MODIFIED WATER DELIVERIES TO EVERGLADES NATIONAL PARK
TAMIAMI TRAIL MODIFICATIONS
FINAL LIMITED REEVALUATION REPORT AND ENVIRONMENTAL ASSESSMENT

U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

US Army Corps of Engineers

U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
EVERGLADES NATIONAL PARK

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE), and the Department of the Interior (DOI), represented by the National Park Service (NPS) and the U.S. Fish and Wildlife Service (FWS), have re-evaluated alternatives to restore Everglades National Park (ENP) by redistributing and providing additional flows of water into the Park through U.S. 41, Tamiami Trail.

After reviewing Congressional directives and targets, all previous reports, and previous and new alternatives and costs, the agencies recommend a plan consisting of two actions: 1) build a one-mile long bridge in the project area's eastern segment and 2) raise the headwater stage constraint in the L-29 Borrow Canal by one foot to eight and one half feet; which would require road mitigation on parts of U.S. Highway 41 in the action area, located between S-333 on the west and S-334 on the east. This Recommended Plan is called Alternative 3.2.2.a.

The Limited Reevaluation Report (LRR) Recommended Plan's total fully funded cost estimate, which includes escalation to the mid-point of construction, is $**212 million**; its total first cost estimate (excluding escalation) is **$205.3 million**. The LRR Recommended Plan would improve connectivity, reduce sharp flow velocity changes, and improve rainy season depth and duration which are hydrologic conditions needed to sustain slough vegetation in ENP. It would provide nearly double the hydrological and habitat benefits as lower cost alternatives and construction could begin in late Fiscal Year (FY) 2008. Since the bridge segment is part of the 2005 Revised General Reevaluation Report (RGRR) recommended plan, it would be compatible with anticipated Comprehensive Everglades Restoration Plan (CERP) stages of up to 9.7 feet. The LRR Recommended Plan would also be compatible with future changes anticipated under CERP, as the bridged segment would not require rebuilding. With the exception of the 10.7-mile bridge (Alternative 4.2.4) and the "Blue Shanty" (Alternatives 5.3 and 5.4), none of the other alternatives appeared capable of accommodating flows of 4,000 cubic feet per second (cfs). Although 4,000 cfs flows are only expected under infrequent, high rainfall events, flows of this magnitude are important to induce positive ecological response. These three alternatives capable of accommodating 4,000 cfs flows were eliminated from consideration due to cost.

Background. The Everglades National Park Protection and Expansion Act, December 1989, authorized the Secretary of the Army to improve water deliveries to ENP and to take steps to restore natural hydrologic conditions to the extent practicable. The General Design Memorandum (GDM) called for in the Act was completed in June 1992. The 1992 GDM and Environmental Impact Statement (EIS) recommended transfer of water into the park from Water

Conservation Area (WCA)-3B to the L-29 Canal, and assumed that the existing culverts under Tamiami Trail (U.S. Highway 41) roadway would be adequate to convey the increased flows. Subsequent hydrologic analyses revealed that the higher stage in the L-29 Canal that would be required for the culverts to convey the increased flows could adversely affect the structure of Tamiami Trail and cause progressive road failure under infrequent storm conditions.

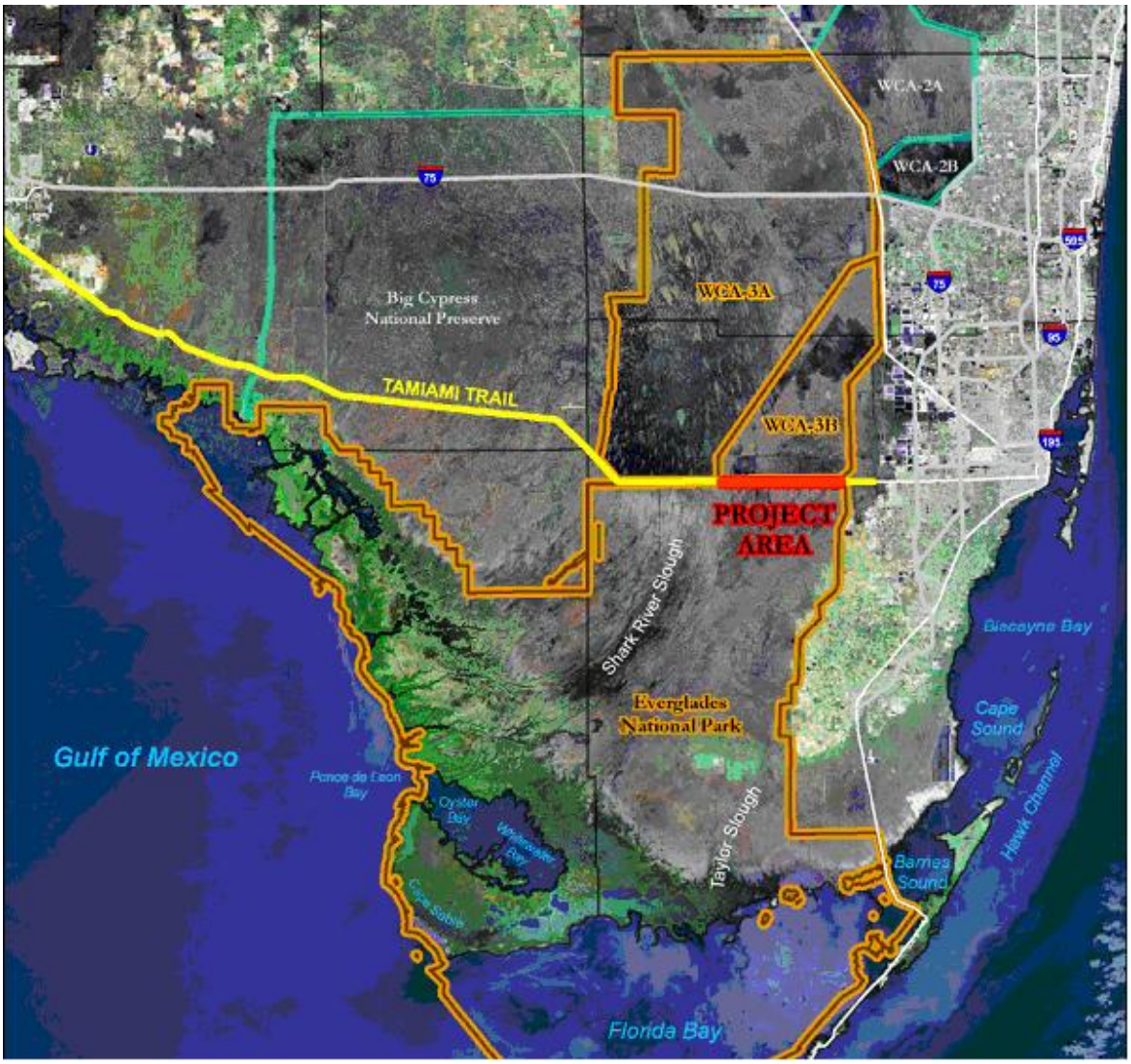

Figure ES-1. Project and Study Area Location

The Project area includes a 10.7 mile long section of Tamiami Trail.

Alternative means for water conveyance were first evaluated in a General Reevaluation Report and Supplemental Environmental Impact Statement (GRR/SEIS), the final version of which was coordinated with the public in 2003. The 2003 Preferred Plan was a 3,000 foot bridge and a proposed agreement to

pay compensation to Florida Department of Transportation (FDOT) for a flowage easement along the unbridged portion of Tamiami Trail. State concerns regarding probable damage to Tamiami Trail were raised prior to, during and subsequent to the public and agency review of the final report, and the Final GRR/SEIS was withdrawn without a signed Record of Decision.

In 2005, a revision of the GRR examined additional alternatives. Ten alternatives, including no-action, were considered, including the previously considered 3,000 foot long bridge. All alternatives would have conveyed the increased flows associated with Modified Water Deliveries (MWD). All would have required removal of the roadway in the footprint of the bridges and the reconstruction, with an asphalt overlay, of the unbridged portion of the road.

The 2005 RGRR Alternatives were as follows:

- No-Action
- Alternative 9 — 3,000 foot long bridge
- Alternative 10 — Four Mile long bridge in the central region of the project area
- Alternative 11 — Four mile long bridge at the eastern end of the project area
- Alternative 12 — Three mile long bridge
- Alternative 13 — Two mile long bridge
- Alternative 14 — Two mile long bridge at the western region of the project area and a one-mile long bridge at the eastern end
- Alternative 15 — 1.3 mile long bridge at the western region of the project area and a 0.7 mile long bridge at the eastern end
- Alternative 16 — Three 3,000 foot long bridges
- Alternative 17 — 10.7 mile long elevated roadway within the existing right of way

All 2005 alternatives incorporated a design high water of 9.7 feet. Alternatives were evaluated by an interdisciplinary team based on their ability to meet targets for hydrologic and ecologic performance measures.

2005 RGRR Recommended Plan. The 2005 RGRR Recommended Plan was Alternative 14 (widen and raise road profile with two mile bridge west and one mile east, and reconstruct the remaining unbridged roadway). Total project cost was estimated at approximately $144 million dollars. After public coordination of a Draft and Final GRR/SEIS, and consideration of all comments from agencies, stakeholders and the public, a Record of Decision selecting Alternative

14 was signed on January 25, 2006 and the proposed project was sent to Congress for consideration in the FY 2007 budget.

Congressional Consideration of 2005 RGRR Plan; 2007 "Managers' Language". When the 2005 RGRR plan was approved in 2006 by the Assistant Secretary of the Army for Civil Works, early Pre-construction Engineering and Design work led to refinement of the total cost estimates for Alternative 14. By the time Congress considered the Tamiami Trail Modifications for inclusion into the authorizing language in the 2007 Water Resources Development Act (WRDA) in early summer of 2007, revised and more detailed cost estimates for the plan, including a newly required cost risk analysis, put the cost at **$305 million**. Congressional managers developing WRDA 2007 expressed dismay at the relatively rapid cost increase and high cost of the 2005 RGRR plan; and directed proponents in the DOI and USACE to re-evaluate the 2005 Plan and develop less costly alternatives. That direction is the basis for this LRR. The cooperating agencies were directed to:

"Re-examine options to modify the water deliveries to the Park. However, the managers also direct the Chief of Engineers to pursue immediate steps to increase flows to the Park of at least 1,400 cubic feet per second, without significantly increasing the risk of roadbed failure. Flows less than 1,400 cubic feet per second will not produce measurable benefits to the Park…"

"…The managers direct the Chief of Engineers to re-examine the prior reports and environmental documentation associated with modifying water deliveries to the Park prepared under the 1989 Act, and to evaluate the practicable alternatives for increasing the flow of water under the highway and into the Park. The recommendations…shall, to the extent practicable, take steps to restore the natural hydrological conditions within the Park. The managers direct that the flows to the Park have a minimum target of 4,000 cubic feet per second so as to address the restoration envisioned in the 1989 Act."

This LRR re-evaluated the most likely cost of Alternative 14, as directed. After applying cost-risk considerations as required by USACE planning guidance implemented beginning in September 2007, the current estimated cost of RGRR Alternative 14 (Alt 4.2.3 in the LRR) is **$430 million**.

The team also examined 27 options including no-action and the 2005 RGRR plan. The actions included reinforcing the road only (in six-inch increments up to 9.7 feet), doubling the number of culverts alone, adding a bridge only (at two different locations), and various combinations of road reinforcement and culverts or road reinforcement and bridges. Alternatives from the RGRR that were more costly than Alternative 14 from the RGRR were not re-evaluated, as the team felt that they would be even more expensive than the previously selected plan.

Each alternative was examined for hydrologic performance (flow volume and flow velocity) and ecologic performance. They were compared against the flow targets set by the Managers' language, and against cost constraints. Finally, they were evaluated in terms of how quickly construction could commence.

The team's analysis quickly eliminated alternatives focused solely on road reinforcement, as they did not provide better velocity distributions of flow than under no-action. Likewise, culvert-only alternatives were eliminated for similarly poor performance, and were less efficient than bridge alternatives (at each stage constraint) in increasing average and peak flow delivery to the Park. Four final alternatives and no-action were carried forward for evaluation according to the USACE's criteria of completeness, efficiency, effectiveness and acceptability. All alternatives retained for detailed screening provided significant improvements in terms of hydrologic and ecological performance. The best performing and most cost-effective plan is Alternative 3.2.2.a, which combines a one-mile bridge in the eastern location with raising the stage constraint at L-29 by one foot, to eight and one half feet, and providing road mitigation to this level. Alternative 3.2.2a provides flow benefits to meet the Managers' language, nearly doubles the ecosystem performance outputs compared to no action, and is forward compatible with future CERP improvements. If approved by Congress, construction could commence on Alternative 3.2.2a with a projected completion date in late 2011. The total fully funded cost estimate for Alternative 3.2.2a, the Recommended Plan, is **$212 million**. This estimate includes risk and uncertainties at the 90 percent confidence level, as well as expected cost escalation to the midpoint of construction. This confidence indicates that there is a 90 percent chance the final cost for this project (at FY-08 pricing levels) would be equal to **or less** than this estimate.

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Table of Contents

* Elements marked with an asterisk (*) are required for NEPA compliance according to CEQ Regulations.

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Acronyms

8.5 SMA	8.5 square mile area

A

AAHU	Average Annual Habitat Unit
ADT	average daily traffic

B

BMPs	Best Management Practices
BO	Biological Opinion
BOD	Biochemical Oxygen Demand

C

C-111	Canal 111
C&SF	Central and Southern Florida
CE/ICA	Cost Effectiveness and Incremental Cost Analyses
CERP	Comprehensive Everglades Restoration Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CSOP	Combined Structural Operating Plan
CSSS	Cape Sable seaside sparrow
CWE	Current Working Estimate
CWE	Control Water Elevation (Appendix B-Engineering)
CY	cubic yard

D

dBA	decibels
DERM	Miami-Dade County Department of Environmental Resource Management
DM	Design Manual
DO	Dissolved Oxygen
DOI	US Department of the Interior
DSL	Design Service Life

E

EA	Environmental Assessment
ECB	Engineering Construction Bulletin

EDEN	Everglades Depth Estimation Network
EDR	Engineering Documentation Report
EIS	Environmental Impact System
ENP	Everglades National Park
EO	Executive Order
EPR	External Peer Review
ER	Engineering Regulation
ESA	Endangered Species Act
EVER	Everglades National Park

F

FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FLUCCS	Florida Land Use/ Cover and Classification System
FONSI	Finding of No Significant Impact
FP&L	Florida Power and Light
FSEIS	Final Supplemental Environmental Impact Statement
FWC	Florida Fish and Wildlife Conservation Commission
FWCAR	Fish and Wildlife Coordination Act Report
FWS	US Fish and Wildlife Service
FY	Fiscal Year

G

GDM	General Design Memorandum
GIS	Geographic Information Systems
GMP	General Management Plan
GRR	General Reevaluation Report

H

HCM	Highway Capacity Manual
HED	Highway Easement Deed
H&H	Hydrology and Hydraulics
HQ	Headquarters
HTRW	Hazardous Toxic and Radioactive Waste

I

IGE	Independent Government Estimate
IOP	Interim Operational Plan
ISOP	Interim Structural and Operational Plan
ITR	Independent Technical Review

J

K

L

LF	linear foot
LOS	Level of Service
LRR	Limited Reevaluation Review

M

MCACES	Microcomputer Aided Cost Engineering System
MOA	Memorandum of Agreement
MOT	Maintenance of Traffic
MWD or Mod Waters	Modified Water Deliveries

N

NAAQS	National Ambient Air Quality Standards
NAC	noise abatement criteria
NAGPRA	Native American Graves Protection and Repatriation Act
NED	national economic development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NESRS	Northeast Shark River Slough
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NPS	U.S. National Park Service
NRHP	National Register of Historic Places
NSM	Natural Systems Model

O

OFW	Outstanding Florida Water
OMB	Office of Management and Budget
OMRR&R	Operation, Maintenance, Repair, Replacement and Rehabilitation

P

PAH	polycyclic aromatic hydrocarbons
PCA	Project Cooperation Agreement
PCB	polychlorinated biphenyls
PDT	Project Delivery Team
PED	Pre-construction Engineering and Design
PL	Public Law

Q

R

Re-MAP	Regional Environmental Monitoring and Assessment Plan
RPAs	Reasonable and Prudent Alternatives
RGRR	Revised General Reevaluation Report
ROD	Record of Decision
ROW	Rights of Way

S

S&A	Supervision and Administration
SEIS	Supplemental Environmental Impact Statement
SFWMD	South Florida Water Management District
SHPO	State Historic Preservation Officer

T

TBT	tributyltin
TCC	Total Construction Cost
TSP	Tentatively Selected Plan
TTM	Tamiami Trail Modification

U

USACE	US Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	US Geological Survey

V

VE	Value Engineering
VLF	vertical linear foot
VOC	volatile organic compounds
VPD	Vehicles per Day

W

WCAs	Water Conservation Areas
WQC	Water Quality Certification
WRDA	Water Resource Development Act
WSRS	Western Shark River Slough

X

Y

Z

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1.0 INTRODUCTION

This report is an integrated Limited Reevaluation Report (LRR) and Environmental Assessment (EA) for Tamiami Trail Modifications (TTM) for Modified Water Deliveries (Mod Waters) to Everglades National Park (ENP). The study leading to this report was conducted by an interdisciplinary team, including hydrologists, design and cost engineers, water modelers, managers, physical scientists, archeologists, planners, biologists, ecologists and National Environmental Policy Act (NEPA) specialists. Cooperating NEPA agencies with the U.S. Army Corps of Engineers (USACE) include the National Park Service (NPS) and ENP. The South Florida Water Management District (SFWMD) would be a cost-sharing partner with the USACE for Operations and Maintenance of the project. Once construction is complete, this project would become part of the Central and Southern Florida (C&SF) Project.

The purpose of this LRR is to identify a recommended plan for modifying Tamiami Trail (U.S. Highway 41) to meet the objectives of the 1992 USACE General Design Memorandum (GDM) called "Modified Water Deliveries to Everglades National Park" (often called the "Mod Waters" or "MWD" Project). Through extensive public and agency coordination, a recommended plan for this project was previously evaluated in the 2005 Revised General Re-evaluation Report (RGRR) and Environmental Impact Statement (EIS). It was approved by the USACE and forwarded to Congress in 2006. However, estimated costs of the plan grew dramatically since original authorization. Consequently, Congressional managers drafting the Water Resources Development Act (WRDA) of 2007 directed the USACE to identify a lower-cost plan still capable of meeting the Mod Waters objectives, and to submit a revised report by July 2008. The present report is intended to tier from the detailed evaluations provided in the 2005 RGRR and EIS, which is available for viewing on the USACE Jacksonville District website[1]. For the reviewer's convenience, sections of this report containing material required for NEPA evaluations are preceded by an asterisk (*) in the Table of Contents.

The project location is a 10.7-mile section of Tamiami Trail (U.S. Highway 41) from Structure 333 (S-333) on the west to Structure 334 (S-334) on the east. It is bordered to the north by Water Conservation Area (WCA)-3B and includes a discontinuous stretch of relatively deep marsh and slough called Northeast Shark River Slough (NESRS) in ENP (***Figure 1-1*** and ***Figure 1-2***).

Shark River Slough is a curving flow-way that originally stretched from the south shore of Lake Okeechobee southeastward through Palm Beach, Broward and Miami-Dade Counties in WCA-3A and 3B, where it curved south and then

[1] http://www.saj.usace.army.mil/dp/mwdenp-c111/index.htm

southwest into ENP. Historically, Shark River Slough was the central core of the Everglades flow-way.

The continuity of the slough into ENP has been blocked at the south end of WCA-3B by the L-29 Levee and adjacent L-29 Canal, both of which parallel the north side of Tamiami Trail. Currently, water flows through Tamiami Trail in a set of culverts into ENP. The goal of this integrated LRR/EA is to propose a plan to Congress that provides immediate steps to increase flows to ENP while meeting directives set by Congressional managers.

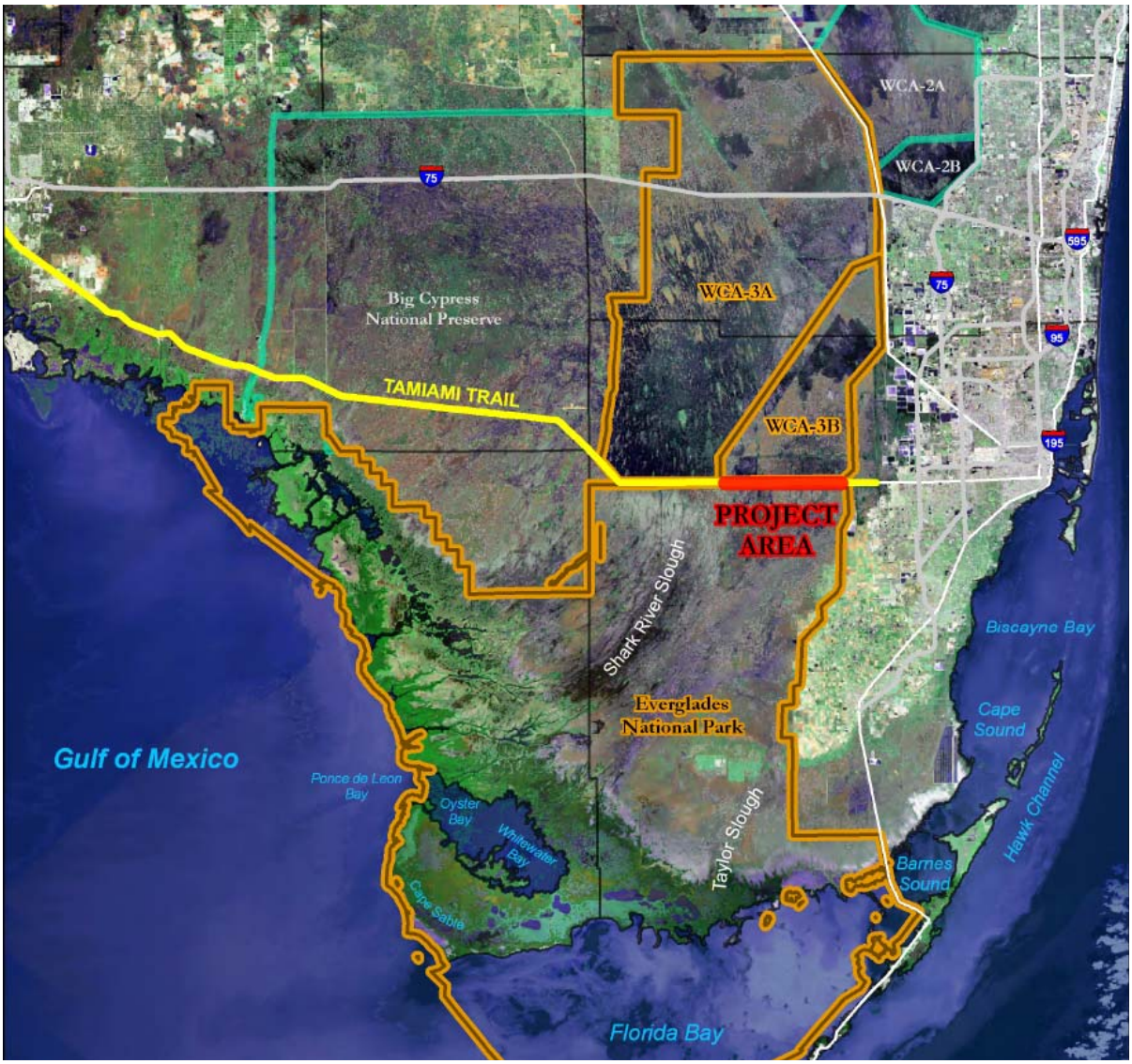

FIGURE 1-1: STUDY AREA AND SOUTH FLORIDA

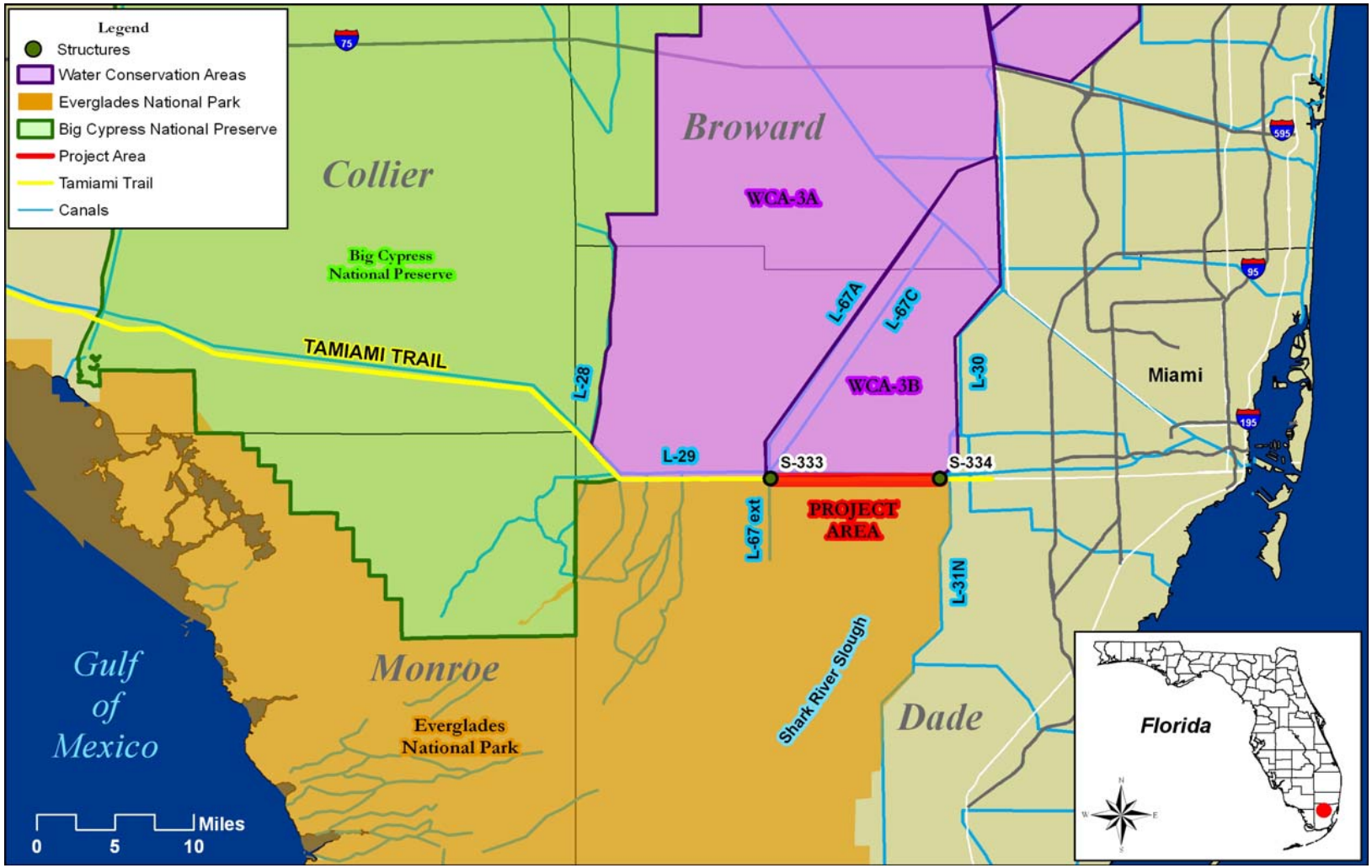

FIGURE 1-2: PROJECT LOCATION

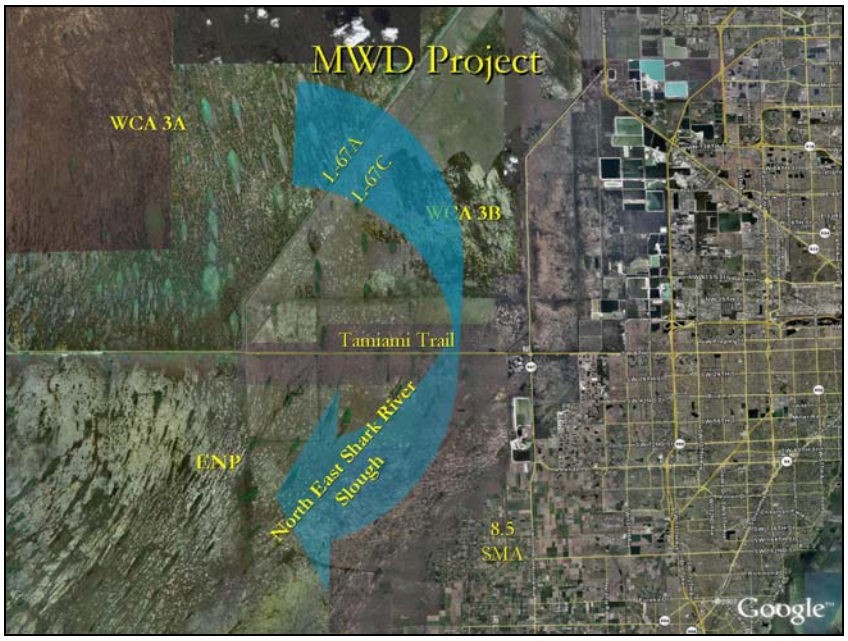

FIGURE 1-3: SHARK RIVER SLOUGH PATH

1.1 Project Authority and Congressional Intent

The Everglades National Park Protection and Expansion Act, (Public Law [PL] 101-229, Section 104, 16 U.S.C. Part 410r-5 *et seq*., December 1989), authorized the Secretary of the Army to undertake certain actions to improve water deliveries from the C&SF Project to the ENP.

Section 104 of the Act directed the USACE to address restoration of water deliveries and natural hydrological conditions. The Act states:

> *Sec 104 (a) (1): Upon completion of a final report by the Chief of the Army Corps of Engineers, the Secretary of the Army, in consultation with the Secretary, is authorized and directed to construct modifications to the Central and Southern Florida Project to improve water deliveries into the park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the park.*
>
> *Sec 104(a) (2). Such modifications shall be based upon the findings of the Secretary's experimental program authorized in Section 1302 of the 1984 Supplemental Appropriations Act (97 Stat. 1292) and generally as set forth in a General Design Memorandum to be prepared by the Jacksonville District entitled Modified Water Deliveries to Everglades National Park. The Draft of such Memorandum and the Final Memorandum, as prepared by the Jacksonville District, shall be submitted as promptly as practicable to the Committee on Energy and Natural Resources and the Committee on Environment and Public Works of the United States Senate and the*

Committee on Interior and Insular Affairs and the Committee on Public Works and Transportation of the United States House of Representatives.

Sec 104 (a) (3): Construction of project modifications authorized in this subsection and flood protection systems authorized in subsections (c) and (d) are justified by the environmental benefits to be derived by the Everglades ecosystem in general and by the Park in particular and shall not require further economic justification.

The USACE published a GDM in 1992 called "Modified Water Deliveries to Everglades National Park." This GDM satisfied in part the direction contained in the Everglades Protection and Expansion Act by providing for flood mitigation for the Indian camps and for the 8.5 Square Mile Area (8.5 SMA) of the "east Everglades", as well as a design for seepage and conveyance control features for the WCAs, but it did not address needed modifications to provide full conveyance capacity under the Tamiami Trail for anticipated additional flow volumes of up to 4,000 cubic feet per second (cfs) during the rainy season. It was known by 2000 that additional modifications to Tamiami Trail would be required to convey improved flows to NESRS. There were widely opposing views on the magnitude of changes to Tamiami Trail that were needed to provide the conveyance, making the evaluation process lengthy and difficult. In 2005, the USACE published a RGRR and Supplemental Environmental Impact Statement (SEIS) that would have provided capacity to allow improved flow volumes across the Trail, once the conveyance and seepage control features in WCA-3A and 3B were built. The major problem with the 2005 Recommended Plan was its anticipated cost. Although a Record of Decision (ROD) selecting the 2005 Recommended Plan was signed in January 2006, and the plan was proposed to Congress, the Selected Plan was not approved.

In 2007, Congress expressed dismay at cost increases associated with Tamiami Trail modifications, as well as the 18-year delay (since passage of the Everglades Protection and Expansion Act) in full implementation of "Mod Waters." Congress directed the USACE, in the managers' language written during drafting of the WRDA 2007, to:

"…re-examine options to modify the water deliveries to the Park… However, the managers also direct the Chief of Engineers to pursue immediate steps to increase flows to the Park of at least 1,400 cubic feet per second, without significantly increasing the risk of roadbed failure. Flows less than 1,400 cubic feet per second will not produce measurable benefits to the Park.

The managers direct the Chief of Engineers to proceed with increasing flows to the Park upon the completion of the eight and one-half square mile area construction this fall. Completing that construction removes the current

constraint on water levels within the Northeast Shark River Slough area of the Park.

The managers direct the Chief of Engineers to re-examine the prior reports and environmental documentation associated with modifying water deliveries to the Park prepared under the 1989 Act, and to evaluate the practicable alternatives for increasing the flow of water under the highway and into the Park. The recommendations resulting from this re-examination are to be for improving flows in a manner that is consistent with the direction in the 1989 Act that the Secretary of the Army construct modifications "to improve water deliveries into the Park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the Park. The managers direct that the flows to the Park have a minimum target of 4,000 cubic feet per second so as to address the restoration envisioned in the 1989 Act."

1.2 History of Tamiami Trail and the Everglades "River of Grass"

The Florida Everglades is one of the largest and most complex freshwater wetland ecosystems in the world. The location, timing, duration, and depth of flooding, combined with geology and other factors, determine the distribution and composition of the plant and animal communities of the Everglades. The southernmost end and receiving waters for the 18,000 square mile south Florida everglades ecosystem is ENP. Virtually all waters delivered to the Park other than direct rainfall are provided by the C&SF Project, which was authorized by the Flood Control Act of 1948 (PL 858, 80th Congress) for flood control, water supply, prevention of salt water intrusion, preservation of fish and wildlife, recreation and navigation. The USACE began building the C&SF Project in the 1950s. Construction was largely complete by 1962, although some construction continues to this day. The C&SF Project divided the shallow and slow-flowing Everglades wetlands into compartments and installed pumps and gated structures to control flow from one segment to another.

The Tamiami Trail, which was completed in 1928 by the Florida State Road Department, is an impediment to flow, slowing and blocking water flow south into the southern Everglades and ENP. Additional blocking of direct flow occurred with the 1962 construction of the L-28 and L-29 levees enclosing WCAs-3A and 3B and enlargement of the road borrow canal (now called L-29 Canal), as part of the C&SF Project. The cumulative result of construction of Tamiami Trail and the C&SF Project was significant reduction in the volume, timing and duration of water flow to NESRS.

Until Congress enacted the 1989 Everglades Protection and Expansion Act, ENP was smaller than at present. The large S-12 gate structures on the L-29 Levee at the south end of WCA-3A could deliver high water volumes to the Park itself, but most of NESRS lay in the undeveloped lands between ENP and the

developed areas near the east coast. This area received water only from direct rainfall and through culvert sets under the road. An extension of the L-67 Levee, running along the Park's eastern boundary, restricted flow into NESRS from the west. Reduced inflows from the north and west resulting from the compartmentalization of the system led to reduction of flooding depths and durations and loss of long-hydroperiod habitats inside the Park. Slough habitat, the unique Everglades wetland complex immortalized as the "river of grass" by Marjory Stoneman Douglas, was among the most adversely impacted by flow reduction.

In response to conservationists' concerns over loss of Everglades values during the 1980s, US Congress passed PL 98-191, providing for experimental supplemental deliveries of water to the Park, in 1983. After a series of studies authorized under this Act, it became evident that it would be difficult to increase water deliveries to Park lands without adversely affecting adjacent agricultural lands. In 1989, Congress passed the Everglades National Park Protection and Expansion Act (PL 101-229). This Act authorized acquisition of 109,000 acres of privately owned and State lands located south of Tamiami Trail between the L-67 Extension and the L-31 Canal. This area was a major expansion of Park lands that would eventually allow for their re-hydration; but in 1989, there were minimal structures available to convey water into these newly acquired Park lands that had previously been kept relatively dry for agricultural and recreational use. Therefore, the Act also directed the USACE to increase flows into the Park to the extent practicable.

The USACE prepared a GDM for "Mod Waters to ENP". The GDM was completed in 1992 and included five major components:

1. Flood mitigation for the 8.5 SMA, a residential area located just west of the L-31N Levee (the new authorized eastern Park boundary) that would flood if additional water were discharged into the eastern Park extension.
2. Conveyance and seepage control features, designed to facilitate flow from WCA-3A to WCA-3B and from WCA-3B to the L-29 Canal adjacent to Tamiami Trail, and to limit seepage eastward from WCA-3B and ENP into developed areas of Miami-Dade County.
3. Modifications to Tamiami Trail to raise it in the vicinity of the S-334 structure.
4. Raising Tigertail and Osceola Indian Camps to levels above the expected flood levels.
5. A new operational plan for the water control structures was recommended that would deliver 55 percent of total water volumes east of L-67, and 45 percent to the west, to reflect historic flow paths.

The 1992 GDM noted that maximum rainy season flow volumes into the Park could reach 4,000 cfs, and recommended structures to deliver these flows into the L-29 Canal just north of Tamiami Trail. It did not anticipate that the existing culvert sets would be inadequate to deliver this volume, and recommended raising the Trail only to accommodate the S-334 and S-356 pump structures (at the far eastern end of the road segment)

Since 1992, ENP has acquired nearly all the additional authorized lands east of the old Park boundary. A flood mitigation plan for the 8.5 SMA, including relocation of the S-357 pump station, was approved in 2000 and reaffirmed in 2003, and construction is now nearing completion. Tigertail Camp has been raised. ENP is in dialog with the Osceola group in preparation for raising this camp as well. The S-356 pump station was built as a temporary pump station at the location indicated in the GDM. The S-355A and S-355B spillways, allowing water flow from the south end of WCA-3B into L-29 Canal, have been built. However, the last remaining conveyance and seepage features, the S-349 spillways and S-345 flow structures that would allow flow through the L-67 Levees between WCAs-3A and 3B, remain to be built. The final design of these structures would depend in part on the selection and approval of the preferred alternative (recommended plan) for Tamiami Trail.

The WRDA 2000 authorized the Comprehensive Everglades Restoration Plan (CERP) ***(Figure 1-4)***. The restudy of the C&SF Project that led to CERP indicated that further work on reducing barriers to flow in WCA-3 was justified. However, WRDA 2000 also required that the MWD plan be complete before "CERP" modifications could begin construction. (***Figure 1-5)*** shows CERP WCA-3 Decompartmentalization as conceptualized in WRDA 2000.

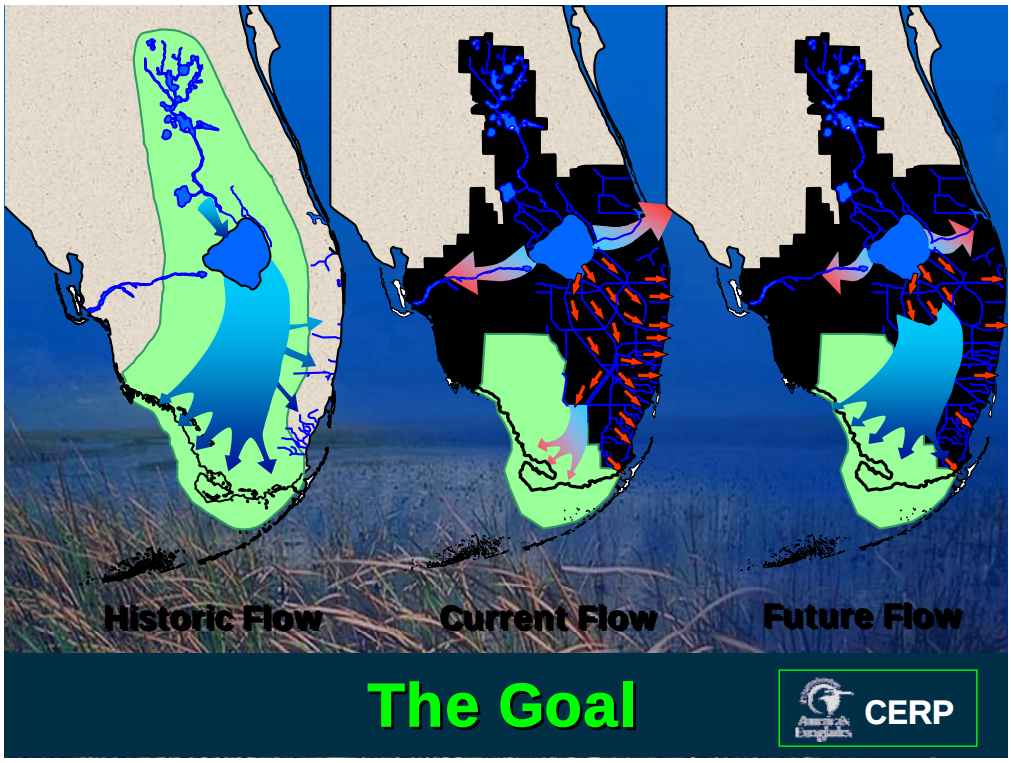

FIGURE 1-4: CERP: THE GOAL

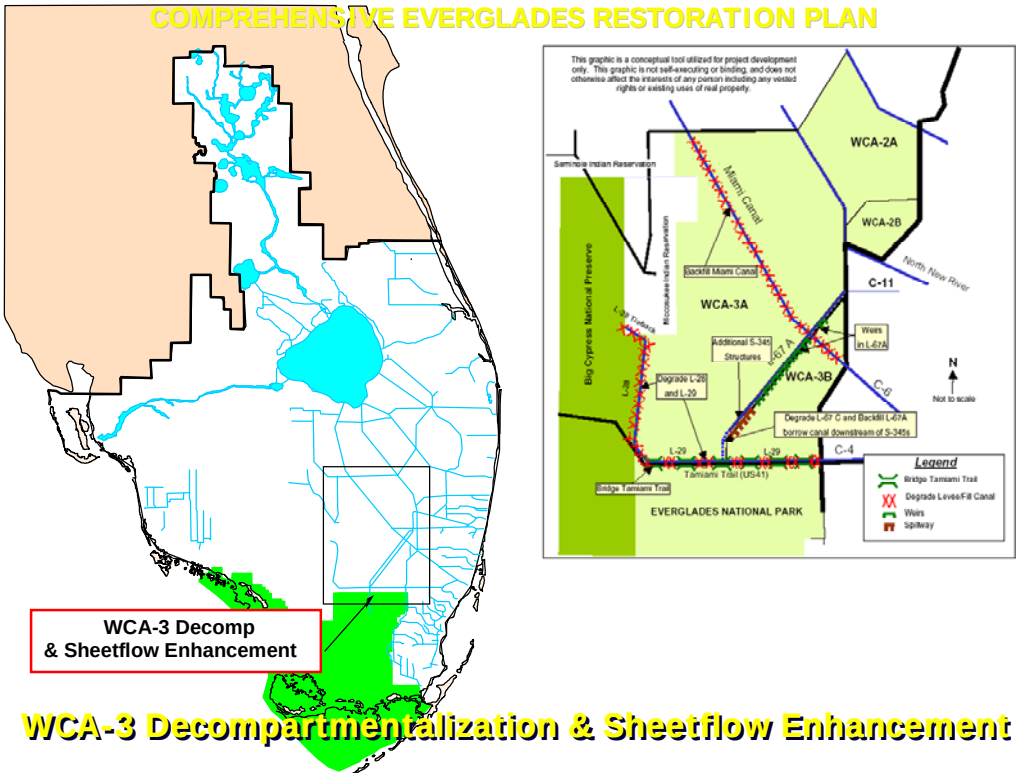

FIGURE 1-5: WCA-3 DECOMP

By the late 1990s it was known that in contrast to the 1992 GDM assumption, the existing culvert sets through Tamiami Trail were inadequate to pass Mod Waters design flows, and that operating with no additional conveyance structures would ultimately damage the road bed. The GDM merely recommended changing the flow distribution across the Trail such that 55 percent of total flows would be delivered east of the L-67 Levee and 45 percent delivered to the west. However, subsequent studies showed that, while the design volumes of water could indeed be passed through the Trail into NESRS, this flow rate through the culverts would only occur with a high "head" on the north side of the culverts; that is, after water levels on the north side of the road increased enough to force water through. Under current operating conditions, such high levels would occur in the rainy season, except that deliveries are stopped to avoid exceeding a stage of 7.5 feet in L-29 Canal, the level considered safe by Florida Department of Transportation (FDOT) standards. Operational safeguards to prevent damage include closing the S-333 Structure according to stage readings on a gauge south of the Trail to avoid high heads in L-29. If high levels were to occur regularly or persist for longer periods they would make the road vulnerable to structural damage.

In 2003, a reevaluation of features along the 10.7-mile stretch of Tamiami Trail east of the L-67 Levee recommended a 3,000-foot bridge and a proposed real estate agreement to pay compensation for a flowage easement. The USACE published a General Reevaluation Report (GRR) and EIS in 2003[2] which recommended a 3,000-foot bridge and noted that the original GDM had probably underestimated the design high water stage. The 2003 study used a design water elevation of 9.7 feet. Although this report recommended acquiring a flowage easement over the unbridged part of Tamiami Trail and compensation to FDOT for damages, no agreement could be reached with FDOT; because of lack of state agency support the report and EIS were withdrawn.

In the 2005 RGRR and SEIS, the recommended plan was Alternative 14– construction of a three-mile, two-bridge alternative and reconstruction of the entire 10.7 mile stretch of Tamiami Trail to accommodate the higher water levels (up to 9.7 foot stage) under the road. After extensive public and agency coordination a ROD identifying the Selected Plan was signed on January 25, 2006, and Alternative 14 was forwarded to Congress. Congress found the estimated cost of the 2005 plan unacceptable and the Congressional managers drafting WRDA 2007 directed the USACE to conduct this reevaluation study.

Estimated costs for the Tamiami Trail features have grown markedly since the original authorization, due to the cost of reinforcing the highway, the cost of improving conveyance and significant increases in the costs of construction materials. As costs of materials, including fuel, real estate, steel, Portland

[2] http://planning.saj.usace.army.mil/envdocs_A-D/Dade_Co/Tamiami_Trail/index.html

cement and asphalt continued to rise in world markets during the 2006-2008 period the estimated cost of the 2005 Selected RGRR Plan increased dramatically from $144 million to the approximately $430 million shown in this report.

The conference report language for WRDA 2007 directed the Chief of Engineers to conduct this reevaluation study. Implicit in the direction was a requirement that the new recommended alternative be less costly than the previous recommended plan.

1.3 Study Scope and Organization

From the conference report language the intent of Congressional managers was that the Chief of Engineers implement cost effective measures to immediately improve water deliveries and adopt an adaptive management approach toward restoring flows to ENP. The managers targeted immediate flow increases to 1,400 cfs, with a target of 4,000 cfs under the Trail to address GDM estimates of peak flows. Flows less than 1,400 cfs were perceived as not being able to produce a measurable benefit to the ENP.

This report documents previous and recent studies to modify Tamiami Trail. It provides a summary of the following information:

1. Updated cost estimates of previous plans proposed in the 2005 RGRR for an improved water delivery system for ENP, including incorporation of cost saving measures and value engineering proposals.
2. Limited reevaluation of alternatives, including cost analyses, for all proposed structural alternatives. Alternatives were arrayed and evaluated stepwise in order of increasing magnitude and potential cost.
3. Evaluation of each alternative's potential to meet flow volume, velocity and distribution targets, as well as potential ecosystem restoration benefits associated with each alternative.
4. Evaluation of forward compatibility with potential CERP actions in the CERP "WCA-3 Decompartmentalization" project element.

This report includes a general description of all viable alternatives, cost estimates, and environmental benefits analysis. Recommendations were developed considering environmental benefits produced, cost, future CERP flow needs, and other relevant factors.

