and support from agencies and different levels of government. It should also ensure the existence of a centralized decisionmaking group that can prioritize projects more effectively. The Restudy team hopes that because of its high visibility and widespread effects, the Restudy will become a

74. See id. at 1259.
keystone for a series of plans that will coordinate resource management throughout South Florida.\textsuperscript{75}

In contrast, local involvement and control of a watershed is presented by its proponents as a more lasting basis upon which to bring about sustainability than relying upon mandates from a far-away government.\textsuperscript{76} The new paradigm represented by the Restudy has been proposed as an alternative to federal decisionmaking in a diverse number of settings, ranging from the management of rivers to grazing decisions on federal lands.\textsuperscript{77} Successful examples of participatory, consensus-based planning reinforce the impression that resources can be equally, if not better, protected through local initiatives than through top-down federal mandates.\textsuperscript{78}

Despite the arguments for local control, substantial ecological rehabilitation will require centralized management to address the underlying hydrological problems. The Everglades' rapid decline occurred under local management because local management districts lacked the resources and the mechanisms for coordination.\textsuperscript{79} While the water management districts should not bear all of the blame for managing water within the system created by the Corps, they were unable to reverse the trend of ecological deterioration. Congress has imposed centralized management through the Restudy because Florida's state-wide water management administration has traditionally deferred control to regional water divisions and lacks the institutional capacity to manage a project as large as the Restudy.\textsuperscript{80} The strong federal interest in preserving the Everglades because of its rich biological diversity and its place in the national heritage overcame federalism concerns. As time runs out for the Everglades, the urgent need for action favors fundamental changes that can be much more efficiently coordinated by a single agency.

The advantages of ecosystem management will be partially offset by the transition period as resource management institutions adapt to implement it. A common problem with this

\textsuperscript{75} For example, the SFWMD has based its local water supply plans on processes outlined in the Restudy. See Restudy, supra note 2, ¶ 10.2.3, at 10-5.


\textsuperscript{78} See id.

\textsuperscript{79} See Christaldi, supra note 33, at 1066-67.

\textsuperscript{80} Id.
management policy is that the ecosystem boundaries often do not match the jurisdictional boundaries politically imposed upon agencies, thus complicating efforts to manage natural resources on a larger scale. The Everglades, for example, span several Florida counties, public and private land, and the jurisdictional boundaries of dozens of federal, state, and local agencies. Often, complex jurisdictional issues such as federalism, mechanisms for coordination, areas of traditionally local control, and state/federal partnerships must be addressed before ecosystem management becomes effective.

The Restudy team intends to solve many of the jurisdictional problems by granting ultimate authority for water management to the Corps. Principles of federalism, however, limit the federal government's ability to coordinate ecosystem management. If federal agencies control areas as expansive as the Restudy area and resources as important as water, they could significantly threaten state and local autonomy in traditional areas such as land control. Although the importance of the Everglades restoration may justify extensive federal intervention, the Restudy team has taken steps to ensure that Florida will retain long-term authority to manage its natural resources. The Restudy team allocates responsibility within the project between the lead agency, the Corps, and its local co-sponsor, the SFWMD. Section 9 of the Restudy assigns the Corps most of the responsibility for development and implementation of projects due to its technological expertise. The Restudy assigns responsibility for involvement in more traditional areas of state control to the SFWMD. Project aspects such as individual project design, costs sharing, furnishing lands, easements, rights of way, relocation, and disposal areas are also assigned to the SFWMD. For Restudy projects, resource specialists envision a large role for local governments in traditional land use

81. See Keiter, supra note 67, at 303; BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS 38 (Lance H. Gunderson et al. eds., 1995).
82. Some of the major agencies involved include the Fish and Wildlife Service, the Environmental Protection Agency, the National Park Service, the Geological Service, the National Resources Conservation Service, the Florida Game and Freshwater Fish Commission, and the Florida Department of Environmental Protection. See RESTUDY, supra note 2, ¶ 1.1, at 1-5 to 1-6.
83. For a case study of how the principles of federalism affect environmental management, see Fort, supra note 77.
84. See RESTUDY, supra note 2, ¶ 9.10, at 9-62.
85. See id.
86. See id.
The Restudy includes another important concession to state control over the water management system; it proposes handing over the operation and maintenance of completed projects to the SFWMD. The complexity of the jurisdictional issues is increased because the Restudy must integrate ongoing projects into the Comprehensive Plan. The NPS, the SWFMD, the Environmental Protection Agency (EPA), and the Florida Department of Environmental Protection each have primary responsibility for ongoing environmental projects in the Everglades. In the past, agencies have conflicted over management practices within the Everglades. For example, the NPS oversees modified water deliveries to Everglades National Park through the system managed by the SWFMD and has proven to be very protective of the quality and quantity of water flows entering the Park. Lack of agency cooperation could prove to be a stumbling block during implementation because the Restudy does not explicitly create mechanisms for coordination between various agencies.