1.4 Purpose of and Need for the Action

The purpose of this Limited Re-evaluation is to answer directives from the Managers' language cited in Section 1.1. The USACE and ENP must recommend a plan in a Report to Congress no later than July 1, 2008. This

report must identify a plan that is efficient, complete and acceptable in terms of cost and specified hydrologic targets that generate desired ecological responses.

The need for the action is the same as cited in the Mod Waters Tamiami Trail Modification 2003 GRR and the 2005 RGRR: In its current condition, the segment of Tamiami Trail located between S-334 on the east and S-333 on the west has inadequate capacity to deliver the volumes of water required to restore ENP and in NESRS without risking damage to the roadbed and its eventual degradation and causing a backwater impact on WCA-3B potentially drowning tree islands. The recommended plan must address: (1) measures to increase conveyance of water to NESRS, and (2) modifications to the existing roadbed, if any, required to allow this conveyance.

The flow requirement of the MWD to ENP Project has generated considerable confusion as to the intent of the Congressional Authorization. The Everglades National Park Protection and Expansion Act (PL 101-229) Sec 104(a) (1) did not authorize a specific flow rate but states, as cited in Section 1.1, to "improve water deliveries into the park" and "take steps to restore the natural hydrological conditions within the park."

The Managers' language references recommendations of the 1992 GDM relative to maximum average rainy season flows and maximum flows. The final 1992 GDM Report, Part 1 Supplement 54 General Design Memorandum and Environmental Impact Statement Modified Water Deliveries to Everglades National Park, Florida June 1992, Section H. Recommended Project (page 52) defines the measures for which restoring the natural hydrologic conditions to the extent practicable would be met:

> *"The goal of restoring natural hydrologic conditions will be met in terms of all three of its dimensions: location, timing and volume:*
>
> a. *Location–The historic path of Shark River Slough will be restored by bringing WCA-3B and NESRS back into the flow-way between WCA-3A and ENP.*
> b. *Timing–Water flows through the restored Shark River Slough will reflect natural local meteorological conditions, including the extremes of natural droughts and floods, and variations in the annual seasonal and long-term cycles.*
> c. *Volume–The volume of water delivered will reflect the naturally available supplies based on local meteorological conditions, except in cases where operations of the C&SF project for other authorized project purposes necessitate increased or decreased deliveries. Natural hydroperiods will be restored."*

In addition, the 1992 GDM Report, Part 1 Supplement 54 General Design Memorandum and Environmental Impact Statement Modified Water Deliveries to Everglades National Park, Florida June 1992, Section I. Environmental Analysis (page 58) went on to state:

> "Hydrologic restoration of WCA No. 3B is also essential to restoring natural water conditions in the Park. Diversion of flood waters from WCA No. 3A into detention in WCA No. 3B would decrease the volume of and, in some cases, the need for regulatory water releases in to the Park from WCA No. 3A. This would reduce the frequency of unnatural distributions of water across SRS, and further reduce the occurrences of alligator nest flooding south of the S-12s. The ability to discharge an additional 2,000 cfs of water in to NESRS through the new S-355 structures and 1,300 cfs through S-333, would allow full restoration of historic water depths in the center of the slough, thereby causing reflooding of the short-hydroperiod marshes on the eastern slope of the slough. This would accrue all the wildlife benefits from increased primary and secondary productivity previously discussed. In addition, aquifer recharge, reestablishment of groundwater flows, surface water reconnection between SRS and Taylor slough, and restoration of estuarine productivity would be maximized."

The specific high flow rate value of 4,000 cfs is based on the total capacity of flow for the recommended structures that would be implemented under this plan to deliver water (Volume) into the L-29 Canal between structures S-333 and S-334, inclusive of the seepage return flow from pump station S-356. These structures and their maximum discharge capacities are:

- S-333 (1,350 cfs), discharges water from WCA-3A
- S-355A (1,000 cfs), discharges water from WCA-3B
- S-355B (1,000 cfs), discharges water from WCA-3B
- S-356 (950 cfs), returns seepage water from NESRS

The 4,000 cfs peak flow volume for the MWD to ENP Project is important because it allows for a discharge sufficient to create the physical changes to the landscape (geomorphology of the system). The changes that occur during these peak discharges are important ecologically; for example, these types of volumes clean out sloughs, potentially create new sloughs, and are important for creating favorable ecological conditions in NESRS that would persist for the wet season and into the dry season. It is even desirable, but beyond the scope of MWD, to actually achieve flows greater than 4,000 cfs. The general goal of MWD to ENP was to restore, to the extent practicable, the natural hydrology of the system. It is felt that the 4,000 cfs discharge into NESRS is approximately representative of a 1 in 10 year flow event. At a minimum the system would have to experience

the variability of stages up to a 1 in 10 year event to allow positive ecological changes.

Under current conditions, the existing 19 sets of culverts under Tamiami Trail cannot meet the target discharge of 4,000 cfs into ENP unless stages on the north side of the culverts in L-29 Canal are raised very high. These higher stages result in structural damage to the Tamiami Trail roadway embankment and increase the likelihood of flooding tree islands within WCA-3B. In its current condition, Tamiami Trail does not have the structural capacity to pass a rainy season average of 1,400 cfs without violating the FDOT stage constraints of 7.5 ft, National Geodetic Vertical Datum (NGVD) for Tamiami Trail.

The 2005 RGRR selected alternative had a one-mile eastern bridge, a two-mile western bridge, and the roadway embankment design was based on elevation 9.7 feet, NGVD (referred to as the Design High Water). One intent of the 2005 RGRR selected alternative was to provide unconstrained flow into ENP. This did not mean that the 9.7 foot stage would not be exceeded, but if the stage were to be exceeded, then the system would not have to be controlled as currently required. In other words, flows and stages would be representative of the naturally available supplies based on local meteorological conditions. This alternative would allow for the 4,000 cfs flow target to be met.

The goal of MWD and therefore this LRR is to evaluate alternatives in terms of their capability to increase flow volume, timing and location to restore the natural hydrologic conditions of the Shark River Slough to the extent practicable. Future construction of the CERP and other project elements, especially storage reservoirs, seepage buffers and decompartmentalization of WCA-3, may allow for future higher volume releases to increase in frequency and duration. It is thus desirable, at a minimum, to indicate which plans could be compatible with further future modifications to increase water deliveries.

1.5 Study Sponsor

The U.S. Department of the Interior (DOI) has provided most of the federal funding to develop the MWD Project elements to date and is a cooperator under the NEPA for this Report. The SFWMD is the non-federal sponsor for operation and maintenance of the C&SF Project, as specified in the 1994 Project Cooperation Agreement (PCA). To ensure appropriate and timely coordination of federal/state activities, an interagency advisory team consisting of the DOI (US Fish and Wildlife Service [FWS] and NPS-ENP), the SFWMD, the Florida Fish and Wildlife Conservation Commission (FWC), the FDOT and the FDEP provided technical input for this report.

1.6 Project Location/Congressional District

The study area includes WCA-3A and 3B, as well as the portion of NESRS located within ENP. The project location, with structures included, is shown in ***Figure 1-2***. The proposed project is within Florida's 25th Congressional District.

The project features are located on US Highway 41, commonly referred to as the Tamiami (Tampa to Miami) Trail, which connects Miami and Tampa. The project location is a 10.7-mile stretch of the highway just west of Miami. The western end of the area is at S-333 near the L-67 Extension Levee, and the eastern end is at S-334 near the L-30 Levee and Canal and the L-31N Levee. The L-29 Canal (also known as the Tamiami Canal) runs along the north side of Tamiami Trail. The L-29 Levee runs along the north side of the L-29 Canal. The levee comprises the southern boundary of WCA-3B. ***Figure 1-6*** shows a cross section of Tamiami Trail, depicting the relationships among WCA-3B, L-29 Levee, L-29 Canal, Tamiami Trail, and ENP.

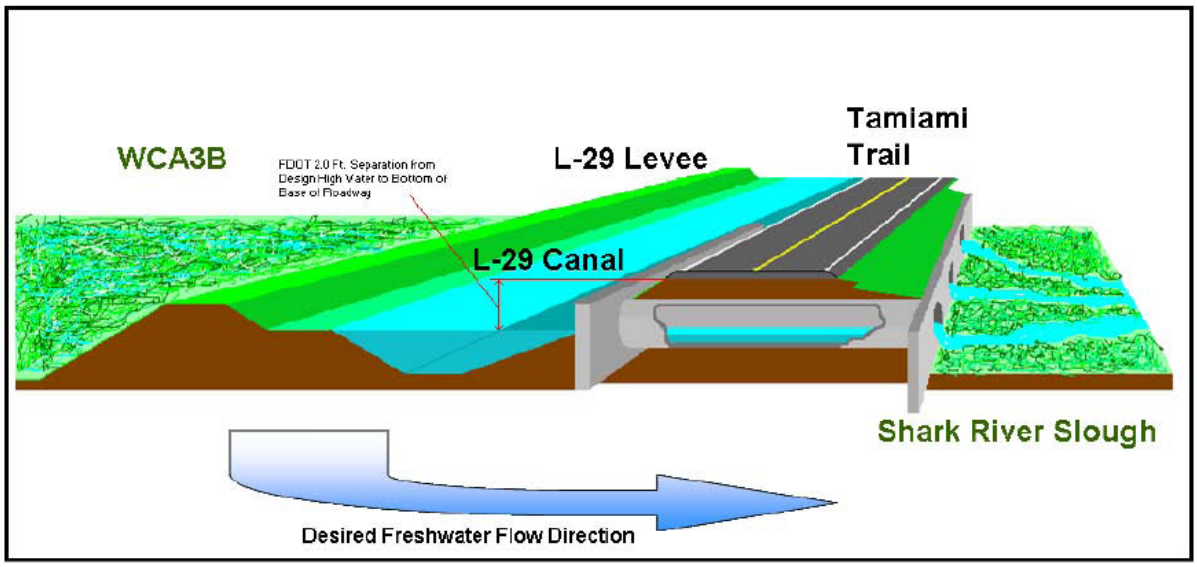

FIGURE 1-6: CROSS-SECTION OF TAMIAMI TRAIL
(current conditions)

1.7 Current Conditions

Over the last 50 years, the C&SF Project contributed to agricultural and residential development in south Florida through the conversion of nearly half of the Everglades ecosystem from wetland habitat to agricultural and urban uses. This development, which occurred along the eastern margins of the original marshlands north of Tamiami Trail, reduced the lands available for storing water and delivering it southward. Additionally, the C&SF Project has altered the hydrology of the remaining Everglades system through the operation of its

network of canals and levees. The altered timing of wet and dry cycles has resulted in water conditions that do not correspond to life cycles of native species. As a result, more water now flows through canals to the east and less flows southward through ENP to Florida Bay than occurred historically. Generally, the C&SF system makes it difficult to provide natural timing, volume and distribution. In wet periods, water is impounded in the WCAs and then discharged to Everglades or coastal canals. During dry periods, water can flow through the canals to coastal areas and bypass the ENP wetlands. Currently the system is operated under the Interim Operating Plan (IOP) for protection of the Cape Sable seaside sparrow (CSSS).

1.8 Prior Reports and Water Projects

The following prior planning efforts and reports are related to the Tamiami Trail portion of the MWD to ENP:

1. 1992 General Design Memorandum-Modified Water Deliveries to ENP Central and Southern Florida Projects
2. 2002 and 2006 Interim Operational Plan for protection of the CSSS, Final Environmental Impact Statement (EIS) and Record of Decision (July 2002), Final Supplemental Environmental Impact Statement and Record of Decision (May, 2007)
3. 8.5 Square Mile Area, General Re-evaluation Report and Final EIS, July 2000, Record of Decision Signed 6 December 2000
4. 2003 General Reevaluation Report and Supplemental Environmental Impact Statement (GRR/SEIS) for the Tamiami Trail Modified Water Deliveries to Everglades National Park (withdrawn)
5. 2005 Revised General Reevaluation Report[3] and Final Supplemental EIS, Tamiami Trail. December 2005 (ROD signed January 25, 2006)

1.9 Current Studies

As discussed earlier, Congress provided language that the Chief of Engineers "pursue immediate steps to increase flows to the Park of at least 1,400 cfs, without significantly increasing the risk of roadbed failure." Spreader swales, east-west ditches designed to receive and help deliver water from Tamiami Trail culverts to the marshes, were considered within the suite of LRR alternatives.

Modeling and evaluation of LRR alternatives suggests that spreader swale implementation would have minor hydrologic benefits that may not be ecologically significant.

Because technical disagreements exist regarding the ability to adequately simulate spreader swale performance, the NPS is taking the lead on a separate planning and NEPA process to consider a spreader swale pilot project and

[3] http://www.saj.usace.army.mil/dp/mwdenp-c111/index.htm

further evaluate the potential benefits of spreader swales along the Tamiami Trail.

1.10 Prior Coordination and Public Scoping

Two previous planning studies have been published, recommending two different alternatives for providing conveyance across Tamiami Trail. The 2003 final GRR and SEIS recommended an alternative of a 3,000-foot long bridge along the 10.7-mile stretch of Tamiami Trail. After this document underwent public and agency coordination, many agencies and environmental groups, including ENP, recommended further studies and evaluation to determine if a greater conveyance capacity could be justified. These studies led to the 2005 RGRR and SEIS, which recommended a one-mile long east bridge and a two-mile long west bridge. Both of these studies aroused considerable public and agency interest, and some controversy. Previously identified public issues and concerns included: maximizing potential connectivity between the ecosystems and communities of the WCAs and the ENP; restoration of historic deep water areas (sloughs) and medium-hydroperiod marshes; restoration of typical ridge-and-slough ground patterns by restoring higher-velocity sheet flow; maintenance of typical ecotourism businesses to the extent feasible along the south side of Tamiami Trail; impacts on the road itself and on other business properties; potential impact on Miccosukee camps and traditional use areas; and potential impacts on endangered species and their habitats. Federal and state agencies including FDOT, FDEP, FWC, Florida State Historic Preservation Officer (SHPO) and Florida Department of State, as well as the DOI, NPS and FWS, the general public and the Miccosukee Tribe provided comments and recommendations for these previous reports.

ENP has accepted an invitation from the USACE to be a NEPA cooperating agency. Agencies that were invited to be NEPA cooperating agencies for this LRR/EA include the SFWMD, FDOT and FDEP. A general public scoping letter was mailed on January 28, 2008, and was closed on March 7, 2008 inviting all concerned agencies and citizens who provided previous comments to provide information on their ongoing issues, concerns and recommendations for this study.

Concerns that have been emphasized in recent scoping responses include the following:

- The suite of studied alternatives includes several that would have provided very substantial potential benefits but were eliminated due to extremely high cost.
- Several government and non-government agencies consider a stage increase of one foot, which would provide a stage constraint of 8.5 feet, a more environmentally favorable stage. Scoping comments from SFWMD, FWS and FWC favor raising the stage constraint to 8.5 feet.

- Additionally many commentors feel that the ability to pass 4,000 cfs is equally important as an average peak rainy season flow goal.
- Representatives of the Miccosukee Tribe, in meetings with USACE representatives, repeated previous comments that cleanout or expansion of the culverts and regular maintenance thereafter would provide sufficient benefits, citing the high cost of bridges relative to road repair as one reason for these comments.
- The FWC would like serious consideration given to improving conveyance along other portions of the Trail in addition to the bridge on the eastern portion.
- Miami Dade County expressed concern about potential seepage and flood protection level of service to the east.
- Some commentors repeated previous calls for bridging the entire road segment to maximize potential re-connection of the WCAs and Park wetlands.
- One commentor, representing several non-governmental organizations and herself, objected to concrete bridge construction on the assumption that the cement used would ultimately come from limestone mines in the Lake Belt area.
- FDOT Representatives called for full inclusion of road repair costs in all project alternatives, and provided detailed specifications for road design along this stretch of Tamiami Trail.
- The Sierra Club stated support for the "Blue Shanty Plan" and asked the USACE to adopt all or a portion of that plan.
- Radio One is concerned with potential flooding impacts to its property.

1.11 Draft LRR Coordination

The draft LRR has been through several levels of review and coordination. Before the draft LRR was released to the public an Independent Technical Review (ITR) was performed by staff from other USACE districts.

The draft LRR was released for public and agency review on April 9, 2008 and available for public comment through May 9, 2008. The draft LRR was sent to local, state, and federal agencies, private interest groups, and interested public for review and comment. Public libraries in the project area were provided copies to maintain in the reference section of the libraries for public review. The draft LRR was also posted on www.evergladesplan.org for web viewing. Comments were submitted via an email address or by regular mail. Once the draft was released, public and stakeholder meetings were held to allow interested parties the opportunity to comment on the document.

Many comments were received in response to the draft LRR. A matrix of the comments and responses, as well as copies of the correspondence, is provided in Appendix J. Comments received during the review were considered in preparing

the final study documents and revisions were made to the report based on these comments.

In addition to the public and agency comments on the draft LRR, there was an External Peer Review (EPR) as well as a model certification review completed according to USACE regulations. The EPR was completed by a panel of independent scientists and engineers to review the technical rigor of the document and analysis. The model review was also completed by an independent review panel focused specifically on the model used in the alternative analysis. All comments submitted by the EPR team and the model review team to the study team were reviewed and answered. Both the EPR and model certification have been completed and approved by both teams.

1.12 Decisions to be Made

The adoption of a Recommended Plan, after USACE-Headquarters (HQ) approval, public and agency coordination of this LRR/EA, is the primary decision that must be made. As directed in the Conference Report for WRDA 2007, the cooperating federal agencies must recommend a plan to Congress by July 1, 2008 to provide immediate steps to increase flows to the Park.

Five agreements are needed in order to implement the Tamiami Trail Project.

1. Land Management Agreement–needed to complete the PCA (see item 3 below). This agreement is between USACE, DOI, and SFWMD on how to manage the project features where they extend into lands owned by ENP.
2. Florida Power and Light (FP&L) Perpetual and Temporary Construction Easements–agreement between USACE and FP&L that conveys rights to USACE to allow construction of the project bridge as well as a conveyance channel underneath the bridge on their land.
3. PCA Amendment–legally binding agreement between USACE and SFWMD identifying the SFWMD project duties and obligations fir the operation, maintenance, repair, replacement and rehabilitation (OMRR&R) of the project.
4. Highway Easement Deed (HED)–legal mechanism negotiated by DOI, Federal Highway Administration (FHWA), FDOT, SFWMD and USACE to convey lands necessary for the construction and operation of the one-mile bridge from ENP through FHWA to FDOT including a flowage easement and a channel easement.
5. Relocation Agreement–final agreement; agreement between USACE and FDOT to acquire the real estate rights to enter onto FDOT lands (from HED) to construct features and modify the existing roadway, a channel easement at the bridge location, and a flowage easement for the entire expanse of roadway within the project limits (i.e., 10.7 miles).

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2.0 HISTORY OF 2005 RGRR RECOMMENDED PLAN COSTS

2.1 Selected Plan from 2005 Revised General Reevaluation Report

The selected plan from the 2005 RGRR is Alternative 14, a plan with a total of three miles of openings in the Tamiami Trail to improve the quantity and distribution of flows from the WCAs to Shark River Slough and ENP. More specifically, the 2005 selected plan for Tamiami Trail consists of installing a two-mile and a one-mile bridge and reconstructing the roadway surface to avoid damage resulting from the required higher water levels (up to 9.7 feet NGVD) in the L-29 Canal. The two-mile bridge would be located near the western end of the 10.7 mile project area of Tamiami Trail, and the one-mile bridge would be located near the eastern end (***Figure 2-1***). The bridges would be located at points where the road was constructed through the historically deepest sloughs to provide the necessary conveyance of water south from WCA-3B into the NESRS section of ENP. The bridges would be constructed immediately south of the existing road (***Figure 2-2***). The existing road adjacent to the new bridges would be removed. The remaining eight miles of roadway would be widened and raised by about two feet to avoid damage to the granular base due to higher stages in the L-29 Canal (***Figure 2-3***). It would also be widened to support the increased elevation. The bridges would reduce the number of existing culverts sets from 19 (55 individual culverts) to 14 (40 individual culverts). The remaining culverts would require lengthening to extend beyond the widened roadway (***Figure 2-3***).

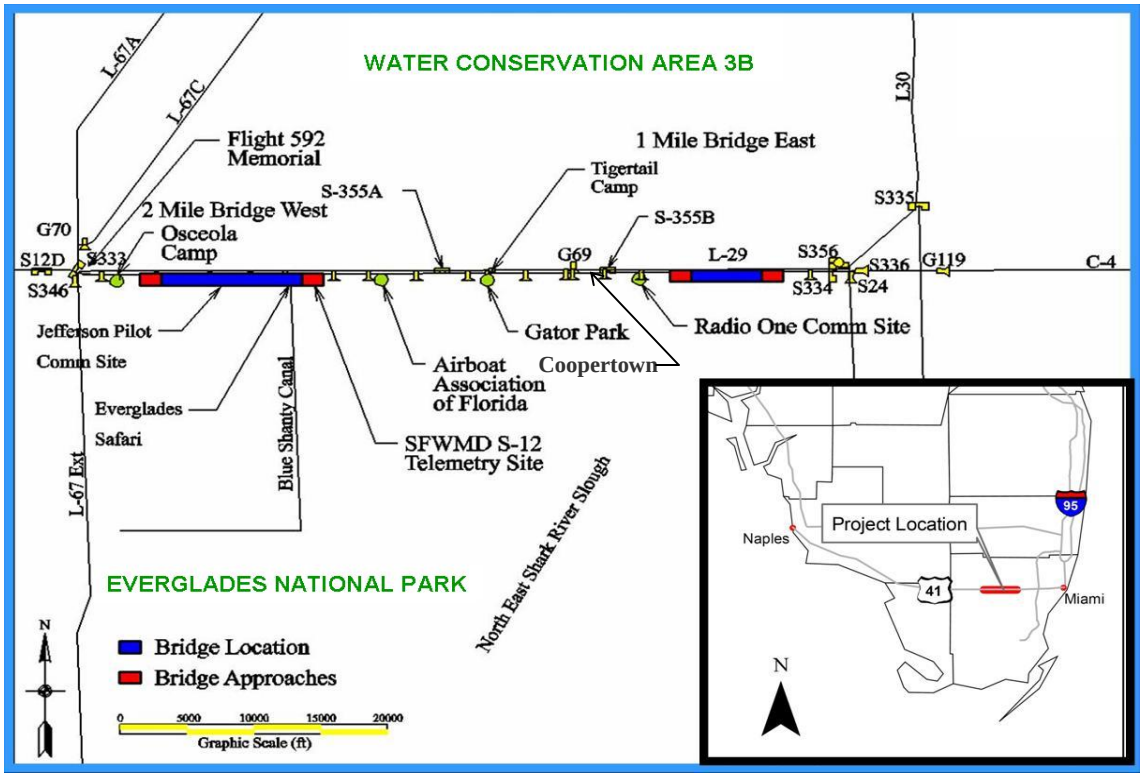


FIGURE 2-1: THE 2005 RGRR RECOMMENDED PLAN, ALTERNATIVE 14, STAGE CONSTRAINT = 9.7 FEET

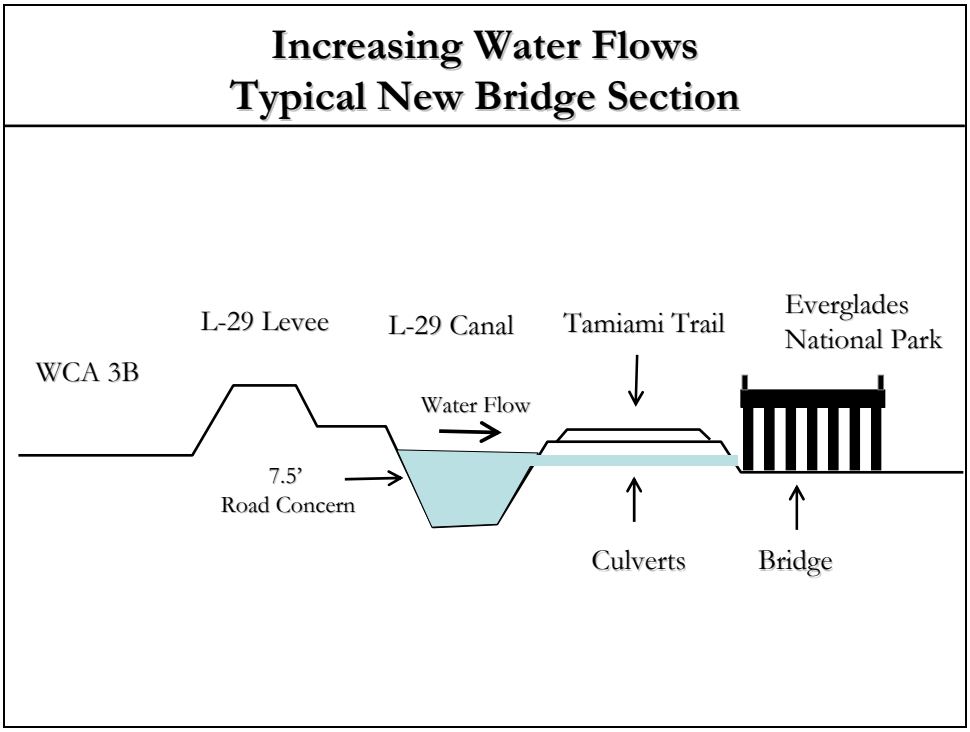


FIGURE 2-2: ALIGNMENT OF BRIDGES IN THE 2005 RGRR RECOMMENDED PLAN

(Compared to the existing Tamiami Trail and the L-29 Canal)

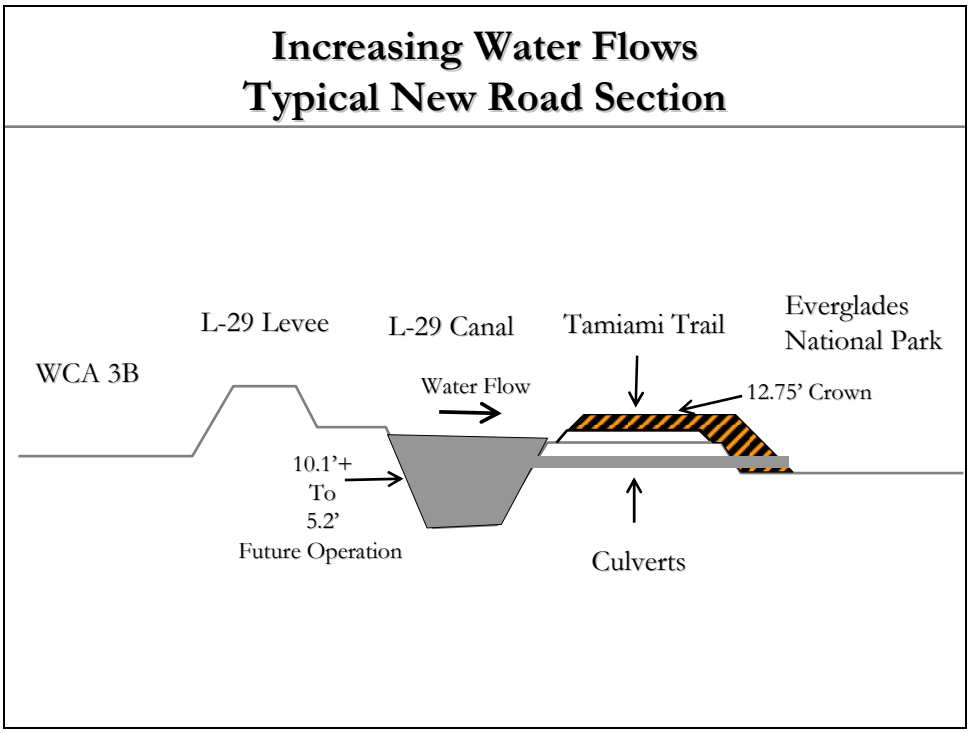


FIGURE 2-3: NEW ROAD SECTION FOR THE 2005 RGRR RECOMMENDED PLAN

(Showing the increased height above and width beyond the existing Tamiami Trail and the lengthened culverts)

2.2 Cost Update Purpose

Project cost estimates consist of several individual cost components. These components are often expressed as some percentage of the cost to construct the project. The components include:

- Construction Costs
- Non-Construction Costs including:
  - Real Estate
  - Pre-construction Engineering and Design (PED)
  - Supervision and Administration (S&A)
  - Escalation
  - Contingency

In the planning stages of a project, a variety of alternatives are developed as potential solutions to the problems and opportunities for the project. In alternative selection, the cost of an alternative is an important factor that plays a significant role in the selection of an alternative. When developing project alternatives, often only limited engineering design and details are available, resulting in preliminary project cost estimates with high uncertainty and large contingency costs. Once an alternative is selected and proceeds through engineering and design, additional data are collected (e.g., survey, geotechnical). These usually result in reduced uncertainty and reduced contingency costs.

The purpose of the cost update is to reexamine the 2005 selected plan presented in the 2005 RGRR, update the project costs to current cost levels and include new project costs associated with real estate and risk. The following sections will discuss the cost increases associated with the 2005 RGRR selected plan and provide an explanation for the discrepancy in costs between the 2005 cost estimate and the cost estimate in this report for same plan.

2.2.1 Cost Development of 2005 Revised General Reevaluation Report Recommended Alternative

During the development of the RGRR, both the design and the cost estimate were coordinated closely with FDOT. For the cost estimate in particular, price quotes and USACE developed unit prices were validated against the historic bid prices maintained by FDOT. In addition, both FDOT and FHWA reviewed the engineering design and the construction cost estimate presented in the RGRR and established that the work performed by USACE was technically adequate and in-line with FDOT and FHWA experiences.

To illustrate the parity between the USACE estimate and FDOT pricing, nine items were selected that represent 50 percent of the total RGRR estimate. As shown below, the unit prices developed during the RGRR are comparable to

FDOT unit prices from 2004 and 2005 as shown in ***Table 2-1*** (note that only partial data was available from FDOT for 2005 when the RGRR estimate was developed):

TABLE 2-1: FDOT UNIT PRICES FOR 2004 AND 2005

		GRR/SEIS Unit Price (July 2005)	2004 FDOT Unit Price	2005 FDOT Unit Price
Reinforced Concrete	CY	$984	$850	$1,085
24" Prestressed Concrete Piling	VLF	$121	$78	$62
24" Prestressed Concrete Test Piles	VLF	$456	$160	$200
Prestressed Concrete Beams-72" Florida Bulb T-Beams	LF	$258	$106	$233
Prestressed Concrete Beams-Type IV AASHTO Beams	LF	n/a	n/a	n/a
Paving-Asphaltic Concrete	TON	$104	$73	$82
Paving-Asphaltic Concrete-Friction Course	TON	$128	$83	$104
Barrier Wall	LF	$130	$115	$183
Embankment Fill	CY	$15	$15	$28
Drainage System	LF	$285	No direct comparison available	

CY-cubic yard; VLF-vertical linear foot; LF-linear foot; TON-ton

Much of the cost growth occurred in late 2005 and 2006 and has been experienced by other agencies (i.e., FDOT and SFWMD). In fact, if the cost of the 2005 RGRR recommended plan is estimated using the FDOT historic unit price data available in the summer of 2005, the estimated construction cost is approximately $110 million (compared to the USACE RGRR construction estimate of $125.1 million). One year later, the cost of the exact same RGRR plan increased by approximately 80 percent using the FDOT historic unit price data available in the summer of 2006. These numbers are intended to illustrate the magnitude of the construction cost increases that were occurring in the construction market during late 2005 and early 2006.

2.2.2 Present Day Cost for 2005 Revised General Reevaluation Report Recommended Alternative

Since the original cost estimate for the 2005 RGRR selected plan, costs of construction labor, equipment and material have significantly increased. ***Figure 2-4*** illustrates the dramatic surge in construction costs beginning in late 2003 and early 2004.

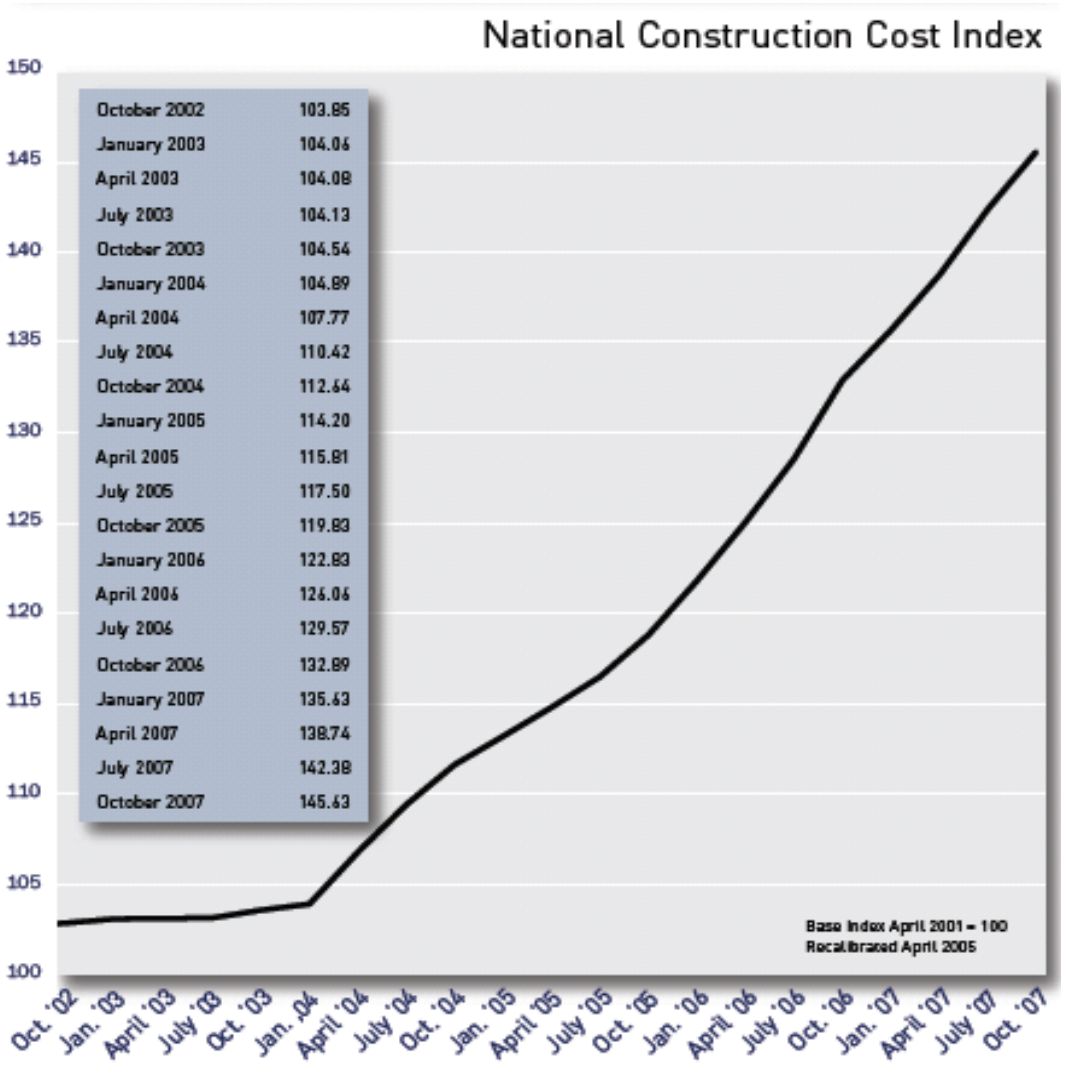


FIGURE 2-4: CHANGE IN THE NATIONAL CONSTRUCTION COST INDEX FROM 2002–2007

(Source: Quarterly Construction Cost Report, 2007 Fourth Quarter Issue -Rider Levett Bucknall)

These changes can largely be attributed to extraordinary economic developments that have occurred globally, regionally, and locally (refer to Appendix C: Cost Estimates for an in-depth analysis of these global, regional, and local economic developments and how they have played an important role in increasing the costs of labor, equipment, and materials). These developments have caused unprecedented increases in the cost of construction materials, equipment, and labor. It is critical to understand that these economic developments would affect construction costs estimates for all of the alternative plans evaluated during the RGRR study or, for that matter, on all alternative plans formulated since. ***Table 2-2*** displays the cost changes for the 2005 RGRR selected plan that have

occurred over the last two years as a result of economic developments and cost increases in labor equipment, and material.

TABLE 2-2: SIGNIFICANT CHANGES IN CONSTRUCTION COST ESTIMATE OF 2005 RGRR RECOMMENDED ALTERNATIVE
(Over a Two Year Period of Time)

Estimate	Date of Estimate	Price Level of Estimate	Construction Cost With Contingency
RGRR	August 2005	FY05	$125.1 Million
30 Percent Design	March 2007	FY07	$277.1 Million
DOI Independent Report	March 2007	FY07	$254.3 Million

The overall effect of these economic developments on cost increases to this project are much more evident than for most USACE projects since more than 65 percent of the project costs for the 2005 RGRR selected plan are for construction materials needed for the project. Construction labor, equipment and materials generally make up only one-third of the total project cost expenses for USACE Civil Works projects. Between the completion of the RGRR study and the 30 percent design for same plan, construction materials price increases have added approximately $60 million dollars to the construction cost. Except for some increases in asphalt and embankment quantities resulting from more accurate survey and geotechnical data obtained during the past two years, the design parameters of the project have not changed.

2.2.3 Cost Increases in the Current Working Estimate

As the design of the Tamiami Trail project has developed, the current working estimate (CWE) has also been updated and revised to reflect current pricing and refined design assumptions. It is important to note that there has not been any significant scope growth or quantity "busts" as the design has progressed except for the increases in asphalt and embankment quantities. For these elements, the design parameters have not changed, but much more accurate survey data has been obtained during 2007. For the RGRR, these quantities were calculated from as-built drawings and a small number of cross-sections taken over the entire 10.7-mile project area. For the current design, these quantities are based on a full survey and digital terrain model of the roadway.

One other change in quantity resulted from a Bridge Optimization Study, which is a standard FDOT cost-effectiveness analysis. As a result of this analysis, it was found that it was less expensive to use shorter Type IV AASHTO beams with more bents than the longer Florida Bulb T-Beams with fewer bents presented in the RGRR. While this design requires more bents and

subsequently, more piles, the overall cost for the bridge system (beams, bents, and piles) is less.

The CWE was developed based on material quotes received from manufacturers, conversations with FDOT and construction contractors regarding construction methods and equipment, and estimates of labor costs based on the very competitive construction environment in south Florida. As the CWE has developed, pricing data has continually been referenced to and validated against FDOT experience. According to FDOT engineers, bids for many of their projects are coming in approximately 40 percent more than their estimates which are based on their adjusted unit prices. Many of the current unit prices are in rough alignment with FDOT experience as shown in ***Table 2-3***:

TABLE 2-3: COMPARISON OF CURRENT WORKING ESTIMATE UNIT PRICES TO 2006 FDOT UNIT PRICES

		30% CWE Unit Price (Oct 2006)	2006 FDOT Unit Price
Reinforced Concrete	CY	$1,172	$1,241
24" Prestressed Concrete Piling	VLF	$220	$280
24" Prestressed Concrete Test Piles	VLF	$655	$670
Prestressed Concrete Beams-72" Florida Bulb T-Beams	LF	n/a	n/a
Prestressed Concrete Beams-Type IV AASHTO Beams	LF	$434	$283
Paving - Asphaltic Concrete	TON	$145	$96
Paving-Asphaltic Concrete-Friction Course	TON	$152	$130
Barrier Wall	LF	$340	$165
Embankment Fill	CY	$50	$17
Drainage System	LF	$753	No Direct Comparison

CY-cubic yard; LF-linear foot; VLF-vertical linear foot; TON-ton

CWE unit prices are based on estimates of the labor, equipment, and materials needed to construct the work. For example, the CWE unit price for Type IV AASHTO beams is based on actual quotes for beams and construction equipment needed to place them. The FDOT unit price is based on historic data from early 2006. When recent FDOT experience is considered, these prices are more closely aligned. Again, it is important to note that FDOT unit prices are used as a validation of the developed unit price in the CWE and not as the basis for the CWE.

The price increases and quantity changes discussed above account for over $60 million of cost growth. Other significant cost increases include:

- Maintenance of Traffic (MOT): Based on the new survey information and more detailed design information, the MOT costs have increased by approximately $6 million.
- Mobilization: Based on new survey information and the loss of a planned staging area identified in the RGRR, mobilization costs have increased by approximately $7 million.
- Escalation through Construction: The RGRR Microcomputer Aided Cost Engineering System (MCACES) construction cost estimate did not include escalation of construction costs based on the construction schedule. This is standard USACE procedure for planning reports since escalation is programmed elsewhere. However, as projects approach bid, this cost must be incorporated into the independent government estimate (IGE) since it is a legitimate cost to the contractor. The CWE contains approximately $10 million for this cost.

This summary illustrates the magnitude of and reasons for much of cost growth seen in the 30 percent CWE. However, it should not be taken as a comprehensive cost analysis for the entire project. In addition, there are several conservative assumptions included in this estimate that need to be refined as the project design progresses.

2.2.4 Cost Verification

The costs for labor, equipment and material used in estimating the 2005 RGRR selected plan cost estimate were based on FDOT unit pricing. Since the project is similar to standard FDOT work, the use of FDOT unit pricing was considered reasonable and prudent. These unit prices were independently verified by USACE to ensure accuracy and were validated against the historic bid prices maintained by FDOT. Both FDOT and FHWA reviewed the RGRR preliminary design and the construction cost estimate and found the work technically adequate and in-line with their experiences. For the 30 percent and 60 percent design estimates, costs were based on actual construction material price quotes received from manufacturers, conversations with FDOT and construction contractors regarding construction methods and equipment, and estimates of labor costs based on the very competitive construction environment in south Florida.

The USACE Cost Engineering Center of Expertise (Walla Walla District) conducted an Independent Technical Review (ITR) of the 30 percent design cost estimate in December 2006. The ITR team's overall conclusion was that the estimate accurately captured anticipated construction costs given the design and market conditions. Additionally, a DOI contractor also conducted an independent construction cost estimate based on the 30 percent design completed by the USACE. A technical analysis of the DOI cost estimate found several differences in scope and engineering assumptions.

While different design assumptions were made in developing the 2005 RGRR cost estimate and the 30 percent design cost estimate (i.e., better survey data, current pricing data, optimized bridge design), no errors or omissions have been found. The increased costs between the 2005 RGRR cost estimate and the 30 percent cost estimate can be largely attributed to the result of extraordinary unforeseen market conditions resulting in increasing labor equipment, and material costs that would affect any other construction alternative similarly.

2.3 New Costs: Real Estate and Risk and Uncertainty

2.3.1 Real Estate/Private Property

There are two separate types of private property impacts that would occur with the Tamiami Trail modifications–construction and operations (additional flows). Under the RGRR selected plan, both of these impacts occur to seven separate private properties adjacent to Tamiami Trail, six within the Everglades expansion area and one located outside of the Everglades boundary line. Current owners of these parcels are identified below:

Within ENP Expansion Area:

- Florida Power and Light
- Radio One
- Coopertown
- Gator Park
- Everglades Safari
- Lincoln Financial Media (formerly Jefferson Pilot Communication Site)

Outside ENP Expansion Area

- Airboat Association of Florida

Funding and responsibility for the six properties within the ENP expansion area acquisitions are strictly borne by the ENP, hence the costs for those acquisitions are not included in this report. Under the ENP Protection and Expansion Act, these properties were included within the ENP boundary map that was established by Congress; therefore, DOI is clearly responsible for acquisition of those properties. The Real Estate Appendix describes the estates needed on these properties as a result of increased water elevations. The Airboat Association of Florida property was explicitly excluded from acquisition under the ENP Protection and Expansion Act. The new real estate costs represent the estimated cost of a flowage easement for the Airboat Association of Florida property for all alternatives that increase the stage constraint in the L-29 Canal. Alternatives which maintain the existing stage constraint of 7.5 feet NGVD do not require this easement.

The RGRR addressed USACE's need to acquire a real estate interest in portions of the private properties that would lie within the construction footprint of the reconstructed road and bridges and the disposition of the utilities within the road right-of-way. However, it did not address induced flooding impacts that would result from the operations of the MWD project. The RGRR assumed that the NPS would acquire the necessary real estate interests in these private parcels of land adjacent to the south side of Tamiami Trail before the completion of construction of the Tamiami Trail project and before initiation of ecosystem restoration water flows directed south into ENP under the combined structural and operational plan (CSOP). However, because the NPS must complete its General Management Plan (GMP) before is can proceed with real estate acquisitions, it is unable to meet the schedule for Tamiami Trail construction. At the request of NPS, USACE proceeded with the work needed to complete the necessary acquisition for Tamiami Trail modifications. This real estate cost was not previously part of the MWD budget and added over $44 million to the project budget.

Through the GMP, the DOI-NPS is evaluating, the appropriate use and disposition of parcels within the project area. The Airboat Association's ten-acre parcel located off of Tamiami Trail was exempt from the ENP boundary.

Since this particular parcel of land was exempt from full acquisition by DOI-NPS in the PL and it has been determined that a minimum of perpetual flowage and perpetual road easements are required over portions of this property for construction, operation and maintenance of this project, USACE would acquire the needed real estate interests. As stated in the previous section on the cost of the RGRR selected plan, a real estate cost of $1,511,000 was the estimate in 2005 for the Airboat Association of Florida parcel. This cost estimate includes the acquisition costs and associated administrative costs on obtaining a fee value of the land.

2.3.2 Risk and Uncertainty

The cost estimates for the RGRR and the 30 percent design did not include risk and uncertainty analyses. USACE, Jacksonville District recognized the need to perform a risk based analysis on the 30 percent CWE; however at the time it was decided that it was more important to begin resolving the problem of significant cost growth revealed by the 30 percent CWE. The ITR team also identified several areas of risk and uncertainty that needed to be included in the risk analysis. Combined, these risk elements had the potential to drive the actual construction costs significantly higher.

2.4 Updated Cost of 2005 Plan

Therefore, based on the results of the 30 percent CWE, the ITR by the USACE Cost Engineering Center of Expertise, and the independent estimate prepared

by DOI, the total project cost for the 2005 RGRR recommended plan in Spring 2007 was approximately $429.7 million based on the following breakdown:

Estimated Construction Cost	$ 277.1 million
Additional Risk & Uncertainty	$ 100.0 million
Future PED	$ 1.5 million
Engineering During Construction (2%)	$ 7.5 million
S&A (10%)	$ 37.7 million
Real Estate	$ 5.9 million
Total Project Cost	$ 429.7 million

The cost of the 2005 RGRR recommended plan, when escalated to the mid-point of construction, is roughly comparable to Alternative 4.2.3 of the LRR alternative array discussed in Section 4 of this report.

3.0 EXISTING AND FUTURE CONDITIONS

3.1 Introduction

This section of the report describes the conditions as they currently exist (refer to ***Figure 3-1*** project area map); it provides a summary of the 2005 RGRR/SEIS discussion of the affected environment, which is unchanged. It is to these baseline conditions that the alternative actions are compared and evaluated.

The study team assumed that future without project conditions would be similar to existing conditions; therefore, the sections of this report describing existing conditions also represent the future without project conditions. The future without project conditions are the conditions expected in the project area if no project is implemented.

The team does not expect significant ecosystem improvements without construction of a MWD Tamiami Trail project. Language within WRDA 2000 prohibits construction of several significant CERP components, including WCA-3 Decompartmentalization, until MWD construction is complete.

However, formulation of the WCA-3 Decompartmentalization Project will be based on what this Tamiami Trail Modification Project is authorized to build. The two projects have different authorizing laws and different sources of funding, and will not be combined for analysis.

Other CERP components and other non-CERP restoration projects would be allowed to proceed. The authorization, construction, and initial operation of these allowable potential CERP or non-CERP restoration projects are uncertain. Some of those projects would provide additional water for the natural system, but the amount of water they could deliver to ENP would be limited by Tamiami Trail and the 7.5-foot stage constraint in the L-29 Canal.

The future without project conditions for this planning study is synonymous with the No Action alternative under NEPA.

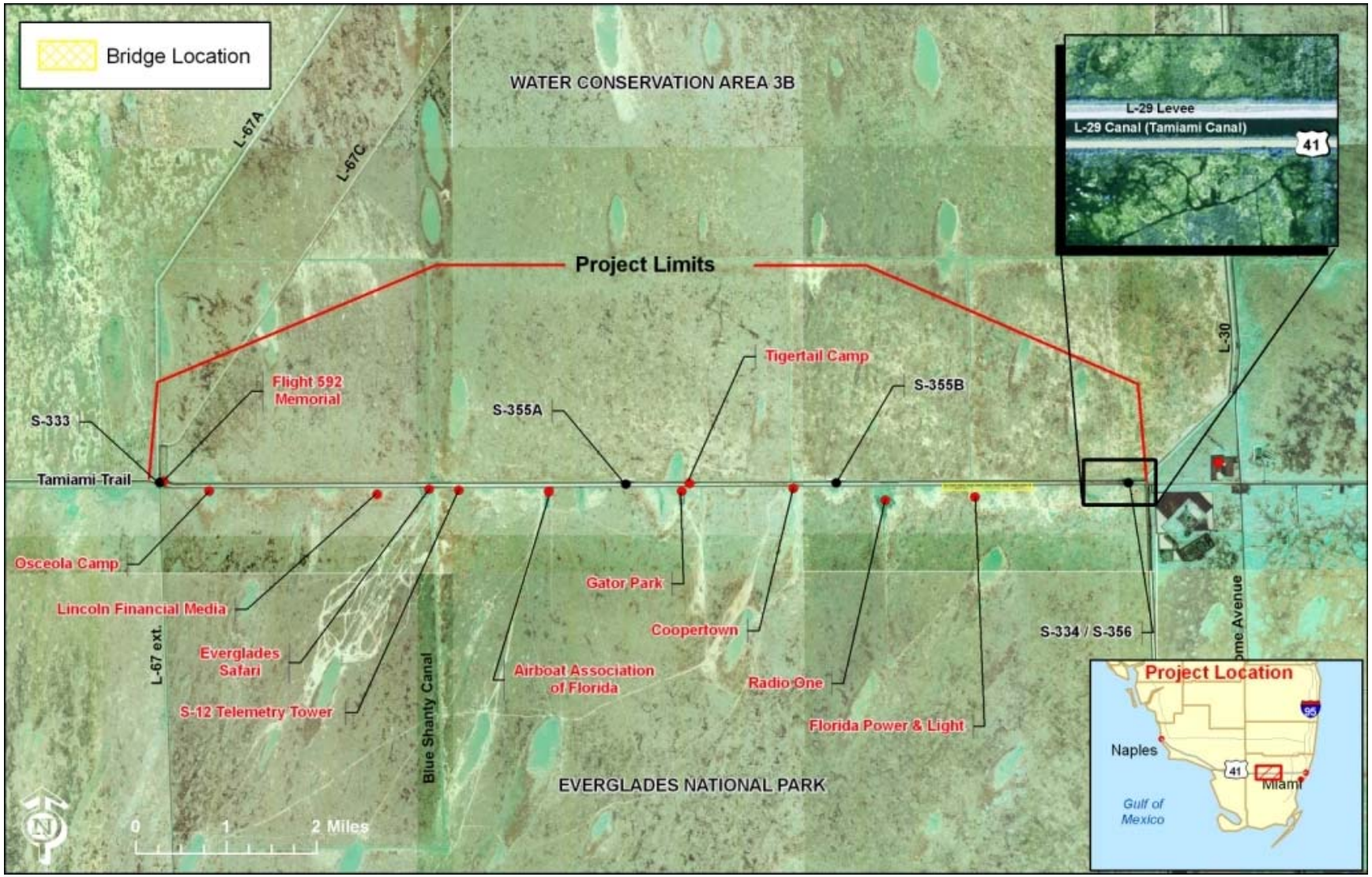


FIGURE 3-1: PROJECT AREA

3.2 Geology and Soils

Florida bedrock is primarily limestone with stratigraphic thicknesses of more than 5,000 feet in the south. The Lower East Coast, which is located on the Atlantic Coastal Ridge, is underlain primarily by thin sand and limestone that are highly permeable and moderately well drained. The soil of the Tamiami Trail project area is mainly of the Lauderhill-Dania-Pahokee Association, which consists of nearly level, poorly drained soils containing organic material eight to more than 51 inches deep over limestone bedrock. These soils extend west from the Atlantic Coastal Ridge into the Everglades. Typically, the soils are black to dark brown muck underlain by soft porous limestone. These soils are characterized by high subsidence, ponding, excess humus, and low strength.

3.3 Surface Waters

Major characteristics of south Florida hydrology are local rainfall, evapotranspiration, canals, and water control structures, flat topography, and the highly permeable Biscayne Aquifer. Water introduced from either direct rainfall or canals is rapidly removed by evapotranspiration, seepage into the aquifer, or canal and overland surface drainage to the Atlantic Ocean, Florida Bay, or the Gulf of Mexico.

Levees and canals constructed during the last 50 years under the C&SF project have divided the former Everglades into areas designated for development and areas for fish and wildlife benefits, natural system preservation, and water storage. The natural areas consist of the three WCAs located north of Tamiami Trail and ENP to the south. Water flow in the vicinity of the project is primarily from WCA-3A through control structures to the L-29 Canal, and from the canal through culverts into ENP.

The WCAs provide detention for water from the agricultural area and parts of the east coast region and for flood discharge from Lake Okeechobee to the sea. Detention of water helps prevent floodwaters from inundating the east coast urban areas; provides a water supply and detention for east coast urban and agricultural areas and ENP; improves the water supply for east coast communities by recharging underground freshwater reservoirs; reduces seepage; and may ameliorate saltwater intrusion in coastal aquifers. While the WCAs may reduce the severity of the drainage of the Everglades caused by the major canal systems, thus reducing impacts to fish and wildlife caused by the major drainage systems, the levees surrounding the WCAs still function to impound the Everglades, precluding the historic flow patterns. The C&SF system makes it difficult to provide natural timing, volume and distribution. In wet periods, water is impounded in the WCAs and then discharged to Everglades or coastal canals. During dry periods, water can flow through the canals to coastal areas and bypass the ENP wetlands.

The maintenance of water levels in the WCAs essentially represents the seasonal and monthly limits of storage. The levels vary from high stages in the late fall and winter to low stages at the beginning of the wet season. This permits the storage of runoff during the wet season and the release of stored water to ENP during the dry season and maintains elements of the habitat essential to fish and wildlife. The distribution of water for flood control and water supply varies seasonally. The schedules for the WCAs include a minimum water level below which water releases are not permitted unless water is supplied from another source. When water levels fall below the minimum levels, transfers of water from Lake Okeechobee or the WCAs are made to meet water supply demands.

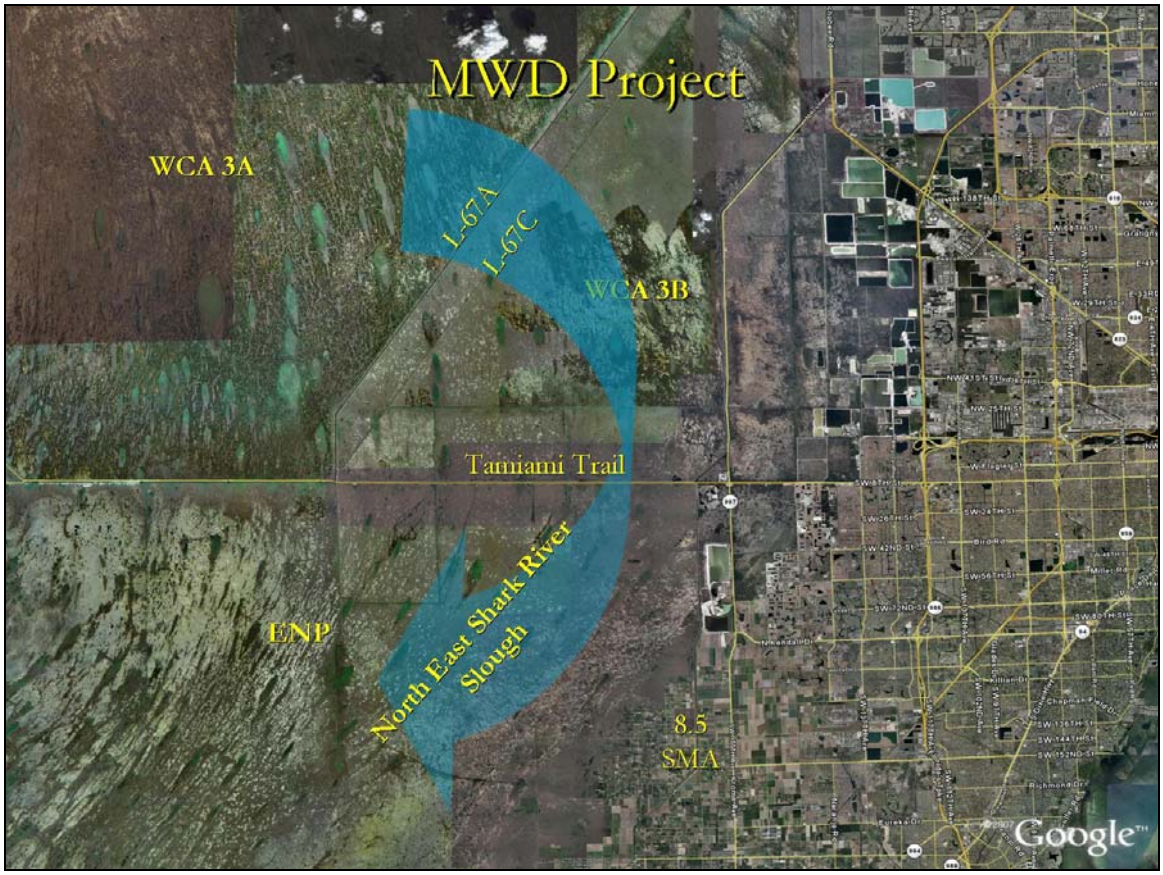


FIGURE 3-2: SHARK RIVER SLOUGH PATH

Shark River Slough, a wide, curving flow-way, began south of Lake Okeechobee. Its original course was southeast from the Lake, gradually curving south and then southwest (through what are now WCAs-2 and 3, *Figure 3-2*). It trends southwest inside ENP and its center of drainage is within the 10.7-mile stretch of Tamiami Trail. It is one of the principal pathways for water to slowly drain from the area south of Lake Okeechobee southward to the tidewaters of the

Everglades. Shark River Slough is a broad, shallow, natural drainage way at a slightly lower elevation than the surrounding Everglades. The width varies based on season, but can range from a several thousand feet to over 40 miles, depending on rainfall and hydrologic conditions. The construction of Tamiami Trail and WCA-3 impounded and altered the slough, effectively creating a barrier through the everglades, between the northern everglades and ENP. ***Figure 1-6*** shows the current configuration of the L-29 Levee and Canal.

The primary source of water from the northern part of the C&SF system to NESRS is WCA-3A. WCA-3A is very large and thus primarily rain fed, though it also receives water deliveries from the north, as well as storm runoff from western Broward County. WCA-3A discharges into the L-29 Canal through Structure S-333, which is located at the extreme southeast corner of the WCA. Water in the L-29 Canal then passes under the Tamiami Trail into ENP through 19 sets of culverts (55 total culverts, three culverts per set in most locations), as shown in ***Figure 3-3***.

Under existing conditions water does not flow directly from WCA-3B into the L-29 Canal. Although there are two discharge structures (S-355A and S-355B) along the L-29 Levee south of WCA-3B that could move water from WCA-3B into the canal, they are not operating at present because of low water stages in WCA-3B. Water stages in WCA-3B are much lower than stages in WCA-3A, due to a lack of inflows into WCA-3B and the reduction of seepage from 3A to 3B due to the design of L67A and C levees. WCA-3B loses seepage to the east by the L-30 borrow canal and to the south by the L-29 borrow canal.

Water deliveries to eastern ENP are controlled by the stage in L-29 Canal, as pressure from the water within the canal (hydraulic head), is required to force water through the culverts and into the Park. As canal stage increases, more water is forced beneath the road. However, canal stage is strictly controlled due to potential flooding within residential or agricultural areas of Miami-Dade County or potential damage to Tamiami Trail. The canal stage constraint is 7.5 feet NGVD. Higher water levels within the canal may erode the sub-base of the road and create a potential safety hazard. In most cases, flows that would cause the canal water level to rise above 7.5 feet NGVD are diverted or held for release at a different time. ***Figure 3-3*** illustrates the small difference in elevation between the water level in the canal and the base and crown of the road. The completion of flood mitigation features at the 8.5 SMA has removed some of the constraints for maintaining water levels in the L-29 Canal at or below 7.5 feet. The management of stage levels is among the most important factors in determining the amount of water entering the ENP.

FIGURE 3-3: ONE OF 19 SETS OF EXISTING CULVERTS, LOOKING SOUTH FROM L-29 LEVEE

3.4 Water Quality

General. The water quality in the Everglades has been greatly influenced by development-related activities. Extensive drainage networks allowed the development of large land tracts for urban and agricultural development. Nonpoint (e.g., agricultural runoff) and point (e.g., wastewater discharges) sources of contamination now influence surface waters in many areas. Parameters of concern include:

- Metals–mercury, copper, cadmium, lead, zinc, arsenic.
- Pesticides–DDT and derivatives, atrazine, simazine, ametryn, endosulfan compounds, ethion, bromacil, 2,4-D, aldecarb, and fenamiphos.
- Nutrients–phosphorus, nitrite/nitrate, and ammonia/un-ionized ammonia.
- Biological–fecal coliforms and pathogens, and chlorophyll-a.
- Physical parameters–pH, dissolved oxygen, conductivity, turbidity, oil and grease, temperature, and salinity.
- Other constituents–polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, sulfate, chloride, tributyltin (TBT), polychlorinated biphenyls (PCBs), and volatile organic compounds (VOCs).

The primary concerns in the Everglades are nutrients, dissolved oxygen (DO), mercury, biochemical oxygen demand (BOD), and coliforms. Marsh and canal

waters typically have low DO levels relative to the standards in Class I and III Florida State Administrative Code. A site specific alternative criterion for DO in the Everglades protection area was adopted by FDEP and subsequently approved by the U.S. Environmental Protection Agency in 2005. Nutrient levels at the marsh perimeter are elevated, probably from the breakdown of organic debris as well as agricultural drainage. Key water quality parameters monitored include DO, conductivity, and nutrients.

Presented below are the of results of SFWMD water sampling in 2004 and 2005 in association with the SFWMD Tamiami Bridge Culverts Project, which monitors water passing under the Tamiami Trail into ENP at 11 sites. The FDOT culvert locations can be found in the 2005 TTM RGRR.

TABLE 3-1: WATER QUALITY RESULTS FOR CULVERT STATIONS

Approximate Location	Years	DO (mg/l)	Sp Cond (µS/cm)	pH	Tot PO_4 (mg/l)	K (mg/l)	Mg (mg/l)	SO_4 (mg/l)
S-333	2004	3.48	581.22	7.24	0.011	5.30	16.20	30.50
	2005	4.72	661.46	7.48	0.014	--	--	--
FDOT 30[1]	2004	3.46	480.12	7.15	0.015	1.10	5.10	1.70
	2005	5.02	667.04	7.43	0.016	--	--	--
FDOT 36[1]	2004	3.69	430.50	7.20	0.011	2.10	7.60	5.40
	2005	4.93	580.00	7.34	0.016	--	--	--
FDOT 40[1]	2004	4.53	583.25	7.36	0.013	3.00	9.00	9.20
	2005	4.84	663.40	7.47	0.014	--	--	--
FDOT 50[1]	2004	4.54	552.01	7.36	0.012	2.90	9.50	12.00
	2005	4.85	677.83	7.49	0.014	--	--	--
FDOT 52[1]	2004	4.85	532.83	7.34	0.011	2.90	9.60	12.30
	2005	5.16	645.44	7.52	0.013	--	--	--
FDOT 54[1]	2004	3.99	561.68	7.30	0.011	3.00	9.70	12.50
	2005	5.47	644.20	7.54	0.012	--	--	--
FDOT 56[1]	2004	4.64	574.85	7.34	0.010	3.00	9.80	12.40
	2005	5.02	689.00	7.60	0.014	--	--	--
FDOT 58[1]	2004	4.76	566.07	7.39	0.011	3.10	10.10	13.30
	2005	5.27	572.34	7.57	0.014	--	--	--
FDOT 60[1]	2004	4.81	567.29	7.44	0.012	3.30	10.60	14.60
	2005	5.35	557.54	7.56	0.013	--	--	--
FDOT 62[1]	2004	4.96	598.90	7.55	0.013	3.50	11.10	15.80
	2005	5.41	555.50	7.52	0.014	--	--	--
Criteria for Surface Water Quality[2]	--	Not less than 5	Not greater than 50% above background or 1275, whichever is greater	6-8.5	N/A	N/A	N/A	N/A

Notes: [1] Locations correspond to FDOT Culvert Stations in Figure 3.
Values represent averages collected throughout 2004 and through July 2005.
[2] F.A.C. 62-302.530 Criteria for Class III, Predominantly Fresh Waters in Florida

Source: SFWMD.

A water quality study along Tamiami Trail was conducted by the U.S. Geological Survey (USGS) National Water-Quality Assessment Program in 1996-1997 and reported in 1999. The report concluded that the quality of water along the Trail is variable due to natural and human influences. Specific conductance and concentrations of chloride, sulfate, and dissolved organic carbon tended to be relatively low in the undeveloped part of Tamiami Trail from the Turner River (mile 30.4) to about S-12-C (mile 66.6) and relatively high at the more developed west and east ends. Relatively high concentrations occurred to the east of S-12-C due to the inflow of mineralized water from the northern Everglades

through a network of canals. Twelve pesticides or pesticide degradation products were detected along the Tamiami Trail, with highest concentrations at Tomato Road in the west and S-12-D in the east where agricultural influences were greatest. Total phosphorus tended to decrease from west to east.

ENP has been designated as an Outstanding Florida Water (OFW) requiring special consideration. In general, an OFW has narrative criteria for not allowing degradation/worsening of water quality conditions relative to the better of (1) a fixed point in time, which for ENP is 1978-79, or (2) the conditions that existed in the year prior to application to FDEP for a Water Quality Certification (WQC). To reduce any potential for degradation of water quality in ENP, the State of Florida requires that the treatment of storm runoff be included as a component of the highway and bridge construction projects.

Highway Runoff. Highway use results in the introduction of metals, fuels, lubricants, combustion products, and toxic chemicals as potential environmental contaminants. ***Table 3-2*** summarizes several of the major constituents in runoff from highway use and their primary sources.

TABLE 3-2: HIGHWAY RUNOFF CONSTITUENTS AND THEIR PRIMARY SOURCES

Constituents	Primary Sources
Lead	Leaded gasoline (exhaust), tire wear, lubrication, bearing wear
Zinc	Tire wear, motor oil
Iron	Rust, vehicle/engine wear
Copper	Metal plating, bearing/bushing wear, engine wear, brake wear
Cadmium	Tire wear, metal plating
Chromium	Metal plating, engine wear, brake wear
Nickel	Exhaust, lubricants, plating, brake wear
Organic compounds	Vehicle exhaust, fuel leaks, lubricants

Source: EPA (1993).

The concentration of pollutants in runoff is dependent on a number of factors, including the amount of traffic to which the road is subjected. ***Table 3-3*** illustrates the differences in concentration of pollutants in highway runoff relative to vehicle usage.

Because there are no known studies of the quality or quantity of runoff from the Tamiami Trail in the project area, the quality of the runoff and the effects to the

Everglades ecosystem must be inferred. The average daily traffic (ADT) volume along the Tamiami Trail, approximately 5,200 vehicles per day (vpd), is quite low. Applying the findings of Driscoll *et al.* (1990), runoff from the Tamiami Trail would have relatively low concentrations of contaminants. Bingham *et al.* (2002) suggested that runoff from the Tamiami Trail would have "little effect on the quality of the water and the surrounding aquatic habitat in the Tamiami Canal."

TABLE 3-3: POLLUTANT CONCENTRATIONS IN HIGHWAY RUNOFF

Pollutant	Event Mean Concentration for Highways with Fewer than 30,000 Vehicles/Day* (mg/L)	Event Mean Concentration for Highways with More than 30,000 Vehicles/Day* (mg/L)
Total Suspended Solids	41	142
Volatile Suspended Solids	12	39
Total Organic Carbon	8	25
Chemical Oxygen Demand	49	114
Nitrite and Nitrate	0.46	0.76
Total Kjeldahl Nitrogen	0.87	1.83
Phosphate Phosphorus	0.16	0.40
Copper	0.022	0.054
Lead	0.080	0.400
Zinc	0.080	0.329

* Event mean concentrations are for the 50 percent median site.
Source: Driscoll *et al.* (1990).

There are local sources of metals in addition to highway runoff, such as airboat franchises and residential areas along the Tamiami Trail, and the potential exists for transport of metals from other locations by the network of canals.

Therefore, it appears that based on existing data and projections, runoff from the Tamiami Trail may have little measurable adverse effect on water quality and biological communities in the L-29 Canal. However, to reduce any potential for degradation in ENP, which is an OFW requiring special consideration, the State of Florida requires that treatment of bridge storm runoff must be included as a component of the proposed project.

3.5 Hazardous, Toxic and Radioactive Waste

A Phase I Hazardous Toxic and Radioactive Waste (HTRW) site assessment of the project area was conducted in late 2006. The assessment area extended the length of the project (between S-333 and S-334/S-356) from the L-29 Canal to 200 feet south of the centerline of the Tamiami Trail (***Figure 3-1***). The area assessed included properties owned by Lincoln Financial Media, Everglades Safari Park, the Airboat Association of Florida, Gator Park, Coopertown Airboat Rides and Restaurant (two adjacent tracts), Radio One Communications, and FP&L.

The site assessments identified four potential contamination sites, all of which are located on private property outside of the construction footprint required for the proposed project. It is anticipated that the federal government would acquire an interest in real estate from the subject private owners since these lands would be impacted not from the project's construction but rather the operation of the project. In a federal acquisition, the cost of remediation of the subject properties would be assessed against the property owner. Prior to a real estate closing, the landowner would be given a choice of conducting the remedial work at his own cost, or the federal government could withhold a sufficient amount of funds necessary for the remediation from the acquisition funds to ensure compliance.

3.6 Special Environmental Resources

The historic Everglades was a broad, shallow wetland with water flowing very slowly over 3,900 square miles from Lake Okeechobee to the mangrove zone at the southern tip of Florida. The flow that naturally occurred over this region was influenced by rainfall and a relatively low surface relief and provided the necessary conditions for the development of the Everglades ecosystem.

3.6.1 Everglades National Park

ENP was authorized by Congress on May 10, 1934 and dedicated by Harry S. Truman on December 6, 1947. The enabling legislation provided the fundamental purpose of the Park as being:

> *. . . permanently reserved as a wilderness, and no development of the project or plan for the entertainment of visitors shall be undertaken that will interfere with the preservation intact of the unique flora and fauna and the essential primitive natural conditions now prevailing in this area.*

The original 460,000 acres in 1947 was expanded to 1.3 million acres by 1958.

Recognizing ENP as a nationally and internationally significant resource, Congress passed the "Everglades National Park Protection and Expansion Act" (PL 101-229) in 1989. This law authorized the acquisition of additional land,

including the portion of the project area just south of Tamiami Trail, to benefit the natural resources of ENP.

With this addition, ENP is now approximately 1.5 million acres in size, making it the third largest unit of the NPS in the lower 48 states.

By NPS policy, lands included in the East Everglades Expansion are being assessed in the East Everglades Wilderness Study to determine whether they are suitable for possible wilderness designation. The East Everglades Wilderness Study was added to the scope of the ENP's GMP/EIS in 2006.

Because the ENP possesses "outstanding natural values," it was designated by the United Nations Educational, Scientific, and Cultural Organization as an International Biosphere Reserve in 1976 and subsequently as a World Heritage Site in 1979. The site includes historic Everglades that have been limited in manmade influences and, for the most part, avoids agricultural land. In 1987, the Ramsar Convention designated ENP as a Wetland of International Importance. ***Figure 3-1*** shows the location of ENP in southern Florida.

3.6.2 Shark River Slough

Historically, Shark River Slough was a 30-mile-wide expanse of relatively shallow water moving downstream through the low-gradient Everglades landscape. The pattern of water flow was regionally uniform across a broad expanse and lacked any central drainage channel or dendritic drainage pattern. The slough collected flows from the eastern portion of the Everglades, including the western side of the Atlantic coastal ridge, and moved that water to the southwest through the mangrove estuaries of the southwestern coast into the Gulf of Mexico.

An extensive ridge and slough landscape was characteristic of Shark River Slough. Within the ridge and slough landscape was a complex mosaic of marsh assemblages with distinct tree islands. The marsh contained large stands of sawgrass interrupted by more open communities with a mixture of smaller aquatic plants and periphyton. These types of habitats are frequently elongated and oriented parallel to the direction of water flow. Tropical hammock and pine forests occur as islands within the prairie landscape and form a third element of the ridge and slough landscape, rising slightly above the elevation of the sawgrass ridges. These tree islands support plants of West Indian origin that are unique to south Florida and contain the highest number of rare plant species in south Florida. The orientation of the larger tree islands has the same parallel alignment to the direction of flow.

Marl prairies, fire-maintained marshes that are intermittently flooded, flank both sides of Shark River Slough. A unique feature of the marl prairies is the

high species richness of the plant communities. Sawgrass (*Cladium jamaicense*) and muhly grass (*Muhlenbergia capillaris* var. *filipes*) dominate, although more than 100 species of mostly herbaceous plants have been reported.

Although seemingly small, the two-to-three-foot difference in elevation between ridge surface and slough bottom was highly significant in the pre-drainage Everglades. During the typical annual rise and fall of wet- and dry-season water levels, this elevation difference allowed sloughs to remain water-filled throughout the year, while adjacent ridges would be exposed only a few months of the year. In the pre-drainage system, native species were adapted to the multiple habitats provided by the tree islands, ridges, and sloughs. Aquatic organisms depended on the sloughs as extensive areas that would remain inundated throughout all but exceptionally dry years.

3.6.3 Biological Habitats

The habitats along the Tamiami Trail are mostly natural with long and short hydroperiod wetlands with an abundance of interspersed willowheads, bayheads, and hardwood hammocks. Sawgrass (*Cladium jamaicense*) communities dominate the long hydroperiod wetlands, whereas muhly grass (*Muhlenbergia capillaris*) and black sedge (*Schoenus nigricans*) dominate the short hydroperiod wetlands mostly influenced by NESRS and local rainfall. Four herbaceous wetland cover types are found in the Everglades: (1) sloughs with persistently deep water levels; (2) sawgrass marshes with moderate water levels and long hydroperiods; (3) wet peat prairies; and (4) wet marl prairies with shorter hydroperiods.

Plant communities present along the Tamiami Trail in the project area include:

- Swamp forest bayheads (*Magnolia virginiana, Annona glabra, Chrysobalanus icaco, Persea borbonia, Ilex cassine, Metopium toxiferum*, among others);
- Maidencane/spike-rush, a mix of shallow open water, *Eleocharis* spp. and *Panicum hemitomon*, which can include sparse association of low-stature *Cladium jamaicense, Typha* spp., *Sagittaria lancifolia, Pontederia lanceolata, Nymphaea* spp., etc., typical of SFWMD impounded conservation areas;
- Graminoid (grasses, sedges, and rushes);
- Non-graminoid emergent marsh (*Pontederia lanceolata, Sagittaria* spp., *Nymphaea odorata, Typha* spp., with *Ludwigia repens* and *Utricularia* spp. as possible submergents);
- Sawgrass (*Cladium jamaicense*);
- Cattail (*Typha* spp.);
- Scrub hardwood, which includes species such as *M. toxiferum, P. borbonia, Myrica cerifera, I. cassine, M. virginiana, Myrsine floridana, Conocarpus*

erectus, Chrysobalanus icaco, often with a moderate-to-heavy component of mixed grasses; and
- Willow shrublands *(Salix caroliniana*).

Sloughs provide critical habitat for submerged and floating vegetation in the Everglades ecosystem as they are the deepest marsh communities that provide the main pathway of water flow through the Everglades (Lodge, 2005). Slough vegetation communities are often associated with tree islands and long patches of sawgrass stands. This vegetation landscape is termed "ridge and slough", since the sawgrass is elevated above the adjacent slough.

The deep water slough vegetation community is typically dominated by submerged and floating aquatic plants such as bladderworts, white waterlily, floating heart, and spatterdock (Lodge, 2005). In the EPA's ecosystem assessment of the Everglades (R-EMAP), Stober *et al.* (2001) noted plant associations across the deep water slough Everglades dominated by white waterlily. However, Stober *et al.* (2001) only noted one sampling location in ENP sloughs containing white waterlily; the lack of white waterlily is thought to result from inadequate water depths and hydroperiods caused by artificial draining of the marsh community. This is consistent with vegetation surveys conducted by Davis (1943), Gunderson (1994), and Olmstead and Armentano (1997). White waterlily is more abundant in deeper slough habitats of the Loxahatchee National Wildlife Refuge and the WCA-2 and WCA-3 of the greater Everglades less subject to drydown events (Stober *et al.*, 2001). Paleoecological seed data indicates that native ENP slough communities were once dominated by white waterlily and banana lily prior to the widespread artificial draining of slough communities (Saunders *et al.*, 2007).

White waterlily has adaptations including an extensive root system and floating leaves that allow it to out-compete other species of emergent and submerged vegetation during optimum hydrologic conditions. Richards' (2007) mesocosm studies illustrated that white waterlily exhibits significantly more root biomass at depths of 60 centimeters (cm) (two-feet) and 90 cm (three-feet) as compared to a depth of 30 cm (one-foot). Field studies also verify that deep water slough vegetation is dominated by white waterlily in wet season water depths exceeding 90 cm (Powers, 2005; and Givnish *et al.*, 2008). McVoy *et al.*'s (in review) historical ecological study of the Everglades estimated that pre-drainage water depths in sloughs had a long term average depth of 60 cm (two-feet). Based on the scientific literature review, the optimal hydrological conditions for white waterlily-dominated deep water sloughs are wet season depths exceeding two to three feet and a maximized average wet season depth.

Other classifications along the Tamiami Trail include Brazilian pepper/shrubland mix, open water, spoil areas, areas influenced by human activities, major roads, and canals.

Partitioning of the Everglades by levees, canals, and roads, including the Tamiami Trail and the L-29 Canal, has created barriers to the free movement of organisms, particularly aquatic species and those with limited mobility. Aquatic connectivity between the WCAs and ENP is currently limited to the series of small culverts under the Tamiami Trail. The L-29 Canal and Levee are obstructions to fish and wildlife movement and migration from WCA-3A to ENP. Traffic mortality on the Tamiami Trail reduces the free movement of terrestrial and semiaquatic animals.

3.6.4 Protected Species

Federally listed species known or potentially encountered in the project area, and which were given consideration by FWS coordination in accordance with Section 7 of the Endangered Species Act (ESA), include the CSSS, eastern indigo snake, Florida panther, snail kite, West Indian manatee and wood stork.

Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*). The CSSS is one of eight extant subspecies of seaside sparrow in North America. Its distribution is limited to the short-hydroperiod wetlands at the bottom of the greater Everglades system, on the southern tip of mainland Florida. The CSSS was first provided protection when it was listed on March 11, 1967, under the Endangered Species Preservation Act of 1967 (32 Federal Register 4001). That protection was continued under the Endangered Species Conservation Act of 1969. The sparrow and all other species listed under the Endangered Species Conservation Act were the first species protected under the Act of 1973, as amended.

The CSSS inhabits six distinct subpopulations called A, B, C, D, E and F. Critical habitat for this species was designated on August 11, 1977 (42 FR 42840). Currently, the critical habitat includes areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Miami-Dade, and Monroe Counties. Much of this area is within the boundaries of ENP. Because this was one of the first critical habitat designations under the Act, there were no primary constituent elements defined. The designated area encompasses about 197,260 acres (79,828 hectares), and includes portions of subpopulations B through F. Subpopulation A is the only area occupied by sparrows that does not have associated designated critical habitat.

Subpopulation A is one of the large subpopulations and thought to be critical to the existence of the CSSS. It is located in western Shark River Slough immediately in the path of water discharges from WCA-3A through the S-12

structures. Unusually intense and unseasonable rainy periods coupled with C&SF operations during the winters of 1992/93 and 1993/94 caused prolonged flooding in subpopulation A, with the result that little or no breeding there was possible during the 1993 and 1994 sparrow breeding seasons. The flooding of the habitat by direct rainfall was exacerbated by discharges of water through the S-12s needed to meet the water regulation schedule for WCA-3A. This is reflected in the dramatic reduction of CSSS detected in subsequent surveys in subpopulation A. As a consequence, FWS issued a biological opinion (BO) in 1999 providing recommendations to the USACE on how water levels must be controlled in nesting habitat so that the existence of CSSS would not be jeopardized. The USACE responded by developing changes in water management operations that are still currently in effect. The goals are to keep subpopulations (particularly subpopulation A) dry during the breeding season and to keep the habitat for the subpopulations B, C, D, E, and F from excessive drying to prevent un-natural fire frequencies.

Eastern Indigo Snake (*Drymarchon corais couperi*). The indigo snake was listed as threatened in 1979 because of a loss of habitat associated with farming, construction, forestry, and other land use conversions, as well as over-collecting for the pet trade. In south Florida, the snake can be found in a variety of habitats, including wet prairies and mangrove swamps. Farther north, it can be found in pine-hardwood forest, mixed hardwood forest, creek bottoms, agricultural fields, and sandy habitats of the Florida scrub communities, typically in association with gopher tortoises.

Florida Panther (*Puma* [*Felis*] *concolor coryi*). The Florida panther was listed as endangered in 1967. Activities beginning as early as the 1800s influenced the status of the panther, with the first bounty passed in Florida in 1832. Following bounty hunting, agricultural land clearing and lumbering reduced its habitat drastically into the 1950s. Significant habitat reduction continues today. Other factors affecting the population's decline include contaminants, prey availability, human-related disturbance and mortality, disease, and genetic erosion.

The current occupied range of the panther is estimated to be 2.2 million acres (890,000 hectares) in south Florida. Panthers prefer native, upland forests, especially hardwood hammocks and pine flatwoods, to wetlands and disturbed habitats. Native landscapes within the Big Cypress Swamp region of south Florida, within occupied panther range, are dominated by slash pine (*Pinus elliottii*), cypress, and freshwater marshes, interspersed with mixed-swamp forests, hammock forests, and prairies. Private lands represent about 50 percent of occupied panther range in south Florida. The largest contiguous tract of panther habitat is the Big Cypress National Preserve/Everglades ecosystem in Collier, Monroe, and Miami-Dade counties.

Suitable habitat extends into Lee, Hendry, Charlotte, Glades, Broward, Palm Beach, and southern Highlands counties.

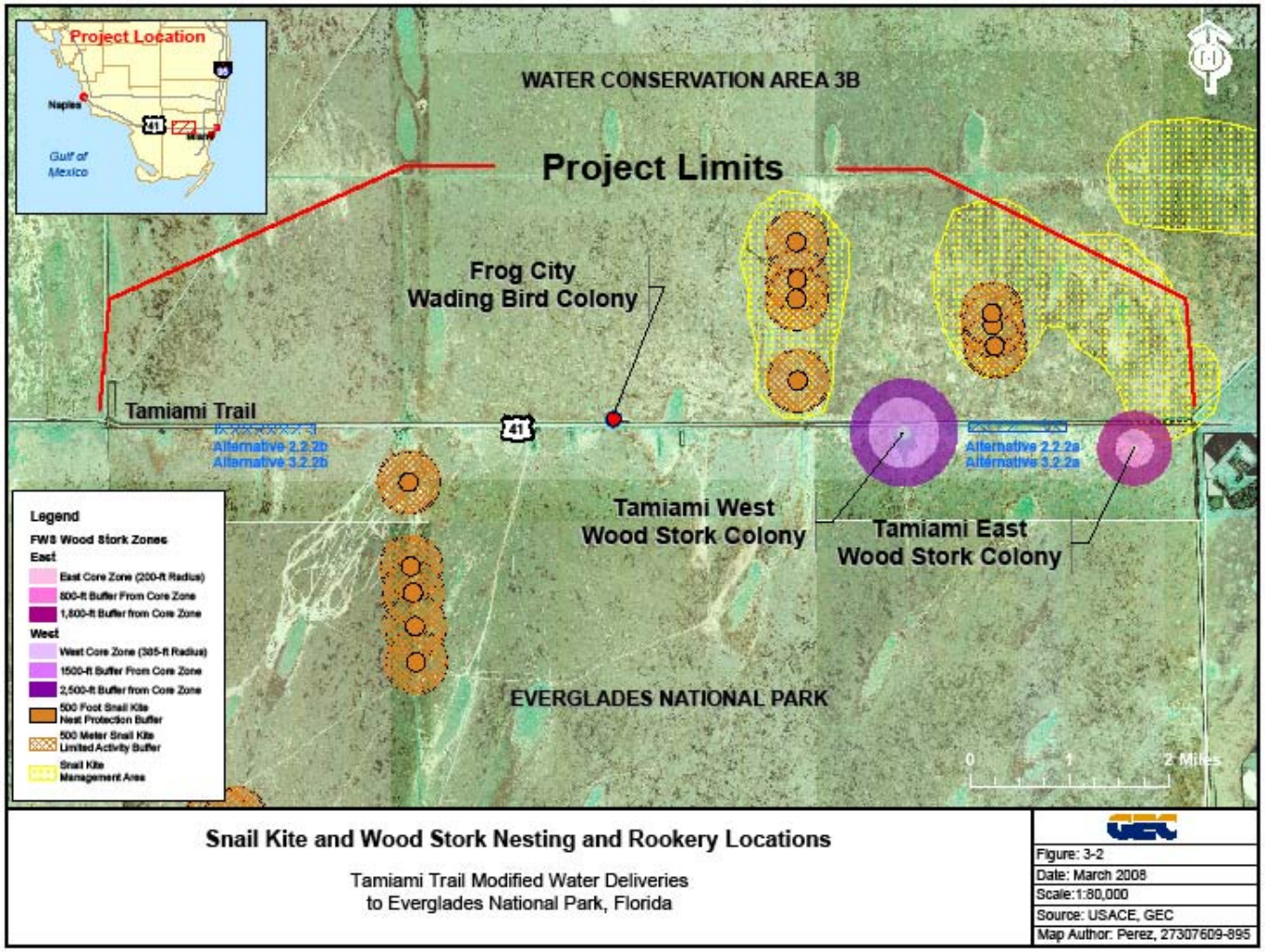
Breeding activity peaks in fall and winter. Parturition is distributed throughout the year with 81 percent of births occurring between March and July. Litter sizes range from one to four kittens, with a mean of 2.2 kittens per successful litter. Intervals between litters range from 16 to 37 months.

The number of radio-collared panthers being monitored has increased from eight in 1984 to 46 in 2001. Throughout the occupied range of the panther, the ENP population represents at least 11 percent of the panther population known to the FWS. Two panthers in ENP have been documented crossing the Shark River Slough into Big Cypress National Preserve. The only known reproducing panther population is located in the Big Cypress Swamp/Everglades physiographic region.

Everglade Snail Kite (*Rostrhamus sociabilis plumbeus*). Snail kites, listed as endangered in 1967, require long hydroperiod wetlands that remain inundated throughout the year. This preference is associated with the apple snail (*Pomacea paludosa*), its primary food source, which requires nearly continuous flooding of wetlands for greater than one year. Suitable habitats for the kite include freshwater marsh and shallow vegetated lake margins where apple snails can be found. Critical habitat for the snail kite was designated in 1977 and includes WCA-1, 2, and 3A, and portions of ENP, as well as Lake Okeechobee shorelines and portions of the St. Johns marsh. Preferred nesting habitat includes small trees and shrubs such as willow, bald cypress, pond cypress, sweet bay, dahoon holly, southern bayberry, and elderberry. During dry periods when suitable shrubs and trees experience dry conditions, herbaceous species such as sawgrass, cattail, bulrush, and common reed are used for nest sites. The breeding season can vary from year to year depending on rainfall and water levels. Ninety-eight percent of nesting attempts occur from December through July, with 89 percent initiated between January and June. ***Figure 3-4*** depicts recent snail kite nesting locations and protection zones.

WCA-3A is the largest and most consistently utilized (as measured by numbers of birds observed during annual surveys from 1970 to 1994) of the designated critical habitat for the kites. Snail kites have increasingly moved their nesting activity to areas of higher elevations in WCA-3A over the past two decades, presumably as the traditional nesting vegetation has been degraded by sustained high water levels due to water management practices. Higher water levels have resulted in the conversion of wet prairies (preferred foraging habitat for kites) to aquatic sloughs in selected sites in that area,

FIGURE 3-4: SNAIL KITE AND WOOD STORK NESTING AND ROOKERY LOCATIONS



along with losses of interspersed herbaceous and woody species essential for nesting habitat.

West Indian Manatee (*Trichechus manatus*). The West Indian manatee was first listed as endangered in 1967. This species lives in freshwater, brackish, and marine habitats and eats submerged, emergent, and floating vegetation. During the hot summer months, the mammal's habitat can range as far north as Rhode Island and as far west as Texas. During winter months, the population concentrates in peninsular Florida, depending on warm water flows from natural springs and power plant outfalls. The most significant threat facing manatees in Florida is death or injury from boat strikes. It is highly unlikely that the West Indian manatee occurs in the project area.

Wood Stork (*Mycteria americana*). The wood stork was listed as endangered in 1984 due to loss of foraging habitat and colony nesting failures. No critical habitat has been designated for the wood stork.

Preferring freshwater wetlands for nesting, roosting, and foraging, wood storks can be found throughout central and southern Florida. Nests are typically constructed in tree stands within swamps or stands surrounded by large areas of open water. Because of their tactile feeding methods, storks feed most effectively in shallow water settings where prey items are concentrated. During winter and spring dry seasons when water levels recede, prey items are often further concentrated, providing foraging areas with abundant food supplies. Drainage in south Florida may be responsible for delaying stork nesting from November to as late as February or March. Nesting delays are believed to contribute to nest failures and colony abandonment because of the dispersal of prey items associated with the onset of the wet season (May-June). Wood stork rookeries occur at two pond apple stands along the south side of the highway: the Tamiami Trail West Rookery and the Tamiami Trail East Rookery (***Figure 3-4***).

In 2001, overall wood stork nesting effort in the WCAs was greater than had previously been seen since the mid-1970s and ten percent greater than 2000, another banner year. As in 2000, the storks nested in February and were able to fledge large numbers of young prior to the onset of rains. In 2005, nests were largely unsuccessful as a result of stable or rising water levels during March due to unseasonable rainfall. Tamiami West had a maximum of 25-35 successful nests.

The FWS, using the Habitat Management Guidelines for the Wood Stork in the Southeast Region (Guidelines) (Ogden 1990) based on recent photography during nesting season, identified primary and secondary restriction zones.

The primary zone is the most critical area and must be managed according to the guidelines to insure the colony survives. For the West Colony, a core area that contains nesting habitat has been designated by FWS to have a radius of 385 feet from the center of the colony. The primary zone for the West Colony extends an additional 1,300 feet in all directions from the core area for a radius of 1,585 feet. The FWS has designated the primary zone for the East Colony as a 1,300-foot radius from the colony center. The pond apple forest creates a visual barrier between the rookery and Tamiami Trail. The storks appear to have become somewhat acclimated to highway traffic noise.

The secondary zone may be used by wood storks for collecting nesting material and for roosting, loafing, and feeding (especially important for newly fledged young). The secondary zone of the West Colony extends an additional 1,000 feet beyond the primary zone for a total radius of 2,885 feet from the center of the colony. For the Tamiami East Colony, the secondary zone extends 1,200 feet beyond the primary zone for a total radius of 2,500 feet.

Approximately 3,700 linear feet of the Tamiami Trail are located within the primary zone of the Tamiami West Colony; none lies within the primary zone of the East Colony. In addition, approximately 5,000 linear feet of the highway lies within the secondary zones of the colonies.

In addition to the wood stork, FWC has identified six birds as species of special concern that may nest or otherwise be found in the vicinity of Tamiami Trail between S-334 and the L-67 Canal: tricolored heron, snowy egret, little blue heron, limpkin, roseate spoonbill, and white ibis. These migratory birds are protected under the provisions of the Migratory Bird Treaty Act. They are protected species under the jurisdiction of FWS. Nesting activities in these rookeries usually last until the rains have dispersed prey, leading to the cessation of nesting. FWS and FWC identified the Frog City wading bird colony, which hosts tricolored herons and great egrets, as potentially requiring protective measures during construction. The Frog City rookery is located in WCA-3B close to the L-29 Levee approximately one-quarter mile west of the Tigertail Camp.

The American alligator (*Alligator mississippiensis*), a species of special concern, and the Everglades mink (*Mustela vison evergladensis*), listed as threatened by the State of Florida, are also found along the Tamiami Trail corridor.

3.7 Air Quality

In accordance with the 1990 Clean Air Act (CAA) Amendments, the EPA designated the Southeast Florida Airshed, consisting of Miami-Dade, Broward, and Palm Beach counties, as a nonattainment area for ozone and its precursors. On April 27, 1995, the airshed was redesignated as an ozone

attainment/maintenance area. Miami-Dade County is an attainment area for carbon monoxide. Nitrogen dioxide, sulfur dioxide, and total suspended particulates are present in concentrations that are better than national standards. EPA has not determined a designation for airborne lead in southeastern Florida. ENP is a Class I Airshed.

3.8 Transportation

The original Tamiami Trail was most likely constructed in the late 1920s and early 1930s primarily by digging the canal by steam shovel and placing the spoil ahead to create the roadbed. In the mid-1940s, about 38 bridges were added at various locations on the Tamiami Trail, 19 of which were within the project area. In the early 1950s, the bridges were removed and replaced with the culverts that are currently in place. In 1968, the shoulders were widened and the pavement was overlaid. In 1970, a guardrail was added on the north side. At some time in the 1980s or 1990s, another guardrail was added on the south side of the road. Finally, in 1993, the shoulders were widened, and the mainline pavement was resurfaced.

FDOT requires that culverts be designed for a projected maintenance-free time or a design service life (DSL) appropriate for the culvert function and highway type. Recently, the FDOT Culvert Service Life Estimator Program was used with soil parameters to determine DSLs for four locations. The results indicated that the existing reinforced concrete pipe culverts under US Highway 41, which have been in operation for approximately 50 years, should continue to provide service for an additional 50 years.

The road is currently in need of maintenance. The asphalt surface of the road has surface environmental stress cracks and subsurface fatigue cracks. Based on FDOT's Flexible Pavement Survey Handbook in 2000 the Pavement Condition Rating, by which road surfaces are rated on a scale of 1 to 10, the Tamiami Trail would receive an FDOT rating of 6. Whenever a road is rated at 6 or below, repair actions are typically required. Because of pavement deterioration in terms of cracking, rutting, and ride, FDOT determined that the portion of the Tamiami Trail within the project area is in need of rehabilitation. The ADT volume from the 2003 GRR based on 1999 Existing Average Daily Traffic along the Tamiami Trail, approximately 5,200 vpd, is quite low.

3.9 Recreation

ENP receives in excess of a million visitors each year. Recreational opportunities include biking, boating, fishing, hiking, camping, and wildlife viewing. Approximately six miles west of the project area, the Shark Valley Information Center offers a 15-mile round-trip tram road (not open to private motorized vehicles) that extends into the marsh, offering one of the best opportunities for viewing wildlife. A two-hour narrated tram ride provides an

overview of the freshwater Everglades, and bicycles are available to rent. An observation tower is located at the half-way point.