Agency culture may present another obstacle for implementation of effective ecosystem restoration. The Florida legislature divided the state into water management districts based on hydrological boundaries almost two decades ago. Since that time, the SWFMD has had primary jurisdiction over the Everglades' water systems as the ecosystem has rapidly declined. To reverse this trend, the SFWMD must disassociate itself from its past management practices. The Corps, given its institutional history of disrupting aquatic ecosystems, seems like an unlikely proponent of the paradigmatic shift in natural resource management envisioned by the Restudy. Concerns about agency culture have been validated in a number of settings; the extent to which recent management policies supersede previous directives has been hotly debated. The Forest Service's recent reluctance to shift focus from resource

88. See RESTUDY, supra note 2, at 8-12.
89. See id. at ¶ 8.
90. See id. at 10-4.
91. See Ankersen & Hamann, supra note 67, at 478.
92. See Christaldi, supra note 33, at 1073.
93. This approach was heavily used by Florida agencies in water management. See WADE & TUCKER, supra note 31, at 33.
94. See Ankersen & Hamann, supra note 67, at 480.
extraction towards more sustainable uses illustrates this struggle.\textsuperscript{95}

Unlike the Forest Service, however, the Restudy's lead agencies are charged primarily with restoring an ecosystem and must ensure that environmental concerns receive priority.\textsuperscript{96} Hopefully, the tenets of ecosystem management will focus management of the system clearly upon the project's mandates, allowing the agency to assert its leadership from the top down.

\textbf{B. Adaptive Management}

Past large-scale management approaches have demonstrated that unforeseen, undesired results can occur when man alters the environment on a large scale. Napoleon Broward's "Cut 'n Try" plan for the Florida Everglades and the original C & SF Project combine to illustrate how uninformed planning can generate long-term threats to an ecosystem's health.\textsuperscript{97} Early strategies for dealing with scientific uncertainty, such as simply ignoring its potential effects or relying heavily on the infallibility of science, proved to be ineffective.\textsuperscript{98} Planning departments later developed the "best information available" approach as a better strategy for addressing uncertainty.\textsuperscript{99} Using this approach, agencies gather sufficient data about a proposed action to make a decision with a reasonable amount of certainty.\textsuperscript{100} The "best information available approach" requires considerable time to gather reasonable data. When projects like the Restudy face large gaps in scientific knowledge, this approach leads to paralysis.

The National Research Council has endorsed adaptive management as a valuable management tool for ecosystem restoration.\textsuperscript{101} Adaptive management embraces scientific uncertainty as an essential assumption in natural resource


\textsuperscript{97} See Light, supra note 20, at 120-25.


\textsuperscript{99} See WADE & TUCKER, supra note 31, at 33.

\textsuperscript{100} This approach was heavily used by Florida agencies in water management. See id.

\textsuperscript{101} See COMMITTEE ON RESTORATION OF AQUATIC ECOSYSTEMS—SCIENCE, TECHNOLOGY, & PUBLIC POLICY, NATIONAL RESEARCH COUNCIL 41 (1992).
Using this method, ecosystem management takes place in a series of steps designed to test hypotheses about effective management policies. This ongoing scientific input builds a solid foundation of science that is used to evaluate past decisions and future alternatives. Situations like the Everglades, where an unusually complex ecosystem will be managed on a system level basis, present a staggering amount of uncertainty. The Restudy team incorporated adaptive management into the Comprehensive Plan as the primary mechanism for coping with the uncertainties surrounding the process of implementing changes on a system-wide basis.

Adaptive management may also confer some ancillary benefits upon the project. In the future, new technology that increases the effectiveness of the restoration effort may become available. Because of its incremental progress approach, adaptive management is well situated to take advantage of these innovations. This feature may become particularly useful in Everglades restoration. The Restudy has already incorporated experimental technology that will be utilized to meet some goals and to continue refinements in groundwater storage and retrieval technology; for example, the latest technology in aquifer recharge and retrieval promises to substantially improve supplies available for maintaining flows within the Everglades.

Another strength of the adaptive management approach taken by the Restudy team is that it incorporates independent scientific review. The Everglades restoration efforts have attracted significant political attention. This attention presents a risk that future political pressure may influence agency decisions to diverge from the most sound scientific decisions. Even without the political pressure, an additional risk is that the Corps could make short-sighted, inappropriate management decisions based upon their limited data. To protect against these risks and to ensure that sound science underlies the ecosystem restoration, the Restudy team provides for ongoing independent scientific peer review from the National Academy of Sciences.