The Airboat Association of Florida is a recreational association with facilities on the south side of the Tamiami Trail about three miles east of the western end of the project area.

Four commercial airboat operators are currently operating south of the Tamiami Trail. Three operators, Coopertown Airboat Rides and Restaurant, Everglades Safari Park and Gator Park operate from facilities located on the south side of Tamiami Trail and receive between two and three hundred thousand visitors each year. The other operator, Airboat USA launches from a public airboat ramp immediately east of Coopertown Airboat Rides. These ecotourism businesses offer guided tours into ENP.

The verge between the L-29 Canal and the L-29 Levee is used for passage along the canal, picnicking, or launching boats into the L-29 Canal. A road atop the L-29 Levee allows panoramic views to the north into WCA-3B.

Primary access to boat ramps on the north side of the L-29 Canal is at S-333 and S-334. Roads across these structures lead to several boat ramps and to bank fishing on the north bank of the L-29 Canal. S-334 provides access to a boat ramp (Boat Ramp 153) three miles to the east that allows boat launching into the L-29 Canal. A picnic area is associated with the boat ramp. Control structure S-333 provides access across the L-29 Canal to one airboat ramp and two boat ramps. There is a boat ramp on Canal 67-A and another on Canal 67-C. Both ramps are heavily used by boat fishermen. The airboat ramps provide access for deer and waterfowl hunters, as well as for recreational airboaters. Approximately 10.5 miles of the north bank of the L-29 Canal are available for bank fishing. Noncommercial airboats also launch south of the Tamiami Trail at two locations for sightseeing. The two locations are the ramp immediately east of Coopertown Airboat Rides and an undeveloped area at the L-67 Extension. The "Everglades National Park Protection and Expansion Act" allows those noncommercial airboat operators using the expansion area on January 1, 1989 to continue to operate airboats inside the expansion area.

Bank fishing is also popular from the shoulders of the Tamiami Trail and L-67 Extension Levee. Fishermen frequent the 10.7 miles of the south bank of the L-29 Canal (north shoulder of the highway). The only places for bank fishing on the south side of the highway are where the culverts discharge water to the south. FWC personnel conducted angler counts along the Tamiami Trail from December 1998 to May 1999. The mean number of anglers per mile for weekdays and weekend days, respectively, was 0.95 and 2.28. Ninety-four percent were bank anglers (personal communication, FWC, September 28, 2000).

These numbers translate into an estimated ten fishermen per weekday and 23 per weekend day, totaling approximately 5,000 man-days of fishing per year within the 10.7-mile study area. Personal observation revealed 25 bank fishermen and two boats with two fishermen in the project study segment at approximately 10:00 A.M. on a Saturday in September 2000. Almost all the bank fishermen were fishing on either side of the highway right-of-way, with only a few on the north bank of the L-29 Canal.

It should be noted that at least some of the fishing is subsistence, not recreational. There is reportedly recreational fishing for oscars (*Astronotus ocellatus)*, an aquarium fish native to South America that has become established in south Florida and which reportedly "puts up a good fight." Recreational anglers have been observed fishing for bass by boat in the canal during the short period of time when dry conditions drive the bass out of the marshes.

3.10 Cultural Resources

Studies for historic and archaeological resources were conducted to identify and assess National Register of Historic Places (NRHP) eligibility of historic properties within the project area, to survey potential archaeological sites, to conduct archival research, and to assess the potential of each historic resource as a Traditional Cultural Property as defined by National Register Bulletin No. 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties. This work was conducted to comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and the Archaeological and Historic Preservation Act of 1974.

Cultural resource surveys have been performed by Janus Research (2001) and New South Associates (2006). Background research was conducted at the Florida Master Site File in the Florida Collection of the Florida State Library. Additional literature was examined at the University of Florida libraries, the Miami-Dade Public Library, and the Historical Museum of Southern Florida.

Ethnographic interviews determined that several cultural groups use the L-29 Canal for recreation and food. Formal and informal interviews were conducted with anglers, business owners, and members of the Airboat Association of Florida. Because these activities are not limited to the canal or form the basis for identity of any group, the L-29 Canal was not recommended as a Traditional Cultural Property (New South Associates, 2006).

Archaeological surveys consisted of visual examinations, limited shovel testing along the right-of-way of the Tamiami Trail, and six areas having the greatest potential for containing archaeological deposit: the Osceola Camp, Everglades Safari Park, the Airboat Association of Florida, Gator Park, and Coopertown

Restaurant and Airboat Rides. None of the locations contained cultural material (New South Associates, 2006).

Architectural historians assessed properties within the project area for NRHP eligibility. Five historic properties within the project corridor were recommended and evaluated for potential eligibility for the NRHP. Private properties include: Coopertown Airboat Rides and Restaurant, Gator Park and the Airboat Association of Florida. However, the Tamiami Trail and the Tamiami Canal were also recommended for NRHP listing. The SHPO has concurred with these recommendations for listing.

The Tamiami (Tampa to Miami) Trail is important as one of the state's major engineering projects during the early 20th century. It has an overall length of 245 miles with approximately 24 miles within Miami-Dade County. Although the roadway has experienced changes over the years, such as the paving of the original limerock road with asphalt, slight widening of the road and the addition of low metal marries on both sides of the road, the Tamiami Trail continues to retain its historic character. Additionally, the road's historic feeling, association, design, and setting are still evident. The Trail's engineering and construction were performed under conditions that at the time were unprecedented in highway construction. It provided the first route across the southern peninsula and offered an opportunity for the general public to observe the Everglades from automobiles. Based on its associations with the developmental, commercial, and transportation history of Florida and the Miami-Dade County, the Miami-Dade County segment, including the portion adjacent to ENP, is considered to be a significant historic resource.

Two additional investigations of cultural resources commissioned by ENP revealed no additional resources within the footprint of the project (Schwadron, 2006a,b).

3.11 Aesthetics

The views along the project segment of the Tamiami Trail are interesting, but somewhat limited and constrained. On the north side of the highway are the L-29 Canal and the L-29 Levee, which extend along the entire 10.7 miles of the project segment. The view of the north side of the canal and levee is broken up by several water control structures and the Tigertail Camp. A panoramic view of the sawgrass and occasional hammocks or tree islands is largely blocked by the height of the levee. On the south side, the view is often blocked by tall vegetation along the roadside. Occasional breaks allow some distance views. The Osceola Camp and the grove of trees at the Airboat Association site provide some points of interest.

3.12 Noise Environment

The 2003 GRR/SEIS evaluated existing conditions, future without project conditions, and the alternatives under consideration at that time. ***Table 3-4*** presents project area traffic data from the report.

Traffic noise impacts were evaluated using maximum peak hour traffic at level of service (LOS) "D" because they provide higher noise levels than maximum peak hour traffic at LOS "C." Because the geometry of all current alternatives is identical with respect to Highway Capacity Manual (HCM) operational analysis, projected flow, LOS, and average speeds are identical for a given year and month for all alternatives.

TABLE 3-4 PROJECT AREA TRAFFIC DATA

Year	ADT (vpd)	Design Hour (vph)	Flow (vph)	Level of Service (LOS)	Average Speed (mph)
2000	5,375	800	860	D	50
2020	8,852	1,316	1,400	D	50

Source: USACE (2003)

Sensitive receivers selected and evaluated for the 2003 report included the Flight 592 Memorial, Osceola Camp, Safari Park, Gator Park, Tigertail Camp, Coopertown Airboats and the Airboat Association of Florida. Three sound levels were determined for each activity: (1) noise abatement criteria (NAC); (2) existing noise levels; and (3) predicted noise levels.

Ambient noise levels were recorded for 16.5 hours at the Osceola Camp and at the Tigertail Camp to determine background and peak hour noise levels. Measurements indicated average background A-weighted hourly equivalents (LAeq1h) of 65.8 decibels (dBA) at the Osceola Camp and 58.4 dBA at the Tigertail Camp. Peak hour levels were 68.0 dBA at the Osceola Camp and 61.0 dBA at the Tigertail Camp.

Peak hour existing conditions from the 2003 report are presented in ***Table 3-5***. Significantly, the evaluation indicated that the northwest portion of the Osceola Camp exceeded FDOT approach criterion of 66 dBA at peak hour existing conditions. All sites were found to be at or near the FDOT approach criterion of 66 dBA for the existing peak hour noise levels.

TABLE 3-5 EXISTING PEAK HOUR NOISE LEVELS

Site	Receiver[1]				
	1	2	3	4	5
Flight 592 Memorial	59.9	--	--	--	--
Osceola Camp	68.3	62.0	57.5	62.2	62.6
Safari Park	69.6	69.9	--	--	--
Gator Park	69.6	62.7	--	--	--
Tigertail Camp	60.5	60.8	--	--	--
Coopertown Airboats	69.6	69.9	62.7	--	--

Note: [1]Receivers are hypothetical points for sites for existing peak-hour modeling.

Source: USACE (2003).

3.13 Economics/Socioeconomics

The project study area is west of the "limits to urbanization" boundary established by the Miami-Dade Planning Department. Coupled with the protected natural areas north and south of the corridor, this effectively means that no additional development would be allowed along the corridor within the project limits. However, new ENP operations/visitor areas are possible in light of the ongoing ENP GMP process consistent with the Everglades National Park Protection and Expansion Act of 1989.

The Miami-Dade County region is a major metropolitan area with a population in excess of two million. The region supports a diverse economy with an emphasis on tourism, wholesale and retail trade, manufacturing, and shipping/transport. One-third of the Miami-Dade County area is within the boundary of ENP.

According to the 2000 census, the population of the county is approximately 70 percent white and slightly more than 20 percent black. Approximately 57 percent of Miami-Dade residents identify themselves as Hispanic. In 2000 it was estimated that 18 percent of the county's residents were in poverty, with almost 25 percent of that number being children under the age of 18. Over one million people were employed.

Three tourist-oriented businesses located on the south side of Tamiami Trail in the study area offer airboat trips, souvenirs and restaurant facilities: Coopertown Airboat Rides and Restaurant, Everglades Safari Park and Gator Park, Inc. The particular attraction of the businesses is ecotourism.

3.14 Tribal Lands

The Miccosukee Tribe of Indians has lived in what is now ENP for generations and has traditional, aboriginal, and statutory rights to live in the Everglades.

Two Miccosukee Tribe family group settlements are located within the project area: the Tigertail Camp and the Osceola Camp. The Tigertail Camp, located north of Tamiami Trail between the L-29 Canal and the L-29 Levee, is home to approximately 15-20 people, as indicated by the 2003 report. Vehicle access is by means of unimproved roads adjacent to and on top of the L-29 Levee that intersect the Tamiami Trail at canal crossings at each end of the project area. A pedestrian bridge crossing the canal connects a small parking area along the northern side of the highway to the Tigertail Camp. The living facilities of the Tigertail Camp were recently elevated above the flow levels anticipated for MWD.

According to the RGRR/SEIS, the Osceola Camp is home to ten to 15 people. It is located on the south side of the Tamiami Trail approximately one-half mile east of the western end of the project area. Access is by vehicle directly from the highway.

3.15 Flight 592 Memorial

The Valu Jet Flight 592 Memorial is located at the western end of the project area on the northern side of the L-29 Levee, about 250 feet from Tamiami Trail. Access to the memorial is via the S-333 canal crossing. The site consists of a parking area and a sculpture/memorial consisting of 110 concrete pillars that symbolize each of the lives lost in the DC-9 crash on May 11, 1996. The pillars are arranged in a triangular pattern that points to the actual crash site eight miles away in the Everglades.

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4.0 FORMULATION AND EVALUATION OF ALTERNATIVES

4.1 Purpose of the Limited Reevaluation

The purpose of the MWD Project is to restore to the extent practicable the natural hydrologic conditions within ENP. The ENP segment of Shark River Slough, the deepest flow way inside ENP, requires higher average water stages and longer flooding durations (compared to current conditions) during the wet and dry season to restore and maintain slough habitat. Historic hydrologic conditions have been altered by the Tamiami Trail, the levees that enclose the southern side of WCA-3A and 3B, and L-29 Canal.

The Tamiami Trail feature of the MWD Project is needed primarily to:

1. create hydraulic conveyance capacity through the Tamiami Trail to allow a return to a more natural flow of water to ENP in timing, location and volume of delivery, as directed in the ENP Protection and Expansion Act 1989 and the 1992 GDM;
2. prevent loss of and restore ridge and slough vegetation through an increase in the volume of water delivered to NESRS.

The purposes of this LRR are:

1. to review previously proposed and new alternatives to identify a cost-effective plan that maximizes benefits in terms of hydrology (flow volume, timing and stages inside ENP), suitability for vegetation and potential ecological connectivity
2. to develop a recommended plan that can be implemented under the MWD authority and funding, and that provides a way forward and source of scientific data to guide the eventual provision of the greater flows and additional restoration anticipated in the future under the CERP or other authority.
3. to recommend a plan consistent with the policy constraints and guidance.

4.2 Problems, Opportunities, Objectives and Constraints

4.2.1 Problems

The fundamental problem identified in previous Tamiami Trail reports remains the same. The problem is a loss of much of the deepest, longest hydroperiod habitat inside ENP as a result of changes to the hydrology of the system. The Tamiami Trail roadway acts as a barrier to flow, reducing flows to the south, shortening the period of inundation (the hydroperiod), and substantially lowering the natural variability in the hydroperiod. Hydrologic changes began when the Tamiami Trail was built in 1929, but became worse after the WCAs were enclosed (circa 1962), further cutting off natural flow paths from WCA-3A to WCA-3B, concentrating southward flows west of NESRS, south of WCA-3A,

and cutting off flows from WCA-3B to the L-29 borrow canal and into the eastern Everglades area (refer to ***Figure 1-1*** and ***Figure 1-2***).

At the time that the WCAs were enclosed, the area east of S-333 was not part of ENP and was destined for agriculture. Therefore it was desired to route water away from this area. The 1989 Everglades Protection and Expansion Act changed the purpose of lands east of the S-333 and the L-67 Extension Levee from agriculture and private ownership to the NPS, and further directed the USACE to restore the eastern Everglades' hydrology to the extent practicable. The L-29 Levee, L-29 Canal and Tamiami Trail together create barriers that obstruct the free movement of water, aquatic organisms and wildlife between ENP and WCA-3B. ***Figure 4-1*** is an isometric figure showing that the L-29 Levee, L-29 Canal and Tamiami Trail act as a barrier to water flow to ENP south of the road. The vegetation depicted in ENP is ridge and slough landscape.

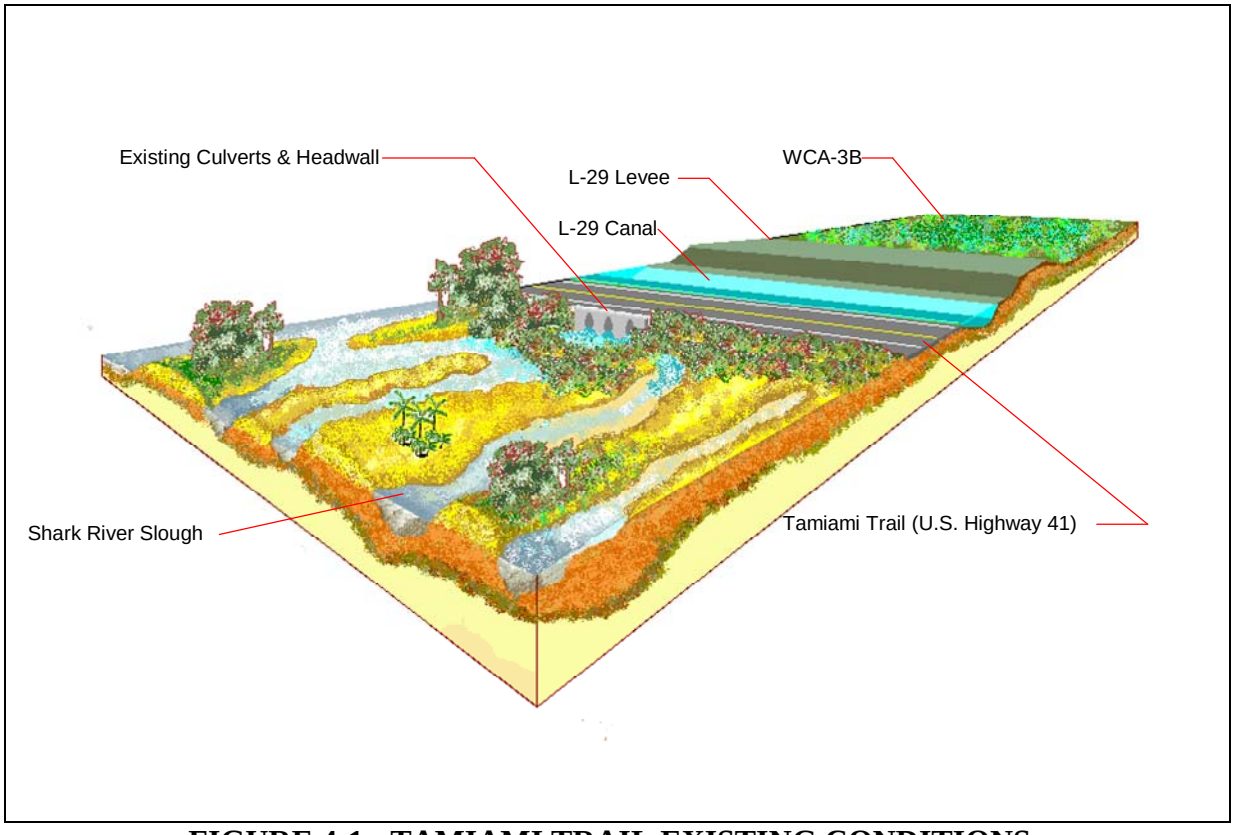

FIGURE 4-1: TAMIAMI TRAIL EXISTING CONDITIONS

Figure 4-2 and ***Figure 4-3*** allow a comparison of pre-drainage vegetation and recent, post-drainage vegetation in the area south of Tamiami Trail. These figures show the same red-outlined area where benefits and impacts were quantified. The J.H. Davis map of original, pre-drainage vegetation of the study area ***(Figure 4-2)*** shows the extent of the ridge and slough landscape. Davis recognized four dominant vegetation types in the potential impact area evaluated for improvements south of the Trail. They were, from approximately northwest to southeast: Deep sawgrass marsh (with tree islands shown as darker ovals and sloughs as lighter color), sparse sawgrass marsh, also with tree islands; medium to sparse sawgrass marsh (representing somewhat higher elevation, shorter hydroperiod and "marsh prairie", the shorter hydroperiod, shallower wetlands on the eastern slope up to more elevated lands to the east

Adverse impacts at the landscape level were caused by drainage and obstruction of natural flow pathways. A gradual loss of elevation difference between the tops of the ridges and slough bottoms created a flatter, more uniform topography, which led to conversion of plant cover to a more uniform sawgrass dominated community with fewer tree islands (***Figure 4-3***). In addition, major interruptions to ecological connectivity between the WCAs and the ENP, as well as animal mortality along the Tamiami Trail were results of the obstruction. It is certain that natural ENP systems would not recover their defining attributes under current conditions.

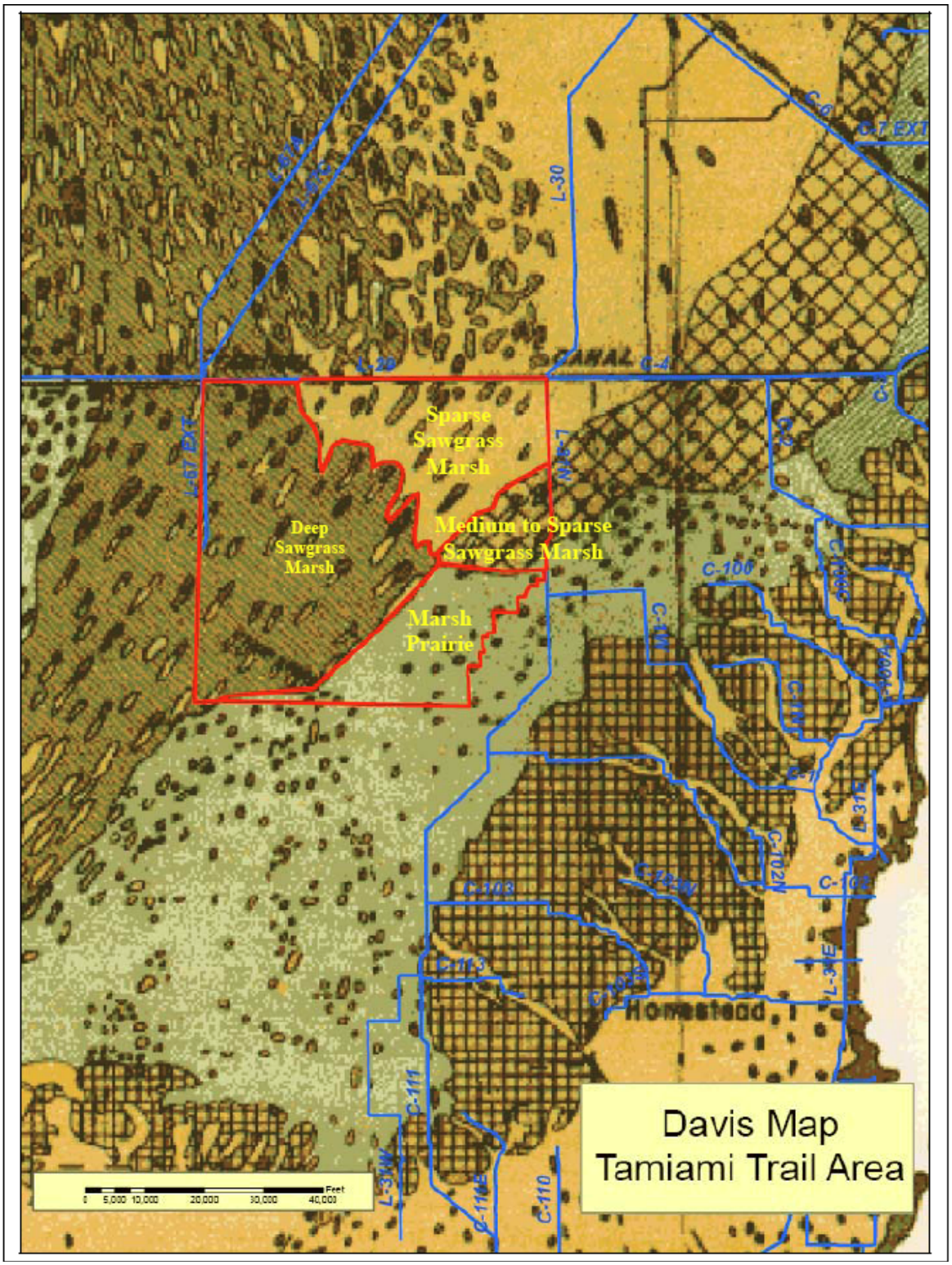

FIGURE 4-2: DAVIS MAP-ORIGINAL VEGETATION OF THE PROJECT AREA
(THE RED-OUTLINED AREA MATCHES THE RED OUTLINED AREA OF FIGURE 4-3)
(FOUR VEGETATION TYPES ARE LABELED WITHIN THE MAP)

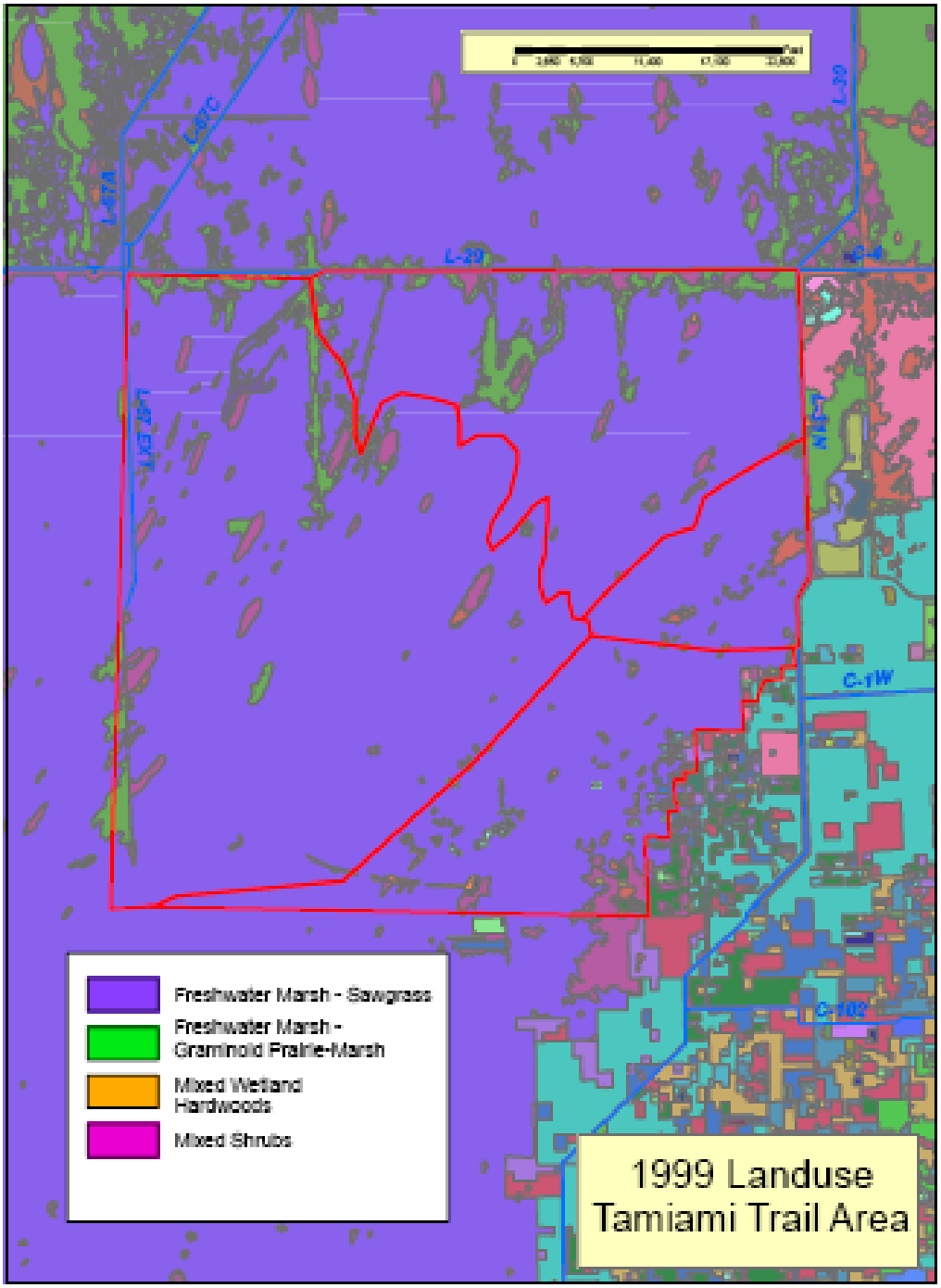

FIGURE 4-3: CURRENT LANDUSE CLASSIFICATION SHOWING SAWGRASS DOMINATION AND LIMITED TREE ISLANDS

(THE RED-OUTLINED AREA MATCHES THE RED OUTLINED AREA OF FIGURE 4-2).

4.2.2 Opportunities

The Tamiami Trail component of the MWD Project is part of an effort to restore the natural flows of water to ENP to the extent practicable. The Tamiami Trail project offers the opportunity for water conveyance to ENP with fewer obstructions to flows. This project includes opportunities to:

1. Allow delivery of more water into the eastern ENP and NESRS, restoring the balance of distribution between eastern and western deliveries, as proposed in the Mod Waters GDM, after the completion of the 8.5 SMA Project. The 8.5 SMA Project would remove a downstream flooding constraint.
2. Restore seasonal flooding and timing of deliveries that would enhance suitability for native vegetation and decrease the potential for invasive species colonization. At present most rainy season deliveries into the ENP are through the S-12 structures, located west of the L-67 Levee. Transfer of water delivery location to the east would benefit western sparrow populations while allowing late rainy season deliveries to continue for a longer season.
3. Increase the quantity of freshwater flows to NESRS. The added additional flows into the NESRS would increase the quality and quantity of ridge and slough habitat.

4.2.3 Planning Objectives

Based on a consideration of the purpose for the project, the problems occurring and the opportunities available to accomplish restoration goals, specific planning objectives for the LRR include the following:

1. Provide additional freshwater flows into NESRS, with more natural timing and distribution.
2. Restore processes that produce and maintain ridge and slough communities in ENP east of the L-67 Extension.
3. Restore slough vegetation and the deep water sloughs.
4. Reduce highway-caused mortality of animals moving across the Tamiami Trail.
5. Provide immediate peak flow capacity of 1,400 cfs with an ultimate target of 4,000 cfs.

4.2.4 Planning Constraints

The C&SF project and the construction of the Tamiami Trail have helped support the agricultural and urban development in and around the Everglades. This economic development has, however, adversely affected the ecosystem functions and values in the Everglades, including reductions in the spatial extent and functional quality of wetland habitat and decreases in native animal, fish and plant populations. While alternative plans are formulated to achieve

restoration of theses functions and values, to be considered for implementation, plans must also avoid violating planning constraints. The following constraints specifically affecting the project include:

1. Maintain at least one lane of traffic along the Tamiami Trail and avoid disruptions to traffic flows (e.g. residential and business access, hurricane evacuation).
2. Do not cause additional damages to the U.S. Highway 41 (Tamiami Trail) roadway.
3. Minimize adverse socioeconomic impacts on local businesses, residents and regional economies.
4. Avoid degradation of water quality in the ENP or any of the contributing water bodies within the basin.
5. Do not adversely affect listed threatened or endangered species.
6. Must start construction before 2010–later start would greatly delay implementation of major CERP components.

4.2.5 Future Without Project Conditions

The future without project conditions are the conditions expected in the project area if no project is implemented. It is a baseline for evaluation and comparison of alternatives. The study team assumed that future without project conditions would be similar to existing conditions. Section 3 of this report describes both the existing conditions and the future without project conditions. Please refer to Section 3 for further discussion. The future without project conditions for this planning study is synonymous with the No Action alternative under NEPA.

4.3 Alternatives

4.3.1 Plan Formulation Rationale and Overview

The plan formulation effort implemented within the LRR is designed to be a limited reformulation of alternatives identified during the 2005 RGRR and other viable alternatives that have been developed during the study process.

In order for additional water to cross Tamiami Trail, water elevation (stage) in the L-29 Canal must be raised and/or the openings in Tamiami Trail must be expanded. Alternative plans were developed as combinations of incrementally increasing stages and openings. The initial array of 26 action alternatives plus the No Action Alternative were tabulated beginning with the lowest stage increment, least action, in a progression to the highest stage increment plans, which were also those that produced the greatest benefits and most extensive structural changes.

After developing performance measure outputs and cost estimates for all 27 alternatives, the team screened alternatives based on whether the alternatives

met minimum performance levels for average annual flow volume, velocity differences, potential ecological connectivity, slough vegetation suitability, and by total project cost.

The screening resulted in a final array of four action alternatives plus the No Action Alternative. These plans were then reassessed and compared for ecological benefits, cost, cost-effectiveness, compatibility with CERP, and ability to implement. This second phase of evaluation identified the recommended plan.

4.3.2 Management Measures and Development of Alternative Plans

Management measures and subsequent alternative plans developed for this project were consistent with those that were produced during prior planning efforts. Management measures for this project focused on increasing conveyance of freshwater flows to ENP. In order to deliver additional flows, two major items need to be evaluated:

1. L-29 Canal Stage Increase: Increasing the stage in the L-29 Canal provides hydraulic head to push water from the L-29 Canal into Shark River Slough and to allow water to flow through the existing 55 culverts. Without a stage increase, there would not be the hydraulic pressure needed to push the water beneath the road. The greater the stage increase, the greater the water availability to ENP and the deeper the potential inundation and corresponding benefit to the ridge and slough community, depending upon operations and seasonal rainfall. The current stage constraint is 7.5 feet, which was introduced in part to prevent damage to the sub-base of the road. Therefore, it is a fundamental assumption that in order to raise the stage in the canal, the road would have to be mitigated to incorporate the change in water level (***Figure 4-4***). The stage in the L-29 Canal can be increased by increasing the amount of water allowed to flow through S-333 from WCA-3A into the L-29 Canal. S-333 is an existing structure that has operated for many years.

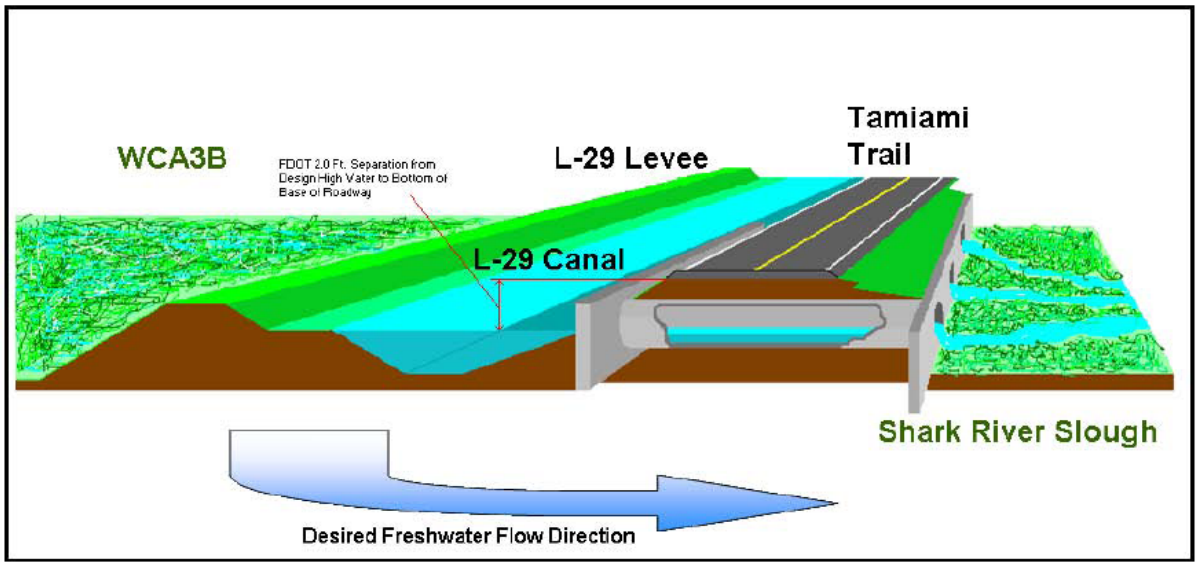

FIGURE 4-4: CROSS-SECTION OF TAMIAMI TRAIL WITH REINFORCED ROADWAY

2. Opening Size and Location: Increasing the width of the opening(s) beneath the Tamiami Trail would increase flow compared to the existing culverts. The major freshwater flow benefits of an increased opening span are derived from the reduction in head loss between the canal and marsh surfaces. By creating a larger space for water to flow between canal and slough, it creates a more equal distribution of water surfaces and functions to enhance the effectiveness of freshwater flows under any set of stage conditions. However, without a stage increase in the canal, there would not be the hydraulic pressure to push the water beneath the road; therefore, the stage must be modified to realize the benefit of the opening size. In addition to this hydrologic connectivity, larger openings provide for potential wildlife connectivity across the trail. The current long, rather narrow and dark culverts are somewhat like dark cave environments that may repel and inhibit passage of certain aquatic species, including fish, reptiles and amphibians adapted to bright surroundings. Even with the open deep water of the L-29 Canal located directly to the north of the northern culvert ends, it is expected that a more open passage illuminated indirectly, such as a bridge span, would enhance aquatic species migration. Wildlife passage is greatly limited under the current culvert openings, as the culverts are frequently wet and not suitable for migrating terrestrial species. Increasing the opening under Tamiami Trail would involve construction activity.

The team considered 0.5 foot increments of increasing stage constraints, starting from existing conditions (no increase) of 7.5 feet NGVD, then 8.0 feet, 8.5 feet, and finally 9.7 feet, which represents a return frequency of 20 years as predicted

by the Natural System Model (NSM). From a roadway design and frequency analysis using other future conditions (including CERP) a 9.7 foot stage was determined to provide reasonable protection to Tamiami Trail which allowed for unconstrained flow into ENP.

The team did not evaluate a 9.5 foot constraint as costs and benefits would be essentially the same as 9.7 feet. The team also did not evaluate a 9.0 foot constraint because at this stage the entire length of Tamiami Trail would have to be reconstructed, and the costs would approach those of a 9.7 foot stage while the benefits would be intermediate between an 8.5 foot constraint and an unconstrained stage of 9.7 foot.

Each incremental stage increase in the L-29 Canal required a consideration of impacts of the raised stage to Tamiami Trail. Increased water levels have the potential to damage the foundation of the road. The 8.0 foot stage constraint (0.5 foot stage increase) required reinforcing Tamiami Trail. The 8.5 foot stage constraint (1.0 foot stage increase) required more reinforcement of Tamiami Trail. At the 9.7 stage constraint, the road had to be reinforced sufficiently that the base of the road also had to be widened to support the increased height. ***Figure 4-5*** shows sample cross sections of the road changes that correspond to the increase in stage in the L-29 Canal.

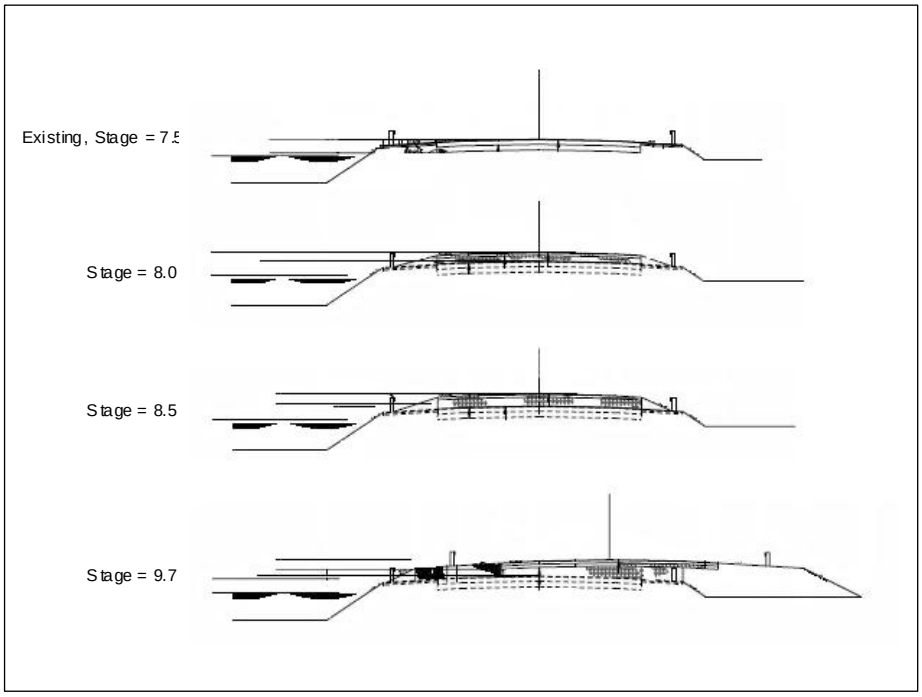

FIGURE 4-5: CANAL STAGE INCREMENTS AND ASSOCIATED MODIFICATION TO THE ROAD CROSS SECTIONS

When the team considered length of opening, many lengths between zero and 10.7 miles were initially considered. ***Figure 4-6*** shows the lengths and locations of the different openings in Tamiami Trail that were assessed in this LRR. Doubling the number of culverts and the 10.7-mile bridge were considered the minimum and maximum amounts of increase of opening size. It might have been possible to triple culvert density, but the estimated cost of doing so would have approached the cost of a one-mile bridge, while the total opening provided would have been only about 820 linear feet, while a one-mile bridge would provide 5,280 linear feet of conveyance.

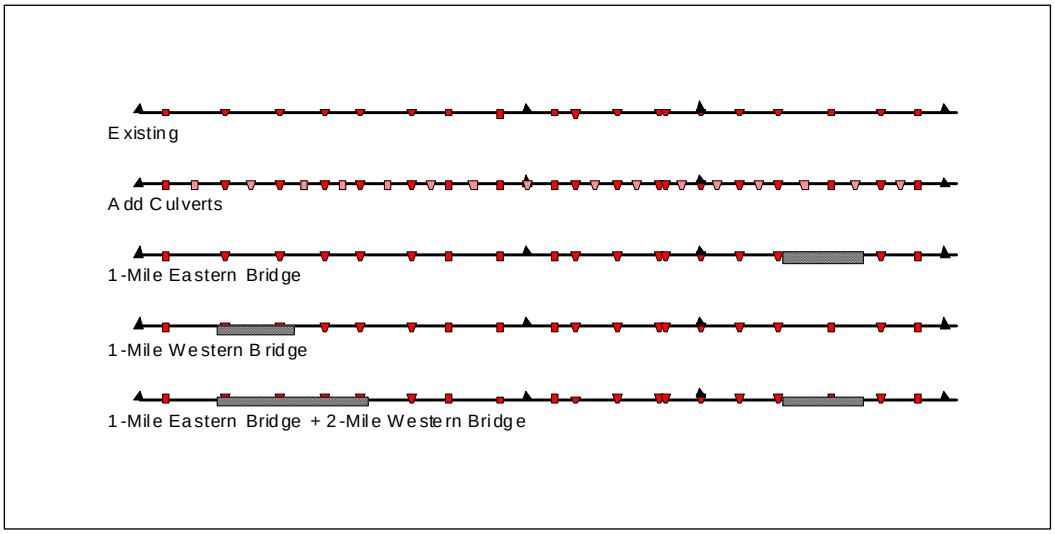

FIGURE 4-6: LOCATIONS OF THE OPENINGS ANALYZED IN THE TAMIAMI TRAIL ALTERNATIVES

(Existing, New Culverts, 1-Mile Eastern, 1-Mile Western, and 2-Mile Western Plus 1-Mile Eastern)
Note: The 10.7 mile-opening was also analyzed, but is not shown.

The two-mile west bridge plus one-mile east bridge opening (two bridges, three miles total) was selected for analysis because that alignment was part of the plan recommended in the 2005 RGRR. The 2005 RGRR Plan also included a stage of 9.7 feet. As this plan was subsequently determined to be too costly, thus initiating this reevaluation study, the LRR did not conduct detailed analysis of other plans with larger openings than the two-mile plus one-mile plan.

The team considered openings that were subsets of the plan selected in 2005. The eastern one-mile bridge would be the same location as the eastern one-mile bridge of the 2005 plan. The team considered a one-mile bridge that would be within the footprint of the two-mile bridge of the 2005 plan. The team did not pursue the two-mile western bridge from the 2005 plan because the cost

estimate developed during its design phase suggested that just this bridge was too expensive.

The team considered but did not pursue openings of less than one mile but larger than culverts. Analysis performed during the 2005 study demonstrated that there is significant head loss or difference of stage when the opening size is less than 5,000 feet (~one mile) (***Figure 4-7*** and ***Appendix D***). This differential is due to the interaction of the bridge opening size and the resistance of the downstream marsh to flow. This differential represents the additional height of water necessary to move water from the L-29 Canal into ENP. With openings smaller than one mile, much of the increase in stage of the various alternatives would be consumed by the head loss and little would be left to increase flows. Furthermore, a culverts-only alternative would not be compatible with future work under CERP. Any additional road reinforcement or bridging would require removal of most if not all of the work done under a culverts-only option.

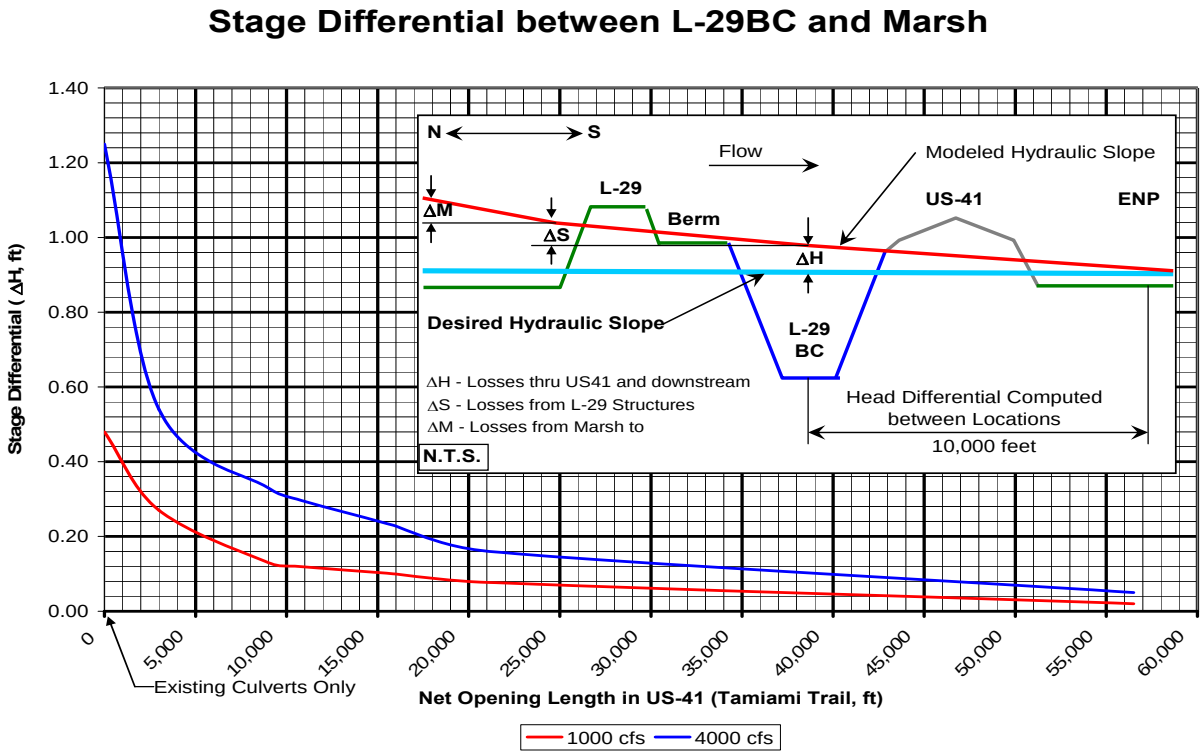

FIGURE 4-7: COMPUTED RMA-2 STAGE DIFFERENTIAL BETWEEN MARSH AND L-29 BORROW CANAL

These two variables, stage and opening, were used in various combinations to develop the incremental array of initial alternatives (***Table 4-1***) for the project. Operational changes to existing structures would be deferred to later studies and therefore were not considered in the formulation of alternative plans.

TABLE 4-1: TAMIAMI TRAIL INCREMENTAL VARIABLES AND MANAGEMENT MEASURES

CANAL STAGE (feet) and ROADWAY CROWN ELEVATION	OPENING SIZE/LOCATION
Canal Stage: 7.5 ft (Existing). Roadway Center Line El.: varies	19 culvert sets (existing), 38 culvert sets (19 existing, 19 new same location), 1 mile bridge (east), 1mile bridge (west)
Canal Stage: 8.0 ft Roadway Center Line Crown El.: 11.05 ft	19 culvert sets (existing), 38 culvert sets (19 existing, 19 new at same location), 1 mile bridge (east), 1mile bridge (west), 2 mile bridge (west) & 1 mile bridge (east)
Canal Stage: 8.5 ft Roadway Center Line Crown El.: 11.55 ft	19 culvert sets (existing), 38 culvert sets (19 existing, 19 new at same location), 1 mile bridge (east), 1mile bridge (west), 2 mile bridge (west) & 1 mile bridge (east)
Canal Stage: 9.7 ft (unconstrained flow) Roadway Center Line Crown El.: 12.75 ft	19 culvert sets (existing), 38 culvert sets (19 existing, 19 new at same location), 1 mile bridge (east), 1mile bridge (west), 2 mile bridge (west) & 1 mile bridge (east) 10.7 mile bridge (entire length of roadway)

Note: Existing roadway centerline varies from 10.1 to 12 feet.

Because of the cost to mitigate or compensate for impacts to the existing road, particularly for the higher canal stages that require that the road base be wider than the existing road, additional alternatives were evaluated that could be used to increase stage without the cost of road reinforcement. Structural alternatives include the use of levees to protect low portions. These alternatives include: (1) relocation of the road to another location, (2) construction of temporary levees to prevent road damage or (3) installation of pump stations. As previously stated, the initial array of alternatives focused on conveyance improvements based upon canal stages and opening sizes. A detailed description of each of the alternatives grouped by roadway center line crown elevations and canal stages is provided in the Engineering Appendix and ***Table 4-2*** below.

Some alternatives are identical to alternatives analyzed in previous reports. Alternative 4.2.3 of this LRR is the same as Alternative 14 of the 2005 RGRR Recommended Plan. Alternative 4.2.4, a 10.7-mile opening and bridge, is the same as Alternative 17 of the 2005 RGRR.

Alternatives do not all have the same number of conveyance openings. Three alternatives include two large openings with bridges. Thirteen alternatives include only one large opening with bridge. Four alternatives only add additional culverts. Seven alternatives do not include additional conveyance openings in Tamiami Trail.

4.3.3 Project Purpose

Recall throughout this report that the project purpose is to flow water from north to south. This project is not a transportation project. The management measures that are the components of almost all of these alternatives are: 1) increase stage in the L-29 Canal and 2) increase size of conveyance openings in Tamiami Trail, not building bridges and roads. The transportation features for the project are part of the compensation, known as the substitute facility, to FDOT for the acquisition of the needed real estate interests from FDOT. The descriptions and titles of the alternatives often refer to "bridge" and "road" because these would be the highly visible changes and these would be the high cost actions.

TABLE 4-2: REEVALUATION ALTERNATIVES

Alt	ALTERNATIVES	L-29 DESIGN STAGE (FEET)	DESCRIPTION
1	**No roadway reinforcement**		**There would be no increase in the elevation of the road except for Alternatives 1.4a and 1.4b, but this would be limited to minimal road reinforcement and only at the locations of bridges on roadway for pavement transitions. The L-29 Canal stage would remain at elevation 7.5 ft. NGVD.**
1.1	no action (19 culvert sets)	7.5	Requires no improvements to Tamiami Trail or its infrastructure.
1.2	spreader swales (30ft x 1000ft)	7.5	This alternative provides for spreader swales at each location of the 19 sets existing culverts. The swales have a bottom width of 30 feet wide and 1000 feet long.
1.3	add culvert sets (19 - 3x5ft dia) with swales	7.5	Add 19 sets of three 5 foot diameter culverts to the road. The new culvert sets would be installed adjacent to the location of the existing culverts. Spreader swales would be added at each location. This alternative would provide for a total opening size of 535 feet or 0.1 miles.
1.4a	add 1-mile eastern bridge	7.5	The 1 mile eastern bridge would be located between the Radio One communications tower and structure S-334. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
1.4b	add 1-mile western bridge	7.5	The bridge would be located near the western end of the approximately 2 mile distance between Osceola Camp and Everglades Safari. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
1.5	reinforce western section of road to 13.0 feet (crown) and add 1-mile western bridge	7.5	This is a subset of Alternative 5.4. It includes a bridge located near the western end of the approximately 2 mile distance between Osceola Camp and Everglades Safari. The remaining road between Osceola Camp and Everglades Safari would be elevated to minimum 13.0 NGVD at the crown. The remainder of Tamiami Trail would not be modified.
2	**Roadway improvements - Crown 11.05ft**		**These alternatives involve reinforcing the low areas of the road to a minimal roadway crown elevation of 11.05 ft. NGVD to allow stage increase in L-29 Canal stage to reach elevation 8.0 ft. NGVD. Road reinforcing would be allowed at bridge location for pavement transitions. Note: This would meet the current FDOT criteria established that the cross section crown elevation of the road be at least 3.05 feet above the average water elevation.**
2.1	reinforce low points along road	8.0	This alternative does not include any additional openings in the road.
2.2.1	reinforce low points, add culverts with swales	8.0	Add 19 sets of three 5 foot diameter culverts to the road. The new culvert sets would be installed adjacent to the location of the existing culverts. Spreader swales would be added at each location. This alternative would provide for a total opening size of 535 feet or 0.1 miles.
2.2.2a	reinforce road, add 1-mile eastern bridge	8.0	The 1 mile eastern bridge would be located between the Radio One communications tower and structure S-334. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.5 ft. NGVD.
2.2.2b	reinforce road, add 1-mile western bridge	8.0	The bridge would be located near the western end of the approximately 2 mile distance between Osceola Camp and Everglades Safari. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
2.2.3	reinforce low points, add 2-mile + 1-mile bridges	8.0	The 2 mile western bridge would start approximately 0.5 miles east of the Osceola Camp and end near Everglades Safari. The 1 mile eastern bridge would be located between the Radio One communications tower and S-334. The bridge control water elevation (CWE) for this alternative is 8.75 ft. NGVD. The bridge low cord would have to be 6 feet above this elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
3	**Roadway improvements - Crown 11.55ft**		**These alternatives involve reinforcing the low areas of the road to a minimal roadway crown elevation of 11.55 ft. NGVD to allow stage increase in L-29 Canal stage to reach elevation 8.5 ft. NGVD. Road reinforcement would be allowed at bridge location for pavement transitions. Note: This would meet the current FDOT criteria established that the cross section crown elevation of the road be at least 3.05 feet above the average water elevation.**
3.1	reinforce road	8.5	This alternative does not include any additional openings in the road.
3.2.1	reinforce road, add culverts with swales	8.5	Add 19 sets of three 5 foot diameter culverts to the road. The new culvert sets would be installed adjacent to the location of the existing culverts. Spreader swales would be added at each location. This alternative would provide for a total opening size of 535 feet or 0.1 miles.
3.2.2a	reinforce road, add 1-mile eastern bridge	8.5	The 1 mile eastern bridge would be located between the Radio One communications tower and structure S-334. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
3.2.2b	reinforce road, add 1-mile western bridge	8.5	The bridge would be located near the western end of the approximately 2 mile distance between Osceola Camp and Everglades Safari. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
3.2.3	reinforce road, add 2-mile + 1-mile bridges	8.5	The 2 mile western bridge would start approximately 0.5 miles east of the Osceola Camp and end near Everglades Safari. The 1 mile eastern bridge would be located between the Radio One communications tower and S-334. The bridge control water elevation (CWE) for this alternative is 8.75 ft. NGVD. The bridge low cord would have to be 6 feet above this elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.

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4	**Roadway improvements - Crown 12.75ft**		**These alternatives involve reinforcing the low areas of the road to a minimal roadway crown elevation of 12.75 ft. NGVD to allow stage increase in L-29 Canal stage to reach elevation 9.7 ft. NGVD. Road reinforcing would be allowed at bridge location for pavement transitions. Note: This would meet the current FDOT criteria established that the cross section crown elevation of the road be at least 3.05 feet above the average water elevation. Raising the L-29 elevation to 9.7 feet would meet the required elevation variations of the Natural System Model (NSM) as proposed in the CSOP or CERP.**
4.1	reinforce road	9.70	This alternative does not include any additional openings in the road.
4.2.1	reinforce road, add culverts with swales	9.70	Add 19 sets of three 5 foot diameter culverts to the road. The new culvert sets would be installed adjacent to the location of the existing culverts. Spreader swales would be added at each location. This alternative would provide for a total opening size of 535 feet or 0.1 miles.
4.2.2a	reinforce road, add 1-mile eastern bridge (RGRR)	9.70	The 1 mile eastern bridge would be located between the Radio One communications tower and structure S-334. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
4.2.2b	reinforce road, add 1-mile western bridge (RGRR)	9.70	The bridge would be located near the western end of the approximately 2 mile distance between Osceola Camp and Everglades Safari. The bridge control water elevation (CWE) for this alternative is 8.75 ft. The bridge low cord would have to be 6 feet above the CWE elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
4.2.3	reinforce road, add 2-mile + 1-mile bridges (RGRR)	9.70	The 2 mile western bridge would start approximately 0.5 miles east of the Osceola Camp and end near Everglades Safari. The 1 mile eastern bridge would be located between the Radio One communications tower and S-334. The bridge control water elevation (CWE) for this alternative is 8.75 ft. NGVD. The bridge low cord would have to be 6 feet above this elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD
4.2.4	10.7-mile bridge (RGRR)	9.70	The bridge would extend the entire length of the project area, between S-333 at the western end to S-334 at the eastern end. The bridge control water elevation (CWE) for this alternative is 8.75 ft. NGVD. The bridge low cord would have to be 6 feet above this elevation for inspection purposes. The low cord elevation would be 14.75 ft. NGVD.
5	**Structural alternatives and/or road realignment**		**Many of the components of the alternatives of Category 5 have not been recently evaluated, such as placing bridge(s) on the L-29 levee rather than along the existing roadway and constructing new levees. These alternatives have received limited evaluation of alternative alignments and Rough Order of Magnitude estimates.**
5.1	northern alignment of Alt 14	9.70	This alternative locates the 2 mile/ 1mile bridge alternative to the north of the current location of the existing Tamiami Trail placing the roadway and bridges entirely onto the L-29 levee. The L-29 levee would be removed and three bridges would be constructed as part of the access curves to transition too and from the levee back onto Tamiami Trail. The top elevation of the road would be 12.75. The bottom cord elevation of the bridges would be 14.75. Water quality treatment of stormwater runoff is required
5.2	northern alignment with 1-mile bridge	9.70	This alternative is similar to alternative 5.1 except there is less bridging. A one mile bridge would be constructed on the west side of Tamiami Trail to the north of the current location of the existing Tamiami Trail, placing the roadway and bridges entirely onto the L-29 levee. The top elevation of the road would be 12.75. The bottom cord elevation of the bridges would be 14.75. Water quality treatment of stormwater runoff is required
5.3	northern alignment with 1-mile bridge and relocation of L-67 levee - Crown 13.00ft	9.70	This alternative would concentrate all increased water stages and all road work between S-334 and the Blue Shanty Canal / Everglades Safari. A 1 mile bridge would be constructed between Osceola Camp and Everglades Safari, aligned along the existing L-29 levee. There would need to be additional bridging to connect the new bridge to the existing road alignment. The L-29 levee would have to be degraded and compacted to make it a suitable sub-grade for the roadway. The road elevation itself would have to be a minimum of 13 feet NGVD at the crown. This alternative includes modifications to L-67A, L-67C, and L-29 levees and L-67A canal to promote water flow from WCA 3A into a small portion of WCA 3B and then under the reinforced portion of Tamiami Trail and into NESS. The proposed structural changes would include water conveyance features added in the L-67A levee, degrading a portion of the L-67C and L-29 levees, and plugging portions of the L-67A canal to promote sheetflow from WCA 3A, through WCA 3B and into NESS. The proposed modifications also include plugs in the L67A canal, with different degrees of backfilling, to investigate the changes in canal flow patterns, as well as, any adverse impacts to recreational boating/fishing. In addition, the plan includes the construction of a new boat ramp to maximize recreational access while the canal plug studies are being completed. Construction of temporary levees along the current north-south alignment of the Blue Shanty Canal in southwestern WCA 3B and northern NESS in Everglades National Park, and a new gated water control structure in the L-29 canal at the temporary levee alignment The Levee to the South and the Levee to the North would be constructed to elevation 13 NGVD. The levee would have 4 to 1 side slopes for maintenance until it is removed at a later date. The road would have to be reinforced to cross the levee which would put the crown at 15 NGVD over the levee.
5.4	current alignment with 1-mile bridge and relocation of L-67 levee - Crown 13.00ft	9.70	This alternative would concentrate all increased water stages and all road work between S-334 and the Blue Shanty Canal / Everglades Safari. A 1 mile bridge would be constructed between Osceola Camp and Everglades Safari, aligned along the existing road. The remainder of the road within this section would be reinforced to a minimum elevation of 13 feet NGVD at the crown. The road cross section would be similar to Alternative 4.2.3. The section of the L-29 levee opposite this new bridge would be removed. This alternative would include moving the L-67 extension eastward to the Blue Shanty canal edge. The Levee to the South and the Levee to the North would be constructed to elevation 13 NGVD. The road would have to be reinforced to cross the new levee which would put the crown at 15 NGVD over the levee.
5.5	pump stations along L-29	-	This alternative would use a pump to move water from the L-29 Canal into Northeast Shark Slough (NESRS) utilizing existing openings under Tamiami Trail.

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4.4 Initial Evaluation and Screening

All 27 alternatives were evaluated for hydrologic and ecosystem restoration benefits, project cost, real estate impacts, implementation schedule, and compatibility with the CERP. Based on this analysis, all action alternatives show an improvement in hydrologic performance compared to the No Action Alternative. As the stage and opening size increases, the performance also increases. A subset of the results of these evaluations is displayed summarized in an evaluation matrix (***Table 4-3***) to identify the top performing plans.

The next subsections of this report provide a summary of how the evaluation parameters were applied to the 27 alternatives and discuss constraints and minimum performance relative to the parameters that were considered. A more in-depth explanation of all of the evaluations can be found in the Hydrology and Hydraulics (D) and Benefits (E) Appendices. The comparison analysis and screening produced a final array of four alternatives, which were then further evaluated.

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TABLE 4-3: TAMIAMI TRAIL PLAN FORMULATION MATRIX

ALTERNATIVE			BENEFIT SUMMARY								COST INFORMATION		IMPLEMENTATION		
Alt	ALTERNATIVES (note 1)	L-29 DESIGN STAGE (FEET)	BENEFIT AREA (ACRES)	1 in 10 YEAR PEAK FLOW (cfs)	AVERAGE ANNUAL VOLUME (kacre-ft/year)	% VOLUME INCREASE	% CONNECTIVITY	VELOCITY DIFFERENCES, MARSH AND OPENING	NUMBER OF DAYS W/ DEPTHS > 2 FEET	AVG ANNUAL LIFT (HU)	AVG ANNUAL COST PER HU ($/HU)	TOTAL TTM COST ($M)	NEPA / Report Coverage	CONSTRUCTION	
														Start	Finish
1	**No roadway raising (note 2)**														
1.1	no action (19 culvert sets)	7.5	0	1250	177	0.0%	0.0%	1.8%	2.8%	0	N/A	0	N/A	-	-
1.2	spreader swales (30ft x 1000ft - bottom dimensions)	7.5	63195	1371	185	4.6%	0.0%	2.5%	2.4%	187	5155	17	EA	Feb-10	Nov-10
1.3	add culvert sets (19 - 3x5ft dia) with swales **(note 3)**	7.5	63195	1371	188	6.4%	0.0%	3.3%	2.6%	238	14532	73	EA	Feb-10	Aug-11
1.4a	add 1-mile eastern bridge	7.5	63195	1410	203	15.2%	9.0%	26.0%	3.3%	3616	2775	219	EA	Aug-09	Aug-11
1.4b	add 1-mile western bridge	7.5	63195	1410	203	15.2%	9.0%	26.0%	3.3%	4209	2587	266	EA	Jul-10	Nov-12
1.5	reinforce western section of road to 12.75ft (crown) and add 1-mile western bridge	7.5	63195	1410	203	15.2%	9.0%	26.0%	3.3%	4209	>2587+	>266+	EA	Aug-10	Feb-13
2	**Roadway improvements - Crown 11.05ft (4)**														
2.1	reinforce road (low points only)	8.0	63195	1434	239	35.6%	0.0%	1.8%	11.0%	2594		144	EA	Feb-10	Feb-12
2.2.1	reinforce low points, add culvert sets with swales	8.0	63195	1508	251	42.2%	0.0%	1.8%	23.3%	3715	1976	181	EA	Feb-10	Feb-13
2.2.2a	reinforce road, add 1-mile eastern bridge	8.0	63195	1577	274	54.9%	9.0%	26.0%	46.7%	8559	1409	298	EA	Dec-09	Dec-12
2.2.2b	reinforce road, add 1-mile western bridge	8.0	63195	1577	274	54.9%	9.0%	26.0%	46.7%	9154	1398	354	EA	Aug-10	Dec-13
2.2.3	reinforce low points, add 2-mile + 1-mile bridges	8.0	63195	1577	293	65.7%	28.0%	65.0%	63.1%	15681	1111	539	EA	Dec-09	Jun-14
3	**Roadway improvements - Crown 11.55ft (note 4)**														
3.1	reinforce road	8.5	63195	1577	303	71.7%	0.0%	1.8%	76.6%	8621		169	EA	Feb-10	Feb-12
3.2.1	reinforce road, add culvert sets with swales	8.5	63195	1577	316	79.1%	0.0%	1.8%	82.6%	9412	1030	239	EA	Feb-10	Feb-13
3.2.2a	reinforce road, add 1-mile eastern bridge	8.5	63195	1848	340	92.4%	9.0%	26.0%	84.3%	13109	985	319	EA	Dec-09	Dec-12
3.2.2b	reinforce road, add 1-mile western bridge	8.5	63195	1848	340	92.4%	9.0%	26.0%	84.3%	13705	1007	381	EA	Aug-10	Dec-13
3.2.3	reinforce road, add 2-mile + 1 mile bridges	8.5	63195	1869	355	101.1%	28.0%	65.0%	84.3%	18972	955	561	EA	Dec-09	Jun-14
4	**Roadway improvements - Crown 12.75ft (note 4)**														
4.1	reinforce road	9.70	63195	2024	409	131.7%	0.0%	1.8%	84.4%	17543		260	EA	Apr-10	Oct-12
4.2.1	reinforce road, add culvert sets with swales	9.70	63195	2104	417	136.1%	0.0%	1.8%	84.4%	18874	664	346	EA	Apr-10	Oct-13
4.2.2a	reinforce road, add 1-mile eastern bridge (RGRR)	9.70	63195	2181	430	143.8%	9.0%	26.0%	84.4%	22585	685	428	EA	Apr-10	Oct-13
4.2.2b	reinforce road, add 1-mile western bridge (RGRR)	9.70	63195	2181	430	143.8%	9.0%	26.0%	84.4%	23184	709	455	EA	Aug-10	May-14
4.2.3	reinforce road, add 2-mile + 1-mile bridges (RGRR)	9.70	63195	2331	436	146.9%	28.0%	65.0%	84.4%	28361	708	557	Complete	Jun-09	Jun-14
4.2.4	10.7-mile bridge (RGRR)	9.70	63195	4036	472	167.1%	100.0%	100.0%	100.0%	53010		1648	EA	Feb-12	Feb-20
5	**Structural alternatives and/or road realignment (note 4)**														
5.1	northern alignment of Alt 14	9.70	63195	2331	436	146.9%	28.0%	65.0%	84.4%	28361	969	1328	EIS/GRR	Apr-12	Apr-20
5.2	northern alignment with 1-mile bridge	9.70	63195	2181	430	143.8%	9.0%	26.0%	84.4%	23228	1183	1187	EIS/GRR	Apr-12	Apr-19
5.3	northern alignment with 1-mile bridge and relocation of L-67 levee - Crown 13.00ft	9.70	17379	4036 (west) 956 (east)	472	167.1%	9.0%	13.0%	37.1%	4871	4463	751	EIS/GRR	Apr-12	Oct-16
5.4	current alignment with 1-mile bridge and relocation of L-67 levee - Crown 13.00ft	9.70	17379	4037 (west) 956 (east)	472	167.1%	9.0%	13.0%	37.1%	4871	4157	626	EIS/GRR	Aug-12	Feb-16
5.5	pump stations along L-29												EIS/GRR	Aug-13	Aug-21

Notes:

2 Existing road has 19 culvert sets resulting in an average culvert set spacing of ~3000 feet.
3 Reduces the average culvert set spacing to approximately 1500 feet.
4 All road improvements require 3.05 feet between road crest and L-29 design elevation.

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4.4.1 Benefits

The goal of the benefits analysis was to identify the hydrologic and ecological conditions that would occur given the alternatives outlined in this LRR document. These conditions were evaluated and compared to identify potential quantitative benefits for each alternative. The hydrologic analysis is presented first, followed by the ecological performance measures.

4.4.1.1 H&H Spreadsheet Analysis

The spreadsheet model was developed in order to analyze the ecological effects of NESRS that different stage constraints and bridge sizes on Tamiami Trail would produce. This spreadsheet analysis/model looked at the area within NESRS in a simplified manner and the following general assumptions were made for all alternatives (details of the model can be found in Appendix D):

a) The area between Tamiami Trail (north side), the NESRS2 monitoring gage (south side), L-67Ext (west side), and L-31N (east side) could be defined as a simple storage area. As water was added/subtracted to the area the stage would increase/decrease based on a mass balance approach.

b) To compute the inflow volumes historical deliveries were used to prevent having to develop an operational model. This general assumption looked at the total deliveries into ENP (S-12A + S-12B + S-12C + S-12D + S-333) and provided 55 percent of this volume into NESRS as long as the L-29BC was at a lower stage than the constraint for Tamiami Trail. If the L-29 stage was above the constraint flows were assumed to be zero. To smooth out the results for comparison purposes a seven-day rolling average was used to compute the discharges into NESRS. For example, Alternative 1.2, during the period of April 1-14, 1995 computed flows (cfs) based on 55 percent of the volume were: 0, 1356, 0, 0, 1253, 0, 1435, 0, 0, 0, 1252, 0, 1172, and 0. In operations of the real system however a weekly flow volume is targeted to prevent the open/closing of the structure and to maintain a more steady flow. The computed seven-day running average produced results of: 420, 614, 398, 398, 577, 373, 578, 578, 384, 384, 563, 384, 551, and 346.

c) If the flow volume was not delivered to NESRS then it was assumed it was discharged via the S-12s to NWSRS. This assumption produced no net change to the WCA-3A stage compared to historical conditions.

d) Bridge locations did not influence the ability of the spreadsheet model to deliver water. The spreadsheet model only considered topography in a very simplistic manner in regards of allowing flow out of the model and in terms of computing volumetric change. In reality the location of the bridge in conjunction

with major sloughs would increase the volume of water delivered into NESRS. However this determination was beyond the scope of the spreadsheet model. It should be noted a separate analysis was used for Performance Measure 2.C (Flows into NESRS provided via Bridge), refer to Appendix E for a description of the analysis.

e) A linear equation based on flow versus stage difference between L-29BC and NESRS2 was used to compute the stage in L-29BC. The basis for this linear equation was results from the RMA-2 modeling from the 2005 RGRR for Tamiami Trail modifications.

The spreadsheet model does a very good job of interpreting the general trends that increased inflows would produce within NESRS as measured at the NESRS2 monitoring gage. However, stage predictions should not be considered absolutes from this analysis. This analysis is a simplification of a very complicated system developed for a comparison purposes between all of the different alternatives. The spreadsheet analysis was not developed to be a predictive model but rather a comparative analysis. It was developed to be an analysis that incrementally looked at stage increases in the L-29BC and the ability to deliver additional flow volume into NESRS due to that stage increase. The model did predict stage increases in relation to increased flows but should not be considered a predictive model.

4.4.1.2 Performance Measures

Ten performance measures were developed and placed into four groups for convenience of evaluation. Each performance measure had a specific target. The ten performance measures were developed to address the important characteristics of hydrology, ridge and slough processes, vegetation, wildlife and connectivity within ENP. Each of the ten performance measures was assessed for all 27 alternatives. The ten performance measures are as follows:

1A. Average annual flow volumes
1B. One-in-ten year maximum discharge

2A. Number of sloughs crossed by bridges
2B. Difference between average velocity in marsh and average velocity at road
2C. Flows into NESRS provided via bridge

3A. Number of days water depth greater than two feet during wet season peak (indicator of deep marsh habitat conditions)
3B. Number of days water depth greater than three feet during wet season peak (indicator of deep marsh habitat conditions)
3C. Average water depth during wet season peak

4A. Reduction in wildlife mortality
4B. Potential connectivity of WCA-3-B Marsh with NESRS as percent of total project length

Appendix E, Environmental Benefits Analysis, provides an explanation of the rationale for each performance measure, its specific target, and a brief explanation of its meaning.

Most alternatives were expected to provide measurable impacts primarily over a rectangular area of 63,195 acres, located south of Tamiami Trail, bounded on the west side by the L-67 Extension (near S-333) and the east side by the L-31N Levee and the 8.5 SMA. The southern limit was defined as an east-west line connecting the southern end of L-67 Extension to 8.5 SMA. The area is depicted with the red outline in ***Figure 4-2*** and ***Figure 4-3***.

The benefits area for the "Blue Shanty" alternatives, 5.3 and 5.4, were smaller, because all flow would have been contained in the section of NESRS between the L-67 Extension and a levee that would be constructed along the Blue Shanty Canal. The benefits area for these two alternatives was 17,379 acres. This benefit area for the two alternatives may actually extend further south. In theory the area south would experience similar benefits from the south point of the L-67 Extension Levee across the ENP to the 8.5 SMA. The benefited acreage for each alternative is shown in ***Table 4-3***.

4.4.1.3 Links between Hydrology and Ecological Performance

As cited earlier in the report, this study team was tasked with immediately improving water deliveries and adopting an adaptive management approach toward restoring flows to ENP. The ultimate purpose of the water deliveries is to result in a positive ecological response. Science cannot accurately predict how a dynamic ecosystem will react to a change in hydrology. Therefore, the best method available involves "proxies" and "indicators" which the team believes will produce positive results for the ecosystem. The performance measures used in this LRR, characterized in Appendix E as "hydro-ecological performance measures," use past studies as well as the best professional judgment of a multi-agency team to predict when positive changes will occur. It is because of this uncertainty that an adaptive management approach is crucial to restoring the Everglades.

Some of the performance measures used in this analysis do not imply a direct relationship between hydrology and ecology. For example, the PMs "average annual flow volumes" and "difference between average velocity in marsh and average velocity at road" are hydrologic measures which the biologists and ecologists on the team felt would represent positive outcomes for the total ecosystem. The team chose hydrologic targets as surrogates for marsh and

slough habitats, as this is widely accepted and there are numerous published reports relating the two.

The mechanisms that control the formation and maintenance of ridges and sloughs are still poorly understood (Science Coordination Team 2003, McVoy and Tarboton 2004). Nevertheless, several models of ridge and slough topography have been proposed (McVoy and Tarboton 2004, Ross et al. 2006, Givnish et al. 2007). McVoy and Tarboton (2004) stress that ridge and slough topography is a function of water depth, water depth variation (seasonal fluctuation), flow velocity, and flow direction. Consequently, the team felt that these factors are reasonable proxies for alternative analysis.

There are, however, three performance measures that are directly linked to a species. The subset of performance measures entitled "Restore Vegetative Communities" includes measures of number of days at certain water depths during the rainy season, as well as average water depths. These measures are based on optimum conditions for the white water lily (Nymphaea odorata), a species characteristic of open sloughs in the Park. These conditions are based on research from Dr. Jenny Richards' mesocosm studies at Florida International University (Bi-annual Report for CA H5297-05-0013 Hydrologic Requirements of Aquatic Slough Vegetation, January 22, 2008).

NESRS historically was part of the ridge and slough ("corrugated") Everglades landscape. Sloughs are conspicuous and major landscape features in the southern Everglades and are the main pathway of water flow through the natural Everglades. The slough community is present in areas with the longest hydroperiods and the deepest water that rarely dries out. It also has a distinct plant community which is a mixture of floating, submerged species and sometimes emergent species.

A dominant and characteristic species of pre-drainage native sloughs is the white water lily. Over the past 40 years of hydrologic isolation from the ecosystem to the north, NESRS has largely converted to a drier community of mixed sawgrass with very little white water lily. White water lily is more abundant in deeper slough habitats and areas less subject to drydown events. Paleoecological studies indicate that pre-drainage ENP slough communities were once dominated by white water lily and banana lily prior to the widespread artificial drainage of slough communities. Many scientific studies and field observations indicate areas with conditions with deep water and few drydown events are where white water lily does better than other plants and is more abundant than other species. The vegetation suitability performance measures measure the hydrologic conditions that favor slough vegetation, particularly the white water lily, and rank favorably those alternatives that are best able to

mimic those conditions. The other performance measures represent hydrologic targets used as surrogates for marsh and slough habitat improvement.

4.4.2 Cost Analysis

Data for the initial design, construction/implementation and land acquisition costs for all 27 alternatives have been developed through engineering design, cost estimation and real estate appraisal efforts. Total construction cost used in the cost analysis of each alternative includes labor and materials costs for completing the structure(s). Total project cost is the sum of total construction cost (TCC), PED cost, S&A cost, real estate cost and escalation.

The 30 percent design cost estimates for the selected plan from the 2005 RGRR served as the starting point for the LRR cost estimates. From this, a parametric cost model was constructed to allow comparable estimates to be developed for all the alternatives.

Cost Risk Analysis. In September 2007, the USACE mandated the use of risk and uncertainty analysis for major projects. Cost risk analysis is the process of identifying and measuring the cost and schedule impact of project uncertainties on the estimated total project cost. When considerable uncertainties are identified, cost risk analysis can establish the areas of high cost uncertainty and the probability that the estimated project cost would or would not be exceeded. The 90 percent confidence level was selected as the appropriate level for the TCC. This means that there is a 90 percent chance that the final cost for this project (at fiscal year-08 pricing levels) would be equal to **or less** than this cost. This is an extremely important point and is different than how USACE project costs have traditionally reported.

Escalation. Generally, civil works projects are escalated using annual indices in accordance with the Civil Works Construction Cost Index System. The indices are indicators of inflation. The indices are used only for near-term escalation for two years or less. Beyond that timeframe it is necessary to evaluate market conditions. The 90 percent TCC estimates were escalated to the mid-point of construction, and then adjusted based on recent inflation trends in the construction industry and the anticipated construction schedule for each alternative. Since 2003, there has been unprecedented inflation in the construction industry due to rising oil prices, huge demand from overseas economies, natural disasters, and the continuing globalization of the construction industry.

Costs of alternatives are estimated at October 2007 price levels (refer to ***Table*** 4-3 for a summary of costs and Appendix C for in-depth discussion of costs). The costs in ***Table 4-3*** include market conditions escalation to the midpoint of construction.

From the cost analysis of the alternatives, the following points are emphasized:

- Costs increase at two points, at every stage increase and as opening size increases.
- Cost is associated with time of construction, both in terms of planning/design and actual construction timelines. Escalation rates observed in Florida are higher than in many other sections of the country. Plans that have shorter implementation timelines have less escalation—they are relatively less expensive.
- Costs are highly dependent on construction materials, especially asphalt and concrete. In general, road work is less expensive than bridge construction; therefore plans that limit bridge lengths tend to be less expensive.
- First costs include the risks and construction techniques necessary for constructing a project within ENP, which is a sensitive environment.
- Risk and uncertainty have been integrated into the cost analysis.

4.4.3 Screening

The screening of the LRR alternatives was based on both performance and cost criteria. These factors were used to remain in compliance with the language of the 2007 WRDA Managers' Report (Section 1) as well as the broad guidance provided by senior policy personnel within the USACE and the DOI. Initially, the guidance provided to the team was based on complying with two over-arching principles, one from the USACE and the other from DOI. USACE guidance was to identify an alternative at a cost less than the 2005 RGRR Selected Plan and not exceeding an initial upper limit cost of $300 million. DOI guidance was less specific and included the need to identify an alternative having an appropriate level of project performance while being cost effective. No upper cost threshold was provided to DOI members of the LRR team. As will be seen later in this section, this general guidance was sufficient to screen the alternatives with minor modifications in response to the expressed desires of the cooperating agencies and/or the local sponsor participating in the development of this report.

Using the broad guidance described above, the LRR team screened the LRR alternatives using a subset of the performance measures described in the Benefits Analysis Section (Section 4.4.1) as well as the estimates of the total project costs provided in ***Table 4-3***. The performance measures selected for use in the screening were those measures which provided the greatest ability to segregate the alternatives based on relative ecological and hydrological performance as well as being representative of measures requiring some minimum level of performance for an alternative to be considered acceptable. The screening strategy employed was to apply the selected ecological and hydrological performance measures sequentially and then subject the remaining

alternatives to a final screening based on the project costs. The ecological and hydrological performance measures used for this process are found in ***Table 4-4*** and are listed in their order of application in the screening process, including the threshold level of performance used for the acceptance/rejection of a given alternative:

TABLE 4-4: ECOLOGICAL AND HYDROLOGICAL PERFORMANCE MEASURES USED FOR SCREENING

Screening Priority	Measure	Hydrological/Ecological Measure Description	Screening Threshold (% above No Action)
1	1A	Average annual flow volumes	<= 20%
2	2B	Difference between average velocity in the marsh and average velocity at road	<= 20%
3	4B[1]	Potential connectivity of WCA-3B marsh with NESRS as percent of total project length	<=5%
4	3A	Hydrologic Suitability for Slough Vegetation	<=20%

[1]Note: this performance measure was originally PM 1B

These performance measures, used in the order stated in ***Table 4-4***, provide a needed combination of hydrologic performance: (1 and 2), marsh connectivity (3), and downstream ecological response (4) for the team to be confident that the screening process would provide an acceptable suite of alternatives following their sequential application.

Results of the iterative screening are described in detail below:

Screening of Alternatives Based on Average Annual Flow Volume Performance (Screening Priority 1). The initial screening of the LRR alternatives was conducted using the average annual flow volume performance measure. The relative performance of each of the alternatives is provided in ***Figure 4-8,*** and includes the threshold of a minimum level of performance of a 20 percent increase in discharge above the No Action Alternative. Alternatives which met this minimum level of performance were all alternatives in Categories 2, 3, 4, and 5. All alternatives in Category 1, which maintained the L-29 canal stage at 7.5 feet, were eliminated from further consideration. This includes alternatives with additional culverts and bridging; therefore, the ability to improve flows into NESRS appears less dependant on openings through the roadway and more dependant on the ability to increase the stage in the L-29 Canal. All alternatives having an L-29 stage greater than or equal to 8.0 feet were retained for subsequent screening.

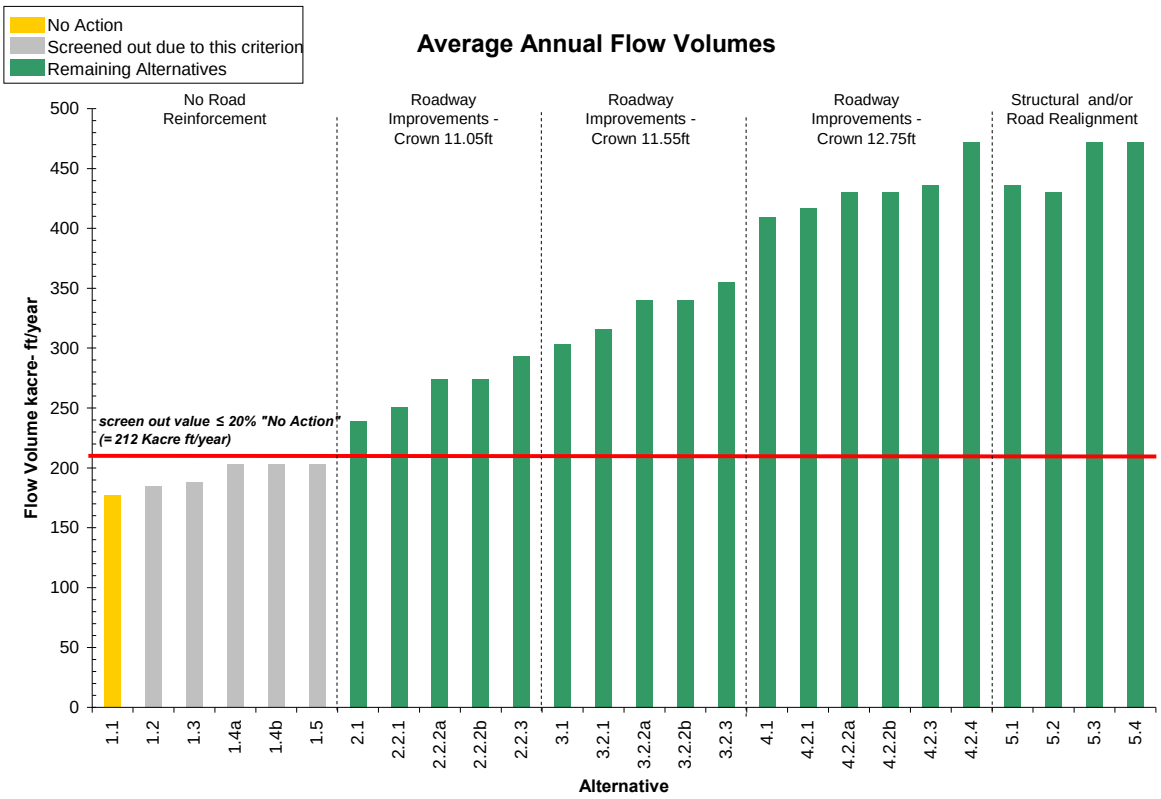

FIGURE 4-8: SCREENING RESULTS FOR AVERAGE VOLUME PERFORMANCE

Screening of Alternatives Based on Difference between Average Velocity in the Downstream Marsh and Average Velocity at Road (Screening Priority 2). Flow velocities different from the natural marsh conditions can result in modifications to the landscape, including unnatural nutrient loading, vegetation cover and soil characteristics. Alternatives were next assessed for their ability to provide slower velocities near the road (approaching marsh water velocities). Current average marsh water velocities are ~0.024 ft/sec compared to current average velocities at the road of ~1.33 ft/sec. To prevent potential erosion immediately downstream of road openings and decrease the deposition of sediment fans inside the Park, velocities of ~1.0 ft/sec or less are desired. The desired velocity approximates 20 percent increase or level of performance compared to the No Action Alternative. Application of this screening measure resulted in the relative performances depicted in ***Figure 4-9*** and resulted in the elimination of an additional six alternatives (2.1, 2.2.1, 3.1, 3.2.1, 4.1, and 4.2.1). Essentially, this screening measure eliminated all alternatives that did not have at least one bridge span within the road alignment. All remaining alternatives that had bridge spans were retained (Alternatives 2.2.2a, 2.2.2b, 2.2.3, 3.2.2a, 3.2.2b, 3.2.3, 4.2.2a, 4.2.2b, 4.2.3, 5.1, 5.2, 5.3, and 5.4) for subsequent screening. It should also be noted that alternatives with multiple bridge spans and larger span lengths performed better than alternatives with single bridges of relatively shorter bridge span length.

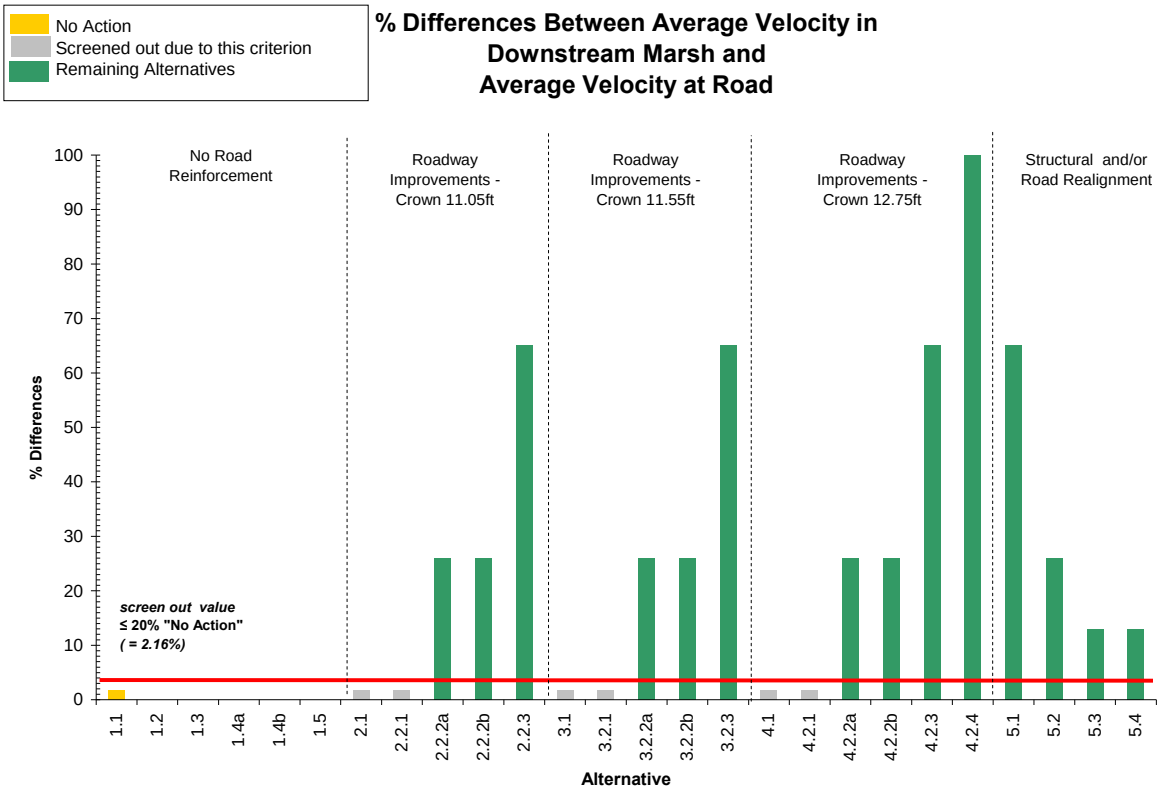

FIGURE 4-9: SCREENING FOR AVERAGE VELOCITY PERFORMANCE

Screening of Alternatives Based on Connectivity of WCA-3B Marsh and NESRS (Screening Priority 3). Connectivity performance is a measure of the degree of unimpeded natural overland flow through the marsh. The remaining alternatives were next screened for connectivity based on a minimum performance of five percent more than the No Action Alternative for marsh connectivity. As stated in earlier sections of this report, connectivity is considered as one of the primary objectives of marsh ecosystem restoration. Application of this screening measure (***Figure 4-10)*** did not result in the elimination of any additional alternatives that remained after step 2 but did affirm the need to eliminate the alternatives that failed to meet the minimum level of performance of the previous screening criteria. For example, Alternatives 1.2, 1.3, 2.1, 2.2.1, 3.1, 3.2.1, 4.1, and 4.2.1 exhibited a level of connectivity performance below the five percent threshold for this screening criterion. Therefore, Alternatives 2.2.2a, 2.2.2b, 2.2.3, 3.2.2a, 3.2.2b, 3.2.3, 4.2.2a, 4.2.2b, 4.2.3, 5.1, 5.2, 5.3, and 5.4 were retained for further screening.

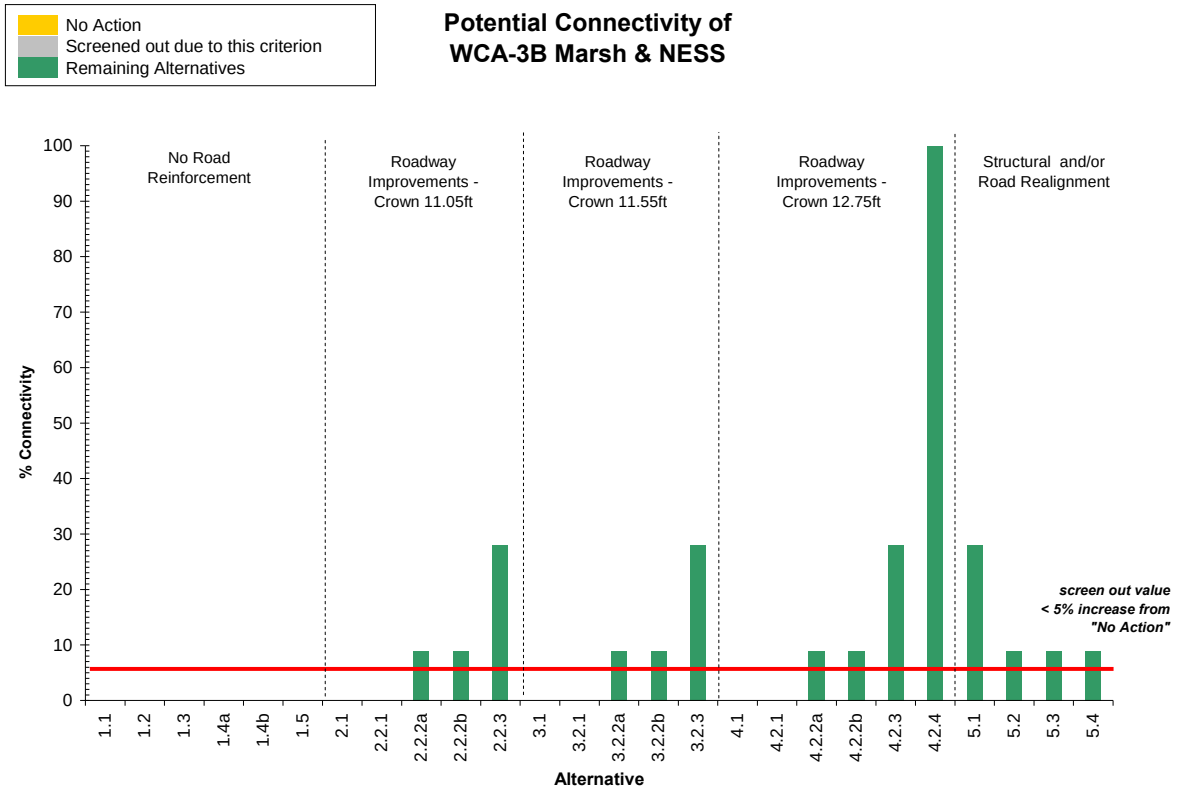

FIGURE 4-10: SCREENING FOR MARSH CONNECTIVITY PERFORMANCE

Screening of Alternatives Based on Hydrologic Suitability for Slough Vegetation (Screening Priority 4). This screening criterion is based on the need to attain water depths within the slough landscape of sufficient depth and duration to promote and sustain vegetation communities that covered the slough landscape in ENP historically. The screening measure produced similar results as the criterion for marsh connectivity. All alternatives that were retained following screening by screening priorities 1, 2, and 3 were again retained following the application of this screening priority using a minimum threshold of performance of 20 percent greater than the No Action Alternative (***Figure 4-11***). Alternatives 2.2.2a, 2.2.2b, 2.2.3, 3.2.2a, 3.2.2b, 3.2.3, 4.2.2a, 4.2.2b, 4.2.3, 5.1, 5.2, 5.3, and 5.4 were retained but also affirmed the results of the application of the earlier screening criteria when Alternatives 1.2, 1.3, 2.1, 2.2.1, 3.1, 3.2.1, 4.1, and 4.2.1 exhibited a low level of performance for marsh connectivity.