Although the Restudy team has attempted to closely bind its

102. See Ankersen & Hamann, supra note 67, at 465.
103. See RESTUDY, supra note 2, ¶ 10.2.8, at 10-11.
adaptive management approach to a purely scientific approach to resource management, political and legal realities will probably limit the extent and environmental effectiveness of experimental management in the Everglades. Commentators have described adaptive management as a radical technique because it encourages large-scale experimentation with natural resources. However, the large numbers of endangered or threatened species in the Everglades study area will strongly constrain the extent of experiments; in addition, the experiments will be limited by more routine constraints imposed on siting the projects. For example, the Restudy acknowledges that the Comprehensive Plan may negatively affect several endangered species, including the Florida scrub jay, the bald eagle, and the indigo snake. Thus, it may avoid releasing higher or lower than normal water flows in order to avoid destroying Critical Habitat Areas for these endangered species in violation of the Endangered Species Act. Although the Department of the Interior has issued a biological opinion predicting that the plan will not jeopardize any listed species or destroy critical habitat, that opinion may change if initial predictions are inaccurate.

Political pressure could also constrain the extent to which implementing agencies may experiment. The NPS is likely to strongly discourage any experiments that compromise the quality or quantity of flows into Everglades National Park. Conversely, the original purpose of the C & SF Project as a flood control device and Florida's proclivity for catastrophic flooding will create substantial political pressure to discourage controlled floods or other ecologically profligate experiments. The political struggle has already begun over a facet of the Restudy proposing that experimental wastewater reuse and aquifer storage technologies augment urban water supplies. One of the initial controversies of the Restudy has been instigated by South Florida cities who are reluctant to accept this alternative and who seek a more traditional water supply.

From Florida's perspective, another concern associated with

106. See Volkman & McConnaha, supra note 73, at 1255-56; Ankersen & Hamann, supra note 67, at 495-96.
108. See RESTUDY, supra note 2, ¶ 8.8, at 8-6.
111. See id. ¶ 9.8, at 9-54.
112. See id.
adaptive management is that Congress will vest a substantial amount of discretion in the Corps. The Corps, in response to data that develops over the course of the project, could make decisions that significantly impact the state's resources but were pre-authorized at the outset of the restoration effort. To that end, the state has sought ways to provide input into the Restudy process. One way in which Florida has accomplished that goal is by creating the Florida Everglades Restoration Commission, a commission comprised of officials from state agencies that made recommendations to the Restudy team. Many of those recommendations have been incorporated into the Restudy.

Florida's attempts to ensure more political oversight of the Restudy as it develops have not fared as well. The Restudy team designed the restoration process using a science-based paradigm, not a political one.

At the end of the day, however, the environmental effectiveness of adaptive management in the Restudy will be shaped by its fundamental nature as a multi-use project. Although the Restudy team conceived of the Restudy primarily as an environmental program and expressly allocated eighty percent of the recaptured water for use in restoring the ecosystem, it is still obliged to follow Congress' mandate to address multiple uses. The enabling statutes from Congress contain built-in directives to consider economic and flood control goals as well as environmental goals in the process of natural resources management. Although the short-term water resources will adequately satisfy environmental restoration, agriculture, and urban needs, it is unlikely that the long-term supply will sufficiently provide for future needs. Commentators predict rapid growth in the drier Southern Florida coastal centers and a substantial increase in water use.

The Restudy's greatest strength, its flexibility to meet the challenges of fundamentally altering the Everglades, may also prove to be its biggest weakness. The flexibility required by the Restudy provides a reason to avoid strict allocation of water flows, and its refusal to override policy decisions among competing users marks the boundaries of the Restudy's

113. See id. ¶ 6.1, at 6-1.
114. See id.
115. See id. ¶ 6.3.1, at 6-3.
117. See id. at § 528(b)(6).
118. See Christaldi, supra note 33, at 1078.
authority. The end result is that the Comprehensive Plan does not provide for environmental protection in cases of eventual conflict between competing water uses. When such pressures arise, deciding whether to provide a mechanism for conserving water for the restored environment will occur on the state level.\textsuperscript{119}

\textbf{CONCLUSION}

Increased appreciation of environmental values and rampant development have combined to create a demand for more effective resource management strategies. Both ecosystem management and adaptive management appear to be well suited vehicles for addressing the complexities of the Everglades ecosystem. Many challenges will arise as the Corps implements the Restudy—some common natural resource management problems and some resource management problems are unique to the Everglades. One of the greatest challenges will be to create a decisionmaking process that produces a functioning Everglades ecosystem and provides sufficient responsiveness toward local input. As these management approaches are implemented in Florida, the results will be worth watching.

\textsuperscript{119} See \textit{Restudy}, supra note 2, ¶ 10.7, at 10-75.