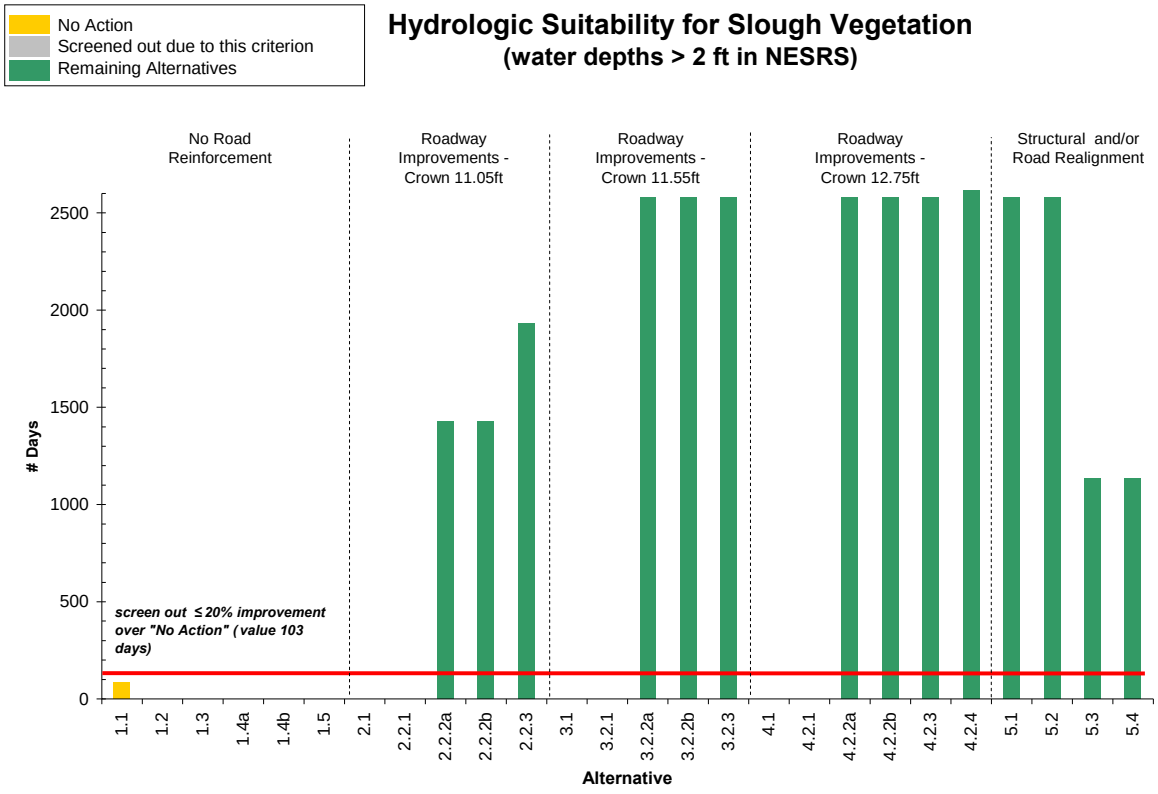

FIGURE 4-11: SCREENING FOR HYDROLOGIC SUITABILITY FOR SLOUGH VEGETATION PERFORMANCE

The results of the screening of the LRR alternatives using the hydrological and ecological performance measures indicated several important findings. First, those alternatives with lower canal stage in L-29 would likely not produce the flows or the water levels necessary for a satisfactory level of restoration

consistent with the objectives of the MWD Project. Second, only the alternatives that contained bridge spans provide potential ecological connectivity and flows that are likely to approximate natural marsh conditions.

Screening of Alternatives Based on Cost. Based on these results, the remaining alternatives (2.2.2a, 2.2.2b, 2.2.3, 3.2.2a, 3.2.2b, 3.2.3, 4.2.2a, 4.2.2b, 4.2.3, 5.1, 5.2, 5.3, and 5.4) were then subjected to the final screening priority-cost. Identification of the appropriate threshold for cost screening was difficult due to the lack of a unified and specific view from policy personnel in the USACE and DOI. Initially, the guidance from the USACE to the LRR team was to use a $300 million threshold as this was interpreted to be the upper limit of support from Congress for the Tamiami Trail component of the MWD Project. This limit was based on the assumptions that the authority of the MWD Project was limited and that additional modifications were also authorized for implementation under the CERP authority. Following public scoping of the LRR alternatives and the subsequent sharing of the preliminary results of the hydrologic and ecologic performance of the LRR alternatives, it became evident that many of the alternatives exhibiting a significantly higher level of performance were alternatives with project costs slightly higher than the initial $300 million threshold. Many of these alternatives were also identified by stakeholders as their preference for implementation. Therefore, based on input from the cooperating agencies and the local sponsor for the project, the technical LRR team elected to raise the cost threshold to $400 million to allow for the review of alternatives exhibiting significantly higher levels of performance than the pervious $300 million threshold. Additional considerations were included in the selection of this threshold cost. The team did not anticipate that $400 million or even $300 million would be approved. The team knew that the screening cost estimates (Table 4-3) were conservatively high and expected that additional design would reduce the costs anywhere from $20 million to $100 million. The threshold took into account this potential cost reduction. $400 million was considered high enough to retain alternatives with a reasonable potential to be funded after the savings and low enough to screen most alternatives that were so costly that they would not be fundable.

The results of the screening of the remaining alternatives with respect to a $400 million cost threshold are depicted in ***Figure 4-12***.

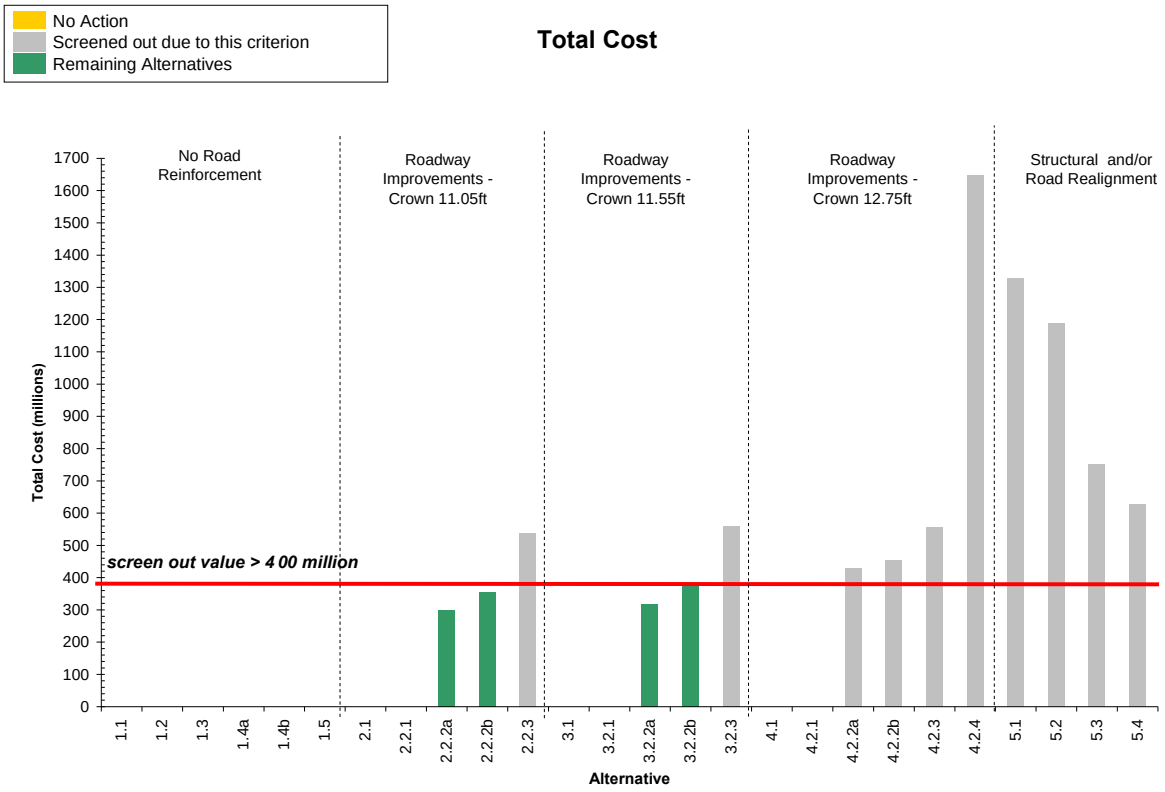

FIGURE 4-12: SCREENING FOR COST PERFORMANCE

Clearly, cost is the most important screening criterion in determining the final suite of LRR alternatives. Ten of the remaining fourteen alternatives were eliminated from further analytical considerations due to the application of the $400 million cost threshold; this includes the 2005 RGRR Environmentally Preferred Alternative - the 10.7-mile bridge plan (Alternative 17 of the RGRR and Alternative 4.2.4 of this LRR). The most important result of using this screening measure is that all of the highest performing alternatives were eliminated. Alternatives 2.2.3, 3.2.3, 4.2.2a, 4.2.2b, 4.2.3, 5.1, and 5.2 consistently exhibited higher level of performance for volume, marsh velocity, connectivity, and slough vegetation suitability than the alternatives which remain following the screening using the $400 million cost threshold. Many of the alternatives eliminated due to cost have features that include more bridging, longer spans for the bridges, and roadway modifications which allow for higher water levels in the L-29 Canal and allow for full restoration of NESRS. The alternatives remaining following the application of all of the screening measures, including cost, are Alternatives 2.2.2a, 2.2.2b, 3.2.2a, and 3.2.2b. This final suite of alternatives would be evaluated more fully in subsequent sections using the remaining performance measures found in Section 4.4.1. It is the opinion of the LRR team that the resulting alternatives meet the general guidance provided by the USACE and DOI for the identification of a cost effective alternative less

costly than the 2005 RGRR Selected Plan but still providing a level of performance consistent with the objectives of the MWD Project.

Sensitivity of Screening Thresholds. The team performed a simple sensitivity analysis of the effect of changing screening thresholds. The screening criteria used by the team are: volume 20%, velocity 20%, connectivity 5%, and depth-days for vegetation 20%. Four alternatives remain after screening: 2.2.2a, 2.2.2b, 3.2.2a, and 3.2.2.b. The sensitivity analysis looked at dramatic changes in the screening thresholds but did not see dramatic changes in the results of screening.

1. Remove the connectivity criterion from the analysis and keep the remaining three criteria at 20%; the same four alternatives would remain.
2. Remove the connectivity criterion and **double** the remaining three thresholds from the current 20% to 40%; the same four alternatives would remain.
3. Remove the connectivity criterion and **reduce by one-quarter** the remaining three thresholds from the current 20% to 15%; the same four alternatives would remain.
4. Remove the connectivity criterion and **reduce by half** the remaining three thresholds from the current 20% to 10%; seven alternatives would be retained - the same four alternatives as the original scenario plus three additional alternatives. The new alternatives would be 1.4a (1-mile eastern bridge, 7.5 stage), 1.4b (1-mile western bridge, 7.5 stage), and 1.5 (1-mile western bridge and raise part of road, 7.5 stage). These new alternatives would have been added due to the relaxation of average annual volume thresholds.

4.5 Evaluation and Comparison of Final Alternatives

After further evaluation to determine the extent to which the alternative plans would meet project objectives and taking into consideration opening size, stage increases and acceptable project costs, four action alternatives were identified in addition to the No-Action Alternative. The final array of alternatives is:

- 1.1 No-Action
- 2.2.2a Raise canal stage to 8.0 feet, reinforce road, one-mile eastern bridge
- 2.2.2b Raise canal stage to 8.0 feet, reinforce road, one-mile western bridge
- 3.2.2a Raise canal stage to 8.5 feet, reinforce road, one-mile eastern bridge
- 3.2.2b Raise canal stage to 8.5 feet, reinforce road, one-mile western bridge

Versions of these four action alternatives were also previously considered in the 2005 Report. It is expected that the four action alternatives listed above can provide a 55-92 percent increase in average annual water flows to NESRS. Since the one-mile eastern bridge is a portion of the previously selected plan, the geotechnical survey data and the intermediate plans and specifications can be used without any loss of time having to redo them.

4.5.1 Ecological Performance

Table 4-5 displays the performance measures and habitat units (HUs) for the four final alternatives. These values are the same as in Table E-3 of Appendix E, but are reproduced here for convenience.

TABLE 4-5: PERFORMANCE MEASURES FOR FINAL ALTERNATIVES

Performance Measure	1.1 No Action	2.2.2a Stage to 8.0, 1-mile Bridge East, Reinforce Road	2.2.2b Stage to 8.0, 1-mile Bridge West, Reinforce Road	3.2.2a Stage to 8.5, 1-mile Bridge East Reinforce Road	3.2.2.b Stage to 8.5, 1-mile Bridge West, Reinforce Road,
1A. Average Annual Flow Volume (acre-feet)	176,559	273,565	273,565	339,703	339,703
1B (re-labeled as 4B)					
1C. One in ten year maximum discharge (cfs)	1146	1416	1416	1642	1642
2A. Number of sloughs crossed by opening	0	2	2	2	2
2B. Ratio between average velocity in marsh and average velocity at road (%)	1.8	26	26	26	26
2C. Flows into NESRS provided via bridge (%)	0	11	20	11	20
3A. Total number of days at NESRS-1 and NESRS-2 with water depth >2 ft during growing season peak	86	1428	1428	2578	2578
3B. Total number of days at NESRS-1 and NESRS-2 with water depth >3 ft during growing season peak	0	3	3	7	7
3C. Average water depth at NESRS-1 and NESRS-2 during growing season peak (ft)	1.3	1.66	1.66	1.88	1.88
4A. Reduction in wildlife mortality (number deaths avoided per year)	0	261	261	261	261
4B. Potential connectivity of WCA-3B and NESRS (% of total length)	0	9	9	9	9
Average Annual Habitat Units (HU)	9,103	17,662	18,257	22,212	22,808
Average Annual HU lift (50 year analysis)	0	8,559	9,154	13,109	13,705

Table 4-6 summarizes the performance, compared to no-action, of the final four alternatives.

Ecological performance indices were calculated as explained in detail in Appendix E by setting the maximum of each performance measure to 100 percent and expressing "lift" of each alternative in terms of percent achievement of that maximum (***Table E-4***). Normalization of all outputs allowed the team to average outputs and multiply the index by affected acres, providing benefits expressed in (HUs). HU output was further adjusted to account for the time required for vegetation to change, and calculated for a 50 year period of analysis.

TABLE 4-6: SUMMARY PMS AND HU LIFT

OUTPUT OF ALTERNATIVES IN AVERAGE ANNUAL HABITAT UNITS LIFT ABOVE THE NO-ACTION ALTERNATIVE

ALTERNATIVE	Area of Benefits (Acres)	Volume increase %	Velocity Differences, Marsh and Opening	Time with Depths > 2 feet	Avg. Annual Lift (HU)
1. (No Action)	63195[1]	0	0	0	0
2.2.2.a Reinforce road 1/2 foot, eastern bridge	63195	54.9	26	46.7	8559
2.2.2.b Reinforce road 1/2 foot, western bridge	63195	54.9	26	46.7	9154
3.2.2.a. Reinforce road 1 foot, eastern bridge	63195	92.4	26	84.3	13109
3.2.2.b. Reinforce road 1 foot, western bridge	63195	92.4	26	84.3	13705

1. A few performance measures were applied over a smaller area. Reference Appendix E for details.

The performance measures that appear most indicative of potential ecosystem restoration are those for slough vegetation suitability and wet season average water levels (PMs 3A, 3B and 3C). Alternatives in the "2" group that would raise stage constraints by only one-half foot increased the frequency of occurrence of deep water stages more than two feet in the marsh dramatically, by 47 percent. Even greater benefits, providing 84 percent stage improvements over no-action, were predicted for the bridge alternatives that would raise the stage constraint by one foot (the "3" group). This appears to indicate that conditions favorable for maintenance of deep slough vegetation would be much more frequent under the one-foot rise alternatives than under the one-half foot

rise alternatives (the "threes" rather than the "twos"). Further, the 84 percent improvement at the "3" level means that these two alternatives are already capable of providing 84 percent of the re-hydration potential of the vegetation suitability two-foot stage target. (100 percent was provided only by the 10.7 mile reinforced road). The second flooding performance measure, number of times the marshes were flooded at three-feet or greater over the period of record, did not show dramatic changes. Apparently achieving these favorable slough-like flooding levels, which might facilitate re-conversion of deep marsh to open water sloughs, required more extreme stage increases at the road than would be provided by the final alternatives. Such high stages (greater than 8.5 feet at Tamiami Trail) occur infrequently at present, but are expected to become more frequent in CERP implementation. As stated elsewhere, the bridge design under all alternatives would allow peak stages of up to 9.7 feet, and only the road would require additional mitigation as stages increase to 9.7 feet under CERP flow conditions.

Stages in the marshes during the average wet season peak are indicated by PM 3C. Wet season peak depth is now approximately 1.3 feet on average. The alternatives with a one-half foot stage increase and a one-mile bridge increased wet season peak depth, on average, to 1.66 feet; the two alternatives with a one-foot stage increase and bridges showed a further increase to an average marsh depth of 1.88 feet. These values complement the performance measures for the frequency of very high stages, showing more average year-on-year performance. What this output may mean is that all of the four final alternatives can increase average depths in Everglades marshes, and the Alternatives 3.2.2.a and 3.2.2.b can do so rather dramatically.

All four final alternatives provided similar water velocity changes in the marsh south of the road, indicating better maintenance of ridge-and slough profiles. To further reduce damaging velocity changes causing scour and deposition it would be necessary to gap the road in additional places.

4.5.2 Cost

Once the final alternatives were identified, their cost estimates were revisited. This additional effort and analysis was reasonable to perform for the final array of alternatives, but it was not feasible to perform this high level of effort for all 26 action alternatives of the initial array. A major goal of the re-look was to reduce construction costs and mitigate risk. The following cost saving options were evaluated for the final suite of alternatives. Not all of these options are applicable to all alternatives.

- Reduce asphalt placement based on revised criteria received January 2008 from FDOT
- Additional Temporary Right of Way for Construction from ENP

- Reduction in Low Chord Height for Bridge Inspection per FDOT
- Obtain Fill Material from L-31(N) Spoil Mounds from SFWMD
- There is the possibility that the scheduled contract award date can be moved to October 2008. This option can be applied to the eastern one-mile bridge but not to the western one-mile bridge. This would substantially reduce future escalation.

The revised total project cost estimates in ***Table 4-7*** include all applicable cost savings options for each alternative. Construction costs incorporate risk analysis procedures and represent the 90 percent confidence not likely to exceed level. The estimates are based on October 2007 price levels. The costs in this table do not include PED costs that accrued during previous Tamiami Trail study efforts as these are considered sunk costs for evaluation purposes. The costs also do not include escalation. Plan formulation costs, as a matter of policy, do not include escalation. By applying the cost saving options and removing PED and escalation, the revised total cost estimates for the final four alternatives do not match, and are lower than the cost estimates presented in ***Table 4-3*** for these alternatives.

TABLE 4-7: TOTAL COST ESTIMATES OF THE FINAL ALTERNATIVES

	2.2.2a	2.2.2b	3.2.2a	3.2.2b
Construction				
Construction Subtotal (includes bridge, road removal, transitions, road, maintenance of traffic, and mobilization)	$126,000,000	$145,100,000	$154,800,000	$188,200,000
PED	$0	$0	$0	$0
EDC (2%)	$2,500,000	$2,900,000	$3,100,000	$3,800,000
S/A (8.5%)	$10,700,000	$12,300,000	$13,200,000	$16,000,000
Real Estate	$5,900,000	$5,900,000	$5,900,000	$5,900,000
Total Cost	**$145,100,000**	**$166,200,000**	**$177,000,000**	**$213,900,000**

4.5.3 Cost-Effectiveness/Incremental Cost Analysis for the Final Array of Alternatives

The purpose of a cost effective/incremental cost analysis (CE/ICA) is to determine the most economically efficient alternatives for producing a given output, which in the case of Tamiami Trail is measured in habitat functionality. Cost effectiveness analysis begins with a comparison of the costs and outputs of alternative plans to identify the least cost plan for every level of output considered. Alternative plans are compared to identify those that would produce greater levels of output at the same cost, or at a lesser cost, as other alternative plans. Alternative plans identified through this comparison are the cost effective alternative plans. Through the incremental analysis, cost effective plans are compared by examining the additional (incremental) costs for the additional (incremental) amounts of output produced by successively larger cost effective plans. The plans with the lowest incremental costs per unit of output for successively larger levels of output are the "Best Buy" plans. The results of these calculations and comparisons of costs and outputs between alternative plans provide a basis for addressing whether the additional outputs are worth the costs incurred to achieve them.

The final array of alternative plans for this project consisted of two alternatives that would increase the stage in the L-29 Canal to 8.0 feet and two alternatives that would increase the stage to 8.5 feet. All other management measures and alternatives were screened from further consideration as a result of previously described evaluation. ICA of the system-wide effects of the final array of plans was performed using IWR Plan software. This analysis is based on and follows guidance from the USACE Institute for Water Resources' publication, Evaluation of Environmental Investment Procedures Manual, Interim: Cost Effectiveness and Incremental Analyses, May 1995, IWR Report #95-R-1. Costs for the final array of alternatives are based upon construction costs with 90 percent confidence and also incorporated expected cost savings measures and include post-authorization PED and construction costs, interest during construction, as well as operation and maintenance costs after construction.

4.5.3.1 Average Annual Habitat Units

In ecosystem restoration projects, CE/ICA requires a comparison of average annual costs and average annual outputs (benefits). Average Annual Habitat Units (AAHU) is a measure of benefits that integrates many characteristics of the ecosystem into a single value. The average annual outputs were calculated as the difference between AAHU with-plan and AAHU without-plan (No Action) over the period of analysis (through year 2060). This difference is the lift, gain, or benefit associated with implementing the alternative. All of the outputs were calculated on an average annual basis to account for the fact that several years may be required for full attainment of the functional capacities to be realized. The calculations are further described in Appendix E. The AAHU lifts for the final alternatives are shown in ***Table 4-8***.

TABLE 4-8: AVERAGE ANNUAL HABITAT UNIT LIFT

Alternative	Average Annual Project Habitat Units
Alternative 2.2.2a	8,559
Alternative 2.2.2b	9,154
Alternative 3.2.2a	13,109
Alternative 3.2.2b	13,705

4.5.3.2 Average Annual Cost

The planning level cost estimate for the alternatives include; construction, lands, and construction management and were conducted utilizing a 90 percent confidence level, to minimize the potential for underestimating costs. Plan evaluation was analyzed using the 90 percent confidence level, but a separate analysis was conducted utilizing lower confidence levels (50 and 80 percent) to determine the sensitivity of the evaluation to the varying cost estimates. Data for initial construction/implementation, land acquisition, and periodically recurring costs for OMRR&R, have been developed through engineering design and cost estimation, and real estate appraisal efforts.

For purposes of this report and analysis, national economic development (NED) costs, as defined by USACE, are expressed in October 2007 (FY 08) price levels, and are based on costs estimated to be incurred over a 50 year period of analysis, annualized utilizing the current federal discount rate of 4 7/8 percent. Costs of a plan represent the value of goods and services required to implement and operate and maintain the selected plan. These costs are included in ***Table 4-9*** and were used in the CE analysis of the alternatives.

The costs in this section of the main report include potential cost savings measures, but do not represent the total cost of the project with escalation. Plan formulation costs, as a matter of policy, do not include escalation. These costs do not include PED costs that accrued during previous Tamiami Trail study efforts as these are considered sunk costs for evaluation purposes.

TABLE 4-9: NATIONAL ECONOMIC DEVELOPMENT COSTS OF FINAL ARRAY OF ALTERNATIVES*

Cost Component	2.2.2a	2.2.2b	3.2.2a	3.2.2b
Construction	$126,000,000	$145,100,000	$154,800,000	$188,200,000
EDC (2%)	$2,500,000	$2,900,000	$3,100,000	$3,800,000
S/A (8.5%)	$10,700,000	$12,300,000	$13,200,000	$16,000,000
Total Construction Cost	**$139,200,000**	**$160,300,000**	**$171,100,000**	**$208,000,000**
Lands	$5,900,000	$5,900,000	$5,900,000	$5,900,000
Total Implementation Cost	**$145,100,000**	**$166,200,000**	**$177,000,000**	**$213,900,000**
Interest During Construction				
Construction	**$6,840,000**	**$7,880,000**	**$10,600,000**	**$12,880,000**
Lands	**$670,000**	**$670,000**	**$670,000**	**$670,000**
Total Economic Investment	**$152,610,000**	**$174,750,000**	**$188,270,000**	**$227,450,000**
Amortized Investment Cost	**$8,199,000**	**$9,388,000**	**$10,120,000**	**$12,219,000**
OMRR&R	$30,000	$30,000	$30,000	$30,000
Average Annual Cost	**$8,229,000**	**$9,418,000**	**$10,150,000**	**$12,249,000**

- Construction and land costs are rounded to the nearest $100,000. Annualized costs are rounded to the nearest $1,000.

4.5.3.3 Cost Effectiveness Analysis

A CE analysis was conducted for the Tamiami Trail final array of alternative plans. The analyses compared the alternative plans' average annual costs against the appropriate AAHU estimates.

A summary of the average annual lift calculations and average annual costs results from the CE/ICA analysis is provided in ***Table 4-10***. The following figure and table show that Alternatives 2.2.2a, 2.2.2b, 3.2.2a and 3.2.2b are all cost effective alternatives. Alternative 3.2.2b provides the greatest habitat lift of all the alternatives, but Alternative 3.2.2a has the lowest average cost per unit of output.

TABLE 4-10: RESULTS OF COST EFFECTIVENESS ANALYSIS

Alternatives	Average Annual Cost	Output	Average Cost Per Output	Cost Effective?
Without Plan	$0	0	N/A	
2.2.2a	$8,229,000	8,559	$961	YES
2.2..2b	$9,418,000	9,154	$1,029	YES
3.2.2a	$10,150,000	13,109	$774	YES
3.2.2b	$12,249,000	13,705	$894	YES

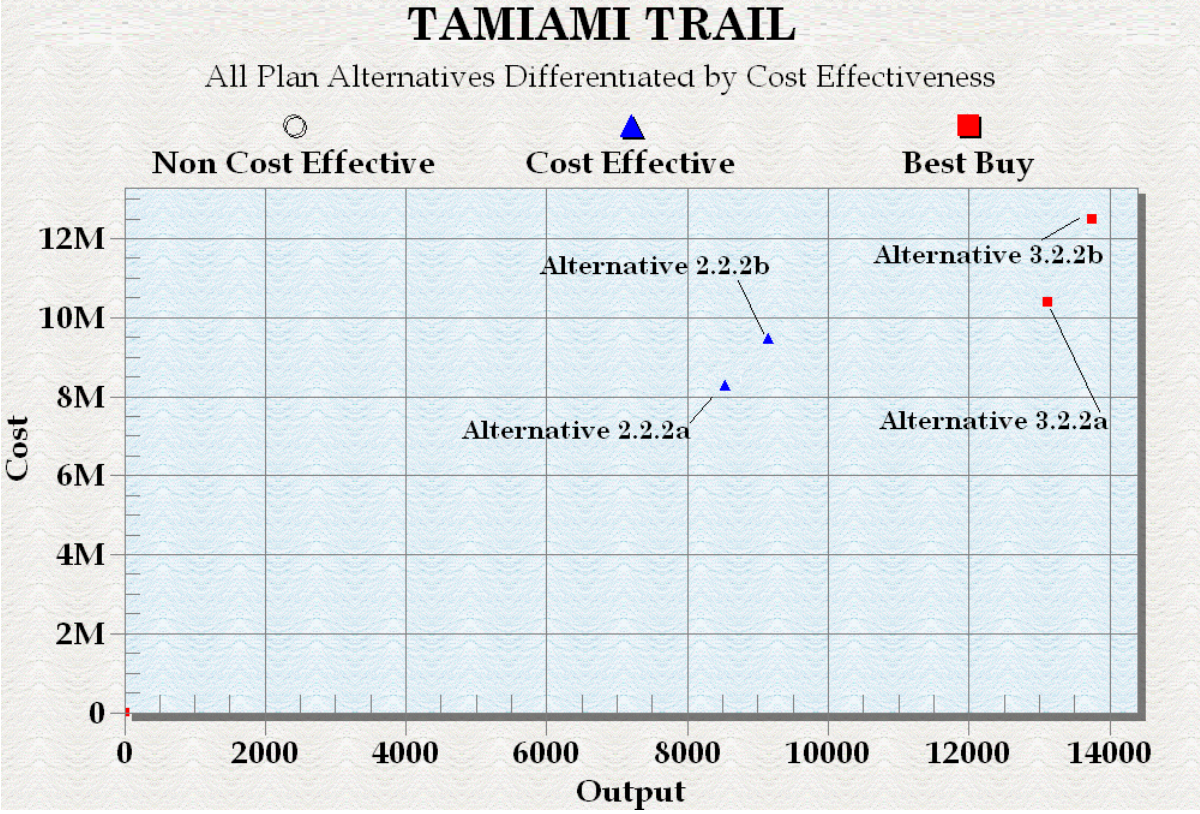

FIGURE 4-13: FINAL ARRAY OF ALTERNATIVES COST EFFECTIVE ANALYSIS RESULTS

4.5.3.4 Incremental Cost Analysis

After the cost effective plans are identified, the plans are arrayed by increasing outputs to clearly demonstrate changes in costs (i.e., increments of cost) and in outputs (i.e., increments of output). For comparison purposes, the average annual cost (AAC) per average annual habitat unit (AAHU) are then examined to determine the plan with the lowest AAC/AAHU. This plan is then considered the first "best buy" plan, or the plan that is the most efficient at producing a given level of output. After this first plan is identified, all larger cost effective plans are compared to this plan in terms of increases in (increments of) cost and increases in (increments of) output. The alternative plan with the next lowest incremental cost per unit of output (for all cost effective plans larger than the first "best buy" plan) is then considered the second best buy plan. ***Table 4-11*** presents the results of the ICA of the different alternative plans for the Tamiami Trail project. The results of the analysis show that there are two best buy plans (Alternatives 3.2.2a and 3.2.2b).

TABLE 4-11: RESULTS OF INCREMENTAL COST ANALYSIS–COST EFFECTIVE AND BEST BUY PLANS ARRAYED BY INCREASING OUTPUT

	Average Annual Cost	Output (Habitat Units)	Average Cost Per Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per Output	Best Buy?
Without Plan	$0	0	N/A	N/A	N/A	N/A	
3.2.2a	$10,150,000	13,109	$774	$10,506,000	13,109	$774	Best Buy
3.2.2b	$12,249,000	13,705	$894	$2,099,000	596	$3,522	Best Buy

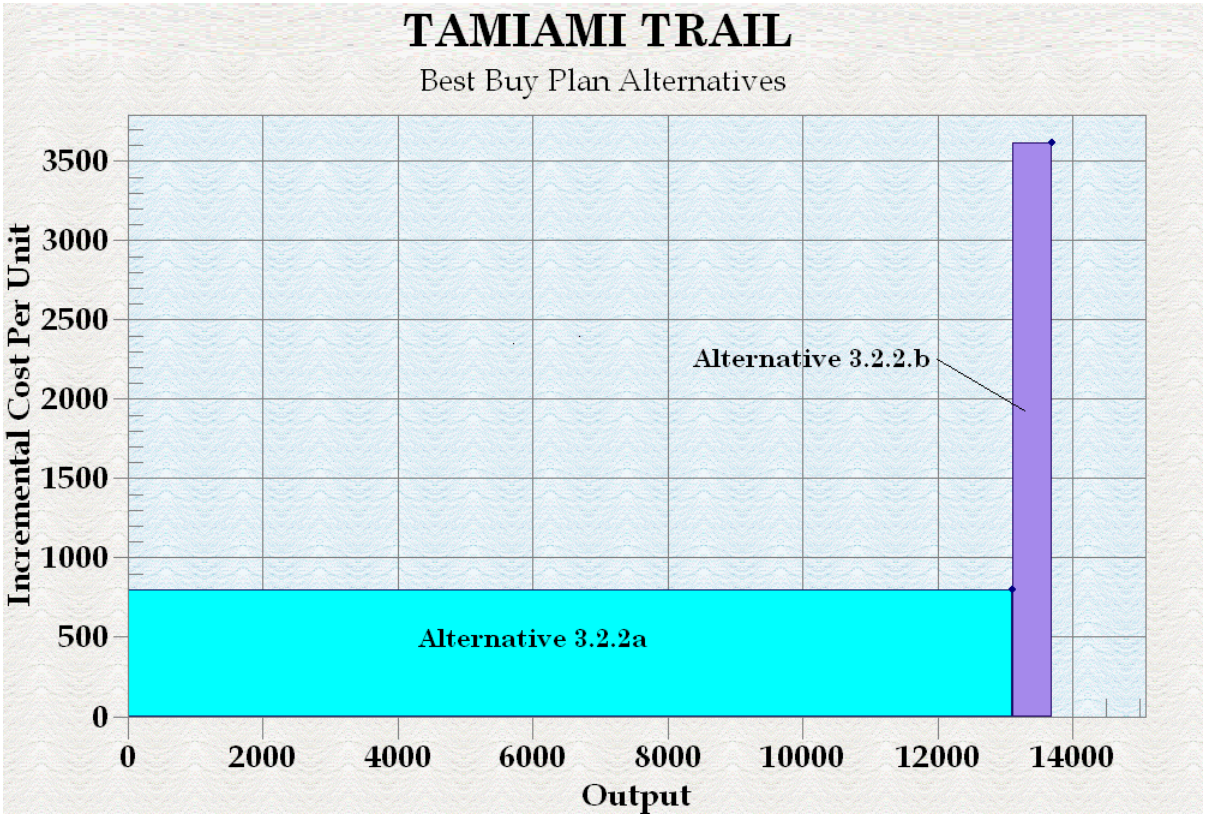

FIGURE 4-14: BEST BUY PLANS-TAMIAMI TRAIL CE/ICA RUN ON COMBINED AVERAGE ANNUAL HABITAT UNIT

4.5.3.5 Sensitivity Analysis

The preceding plan evaluation CE/ICA was conducted utilizing costs at a 90 percent confidence level. As previously described this implies that there is a 90 percent likelihood that the cost of construction would come in at this point or less. This high confidence level was selected to capture the risk associated with the costs of the project, and reduce the risk of underestimating the fully funded

project cost. This high confidence level warranted an additional analysis to ascertain that the results of the evaluation were not being skewed by incorporating this risk. This additional sensitivity analysis was conducted utilizing 50 and 80 percent confidence levels to examine the potential impact that utilizing less risk adverse costs would have on plan selection.

As can be seen in ***Table 4-12,*** the results of the CE/ICA do not change when lower cost confidence levels are used. Obviously the total economic investment is decreased for both of the lower confidence levels, due to the lower TCC, but this lower cost does not change the outcome of the analysis. The confidence level changes affect each alternative proportionately leading to the same alternatives being identified as the most efficient in production of HUs (best buys).

TABLE 4-12: SENSITIVITY OF CE/ICA TO DIFFERENT COST CONFIDENCE LEVELS

Alt.	Cost Confidence Level	Real Estate Cost	TCC	EDC	S&A	Construction, EDC and S&A Total	IDC Real Estate	IDC Construction	Total Economic Investment	Average Annual Cost (AAC)	Habitat Units (HU)	AAC/HU	Cost Effective/Best Buy?
2.2.2a	50%	$5,900,000	$122,000,000	$2,440,000	$10,370,000	$135,000,000	$ 670,000	$ 6,000,000	$147,570,000	$ 7,930,000	8,559	$927	Cost Effective
2.2.2b	50%	$5,900,000	$ 141,000,000	$2,800,000	$12,000,000	$156,000,000	$ 670,000	$ 6,930,000	$169,500,000	$ 9,110,000	9,154	$995	Cost Effective
3.2.2a	50%	$5,900,000	$ 150,000,000	$3,000,000	$12,750,000	$166,000,000	$ 670,000	$ 9,290,000	$181,860,000	$ 9,770,000	13,109	$745	Cost Effective/Best Buy
3.2.2b	50%	$5,900,000	$ 183,000,000	$3,700,000	$15,600,000	$202,000,000	$ 670,000	$11,330,000	$219,900,000	$ 11,810,000	13,705	$862	Cost Effective/Best Buy
2.2.2a	80%	$5,900,000	$124,000,000	$2,480,000	$10,540,000	$137,000,000	$ 670,000	$ 6,090,000	$149,660,000	$ 8,040,000	8,559	$939	Cost Effective
2.2.2b	80%	$5,900,000	$ 144,000,000	$2,900,000	$12,200,000	$159,000,000	$ 670,000	$ 7,080,000	$172,650,000	$ 9,280,000	9,154	$1,014	Cost Effective
3.2.2a	80%	$5,900,000	$ 153,000,000	$3,060,000	$13,005,000	$169,000,000	$ 670,000	$ 9,480,000	$185,050,000	$ 9,940,000	13,109	$758	Cost Effective/Best Buy
3.2.2b	80%	$5,900,000	$ 186,000,000	$3,700,000	$15,800,000	$206,000,000	$ 670,000	$11,520,000	$224,090,000	$ 12,040,000	13,705	$879	Cost Effective/Best Buy

4.6 Additional Factors

4.6.1 Compatibility with Future Projects

As discussed during the screening of the 27 initial alternatives, L-29 Canal stages currently only go above 7.5 feet approximately 12 percent of the time based on analyzing the period of record from 1983 through 2007. This is achieved by operating the water control structure S-333 at the southeast corner of WCA-3A to minimize events with stages greater than 7.5 feet, for protection of the Tamiami Trail roadway embankment and flood protection for south Dade County based on the trigger gage G-3273. Instances where stages exceed 7.5 feet in the L-29 Canal are typically a result of direct rainfall on the area.

The pre-drainage system (as represented by NSM version 4.6.2) would produce a different hydroperiod for NESRS based on a different timing, volume, and distribution of flows much higher than the existing condition within the area. ***Figure 4-15*** compares the frequency of stage occurrences from three different model runs based on the same hydrologic (rainfall) conditions (1965 through 2000, a total of 13,149 modeled days) but different operational criteria and landscape. These model runs represent the NSM, existing conditions (referred to as ALT7R5, based on the IOP for the protection of the CSSS), and the future CERP (which assumes that all proposed CERP restoration features are in-place). The NSM and CERP analysis both use unconstrained flow in modeling the volume of water conveyed into NESRS. This figure shows the inherent problems of the current operations of the system in regards to NESRS being held too low due to constraints on the system and not being able to see the natural fluctuations of stages needed to support the ecology.

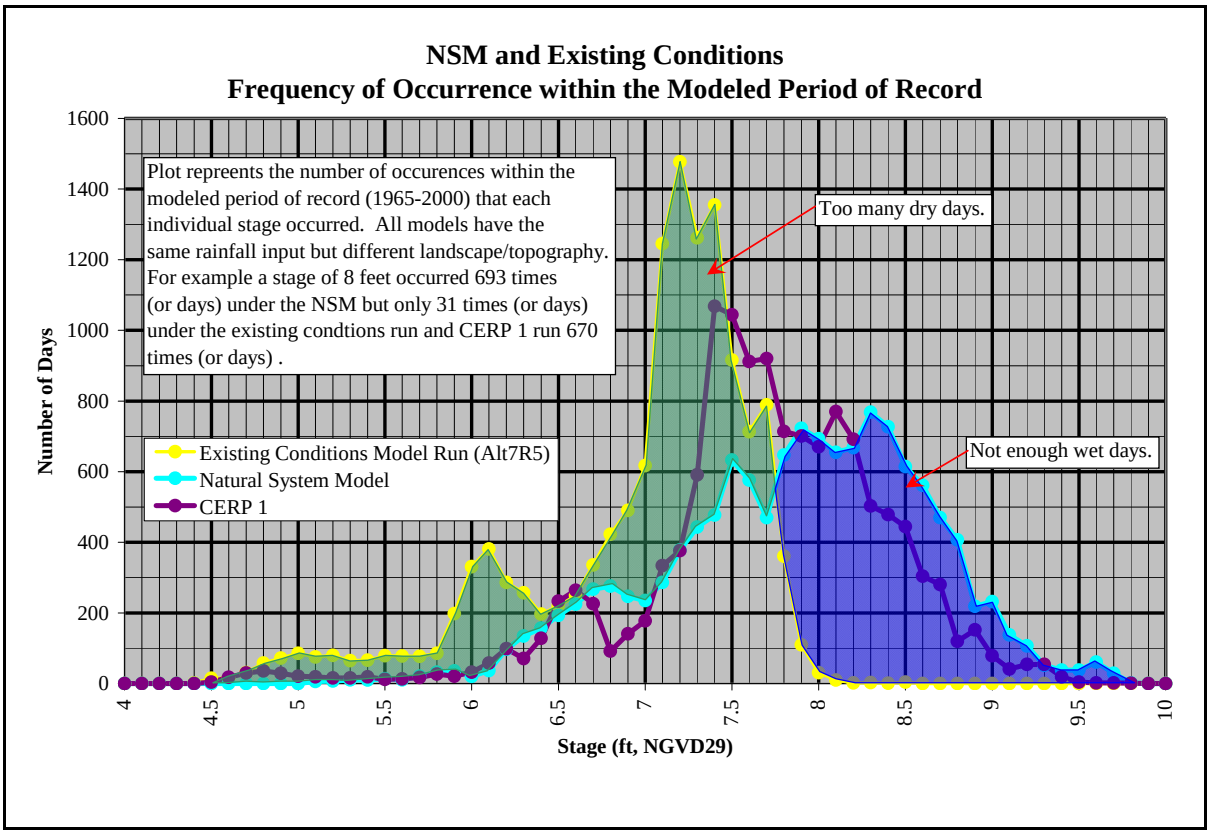

FIGURE 4-15: FREQUENCY OF STAGE OCCURRENCE FOR DIFFERENT MODEL SCENARIOS

Existing studies have determined that water levels must be raised higher than the stages considered in the final suite of alternatives. Section 601(b)(2)(C) of WRDA 2000 authorized raising and bridging of Tamiami Trail as an initial project of the CERP. It is therefore necessary to ensure that Tamiami Trail modifications projects are compatible with CERP. However, bridges constructed under this project would not have to be replaced or "un-done" by future projects. Any bridge constructed would be high enough to accommodate any anticipated stage in the L-29 Canal produced by CERP or other projects in the future. Modifications to the Tamiami Trail roadway embankment however would have to be made to incorporate higher stages and removal of sections of the roadway to increase the hydrologic connectivity to NESRS to produce a more natural sheet flow pattern between WCA-3B and ENP.

The degree of compatibility of the remaining roadway with future restoration projects is not as simple. On one hand, any length of road, at any height, represents a barrier to sheet flow and ecological connectivity. Future restoration projects may involve additional openings and/or additional water stage increases and associated road mitigation (road reinforcing). Differences among the LRR

alternatives of compatibility with these unspecified future restoration project depends on what features would in these future projects.

If an additional conveyance opening (bridge) was recommended for a future restoration project, then some of the asphalt and fill placed as part of the MWD Tamiami Trail project alternatives would have to be removed. For Alternatives 2.2.2a and 2.2.2b (stage 8.0), the amount of "new" material that would be removed would be less than for Alternatives 3.2.2a and 3.2.2b (stage 8.5). The lower road for the 8.0 stage alternatives would be more compatible than the higher road for the 8.5 stage alternatives.

If the future restoration project recommended in the L-29 Canal an additional increase in the stage (road height), then the asphalt and fill placed as part of the LRR alternatives would be usable to the new plan. The new project would have to provide less new material if Alternatives 3.2.2a or 3.2.2b (stage 8.5) were implemented than if Alternatives 2.2.2a or 2.2.2b (stage 8.0) were implemented. The 8.5 stage alternatives, with a higher road surface, would be more compatible than the 8.0 stage alternatives, with the lower road surface.

4.6.2 Real Estate

All four alternatives would require real estate transactions and agreements among the following public agencies: (1) FDOT and ENP for any new bridge, which would be located on land currently owned by ENP; (2) SFWMD and ENP for access and maintaining flows under any bridges that may be constructed; (3) USACE and ENP for temporary construction activities on ENP land; and (4) USACE and FDOT for construction of the road and/or bridge.

All four alternatives have road work included which would require temporary work area easements from each private landowner within the project footprint to construct access from the reinforced road down to the existing driveway or parking lot.

All four alternatives have a proposed bridge. Additional water would flow to an elevation of approximately 8.5 feet and may impact privately owned properties south of Tamiami Trail. At a minimum, perpetual flowage easements would be required on each parcel prior to implementing the operation of the project. If it is determined during the appraisal process that the value of the easement estate approaches fee value, it may be in the best interest of the government to acquire fee for the operation and maintenance of the project. The impacts to each parcel are discussed in Appendix F of this report.

In addition to the real estate requirements discussed above, Alternatives 2.2.2a and 3.2.2a for bridge construction require perpetual road and channel easements from FP&L as they own a parcel of land that runs north-south across the project.

Alternatives 2.2.2b and 3.2.2b bridge construction would cross the access road to the Lincoln Financial radio tower site. An alternate access to this facility would be required. If an alternate access route is not possible, the real estate interest required would be fee.

Since the width of Tamiami Trail would not be increased under any of the final four alternatives, the footprint of the reinforced road would not encroach on any privately owned properties.

4.6.3 Timing of Project Implementation

Construction of the eastern bridge of Alternatives 2.2.2a or 3.2.2a can start earlier than the western bridge of the other two final alternatives. The USACE began detailed design of the selected plan from the 2005 RGRR soon after its ROD was signed in January 2006, and was nearly complete with the design when this LRR was initiated. The eastern bridge of Alternatives 2.2.2a and 3.2.2a is identical to the eastern bridge of the 2005 RGRR plan and these alternatives can use the nearly completed design developed for the 2005 RGRR plan. The western bridge of Alternatives 2.2.2b and 3.2.2b is different from the western bridge of the 2005 RGRR plan in that it is only one mile long rather than two miles long. A geotechnical survey performed during the design phase of the 2005 RGRR plan discovered soil conditions of the area of the western bridge that require a redesign of the foundations for the western bridge. The differences in length and soil conditions prevent reusing much of the engineering and design initially developed for the 2005 RGRR plan, and additional time would be required for redesign. This would result in a later start date for construction.

Mitigation of the road to accommodate a stage of either 8.0 or 8.5 feet is different from raising and widening the road for the 2005 plan, which was to 9.7 feet stage, and would require additional engineering prior to construction. However, it is expected that road design, and the subsequent construction, could be completed within the time period needed for bridge construction.

The timing of construction influences the cost of construction-the longer the time to construction, the greater the cost growth due to the effects of risk factors and escalation. Construction market conditions continue to be volatile in south Florida and these conditions have been documented by FDOT, SFWMD and USACE. These volatile conditions would likely continue for the foreseeable future, since they are influenced by both world and local market conditions. Additionally, several large upcoming construction contracts associated with the Acceler8/CERP program would likely add to the competition for the labor, equipment and materials needed to construct these projects which would result in higher construction costs.

4.6.4 Evaluation of the Planning Objectives

Table 4-13 illustrates how each of the final four alternatives addresses each of the planning objectives. Alternative 1.0, the No Action Alternative, does not address any of the planning objectives.

TABLE 4-13: PLANNING OBJECTIVES FOR FINAL ALTERNATIVES

Objectives	1.1 No Action	2.2.2a Stage 8.0, Reinforce Road, 1-mile Bridge East	2.2.2b Stage 8.0, Reinforce Road, 1-mile Bridge West	3.2.2a Stage 8.5, Reinforce Road, 1-mile Bridge East	3.2.2b Stage 8.5, Reinforce Road, 1-mile Bridge West
Provide additional water into Shark River Slough	Average 177,000 acre feet per year. No change	Increase in average annual flow to 274,000, 55% increase over No Action;	Same as 2.2.2a	340,000 acre feet per year. 93% increase over No Action; 26% increase over Alt 2.2.2a	Same as 3.2.2a
Restore processes that produce and maintain ridge and slough communities	No connection to sloughs. High velocity near culverts is damaging.	Moderate restoration. Bridge alts pass more water into existing sloughs. Velocities at culverts and bridge are not damaging.	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a
Restore slough vegetation	86 days with water depth >2 feet. No change	Substantially more days (1,428) with required conditions (water depth >2 feet) 1,560% inc over No Action	Same as 2.2.2a	Substantially more days (2,578) with required conditions (water depth >2 feet). 2,898% inc over No Action; 81% inc over 2.2.2a	Same as 3.2.2a
Reduce highway-caused mortality	No reductions. No change	Mortality reduced by 261 per year (9 percent)	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a
Increase ecological connectivity between Shark River Slough and the WCAs north of the roadway	No change	No direct connection. Indirect increase due to the 1-mile connection of ENP to L-29 Canal; canal connects to S-333 and WCA-3A.	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a
Increase peak flows to 1,400 cfs and target 4,000 cfs	Average peak flow 1,250 cfs. No change.	Peak flow 1,577 cfs. 26% increase over No Action		Peak flow 1,848 cfs. 48% inc over No Action; 17% inc over 2.2.2a	Same as 3.2.2a

4.6.5 Evaluation of the Planning Constraints

Some of the initial 27 alternatives did not satisfy one or more of the planning constraints and thus were eliminated from the final array of alternatives. All of the final four action alternatives satisfy all of the constraints identified by the team. The list of constraints is repeated here for ease of reference.

1. Maintain traffic along Tamiami Trail
2. Avoid causing additional damage to Tamiami Trail
3. Minimize adverse socioeconomic impacts on local businesses, residents
4. Avoid degradation of water quality in ENP or any of the contributing water bodies
5. Not adversely affect listed species
6. Start construction by 2010

4.6.6 Evaluation of Planning Criteria and Identification of the NER Plan

USACE policy (Engineering Regulation [ER] 1102-2-100) requires the use of four screening criteria in the evaluation of plans. The identification of the National Ecosystem Restoration plan incorporates the results of the CE/ICA analysis with the four planning criteria to make an informed plan selection decision. The planning criteria are acceptability, completeness, effectiveness and efficiency. Results are described below and summarized in ***Table 4-14***.

TABLE 4-14: SCREENING CRITERIA FOR EVALUATION OF PLANS

Criteria	1.0 No Action	2.2.2a Stage to 8.0, Reinforce Road, 1-mile Bridge East	2.2.2b Stage to 8.0, Reinforce Road, 1-mile Bridge West	3.2.2a Stage to 8.5, Reinforce Road, 1-mile Bridge East	3.2.2b Stage to 8.5, Reinforce Road, 1-mile Bridge West
Acceptability	No	Yes	Yes	Yes	Yes
Completeness	N/A	Complete	Complete	Complete	Complete
Effectiveness	No benefits; does not address planning objectives	Fewest benefits of the final four action Alts	Second fewest benefits; slightly more than Alt 2.2.2a	Provides the second most benefits, very similar to Alt 3.2.2b	Provides the most benefits
Efficiency (Avg annual cost/ avg annual habitat unit)	N/A	$961/aahu Second highest unit cost of the final Alts	$1,029/aahu Highest unit cost of the bridge Alts	$741/aahu Lowest cost per unit of benefit	$894/aahu Second lowest unit cost; intermediate between 3.2.2a and the 8.0 stage alts

Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public as well as compatibility with existing laws, regulations and public policies. One aspect of acceptability is whether the alternative is feasible or doable with regard to technical, environmental, economic, social or similar reasons.

Completeness is the extent to which an alternative plan includes and accounts for all necessary investments or other actions to ensure the realization of the planned effects. All of the final four alternatives contain all of the features needed to achieve the predicted benefits.

Effectiveness is the extent to which an alternative plan contributes to the attainment of the planning objectives. The most effective alternatives make significant contributions to all of the planning objectives. Less effective alternatives make smaller contributions to one or more of the alternatives.

Effectiveness is a matter of degree rather than all or nothing. Among the final four alternatives, Alternatives 3.2.2a and 3.2.2b contribute more to the planning objectives. They provide the most AAHU lift, the most flow volume, the best conditions for restoring slough vegetation, and the greatest reduction in wildlife mortality (***Table 4-13*** and ***Table 4-14).*** Alternatives 2.2.2a and 2.2.2b perform similarly to each other and provide substantial benefits, but are less effective in contributing to the objectives than Alternatives 3.2.2a and 3.2.2b.

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating problems and realizing opportunities, consistent with protecting the nation's environment. It is a measure of allocation of resources. CE is one common measure of efficiency. Both monetary and non-monetary costs are considered. All four alternatives are cost effective in that if additional money were spent for a larger plan, more benefits would be achieved. The 8.5 foot stage plans (Alternatives 3.2.2a and 3.2.2b) have lower costs per unit of benefit gained than the 8.0 foot stage plans. Alternative 3.2.2a has the lowest cost per unit of benefit among the final alternatives.

The results of the CE/ICA analysis identified two alternatives as best buy plans; Alternatives 3.2.2a and 3.2.2b. The national ecosystem restoration (NER) plan is typically identified from the final set of best buy solutions by evaluating whether successive investments are worth the additional expenditure. Comparing alternatives 3.2.2a and 3.3.2b from Table 4-11, it is evident that 3.2.2b provides 5% more output (habitat units) than does alternative 3.2.2a, while the annual cost is 20% greater. The 596 additional units of output come at an incremental cost that is almost 5 times greater than the cost per unit of output for Alternative 3.2.2a. Given the steep increase in cost and relatively small increase in output, it was determined that Alternative 3.2.2a was the plan that reasonable maximized ecosystem restoration benefits compared to costs, and therefore was identified as the NER plan. This plan is consistent with federal objectives and is a complete and effective alternative.

4.6.7 Evaluation of Managers' Report Directives

The conference report for the WRDA 2007 contained language to the Chief of Engineers regarding the MDW project and the Tamiami Trail component. The directives in that report are not considered law, but are considered strong guidance to the project team. Section 1 of the LRR discusses some of these directives. ***Table 4-15*** presents the directives and the status of how well the final alternatives satisfy the directives.

TABLE 4-15: WRDA 2007 CONFERENCE REPORT MANAGERS' DIRECTIVES

Directive	Status
Take steps upon completion of 8.5 SMA to increase flows to Park of at least 1,400 cfs without significantly increasing risk of roadbed failure	Most initial alternatives can achieve 1,400 cfs peak flow. All of the final alternatives achieve 1,400
Reexamine prior reports and evaluate practicable alternatives	Complete
Recommendations consistent with directive in ENP Protection and Expansion Act; "improve water deliveries to the park and shall, to the extent practicable, take steps to restore natural hydrologic conditions within the Park." The managers direct that the flows to the Park have a minimum target of 4,000 cfs so as to address the restoration envisioned in the ENP Protection and Expansion Act.	4,000 cfs target was assessed. 4,000 cfs events require large storms which occur rarely. Only three alternatives would achieve 4,000 cfs. These were screened due to very high cost.
Take into account future modifications to Tamiami Trail may be performed under CERP; modifications that are not compatible or duplicative should be avoided.	Compatibility and duplication are considered
Submit for public review and comment	Review scheduled to begin early April 2008
Submit to Congressional committees by July 1, 2008	In-progress. On-schedule to meet this deadline.
Cost sharing arrangements are prospective only	Complete
Do not support arrangement where DOI is credited for land acquisition toward the costs of modifying water delivery to the Park. These costs are separate responsibilities within the missions of Army and Interior. Costs of one should not be used to offset the costs of the other.	Land acquisition costs are reported separately in the Real Estate appendix. Credit is not recommended.
Initiate evaluation of Tamiami Trail component of CERP as soon as practicable, including an evaluation of modifying Tamiami Trail from Krome Avenue to the boundary of Big Cypress National Preserve	Not started. Plan to initiate study once this LRR is complete.

4.7 Recommended Plan

The Recommended Plan is Alternative 3.2.2a, raise L-29 Canal stage constraint to 8.5 feet and a one-mile eastern opening and bridge. This study initially analyzed 27 alternatives, screened the total to four alternatives, and then after further analysis identified one alternative as the Recommended Plan–the best alternative among the final four alternatives. Alternative 3.2.2a would raise the constraint in the L-29 Canal one-foot to 8.5 feet NGVD. The Recommended Plan includes a one-mile bridge in the eastern section of the 10.7 mile length of road. The Recommended Plan also includes roadway reinforcement of the remainder of Tamiami Trail. Additional details of this alternative are in Section 6 of this report.

Alternative 3.2.2a represents a balance between alternatives that produce a very large quantity of ecosystem benefits but are very costly and alternatives that are less expensive but provide few ecosystem benefits. Alternative 3.2.2a meets both the requirements to exceed minimum flow and benefits to NESRS and to stay below the cost of the 2005 RGRR plan.

Alternative 3.2.2a makes more progress toward achieving objectives–increased water delivery, ridge and slough processes and connectivity, slough vegetation, and wildlife mortality–than all but one of the final four alternatives. CE/ICA shows that Alternative 3.2.2a is cost effective and has the lowest cost per unit of benefit. The average cost per HU and the incremental cost of the next larger plan, Alternative 3.2.2b, are higher than for Alternative 3.2.2a.

Construction on Alternative 3.2.2a can be initiated much earlier than two of the other final alternatives. The bridge of Alternative 3.2.2a is identical to the eastern bridge of the 2005 RGRR Selected Plan. The bridges of Alternatives 2.2.2b and 3.2.2b are less similar to the 2005 plan and would require additional time for additional design. Construction on the eastern bridge for Alternative 3.2.2a could start as early as October 2008 whereas the western bridge of Alternative 2.2.2b or 3.2.2b would not start until approximately one year later. Because of further design needed, roadway reinforcing for any of the final four alternatives could not start as quickly as the eastern bridge. Since completion of a bridge is expected to take longer than roadway reinforcing, an earlier start of a bridge represents the earlier completion of all construction and earlier achievement of ecosystem benefits. The recent history of rapid cost growth (Section 2 and Appendix C) also suggests that waiting to start construction would result in substantial escalation of cost.

Alternative 3.2.2a includes a one-mile bridge that would be able to handle any higher stage in the L-29 Canal that might be recommended by future projects. This bridge would not have to be retrofitted and would continue to provide unobstructed flow. The other three final alternatives would also attain this level

of compatibility. Some of the alternatives that were screened from the final analysis included raising the stage in the L-29 Canal but did not include bridges. As a result, if future restoration projects recommend higher stages in the L-29 Canal, all of the work completed under these alternatives would have to be retrofitted or replaced. No features would be "permanent" for these potential future actions.

Operations. The analyses performed during this study effectively compare alternatives, but are not able to fully analyze operational plans for the structures that deliver water to this project. The benefits described in the LRR/EA are potential benefits associated with the evaluation of the LRR alternatives based on a single constraint of 8.5 feet in the L-29 Canal. It must be recognized that additional constraints will be required by FDOT immediately before and during some large rainfall events in order to ensure the stability and safety of the highway. Therefore, when these FDOT constraints are applied to the recommended plan, there will be some change of benefits from those identified in this document. During the Combined and Structural and Operational Plan (CSOP) alternative planning process, the effects of these constraints on benefits will be thoroughly evaluated. In addition, there is an expectation that field monitoring, based on a reconfiguration of existing monitoring activities, will continue following implementation of the LRR features in conjunction with the CSOP operating plan. Such monitoring will allow for adaptive management to potentially mitigate any loss of benefits from those identified in this document.

4.8 Environmentally Preferred Alternative

The NPS is required to identify the environmentally preferred alternative in its NEPA documents for public review and comment. The NPS, in accordance with the DOI policies contained in the Department Manual (516 DM 4.10) and the Council on Environmental Quality's Forty Questions, defines the environmentally preferred alternative (or alternatives) as the alternative that best promotes the national environmental policy expressed in NEPA (Section 101(b)) which considers: (1) fulfilling the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assuring for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attaining the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserving important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice; (5) achieving a balance between population and resource use which would permit high standards of living and a wide sharing of life's amenities; and (6) enhancing the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

The Council on Environmental Quality's Forty Questions (Q6a), further clarifies the identification of the environmentally preferred alternative, stating "ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves and enhances historic, cultural, and natural resources."

Based on the analysis prepared for the 2005 RGRR/SEIS and input from other agencies and the public, the ROD for the RGRR/SEIS identified the environmentally preferred alternative for the Tamiami Trail Modifications component of the MWD Project as the 10.7 mile bridge (Alternative 17 in the RGRR/SEIS). This alternative was not recommended for implementation in the RGRR/SEIS because of its extremely high cost and significant adverse cultural and socio-economic impacts (ROD page 2). For this LRR, the 10.7 mile bridge alternative (Alternative 4.2.4) is again the environmentally preferred alternative. As before, this alternative was not recommended for implementation in the LRR because of its extremely high cost.

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5.0 ENVIRONMENTAL EFFECTS

5.1 Introduction

This environmental assessment evaluates the impacts of the alternative actions described in Section 4.0, *Formulation and Evaluation of Alternatives.* Many of the environmental impacts of highway and bridge construction evaluated in this EA are similar or identical to those of the 2005 RGRR/SEIS, which provides more detailed discussions of environmental impacts and is incorporated by reference.

5.1.1 General Definitions

The following definitions were used to evaluate the context, intensity, duration, and cumulative nature of impacts associated with project alternatives:

Context is the setting within which an impact is analyzed, such as the affected region, society as a whole, the affected interests, and/or a locality. In this EA, the intensity of impacts is evaluated within a local (e.g. construction footprint) or project area context, while the intensity of the contribution of effects to cumulative impacts is evaluated in a regional context.

Impact Intensity: For this analysis, intensity or severity of the impact is defined as follows:

- Negligible-impact to the resource or discipline is barely perceptible and not measurable and confined to a small area
- Minor-impact to the resource or discipline is perceptible and measurable and is localized
- Moderate-impact is clearly detectable and could have appreciable effect on the resource or discipline; or the impact is perceptible and measurable throughout the project area
- Major-impact would have a substantial, highly noticeable influence on the resource or discipline on a regional scale

Duration: The duration of the impacts in this analysis is defined as follows:

- Short term-when impacts occur only during construction or last less than one year; or
- Long term-impacts that last longer than one year.

TABLE 5-1: POTENTIAL ENVIRONMENTAL EFFECTS OF FINAL ALTERNATIVES

Stage Constraint	7.5 Feet	8.0 Feet		8.5 Feet	
Alternatives	**Alt 1.1 No Action**	**Alt 2.2.2a Road Reinforcement & Add 1-Mile Eastern Bridge**	**Alt 2.2.2b Road Reinforcement & Add 1-Mile Western Bridge**	**Alt 3.2.2a Road Reinforcement & Add 1-Mile Eastern Bridge**	**Alt 3.2.2b Road Reinforcement & Add 1-Mile Western Bridge**
Surface Waters	No beneficial effect. Current deliveries are constrained by stages at G-3273 and height of Tamiami Trail roadway above water surface in L-29 Canal. These constraints cause closure of S-333 Structure and limit deliveries to a peak flow of 1,250 cfs.	Peak water flow into ENP would increase to 1,577 cfs, a 26% increase over no-action.	Same as 2.2.2.a	Peak water flow into ENP would increase to 1,848 cfs, a 47% increase over no-action.	Same as 3.2.2.a
Water Quality	No effect	Minor, short-term increases in sediment and nutrients during construction adjacent to roadway culverts and bridge footprint. Short-term, moderate release of soil-bound nutrients where roadway is degraded after the bridge is built to create conveyance. No permanent change in water quality.	Same as 2.2.2a	Same in type and location as 2.2.2a; due to increased roadway work to achieve higher stage constraint, the duration and footprint of impacts (adjacent to the road) may be a little larger (refer to text for footprints). When construction is complete, no further adverse effects are anticipated.	Same as 3.2.2a
HTRW	No effect	No effect	No effect	No effect	No effect
Water Deliveries to ENP	No beneficial effect. Current deliveries are constrained by stages at G-3273 and height of Tamiami Trail roadway above water surface in L-29 Canal. These constraints cause closure of S-333 Structure and limit deliveries to a peak flow of 1,250 cfs.	Peak water flow into ENP would increase to 1,577 cfs, a 26% increase over no-action.	Same as 2.2.2.a	Peak water flow into ENP would increase to 1,848 cfs, a 47% increase over no-action.	Same as 3.2.2.a
Parklands	No effect	8.5 acres lost to bridge and bridge approaches. 6.3 acres temporarily affected.	9.0 acres lost to bridge and bridge approaches. 6.7 acres temporarily affected.	Same as Alt. 2.2.2a	Same as Alt. 2.2.2b

Biological Communities	No change. Adverse quantity and timing of flows into ENP have led to loss of deep marsh and slough habitat and reduced dry season refugia for fishes, leading to overall reduction in fish populations, reduced forage for wading birds.	Flow volume would increase 55% over no-action, potentially improving conditions for fish propagation and wading bird foraging during dry seasons. Additionally, adding a bridge would increase potential connectivity and reduce adverse velocity changes by 26%, reducing erosion and sedimentation associated with culverts and assisting to preserve the ridge-and slough landscape. Deep marsh inundation would be expected to last longer and reach a deeper stage than previous non-bridge alternatives.	Same as 2.2.2a, but since sloughs are slightly deeper on the western side, a modest increase slough hydroperiods may be slightly more favorable for fish refugia and wading bird foraging than the previous alternative.	Flow volume would increase 92% over no-action, potentially improving conditions for fish propagation and wading bird foraging during dry seasons. Additionally, adding a bridge would increase potential connectivity and reduce adverse velocity changes by 26%, reducing erosion and sedimentation associated with culverts and assisting to preserve the ridge-and slough landscape. Deep marsh inundation would be expected to last longer and reach a deeper stage than previous non-bridge alternatives.	Same as 3.2.2a, but since sloughs are slightly deeper on the western side, a modest increase slough hydroperiods may be slightly more favorable for fish refugia and wading bird foraging than the previous alternative.
Average Annual Lift (Habitat Units)	No effect	8,559	9,154	13,109	13,705
Ecological Connectivity between WCA and ENP Marshes	No effect. High-velocity flows through culverts during periods of high flow impede potential connections between ENP and WCA marshes; continuous roadway is a barrier to movement of large animals. L-29 canal and Levee continue to act as a barrier to movement of native species, especially terrestrial species.	Potential for ecological connectivity between ENP and upstream wetlands, which could be realized if the L-29 Levee is removed and the L-29 Canal filled under future projects.	Potential for ecological connectivity between ENP and upstream wetlands, which could be realized if the L-29 Levee is removed and the L-29 Canal filled under future projects.	Potential for ecological connectivity between ENP and upstream wetlands, which could be realized if the L-29 Levee is removed and the L-29 Canal filled under future projects.	Potential for ecological connectivity between ENP and upstream wetlands, which could be realized if the L-29 Levee is removed and the L-29 Canal filled under future projects.
Wetlands	No effect	2.29 acres filled; 6.6 acres temporarily affected. 63,000 acres of improved quality.	8.95 acres filled; 6.72 acres temporarily affected. 63,000 acres of improved quality.	Same as Alt. 2.2.2a	Same as Alt. 2.2.2b

Ridge and Slough Processes	Deep marshes and their characteristic flora are uncommon in the NESRS landscape. Shortened hydroperiods and lowered maximum stages (relative to historic conditions) favor sawgrass over slough vegetation. Patterning of landscape into ridge-and slough is being gradually eliminated by sedimentation of sloughs.	Moderate improvement in ridge and slough processes.	Moderate improvement in ridge and slough processes.	Moderate improvement in ridge and slough processes.	Moderate improvement in ridge and slough processes.
Protected Species					
Cape Sable Seaside Sparrow	No beneficial effect. Long-term high volume water releases from S-12 gates may have adversely affected CSSS habitat inside ENP in Sub-population "A." This adverse effect would continue until more releases can be made east of the L-67 levees into ENP.	The closest occupied CSSS nest lies 10 miles south of the project area. Construction activities would have no effect on this species. There is no designated Critical Habitat located within the project area, so none would be affected. The project may affect but is not likely to adversely affect the CSSS.	The closest occupied CSSS nest lies 10 miles south of the project area. Construction activities would have no effect on this species. There is no designated Critical Habitat located within the project area, so none would be affected. The project may affect but is not likely to adversely affect the CSSS.	The closest occupied CSSS nest lies 10 miles south of the project area. Construction activities would have no effect on this species. There is no designated Critical Habitat located within the project area, so none would be affected. The project may affect but is not likely to adversely affect the CSSS.	The closest occupied CSSS nest lies 10 miles south of the project area. Construction activities would have no effect on this species. There is no designated Critical Habitat located within the project area, so none would be affected. The project may affect but is not likely to adversely affect the CSSS.
Eastern Indigo Snake	No effect. This species may be in the project area, although there are no known sightings.	Because it could potentially be in the area affected by construction activities, USACE would implement the "Standard Construction Precautions for the Eastern Indigo Snake" during construction. The project may affect, but is not likely to adversely affect the Eastern indigo snake	Because it could potentially be in the area affected by construction activities, USACE would implement the "Standard Construction Precautions for the Eastern Indigo Snake" during construction. The project may affect, but is not likely to adversely affect the Eastern indigo snake	Because it could potentially be in the area affected by construction activities, USACE would implement the "Standard Construction Precautions for the Eastern Indigo Snake" during construction. The project may affect, but is not likely to adversely affect the Eastern indigo snake	Because it could potentially be in the area affected by construction activities, USACE would implement the "Standard Construction Precautions for the Eastern Indigo Snake" during construction. The project may affect, but is not likely to adversely affect the Eastern indigo snake

Florida Panther	No beneficial effect. Minor Florida panther cover habitat was identified in 2006 Biological Opinion along the south side of Tamiami Trail in the project area. This habitat would not be affected under the no-action alternative.	A linear strip of native and exotic woody vegetation, which constitutes low quality panther habitat, would be removed along the highway for construction of the transition roadways and the bridge. This may affect but is not likely to adversely affect the panther.	A linear strip of native and exotic woody vegetation, which constitutes low quality panther habitat, would be removed along the highway for construction of the transition roadways and the bridge. This may affect but is not likely to adversely affect the panther.	A linear strip of native and exotic woody vegetation, which constitutes low quality panther habitat, would be removed along the highway for construction of the transition roadways and the bridge. This may affect but is not likely to adversely affect the panther.	A linear strip of native and exotic woody vegetation, which constitutes low quality panther habitat, would be removed along the highway for construction of the transition roadways and the bridge. This may affect but is not likely to adversely affect the panther.
Everglade Snail Kite	No beneficial and some apparent long-term adverse effects due to ponding of water in southern WCA-3A when releases cannot be made through the S-12 gates West of L-67. Ponding during the snail kite nesting season inhibits foraging for apple snails, the kite's principal prey item.	Because the closest known snail kite nest is a considerable distance from the project area, no specific precautions are necessary at this time. The project may affect, but is not likely to adversely affect the Everglade snail kite. Raising the stage constraint would allow releases from WCA-3A and potentially reduce adverse high stages in the WCA, which are believed to have degraded snail kite foraging habitat.	Because the closest known snail kite nest is a considerable distance from the project area, no specific precautions are necessary at this time. The project may affect, but is not likely to adversely affect the Everglade snail kite. Raising the stage constraint would allow releases from WCA-3A and potentially reduce adverse high stages in the WCA, which are believed to have degraded snail kite foraging habitat.	Because the closest known snail kite nest is a considerable distance from the project area, no specific precautions are necessary at this time. The project may affect, but is not likely to adversely affect the Everglade snail kite. Raising the stage constraint would allow releases from WCA-3A and potentially reduce adverse high stages in the WCA, which are believed to have degraded snail kite foraging habitat.	Because the closest known snail kite nest is a considerable distance from the project area, no specific precautions are necessary at this time. The project may affect, but is not likely to adversely affect the Everglade snail kite. Raising the stage constraint would allow releases from WCA-3A and potentially reduce adverse high stages in the WCA, which are believed to have degraded snail kite foraging habitat.
Wood Stork	No effect. There are two nesting colonies of WS close to the road in ENP (see text) but they are not sensitive to highway traffic	About 1,200 feet of bridge approach road would fall within the Secondary Zone of the West Colony. Highway construction would occur on 3,700 feet in the primary zone and 2,050 feet of the secondary zone of the Tamiami West Colony, and in 3,000 feet in the secondary zone of the East Colony. With management according to the USFWS Guidelines, the project may affect, but is not likely to adversely affect the wood stork.	No effect from bridge construction. Highway construction would be the same as Alt 2.2.2a. With management according to the USFWS Guidelines, the project may affect, but is not likely to adversely affect the wood stork.	About 1,200 feet of bridge approach road would fall within the Secondary Zone of the West Colony. Highway construction would be the same as Alt 2.2.2a. With management according to the USFWS Guidelines, the project may affect, but is not likely to adversely affect the wood stork.	No effect from bridge construction. Highway construction would be the same as Alt 2.2.2a. With management according to the USFWS Guidelines, the project may affect, but is not likely to adversely affect the wood stork.
Other Wildlife	No Effect	Bridge provides one-mile reduction in potential opportunity for mortality	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a

Air Quality	No effect	Minor, localized short-term increase in particulates and combustion products due to construction; no permanent change (air quality standards not violated).	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a
Transportation	No effect	Traffic flow would be maintained, but delays could be encountered in construction zones.	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a
Public Recreation	No effect	Permanent loss of bank fishing at bridge location.	Permanent loss of bank fishing at bridge location.	Permanent loss of bank fishing at bridge location.	Permanent loss of bank fishing at bridge location.
Cultural Resources	No effect	No effect	No effect	No effect	No effect
Aesthetics	No effect	Potential for improved view of Everglades	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a
Noise	No effect	Short-term localized noise in construction zones	Same as 2.2.2a	Same as 2.2.2a	Same as 2.2.2a
Businesses	No effect	Approximately 0.88 acres would be needed for permanent and temporary construction easements from FP&L. If reinforcement of the highway occurs at the access to properties of private landowners, temporary work area easements would be required. Operation of the project would require perpetual and occasional flowage easements.	If reinforcement of the highway occurs at the access to properties of private landowners, temporary work area easements would be required. Operation of the project would require perpetual and occasional flowage easements.	Approximately 0.88 acres would be needed for permanent and temporary construction easements from FP&L. If reinforcement of the highway occurs at the access to properties of private landowners, temporary work area easements would be required. Operation of the project would require perpetual and occasional flowage easements.	If reinforcement of the highway occurs at the access to properties of private landowners, temporary work area easements would be required. Operation of the project would require perpetual and occasional flowage easements.

5.2 Geology and Soils

Although construction of the project involves the movement of soils, driving of piles and making shallow excavations into the limestone bedrock, there would be no effect on geological conditions or soils along the Tamiami Trail from the No-Action Alternative and only a small local effect from the action alternatives.

5.3 Surface Waters

No-Action Alternative. The No-Action Alternative would maintain the existing capacity for conveying water from the L-29 Canal, under the Tamiami Trail, to ENP without causing deterioration of the roadway. The existing culvert system (19 culvert sets), which extends along the length of the Tamiami Trail in the project area (***Figure 5-1***), would continue to provide a general equalization of flows to ENP. No structures would be placed in the L-29 Canal or adversely affect its ability to provide conveyance and equalization of flows from the L-29 Canal into ENP. Channel dimensions would not decrease. The stage elevation constraint in the L-29 Canal would remain at 7.5 feet and the existing culverts would remain capable of conveying a peak flow of 1,250 cfs.

Action Alternatives

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). A one-mile eastern bridge would be located between the Radio One communications tower and structure S-334 (***Figure 5-2***). The bridge would be constructed outside the FDOT right-of-way, 40 feet south of the existing road. Most of the land on which the bridge would be located is federally owned land and part of ENP; the remainder is owned by FP&L. All vegetation and soil would be removed beneath the bridge to facilitate water flows. The existing highway would require reconstruction at either end of the bridge to provide a transition from the existing alignment to the bridge. After completion of bridge construction, the unneeded portion of the highway embankment would be removed. This modification to the hydraulic conveyance system, coupled with the 8.0-foot stage elevation in the L-29 Canal, would be capable of a peak flow of 1,577 cfs, an increase in peak flow of 327 cfs over the No Action Alternative. The average annual flow would increase by 55 percent.

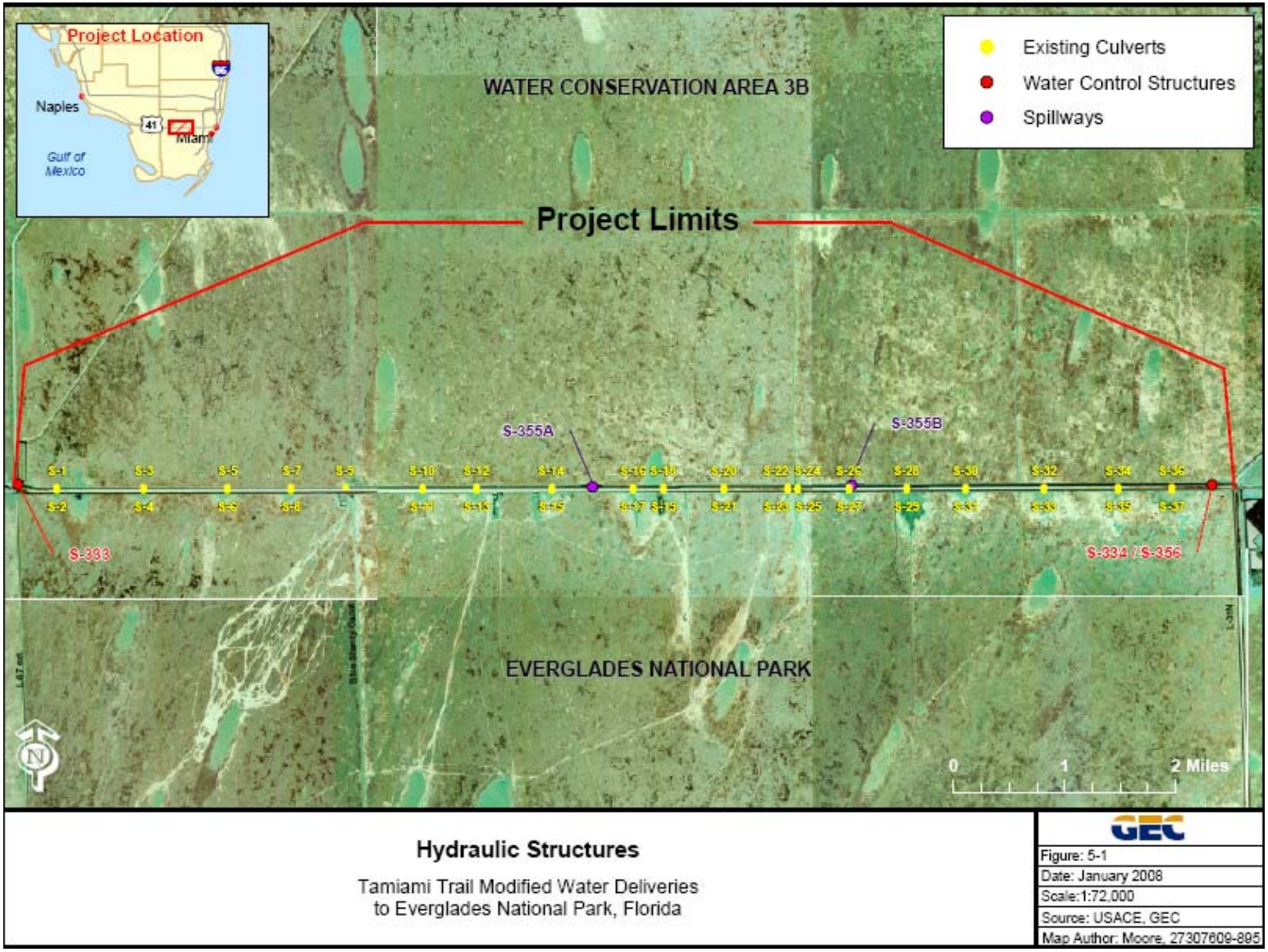

FIGURE 5-1: HYDRAULIC STRUCTURES

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). A western bridge would be constructed near the western end of the approximately two-mile distance between Osceola Camp and Everglades Safari (***Figure 5-3***). Features of the bridge and its capability to convey surface waters would be the same as those of the eastern bridge with a stage constraint of 8.0 feet.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). By raising the stage constraint from 8.0 to 8.5 feet, the eastern bridge would be capable of conveying a peak flow of 1,848 cfs. This would provide an increase in peak flow of 598 cfs and a 92 percent increase in average flow over the No Action Alternative.

Alternative 3.2.2b Road Reinforcement and Add One-Mile Western Bridge (Stage Constraint of 8.5 Feet). Features of the bridge and its capability to convey surface waters would be the same as those of the eastern bridge with a stage constraint of 8.5 feet.

5.4 Water Quality

No-Action Alternative. The No-Action Alternative would have no effect on water quality.

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). Construction would result in localized, short-term increases in concentrations of suspended solids and turbidity. Following completion of construction, turbidity and suspended solids concentrations are expected to return to existing conditions. Best management practices (BMPs) would be implemented following coordination with DOI and FDEP. This alternative would include the construction of a water quality treatment system to collect and treat stormwater runoff from the bridge prior to its release into ENP. Therefore, this alternative could provide an incremental benefit to long-term water quality by treating a one-mile section of highway runoff.

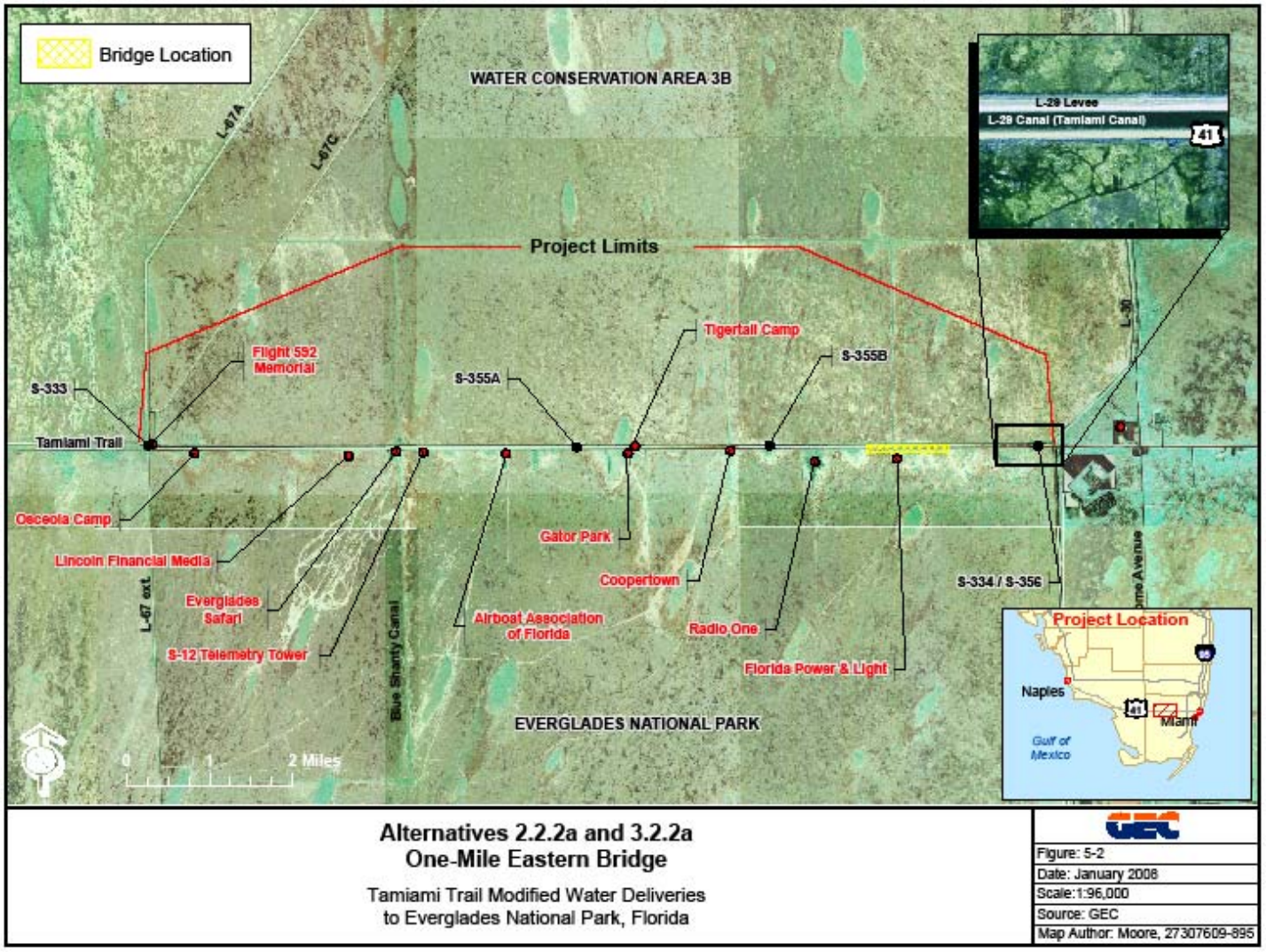

FIGURE 5-2: ALTERNATIVES 2.2.2A AND 3.2.2A ONE-MILE EASTERN BRIDGE

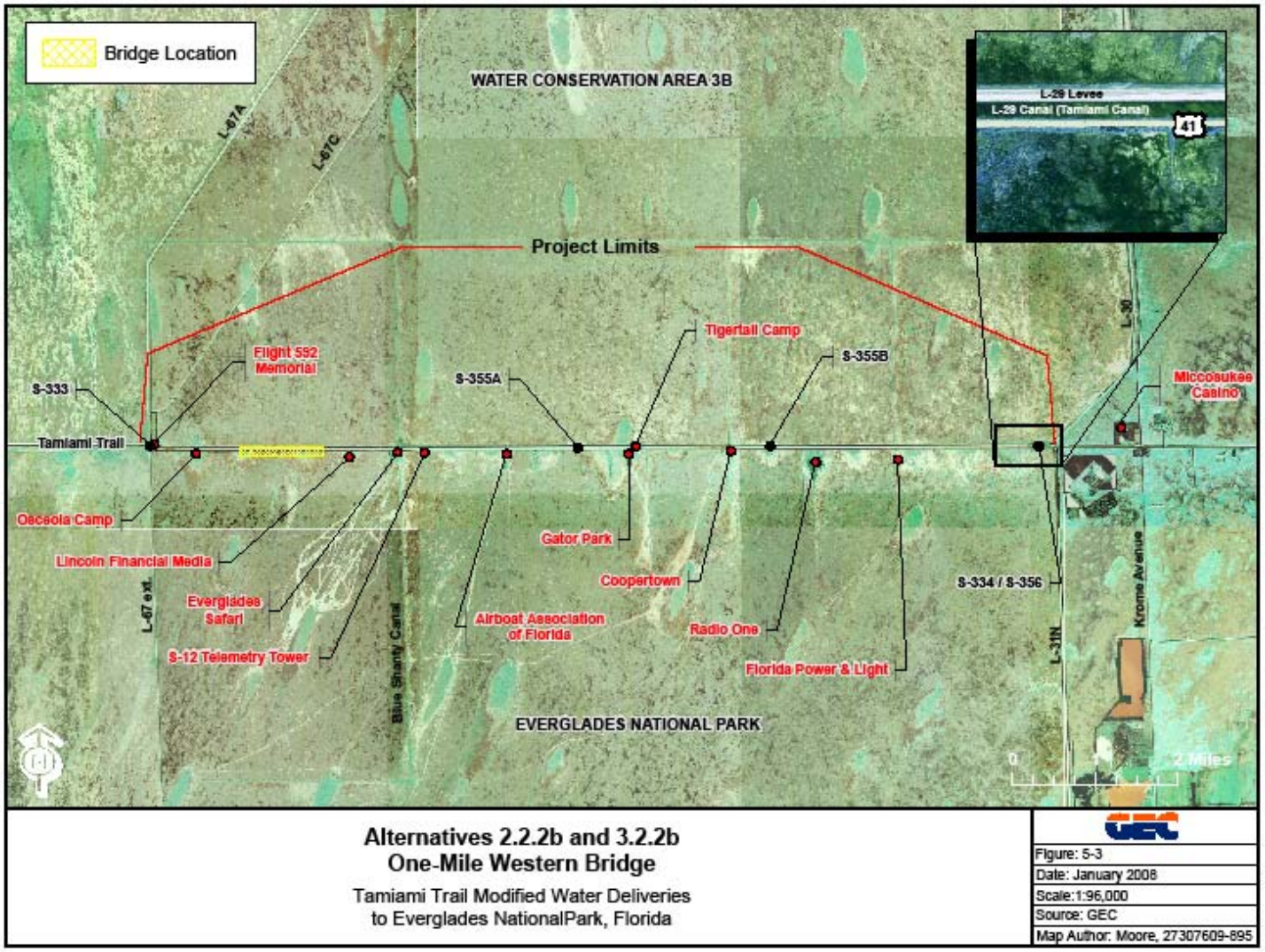

FIGURE 5-3: ALTERNATIVES 2.2.2B AND 3.2.2B ONE-MILE WESTERN BRIDGE

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). As with the eastern bridge, construction would result in localized short-term increases in suspended solids and turbidity. BMPs for controlling turbidity would be fully coordinated with DOI and FDEP prior to implementation. This alternative would also include a water quality treatment system to collect and treat stormwater runoff from the bridge prior to its release into ENP, which would benefit water quality in the long term.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). The effects of this alternative on water quality would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2b. Road Reinforcement and Add One-Mile Western Bridge (Stage Constraint of 8.5 Feet). The effects of this alternative on water quality would be the same as those of Alternative 2.2.2a.

5.5 Hazardous, Toxic and Radioactive Waste

No-Action Alternative. The No-Action Alternative would neither affect nor be affected by HTRW.

Action Alternatives. None of the action alternatives would affect or be affected by HTRW. If contaminants are found during project construction, a safety zone would be established around the contaminated site, and the site would be remediated before construction could resume.

5.6 Special Environmental Resources

5.6.1 Everglades National Park

Water Deliveries to Everglades National Park. ***Table 5-2*** summarizes some of the changes to water deliveries to ENP provided by alternatives.

TABLE 5-2: WATER DELIVERIES TO EVERGLADES NATIONAL PARK

Alternative	Average Annual Volume		Peak Flow		Potential Hydrologic Connectivity of WCA-3B and NESRS (% tot length)
	kacre-ft/yr	% Increase	cfs	% Increase	
No-Action	177	0%	1,250	0%	0.0
2.2.2a	274	55%	1,577	26%	9.0
2.2.2b	274	55%	1,577	26%	9.0
3.2.2a	340	92%	1,848	47%	9.0
3.2.2b	340	92%	1,848	47%	9.0

No-Action Alternative. The No-Action Alternative would maintain the existing hydraulic conveyance of flows from the L-29 Canal to ENP. While no adverse direct impacts would result from the No-Action Alternative, no benefits from increased flows would be realized.

Action Alternatives

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). A one-mile eastern bridge could increase average annual flows by about 55 percent; peak flows could increase by about 26 percent. One mile of connectivity would be provided between ENP and the L-29 Canal, which with the potential degradation of the L-29 Levee, would enable hydrologic connectivity between WCA-3B and NESRS. There would be net loss of 15 acres of wetlands near the existing roadway within ENP. The permanent conversion from mixed exotic and native vegetation to a bridge and its approaches would allow for the significant benefits of additional water provided to thousands of acres within ENP.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). Effects of a western bridge would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). With a stage constraint of 8.5 feet, the eastern bridge would be capable of increasing annual flows by 92 percent and peak flows by 47 percent. Other effects would be the same as for Alternative 2.2.2a.

Alternative 3.2.2b Road Reinforcement and Add One-Mile Western Bridge (Stage Constraint of 8.5 Feet). Effects of a western bridge would be the same as those of Alternative 3.2.2a.

5.6.2 Parklands

This section examines the extent of ENP-owned land that would be affected by the project. Because a bridge would be located primarily on ENP lands 40 feet to the south of the existing highway, new construction would be necessary to provide transitions from the existing highway alignment to the bridge. These transitional areas to access the bridge would be constructed on ENP property, resulting in a permanent loss through conversion to highway embankment.

A temporary wetland loss would occur in the 50-foot construction easement on ENP south of a bridge. Vegetation in this area would be removed to facilitate access by equipment. After bridge construction had been completed, the site would be restored.

No-Action Alternative. Existing conditions would be maintained. No conversion of parklands would take place.

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). The eastern bridge would result in a permanent loss of approximately 8.5 acres of parkland that would be lost under the bridge and incorporated into the two portions of the highway that transition to the bridge. Additionally, construction easements would temporarily affect about 6.3 acres of parkland.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). Because a construction footprint for the western bridge has not been prepared, parklands required for the project were estimated with the assumption that all affected land is within ENP. The western bridge would result in the permanent loss of approximately nine acres of parkland that would be lost under the bridge and incorporated into the portions of the highway that transition to the bridge. The construction easements would temporarily affect about 6.7 acres.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). Effects would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2b Road Reinforcement and Add One-Mile Western Bridge (Stage Constraint of 8.5 Feet). Effects would be the same as those of Alternative 3.2.2b.

5.6.3 Biological Communities

Habitat Units. Engineers, hydrologists, and biologists from six agencies (SFWMD, ENP, FWS, FWC, FDEP, and USACE) collaborated in November 2007 to identify hydrologic and ecological conditions that would occur with alternative lengths and locations of conveyance (equal to bridge length and location) of water under Tamiami Trail. The goal was to evaluate and compare quantitative benefits for each alternative. Ten performance measures were developed and placed into four groups for convenience of evaluation:

1. Restore Water Deliveries to ENP
   A. Average annual flow volumes
   B. Potential connectivity of WCA-3B Marsh and NESRS as percent of total project length
   C. One-in-ten year maximum discharge
2. Restore Ridge and Slough Processes
   A. Number of sloughs crossed by bridges

B. Difference between average velocity in marsh and average velocity at road
C. Flows into NESRS provided via bridge

3. Restore Vegetative Communities
   A. Number of days water depth is greater than two feet during wet season peak
   B. Number of days water depth is greater than three feet during wet season peak
   C. Average water depth during wet season peak
4. Restore Fish and Wildlife Resources
   A. Reduction in wildlife mortality

All environmental outputs were calculated on an average annual basis to account for the fact that several years may be required before full attainment of the functional capacities is realized. Results of the analysis are presented in ***Table 5-3.*** More information about the benefits analysis can be found in Section 4.4.1.

TABLE 5-3: RESULTS OF THE BENEFITS ANALYSIS EXPRESSED IN HABITAT UNITS

Alternative	Average Annual Habitat Units (HU)	Average Annual Lift (HU)
No-Action	9,103	0
2.2.2a Reinforcing the Road and Adding a 1-Mile Eastern Bridge (8-ft Constraint)	17,662	8,559
2.2.2b Reinforcing the Road and Adding a 1-Mile Western Bridge (8-ft Constraint)	18,257	9,154
3.2.2a Reinforcing the Road and Adding a 1-Mile Eastern Bridge (8.5-ft Constraint)	22,212	13,109
3.2.2b Reinforcing the Road and Adding a 1-Mile Western Bridge (8.5-ft Constraint)	22,808	13,705

Ecological Connectivity. In the short term, the project has a potential of increasing the aquatic habitat connectivity between the L-29 Canal and ENP. This is considered an undesirable effect because of consequences such as facilitating the spread of non-native species into ENP. The project offers a long-term potential for enabling additional connectivity between ENP and upstream wetlands, which could be realized if the L-29 Levee is removed and the L-29 Canal filled under future projects.

No-Action Alternative. Biological community structure has become affected by the loss of pre-C&SF hydroperiods and a general reduction in water levels and flows in the Everglades. The No-Action Alternative would maintain existing water levels and flows, prolonging the existing structure of biological communities. No increase in ecological connectivity would be realized.

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). The bridge would provide an ecological connectivity of one mile.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). The bridge would provide an ecological connectivity of one mile.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). The bridge would provide an ecological connectivity of one mile.

Alternative 3.2.2b Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.5 Feet). The bridge would provide an ecological connectivity of one mile.

5.6.4 Wetlands

To determine the number of acres and types of vegetated wetlands affected by the project, Geographic Information Systems (GIS) technology was used by ENP to compare the construction footprint of the alternatives to a land use database. ***Table 5-4*** shows the land uses and number of acres impacted by each of the alternatives.

The additional conveyance and water distribution associated with this project would enable the restoration of many thousands of acres of wetlands of NESRS within ENP, thereby offsetting wetland losses. Wetland habitats would be improved through the partial restoration of deep sloughs in NESRS and the promotion of sheetflow downstream of the bridges and culverts.

TABLE 5-4: LAND USE IMPACTS RESULTING FROM ALTERNATIVE ACTIONS

Description	Alternative								
	No Action	2.2.2a		2.2.2b[1]		3.2.2a		3.2.2b	
		Permanent Construction Easement	Temporary Construction Easement	Permanent Construction Easement	Temporary Construction Easement	Permanent Construction Easement	Temporary Construction Easement	Permanent Construction Easement	Temporary Construction Easement
Graminoid Wetlands	--	0.61	3.57	5.53	4.15	0.61	3.57	5.53	4.15
Forested Wetlands	--	1.38	2.72	--	--	1.38	2.72	--	--
Mixed Forest & Graminoid Wetlands	--	--	0.31	2.95	2.24	--	0.31	2.95	2.24
Uplands	--	6.67	--	0.43	0.33	6.67	--	0.43	0.33
Upland Forest	--	--	0.13	--	--	--	0.13	--	--
Open Water	--	0.3	--	0.04	--	0.3	--	0.04	--
TOTAL ACRES	0.00	8.96	6.73	8.95	6.72	8.96	6.73	8.95	6.72
TOTAL WETLAND ACRES	--	2.29	6.60	8.95	6.72	2.29	6.60	8.95	6.72

[1] **BECAUSE NO ENGINEERING FOOTPRINTS EXISTS FOR ALTERNATIVES 2.2.2B, AND 3.2.2B, ACREAGES ARE ESTIMATED**

No-Action Alternative. Under the No-Action Alternative, no impacts to wetlands would occur.

Action Alternatives

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). This alternative would result in both permanent and temporary losses in vegetated wetlands. The proposed bridge would be located 40 feet south of the existing highway alignment. Access to the bridge would require constructing transitions from the existing highway alignment 40 feet to the south to intersect the bridge. A permanent loss of wetlands would occur from constructing the transitions. Wetlands under the bridge would be permanently lost by conversion to open water. The area would be cleared of soil and vegetation to promote the flow of water. Shading by the bridge would prevent the reestablishment of wetlands. A total of 2.29 acres of wetlands would be lost (***Table 5-4)***.

A 50-foot-wide construction easement needed for the operation of cranes and other heavy equipment to construct the bridge would create a temporary loss of wetland function. Vegetation within this area would be removed to facilitate access by equipment. After bridge construction has been completed, the sites would be returned to wetlands. Approximately 6.6 acres of wetlands would be temporarily impacted (***Table 5-4)***.

This alternative would result in the long-term improvement in the quality of over 63,000 acres of wetlands in ENP.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). Effects of the western bridge would be similar to those of the eastern bridge. Because no construction footprint of the western bridge has been completed, wetland acreages in ***Table 5-4*** for this alternative are estimates based on the Florida Land Use, Cover, and Forms Classification System (FLUCCS) data (FDOT, 1999) for the general area where the bridge would be located. FLUCCS codes used for the analysis were modified by the SFWMD in 2002. It is assumed that the construction footprint would be the same as that of the eastern bridge. Transitions to the bridge and bridge construction would result in a permanent loss of about 8.95 acres of wetlands. An estimated 6.72 acres would be temporarily lost. Approximately six acres of wetlands used for a bridge constructed easement would be temporarily impacted.

As with the eastern bridge, this alternative would result in the long-term improvement in the quality of over 63,000 acres of wetlands in ENP.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). Effects would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2b Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.5 Feet). Effects would be the same as those of Alternative 2.2.2b.

5.6.5 Protected Species

The 2005 Fish and Wildlife Coordination Act Report (FWCAR) referenced six threatened or endangered species in the project area: CSSS, eastern indigo snake, Florida panther, snail kite, West Indian manatee, and wood stork. FWS and the FWC also identified the Frog City wading bird colony as potentially requiring protective measures during construction.

Cape Sable Seaside Sparrow. A federally endangered species, the CSSS is currently being protected under the IOP as described in the December 2006 IOP FSEIS. As part of the FWS 1999 BO on the project, Reasonable and Prudent Alternatives (RPAs) were developed to "preclude jeopardy" to the CSSS. The December 2006 IOP FSEIS, accompanied by a FWS BO of November 17, 2006, evaluated additional RPAs and action alternatives for water management actions to avoid jeopardy to the CSSS. All alternatives considered in this LRR/EA would be capable of passing sufficient flow through their respective hydraulic openings to satisfy the RPAs of the 1999 and 2006 BOs for the CSSS. The closest occupied CSSS nest lies ten miles south of the project area. Construction activities would have no effect on this species. There is no designated critical habitat located within the project area, so none would be affected. It is concluded that the project may affect, but is not likely to adversely affect, the CSSS.

Eastern Indigo Snake. This species may be in the project area, although there are no known sightings. Because it could potentially be in the area affected by construction activities, the 2005 FWCAR requested the implementation of *Standard Protection Measures for the Eastern Indigo Snake* during construction. USACE would include the "Standard Construction Precautions for the Eastern Indigo Snake" in the project design. It is concluded that the project may affect, but is not likely to adversely affect, the Eastern indigo snake.

Florida Panther. Telemetry data from radio-collared panthers between 1991 and 2000 indicates there were no panthers present in the vicinity of Tamiami Trail. In 2001, collared panther #85 ranged to within about one-half mile south of Tamiami Trail. That panther died four years ago and no other panthers are known to be in the area (email pers. com., Sonny Bass, 8/2/05). The FWS determined that formal consultation under Section 7 of the ESA would be

necessary to assess the effects of habitat loss. Under the recent panther consultation protocols, any loss of habitat greater than five acres in the primary habitat zone must undergo formal consultation. The primary habitat zone for the panther extends north through NESRS to the southern edge of Tamiami Trail. A linear strip of native and exotic woody vegetation would be removed along the highway for construction of the transition roadways and the bridge. The FWS considers this to be low quality potential panther habitat due to proximity of the highway and the infestation of exotic vegetation. The project may provide some protection for any panther that might wander north in the future by providing safe passage across the highway under the bridge. The USACE has agreed to compensate for the loss of panther habitat through the preservation and restoration of land located on the western side of the 8.5 SMA, which is part of the MWD Project. It is concluded that the project may affect, but is not likely to adversely affect the Florida panther.

Everglade Snail Kite. Potential effects on the snail kite would be a result of construction activities during the 36 months it would take to complete the project. Based on nesting data from 2000 to 2004, the closest nests to Tamiami Trail that have been recorded to date are 500 feet from the road (2000) and 1,800 feet (2004). Because the closest known snail kite nest is a considerable distance from the project area, no specific precautions seem appropriate at this time. The FWS and the FWC monitor snail kite nesting and would notify the USACE if new information would warrant a change. There is no designated critical habitat located within the project area, so none would be affected. It is concluded that the project may affect, but is not likely to adversely affect the Everglade snail kite.

West Indian Manatee. For the period of record of over 20 years, there has been only one record of a manatee utilizing the L-29 Canal adjacent to Tamiami Trail. It is highly unlikely that a manatee would be encountered in the project area. However, the USACE has agreed to provide for manatee protection procedures in its construction contracts. There would be no activities in the canal during construction. It is concluded that the project may affect, but is not likely to adversely affect the West Indian manatee.

Wood Stork. There are two nesting wood stork colonies located in the vicinity of Tamiami Trail: the Tamiami West Colony and the smaller Tamiami East Colony. The FWS has applied the *Habitat Management Guidelines for the Wood Stork in the Southeast Region* (Ogden 1990) to designate primary and secondary management zones for both colonies. The primary zone is the most critical area and must be managed according to recommended guidelines to insure the colony's survival. Restrictions in the secondary zone are needed to minimize disturbances that might impact the primary zone, and to protect essential areas outside of the primary zone. The FWS has designated the primary zone for the

Tamiami West Colony as the distance of 1,300 feet extended in all directions from the core area of the colony; the secondary zone includes the area between the 1,300 and 2,500 foot radii. The primary zone of the Tamiami East Colony extends 1,000 feet from the center of the colony; the secondary zone is the area between 1,000 feet and 2,000 feet from the colony center.

The existing Tamiami Trail runs through about 3,700 feet of the primary zone and 2,050 feet of the secondary zone of the Tamiami West Colony. Approximately 3,000 feet of the highway lies in the secondary zone of the East Colony. Highway construction would occur within these respective zones. Alternatives 2.2.2b and 3.2.2b would not involve bridge or bridge approach construction within the protection zones. For Alternatives 2.2.2a and 3.2.2a, no bridge construction would occur within the wood stork protection zones, but approximately 1,200 feet of bridge approach road would fall within the secondary zone of the West Colony. The following FWS guidelines for the primary and secondary zones are quoted from the FWCAR accompanying the 2003 GRR/SEIS.

1. **Primary Zone:** From February (or onset of nesting activity) through the onset of the rainy season (or when the young have fledged), highway construction *(*e.g., heavy human/equipment activity, pile driving, blasting) should not be permitted in the reach of the highway affected by that alternative.
2. **Secondary Zone:** No unauthorized human activity (on foot, airboat, or off-road vehicle) should occur at any time of the year within the reach of highway affected by that alternative on the south side of the highway and particularly during the nesting season.
3. **Length of Restrictions:** These restrictions shall remain in effect during the construction phase of the Tamiami Trail project.
4. **Qualified Observer:** Subject to the approval of the FWS and FWC, a qualified observer(s) shall be stationed onsite during the construction phase of the Tamiami Trail project. The observer shall monitor wood stork activity and shall notify FWS, FWC and the USACE if wood stork behavior is modified such that roosting, nest building, breeding, nesting, and/or fledging of young is disrupted or otherwise interfered with.
5. **Modification of Restrictions:** If new information becomes available concerning the wood stork colonies, the USACE, FWS and FWC should immediately contact each other to determine what modifications, if any, are warranted.

The USACE would manage construction activities within the protection zones according to the FWS "Draft Supplemental Habitat Management Guidelines for the Wood Stork in the South Florida Ecological Services Consultation Area." By

so doing, it is concluded that the project may affect, but is not likely to adversely affect the wood stork.

Other Protected Species. The Frog City rookery, which supports nesting by tricolored herons and great egrets, is located in WCA-3B close to the L-29 Levee approximately one-quarter mile west of the Tigertail Camp. Because all alternatives would be located south of the L-29 Levee/Canal, FWS and FWC did not recommend that any buffer zone restrictions be applied to the Frog City colony. The colony is protected from construction noise by the approximately 20-foot-high L-29 Levee; the wading birds nesting at this colony have acclimated to continuous highway traffic and noise. Therefore, no adverse impacts to the rookery are anticipated.

Because construction activities would be restricted to the immediate vicinity of the highway, no adverse effects on the American alligator, the Everglades mink, or any wading birds are expected.

5.6.6 Other Wildlife

The restoration of more natural hydropatterns in NESRS would increase the abundance and availability of forage fish during the crucial nesting period. Improved foraging would, in turn, improve nesting success. Other effects of the project would include the potential for decreasing wildlife mortality on the highway.

No-Action Alternative. The No-Action Alternative would maintain the existing effects of the Tamiami Trail on hydropatterns, wading birds, and other wildlife. The amount of wildlife mortality on Tamiami Trail would be unchanged.

Action Alternatives

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet. A one-mile conveyance would aid in the restoration of hydropatterns in NESRS, thereby benefiting wading birds.

Although there are no specific provisions made to reduce wildlife mortality, the bridge spans are anticipated to provide some reduction in mortality of wildlife crossing the Tamiami Trail, particularly at the eastern bridge where a wildlife mortality survey revealed the highest incidence of mortality along the project (47 percent of deaths) (USFWS, 2003). Bridging a one-mile section of the 11-mile-long Tamiami Trail would reduce the opportunity for wildlife mortality by about nine percent.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). Similar to the eastern bridge alternative, hydropatterns and wading birds would benefit from a one-mile-wide conveyance.

The bridge spans are anticipated to provide some reduction in mortality of wildlife crossing the Tamiami Trail. Small animals would be able to move north or south in the bridged area without the need to cross a highway. Although the wildlife mortality survey (USFWS, 2003) indicated that the highest incidence of mortality was at the eastern portion of the project area, because the eastern bridge and the western bridge are the same dimensions, this alternative would offer the same reduction in opportunity for wildlife mortality (about nine percent) as an eastern bridge.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). Improvements to habitat quality resulting from a stage constraint of 8.5 feet would provide incremental benefits to wildlife over those of Alternative 2.2.2a. Otherwise, the effects would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2b Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.5 Feet). Improvements to habitat quality resulting from a stage constraint of 8.5 feet would provide incremental benefits to wildlife over those of Alternative 2.2.2b. Otherwise, the effects would be the same as those of Alternative 2.2.2b.

5.7 Air Quality

No-Action Alternative. The No-Alternative would result in no adverse effect on air quality.

Action Alternatives. Every federally funded project must be consistent with state plans for implementing the provisions of the CAA Amendments (State Implementation Plans). This project is in conformance with the State Implementation Plan and Clean Air Act Section 176 because it is not located within a National Ambient Air Quality Standards (NAAQS) non-attainment area and it would not result in violations of the NAAQS. Emissions associated with this alternative would be largely generated from heavy machinery operating for short periods. Construction activities would cause minor short-term air quality impacts in the form of fugitive dust or airborne particulate matter from earthwork. The area is rural and the existing air quality is good to moderate, additional short-term loadings of exhaust from internal-combustion engine gases would not measurably impact the quality of the air.

5.8 Transportation

No-Action Alternative. The No-Action Alternative would result in no adverse effect on transportation.

Action Alternatives. Implementation of the project would not increase or decrease traffic on the Tamiami Trail under any alternative. Construction associated with reinforcing of the roadway would reduce the undulations and cracks in the highway surface and improve the drivability of the road. During construction of the project, traffic may be delayed in construction zones, particularly when it is necessary to temporarily close one lane of the highway. Under these situations, signage, signals, and other appropriate traffic control measures would be utilized to ensure safety.

The highway would remain available for evacuation during hurricane season; improvements made to the highway would improve safe travel of motorists during future evacuations. During hurricane evacuations, the contractor would secure the area and provide two way travel on the road unless otherwise designated by evacuation requirements.

Under the action alternatives, Tamiami Trail itself would be reinforced. Additionally, sections of the road would be bridged. Alternatives 2.2.2a and 3.2.2a would involve constructing a one-mile eastern bridge between Radio One and structure S-334 (***Figure 5-2***). The bridge would be constructed outside the FDOT right-of-way, 40 feet south of the existing road. The existing highway would require reconstruction at either end of the bridge to provide a transition from the existing alignment to the bridge. After completion of bridge construction, the unneeded portion of the highway embankment would be removed. Alternative 3.2.2b would involve building a one-mile western bridge (***Figure 5-3***). Features of the bridge and transitions would be the same as those of the eastern bridge.

The effects to traffic were considered. However, it was concluded that differences in traffic, traffic delays, and road user costs among alternatives would not be sufficient to affect the selection of a recommended alternative.

- Because bridge would be constructed adjacent to the existing roadway rather than within the existing road alignment, bridge construction would not significantly impact traffic flow.
- All final alternatives include reinforcing the same length of road.
- Barring unforeseen construction constraints, two-way traffic would be maintained during weekends, when most of the traffic is evident.
- Staging areas would be the same for all alternatives.
- The main difference among alternatives would the duration of construction for the different road heights.

During design, a traffic control plan would be completed for the selected alternative to minimize impacts during construction and provide for workers' safety.

5.9 Recreation

No-Action Alternative. No adverse impacts to non-commercial recreation (e.g., private airboating, fishing, wildlife viewing) would result. Access to boat ramps via S-333 and S-334 would not be affected. No effect on bank fishing access to the north bank of the L-29 Canal is anticipated.

Action Alternatives

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). Bank fishing from the Tamiami Trail would not be available at construction sites during the construction period. Although the use of shoulders for temporary lanes would preclude parking on roadsides in the construction area, a method of "rolling construction" would be employed, and impacts from construction would be localized. After the completion of construction, bank fishing from the roadway in the L-29 Canal at culvert outfalls could resume fully. Because the roadway embankment would be removed from the bridge location, there would be a net loss of bank fishing opportunity. Bank fishing losses at the bridge locations on the south side of the highway would be more than compensated for by the north side of the canal, which would not be impacted by the project and which would provide a safer location away from traffic. However, access to the north side of the canal via the unpaved road is not as convenient as the paved highway. On the south side of the highway, only culvert fishing is possible because there is no other open water. These locations would be decreased where the bridge replaces culverts.

No effects on boat ramps or non-commercial airboating and related activities would occur.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). Except for differences in location, Effects of this alternative on public recreation are the same as those of the eastern bridge.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). The effects would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2b Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.5 Feet). The effects would be the same as those of Alternative 2.2.2b.

5.10 Cultural Resources

No-Action Alternative. The No-Action Alternative would not adversely affect cultural resources.

Action Alternatives. All four action alternatives would involve modifications to the Tamiami Trail and associated Tamiami Canal. These historic structures would be affected by the project.

Five cultural resources have been recorded within the Tamiami Trail MWD to the ENP-GRR/SEIS project area; four being eligible or potentially eligible to the NRHP. It has been determined two, 8DA6765 (Tamiami Trail), and 8DA6766 (Tamiami Canal) would be adversely affected by proposed Alternative 2.2.2a. A draft Memorandum of Agreement (MOA) has proposed a kiosk be constructed in an appropriate area, showing the history of the area. Consultation with the Advisory Counsel, ENP, federally recognized Native American Tribes, FDOT, SHPO, SFWMD and other interested parties, addressing the MOA is ongoing. The consultation with all parties would continue until the implementing regulations for Section 106 of the NHPA (36CFR800) are met.

Adverse effects to the Tamiami Trail and Tamiami Canal would be mitigated by appropriate measures identified in a MOA with the Florida SHPO.

As the anticipated stage increase resulting from implementation is 12 inches, the effects to archeological sites located within the Shark River Slough National Register Archeological District in ENP by rising waters should be negligible, as this is well below historic flood stage. However, as detailed topographic data are not available for all sites within the archeological district, monitoring of these sites for erosion and cumulative effects from future restoration projects would be employed.

Should construction activities uncover any unanticipated archaeological finds, activity in the immediate area of the find would be stopped and the USACE notified. Construction would not continue until the site finds are evaluated by a professional archaeologist and the USACE provides a notice to proceed.

In the event that human remains are found during construction or maintenance activities, the provisions of *Chapter 872, Florida Statute (872.05)* would apply to the extent there exists a waiver of Federal sovereignty. *Chapter 872, Florida Statute* states:

> *When human remains are encountered, all activity that might disturb the remains shall cease and may not resume until authorized by the District Medical Examiner (if the remains are less than 75 years old) or the State Archaeologist (if the remains are more than 75 years).*

If Native American remains are encountered within the boundary of ENP, provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) would apply.

5.11 Aesthetics

No-Action Alternative. The No-Action Alternative would have no effect on the aesthetics of the area.

Action Alternatives

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). The removal of exotic vegetation on the southern side of the Tamiami Trail would be necessary for construction of the bridge and the highway transition to the bridge. Depending on how the bridge is constructed, it may improve the aesthetic quality of the area by offering motorists a view of the expanse of the Everglades within the project corridor.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). The effects would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). The effects would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2b Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.5 Feet). The effects would be the same as those of Alternative 2.2.2a.

5.12 Noise Environment

No-Action Alternative. No effects on the noise environment would be created by the No-Action Alternative.

Action Alternatives

Noise modeling performed for the 2005 RGRR/SEIS concluded that the project would have little or no impact on the baseline, future without project, or future with project noise environment at sensitive receptor sites located at the Osceola and Tigertail camps. The model also predicted no noise impact on the Flight 592 Memorial.

Construction and vibration noise generated during project construction would cause temporary impacts through increased noise levels near the receptor sites. Noise emissions from construction equipment range generally from 70 dBA for

pumps and portable equipment to approximately 95 dBA for tractors, graders, and other heavy equipment. Construction of bridge supports would entail the use of pile driving. There is a possibility that pile driving activity could cause disturbance to nearby rookeries.

Avoidance and/or mitigation options would be developed during the project development and design phases and specified in construction plans in accordance with FDOT's *Standard Specifications for Road and Bridge Construction*.

5.13 Economic Effects of Construction Expenditures

No-Action Alternative. Without construction, no economic effects of construction expenditures would be realized.

Action Alternatives. Analyses in the 2005 RGRR/SEIS using the IMPLAN model concluded that the action alternatives would stimulate economic activity in the region through short-term construction activities. IMPLAN is a regional impact model that enables the evaluation of the economic impact of specific activities such as construction of public works projects. IMPLAN was used in this analysis to estimate the economic impacts of the proposed project as measured by expected increases in business activity, personal income, and employment. The IMPLAN model for Miami-Dade County indicated that each million dollars in construction expenditures would result in an expected increase of $2.179 million in business sales, $0.969 million in personal income, and 22 jobs within the local economy.

5.14 Effects on Businesses

5.14.1 Project Construction

No-Action Alternative. No effects on businesses of the area would occur.

Action Alternatives. Six privately owned commercial properties are present along the south side of Tamiami Trail.

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). Construction of the eastern bridge would require the acquisition of property rights from FP&L. Efforts are currently underway to obtain a construction easement for FP&L lands that are needed for the construction of the bridge. Approximately 0.44 acres would be needed for a permanent construction easement and an additional 0.44 acres needed for a temporary construction easement. If reinforcing of the highway occurs at the private landowner's property access, temporary work area easements would be required.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). Because all property required for constructing the bridge for this alternative is owned by ENP, the acquisition of property rights from businesses is not needed. As with Alternative 2.2.2a, reinforcing of the road may require work area easements form private landowners.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). The effects would be the same as those of Alternative 2.2.2a.

Alternative 3.2.2b Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.5 Feet). The effects would be the same as those of Alternative 2.2.2b.

5.14.2 Flooding

No-Action Alternative. No impacts on businesses from flooding are anticipated.

Action Alternatives. It is anticipated that the federal government would acquire an interest in real estate from the private landowners that would be impacted not from the project's construction but rather the operation of the project. An analysis performed by the USACE on each affected tract and discussed in Appendix F, Real Estate Plan, concluded that perpetual and occasional flowage easements are required for FP&L, Radio One, Coopertown, Gator Park, Everglades Safari and Lincoln Financial. DOI has the responsibility of acquiring any lands within the ENP boundary. The necessary interests in the Airboat Association of Florida would be acquired by USACE. The operations of the project would not be implemented until the necessary real estate interests have been acquired.

5.15 Effects on Ecotourism

The airboat businesses on Tamiami Trail (Everglades Safari Park, Gator Park, and Coopertown Airboat Rides) draw a large influx of state, national and international tourists to this area of ENP every year. The three operations cumulatively bring in approximately 300,000 visitors annually, with peak numbers occurring in the winter months. Business owners have reported that these numbers are growing steadily every year.

No-Action Alternative. No effects on ecotourism would result from the No-Action Alternative.

Action Alternatives. While the flow of traffic along the Tamiami Trail would be maintained, the inconveniences associated with highway and bridge

construction may inhibit some tourists from visiting the businesses. Following the completion of construction and the improvement of the highway, visitations would be expected to rebound.

5.16 Airboat Association of Florida

The Airboat Association of Florida is a non-profit conservation and outdoor recreation organization. The site is located approximately three and a half miles from the western end of the project corridor.

No Action Alternative. No effects on the Airboat Association of Florida would result from the No-Action Alternative.

Action Alternatives. All action alternatives include provisions for maintaining access to the site. During construction, the flow of traffic on the Tamiami Trail would be maintained; however, motorists accessing the site may experience temporary delays because of traffic control measures.

If reinforcing of the highway occurs at the access to the Airboat Association, a temporary work area easement would be required.

5.17 Osceola and Tigertail Camps

No-Action Alternative. The No-Action Alternative would not result in any effects on the Osceola or Tigertail camps.

Action Alternatives. Under all action alternatives, access to the Osceola and Tigertail camps would be provided during construction and following completion of the project. Short-term traffic disruptions and noise would be created by construction.

With an increase in the stage elevation of water levels in the L-29 Canal, there may be some minor inundation in low lying areas. In the case of the Tigertail Camp, the impact of flooding has already been addressed by raising the buildings and access. This is not yet the case for the Osceola Camp, which would be raised by USACE pending the outcome of negotiations between the Osceola Family and ENP regarding how to implement the mitigation measures.

5.18 Flight 592 Memorial

No impacts on the Flight 592 Memorial are expected. Access to the site would be provided.

5.19 Environmental Justice and Impacts on Children

5.19.1 Environmental Justice

An environmental justice analysis, which is intended to "analyze and address the distributional effects of environmental impacts on certain populations," is included to address the requirements of Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. The purpose of the EO is to prevent the impacts of an action from falling disproportionately on minority or low-income communities. A determination that disproportionate impacts are evident can be subjective and a matter of legal interpretation. Disproportionate impacts occur when, in order to minimize or avoid impacts to another community or environmental resource, the impacts are instead focused on the minority or low-income community.

Neither the No-Action Alternative nor the action alternatives are expected to create long-term adverse impacts to the Tigertail or Osceola camps. Likewise, no disproportionate impacts are expected.

5.19.2 Impacts on Children

An investigation of environmental health risks and children is included to comply with the intent of EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. Data used to characterize the population within the affected area were obtained from local resources through interviews.

No increased environmental health or safety risks to children in either Tigertail or Osceola camps are expected.

5.20 Cumulative Impacts

Cumulative impacts are defined in 40 Code of Federal Regulations (CFR) 1508.7 as those impacts that result from:

> *...the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Cumulative environmental effects for the proposed project were assessed in accordance with guidance provided by the President's Council on Environmental Quality (CEQ). This guidance provides an 11-step process for identifying and evaluating cumulative effects in NEPA analyses, which may be further grouped into three general phases: scoping, describing the affected environment and determining the environmental consequences (CEQ, 1997, p. v).

5.20.1 Scoping

The CEQ provides the following summary guidance for the scoping phase of the cumulative effects analysis:

> *In many ways, scoping is the key to analyzing cumulative effects; it provides the best opportunity for identifying important cumulative effects issues, setting appropriate boundaries for analysis, and identifying relevant past, present, and future actions. Scoping allows the NEPA practitioner to "count what counts" (CEQ, 1997, p. v).*

Identifying the significant cumulative effects issues associated with the proposed action: All impacts on affected resources can be called cumulative. However, according to CEQ guidance, "the role of the analyst is to narrow the focus of the cumulative effects analysis to important issues of national, regional, or local significance" (CEQ, 1997, p. 12). Based on public and agency scoping and review on previous NEPA documents for this project (Section 1.9), the following resources have been identified as target resources for the cumulative effects analysis:

- Hydrology, including hydrological conditions in ENP and NESRS
- Water quality
- ENP parklands
- Protected species
- Vegetated wetlands
- Recreation
- Airboat touring businesses

Past, Present and Reasonably Foreseeable Actions Affecting Resources in the Study Area: Historically, the Everglades was a shallow wetland conveying water from Lake Okeechobee to the southern coast of Florida. The original construction of the Tamiami Trail, completed in 1928, involved the bridging of deep-water sloughs in the ridge and slough habitat through which the highway was built. Although modifications to the flow of water were begun in the 1880s, the greatest influence on the alteration of flow was the C&SF Flood Control Project, which was originally authorized by Congress in 1948.

With the construction of WCA-3A, WCA-3B, and the extension of the L-67 Levee, flows to ENP became subject to water supply deficits during the dry season and excesses during the wet season, resulting in a decline in ecological quality. During this period, reduced flows allowed the bridges along Tamiami Trail to be replaced with sets of culverts.

Among the first Congressional actions to offset adverse impacts to ENP by improving the supply and distribution of water was the Flood Control Act of

1968, which provided for modifications to the C&SF Project through the implementation of the ENP-South Dade Conveyance System. Additional Congressional actions ensued, among which was the ENP Protection and Expansion Act of 1989, which provided for the MWD program, and WRDA 2000, which established CERP. ***Table 5-5*** lists past, current, and anticipated future actions affecting the study area.

TABLE 5-5: PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS AND PLANS AFFECTING THE STUDY AREA

Past Actions/Authorized Plans	Current Actions and Operating Plans	Reasonably Foreseeable Future Actions and Plans	Expected Impacts
Construction of the Tamiami Trail (1928, Florida Department of Highways) C&SF Project, 1948 (Creation of L-28 and L-29 Levees and enclosure of WCAs).Completion of S-12 Gates with relocation of Tamiami Trail w. of S-333 (1962) Modified Water Deliveries to ENP (USACE, ENP). Authorized 1992.	Tamiami Trail Modifications LRR (this EA) Conveyance between WCA-3A and WCA-3B (Conveyance and Seepage Control Project) (USACE/ENP) Authorization of Mod Waters, 8.5 Square Mile Area, 2000. Construction of 8.5 SMA levees, canals, and pump station (USACE).	Complete Mod Water Deliveries, operate along with C-111 Project Features under CSOP (USACE) Lower East Coast Regional Water Supply Plan–South Florida Ecosystem Restoration Plan (SFWMD)-Integrate 8.5 SMA into IOP operations of C&SF system, phase II	Opening of L-67 A and C Levees under Conveyance and Seepage control will add water available to move through WCA-3B to L-29 and ENP. Pump Station S-357 S. of 8.5 Square Mile Area will provide additional seepage control to lands E of L-31 N; connection to C-111 Impoundment areas will aid in rehydrating Taylor Slough part of ENP.
Water Control Operations: WCA-3A Water Management Plan. Experimental Program of Water Deliveries to ENP–Test Iterations 1-7 (Shark River Slough) (USACE) CSSS 1999 Biological Opinion Interim Structural and Operational Plan (ISOP) 2000-2001	IOP 2002 to Present	IOP envisions operating up to stage of 9.7 feet in L-29; current constraint is el. 6.8 feet at G-3273 gauge.	Modifications to IOP, currently proposed, include incorporation of Mod Waters' S-357 pumping station. Subject of an independent NEPA documentation, expected for coordination in July of 2008.
ENP Protection and Expansion Act	ENP GMP (ENP) Determination of real estate actions.	General Management Plan expected to be complete 2009. ENP will document under NEPA. Decision on real estate still pending as of this EA.	Impact on private tourist developments along the Trail in the acquisition area depends on conclusions of ENP General Management Plan.
MWD to ENP–Raising Tigertail Camp (USACE/ENP)	Real Estate Acquisition and Osceola Camp raising (ENP)		Tiger Tail Camp has been raised to expected "CERP" water levels (above 10 ft.). ENP is in discussions with Osceolas; Osceola Camp will likewise be raised above CERP flood levels. (Not part of this EA).

C-111 Project	Build-out of C-111 under 1999, 2002, 2006 Sparrow BO, IOP. Changes to Canal 111 (C-111) were authorized in 1994 after Corps published a C-111 GRR. Changes are to make the C-111 Canal system, previously an agricultural flood control system, compatible with restoration of the lower Taylor Slough drainage sub-basin of Everglades National Park. New features in 1994 included seepage control impoundments to be built on the eastern edge of the former East Everglades Area (Park acquisition area).	Complete build-out of C-111 Impoundments and structural features with replacement of temporary structures by permanent. IOP to be replaced by Combined Structural and Operational Plan (CSOP) when C-111 and Mod Waters are complete.	C-111 Project has been altered as authorized in ENP Act of 1989 to facilitate restoration of the Taylor Slough region of ENP. A series of N-S linear impoundments receive seepage water from L-31 N and hold it to decrease the rate of seepage eastward from the Park and re-direct waters to Taylor Slough headwaters. This project is under construction; expected completion in 2013.
SFWMD	Lower East Coast Regional Water Supply Interim Plan (SFWMD)		
CERP Projects	CERP-Broward County Water Preserve Areas Project (SFWMD) awaiting authorization. PIR approved by HQ in 2007. CERP WCA-3 Decompartmentalization (USACE/SFWMD)	When authorized, Broward County WPA will build large impoundments and a seepage management area E. of WCA-3B to reduce seepage loss and reduce stormwater pumping into WCA-3A Decompartmentalization of the WCA-3's would further degrade L-29 Levee, partially fill Miami Canal and reduce structure based flow in favor of sheet flow. Additional conveyance features through Tamiami Trail will be studied.	Storm water deliveries to WCA-3 will decrease, increasing overall water quality available for delivery to ENP. Filling or partially blocking Miami Canal will reduce structure flow and increase sheet flow; additional conveyance structures and blockages in L-67 Canals will increase flow into WCA-3B. Additional conveyance features under WCA 3 Decomp. should increase sheet flows, decrease adverse high water stages in WCA-3, and re-connect WCA 3 and ENP portions of Shark Slough.

Source: U.S. Army Corps of Engineers.

Timeframe: Considering the past, present, and future events affecting the study area, the temporal boundaries for the cumulative impact assessment were established as follows:

- Past-back to 1928, when construction of the Tamiami Trail was completed.
- Present-2008, when the USACE and DOI plan for work on the Tamiami Trail modifications is to be initiated.
- Future-present to 2058, which is considered a reasonable period for assessment given the indefinite life of the project.

Geographic Scope: For purposes of cumulative impact assessment, the spatial boundary (scope of analysis) is considered to be the same as the boundary used in the Benefits Analysis (Appendix E). The area is defined by L-67 Extension on the west, Tamiami Trail on the north, and the L-31N and the 8.5 SMA on the east. The southern limit is defined as an east-west line connecting the end of the L-67 Extension to 8.5 SMA. The total area is 63,195 acres.

5.20.2 Describing the Affected Environment (Baseline Condition)

This phase of the cumulative effects assessment involves characterizing the resources in terms of their response to change and capacity to withstand stress, characterizing the stresses affecting the resources, and defining the baseline condition for these resources. Descriptions of affected resources are summarized in Chapter 3.0 of this LRR/EA and in referenced documentation.

5.20.3 Determining the Environmental Consequences

One main goal of this cumulative effects assessment is to determine whether the sustainability of resources affected by the proposed project are adversely affected by other past, present and reasonably foreseeable future actions. In simpler terms, the Tamiami Trail modifications must impact a resource in order to combine with other actions for *cumulative impacts* on that resource.

Causal relationships are very difficult to determine when multiple actions and resources are involved (CEQ, 1997). However, upon considering the identified past, present and reasonably foreseeable future actions, the following resources have been identified as having a potential to accumulate impacts from the proposed project and other actions.

Hydrology. Past effects on the hydrology of the Everglades by various projects are summarized in Chapter 3 of this LRR. The proposed project would not directly affect hydrology but would provide the opportunity for

future modifications in the hydrology of NESRS and ENP through the operational aspects of the Mod Waters program and CERP.

Everglades National Park. The primary source of water for the ENP comes from direct rainfall and accounts for approximately 70 percent of the total influx. The remaining 30 percent enters the ENP in the form of surface flow. Since 1985, the water delivery management schedule for ENP has followed the Rainfall Plan. The operational target for the managed deliveries under the Rainfall Plan is 45 percent delivered to Western Shark River Slough (WSRS) (via the S-12 structures) and 55 percent delivered to NESRS (via S-333, S-355A, and S-355B). The Rainfall Plan bases the amount and timing of water deliveries to SRS on recent rainfall and evapotranspiration to the north in WCA-3A. Weekly adjustments are made to delivery rates based on the previous week's flow rate and the rainfall and evapotranspiration data from the previous ten weeks. In addition to the Rainfall Plan component, a supplemental stage component is added based on the degree to which average water levels in WCA-3A exceed the regulation schedule. Under normal or dry conditions, this stage component is zero.

Northeast Shark River Slough. NESRS is a complex area located in the northeast corner of the ENP. It is currently the northern terminus of Shark River Slough, which is aligned from the northeast to southwest across the ENP. Tamiami Trail is the northern boundary, the L-31N Canal the eastern boundary, and the L-67 Extension Canal the western boundary of the area. Historically, the area would be characterized as wet the majority of the year, but regional developments have impacted fresh water routes into the area and the dry seasons can significantly reduce surface waters.

The NESRS is an important area with regard to water delivery, but it is a complex area. The average annual number of days of inundation in NESRS ranges from 1 to 60 days, to 240 to 300 days immediately adjacent to L-31N Canal, and to 330 to 365 days toward the west near the L-67 Extension Levee. In a dry year, the range is from 0 to 60 days to 240 to 300 days. In a wet year, such as 1995, the hydroperiod is in the maximum of 300 to 365 days of inundation per year. There is a significant difference between a dry year and a wet year. Average ponding depths generally range from one half to one and a half feet. For a wet year, depths are about twice the average. For a dry year, depths average from one half to one foot.

The intent of on-going and foreseeable future projects is to increase flows to ENP and restore, to the extent practicable, the natural hydrology of the area. This LRR provides an incremental component of that restoration.

Water Quality. Effects of the proposed project on water quality consist of short-term localized elevations in suspended solids in conjunction with construction activities.

Water quality in the study area is significantly influenced by development. The C&SF project led to significant changes in the landscape by opening large land tracts for urban development and agricultural uses, and by the construction of extensive drainage networks.

Natural drainage patterns in the region have been disrupted by the extensive array of levees and canals such that nonpoint source (stormwater) runoff and point sources of pollution (wastewater discharges) are now entering the system in many areas. Several pollutants of concern have been identified and include metals, pesticides, nutrients, biologicals, physical pollutants, and other various industrial constituents. Specifically, phosphorus and pesticides are considered the most important contributors to water quality degradation in the area.

In the central Everglades, phosphorus concentrations entering the ENP were lower in 1997 than the interim and long-term limits established by the 1992 Settlement Agreement in United States v. South Florida Water Management District, Case No. 88-1886-CIV-WMH (S.D.Fla.). While no significant trends in annual average mercury concentrations in water, sediment or fish have been observed in recent years, mercury concentrations in fish tissue were high enough to warrant a no-consumption advisory for largemouth bass throughout most of the eastern two thirds of the ENP, and a recommendation of limited consumption for the southeast corner of the ENP.

The best water quality conditions in the ENP were found in the central Shark River Slough and along regions of the basin.

In addition to the proposed project, construction operations associated with other on-going and future projects would result in localized and temporary elevated levels of suspended solids and turbidity. However, because the flow rates through the Everglades are relatively low, there would be no effect on the sustainability of water through these actions.

Even though concentrations of pollutants in highway runoff may increase as traffic volumes increase from an estimated 5,200 VPD in 2000 to an estimated 9,200 VPD in 2020, there would be little effect on surrounding water quality or wetlands (USACE, 2003). The proposed project, as well as other on-going and future projects, is not expected to induce additional traffic. Construction of a bridge and the incorporation of storm water collection and

treatment facilities would provide an incremental reduction in the amount of potentially contaminated runoff entering ENP.

Everglades National Park. Direct effects of the proposed project on ENP include the conversion of parklands to transportation conveyances in the form of bridges and bridge approaches. Through providing the opportunity for increased flows, the project offers the potential for improvement of ENP wetland habitats.

In combination with other reasonably foreseeable future projects, such as additional bridges, the proposed project would convert parklands to highway right-of-way. The quality of parklands is expected to improve as MWD and CERP projects offset some of the deterioration caused by past water projects in the Everglades.

Protected Species. It has been concluded that the proposed project may affect but is not likely to adversely affect any protected species. Species that may be affected are discussed in the following paragraphs.

Threatened and endangered species of the Everglades have been adversely affected by past actions that have resulted in habitat degradation and destruction and by such actions as the introduction of exotic species. On-going and future projects are expected to provide some degree of restoration to the habitats of protected species. Consultation under Section 7 of the ESA would serve to control cumulative impacts on protected species from actions that involve Federal funding, permits, or direct Federal involvement.

Cape Sable Seaside Sparrow. In the 1930s, Cape Sable was the only known breeding range for the sparrow. Areas on Cape Sable that were occupied by CSSS in the 1930s have experienced a shift in vegetative communities from freshwater vegetation to mangroves, bare mud flats, and salt-tolerant plants such as *Batis maritima* and *Borrichia frutescens*.

The hurricane of 1935 is believed to have initiated the succession of the plant community on Cape Sable from one dominated by freshwater plants to one dominated by salt tolerant plants. Sea level rise, reduced freshwater flows to the area resulting from upstream water management practices, and another hurricane in 1960 were also likely factors in this habitat change. As a result, the CSSS no longer use this area. The currently preferred nesting habitat of the CSSS appears to be a mixed marl prairie community that often includes muhly grass (*Muhlenbergia filipes*). These short-hydroperiod, mixed marl prairies contain moderately dense, clumped grasses with open space permitting ground movements by the sparrow.

Sparrows tend to avoid tall, dense, sawgrass-dominated communities, spike rush (*Eleocharis*) marshes, extensive cattail (*Typha*) monocultures, long-hydroperiod wetlands with tall, dense vegetative cover, and sites supporting woody vegetation. The birds also avoid sites with permanent water cover. The suitability of short-hydroperiod, mixed marl prairie communities for the sparrow is driven by a combination of hydroperiod and periodic fires. Fires prevent hardwood species from invading these communities and prevent the accretion of dead plant material, both of which decrease the suitability of habitat for Cape Sable seaside sparrows. In the Taylor Slough area, sparrow numbers increased annually in areas that had been burned up to three years previously.

The proposed project would have no direct affect on the CSSS or its habitat. Because the proposed project would provide an opportunity for increased flows into ENP, thereby providing an opportunity for greater flexibility than is now present, it is possible that future operation and management of flows could enhance CSSS habitats.

Snail Kite: The principal threat to the snail kite is the loss or degradation of wetlands and littoral zones of lakes in central and south Florida. The C&SF Project encompasses 17,913 square miles (46,600 km2) from Orlando to Florida Bay and includes about 990 miles (1,600 km) each of canals and levees, 150 water control structures, and 16 major pump stations. This system has disrupted the volume, timing, direction, and velocity of freshwater flow. Drainage of Florida's interior wetlands has reduced the extent and quality of habitat for both the apple snail and the snail kite. Nearly half of the Everglades has been drained for agriculture and urban development. The Everglades Agricultural Area (EAA) alone eliminated 3,051 square miles (8,029 km2) of the original Everglades, and the urban areas in Miami-Dade, Broward and Palm Beach counties have also reduced the extent of habitat. North of ENP the remaining marsh has been dissected into five shallow impoundments, the WCAs. Although the major drainage works completed conversion of wetlands to agriculture in the EAA by about 1963, loss of wetlands continues to the present at a slower, but significant, rate.

Despite the cumulative effects of many decades of wetland development and water management practices, which have resulted in degradation of snail kite foraging habitat due to the loss of wet prairie communities and degradation of nesting habitat due to the loss of woody vegetation, snail kite numbers have exhibited an increasing trend over the past decade. The minor increase in the chances of disturbance to nesting kites in the WCAs due to future tribal and hunting camp use would be a negligible incremental addition to the baseline adverse effects.

Depending on the alternative, the proposed project would fill a small amount of wetlands. However, it is unlikely that this loss would to have an effect on the apple snail or the snail kite. Because the proposed project would provide an opportunity for increased flows into ENP, future operation and management of flows could result in improved habitat quality of many tens of thousands of acres of wetlands.

Florida Panther. The Florida panther population may have numbered as many as 500 at the turn of the century. Historically, the panther was distributed from eastern Texas or western Louisiana and the lower Mississippi River valley east through the southeastern States in general, intergrading with other subspecies to the west and northwest. The first bounty on Florida panthers was passed in 1832, and another Florida law passed in 1887 authorized a payment of $5.00 for panther scalps. Hunting, habitat loss, and reduced prey availability have led to the decline of this species since that time.

The State of Florida declared the panther a game species in 1950 and an endangered species in 1958. The population was estimated at 100 to 300 statewide in 1966. The Federal government listed panthers as endangered in 1967. The UFWS cited heavy hunting and trapping pressures, an inability to adapt to changes in the environment, and developmental pressures as the reasons for the decline of the panther. The Florida Panther Act, a State law enacted in 1978, made killing the panther a felony.

Depending on the alternative selected, the proposed project would fill a strip of marginal potential panther habitat. It is concluded that the project is unlikely to adversely affect the panther.

Wood Stork. The loss or degradation of wetlands in central and south Florida is one of the principal threats to the wood stork. Nearly half of the Everglades have been drained for agriculture and urban development. The EAA alone eliminated 802,900 ha of the original Everglades, and the urban areas in Miami-Dade, Broward and Palm Beach counties have contributed to the loss of spatial extent of wood stork habitat. ENP has preserved only about one-fifth of the original extent of the Everglades, and areas of remaining marsh outside of ENP have been dissected into impoundments of varying depths.

The C&SF Project encompasses 4,660,000 ha from Orlando to Florida Bay and included about 1,600 km each of canals and levees, 150 water control structures, and 16 major pump stations. This system has disrupted the volume, timing, and direction of fresh water flowing through the Everglades. The natural sheet flow pattern under which the Everglades evolved since

about 5,000 years ago has not existed for about 75 years. Although major drainage works completed the conversion of wetlands to agriculture in the EAA by about 1963, loss of wetlands continues to the present at a slower, but significant rate. In the entire State of Florida between the mid- 1970s to the mid-1980s, 105,000 ha of wetlands (including marine and estuarine offshore habitats) were lost.

Depending on the alternative selected, the proposed project would result in the filling of a small amount of wetlands. However, because the proposed project would provide an opportunity for increased flows into ENP, future operation and management of flows could result in improved habitat quality of many tens of thousands of acres of wetlands. The application of management practices and observance of restrictions during construction operations in the primary and secondary zones of the eastern and western wood stork rookeries are not expected to adversely affect the nesting and rearing of young. The project is unlikely to have an adverse effect on the wood stork.

Indigo Snake. The indigo snake was listed as threatened in 1979 because of a loss of habitat associated with farming, construction, forestry, and other land use conversions, as well as over-collecting for the pet trade. In south Florida, the snake can be found in a variety of habitats, including wet prairies and mangrove swamps. Farther north, it can be found in pine-hardwood forest, mixed hardwood forest, creek bottoms, agricultural fields, and sandy habitats of the Florida scrub communities, typically in association with gopher tortoises.

This species may be in the project area, although there are no known sightings. Because it could potentially be in the area affected by construction activities, the 2005 FWCAR requested the implementation of *Standard Protection Measures for the Eastern Indigo Snake* during construction. USACE would include the "Standard Construction Precautions for the Indigo Snake" in the project design. It is concluded that the project may affect, but is not likely to adversely affect the Eastern indigo snake.

Vegetated Wetlands. Direct effects of the project on vegetated wetlands consist of filling wetlands and their conversion to bridge approaches. By creating the potential for increased flows to ENP, the project provides an opportunity for the improvement of the wetland communities to the south of the Tamiami Trail.

The Everglades ecosystem is characterized by the unique mosaic of freshwater wetland communities that dominates the landscape between Lake

Okeechobee and Florida Bay. The Everglades has experienced dramatic impacts over the last century, with approximately one-half of the original wetlands being lost to urban and agricultural development. The remaining wetlands have largely been adversely affected by water management practices that have altered the natural Everglades hydrological regime.

The Everglades landscape is dominated by a complex of freshwater wetland communities that includes open water sloughs and marshes, dense grass- and sedge-dominated marshes, forested islands, and wet marl prairies. These communities generally occur along a hydrological gradient with the slough/open water marsh communities occupying the wettest areas (flooded more than nine months per year), followed by sawgrass marshes (flooded six to nine months per year), and wet marl prairie communities (flooded less than six months per year).

Alteration of the normal flow of freshwater through the Everglades has also contributed to conversions between community types, invasion by exotic species, and a general loss of community diversity and heterogeneity. In contrast to the vast extent of wetland communities, upland communities comprise a relatively small component of the Everglades landscape and are found in the many tree islands scattered throughout the region.

Slough/Open Water Marsh. The slough/open water marsh community occurs in the lowest, wettest areas of the Everglades. This community is a complex of open water marshes containing emergent, floating aquatic, and submerged aquatic vegetation components. Vegetative trends in ENP have included a substantial shift from the longer hydroperiod slough/open water marsh communities to shorter hydroperiod sawgrass marshes.

Sawgrass Marsh. Sawgrass marshes occurring on deep organic soils (>1 meter) form tall, dense, nearly monospecific stands, while those occurring on shallow organic soils (<1 meter) form sparse, short stands that contain additional herbaceous species. The adaptations of sawgrass to flooding, burning, and oligotrophic conditions contribute to its dominance of the Everglades vegetation. Sawgrass-dominated marshes once covered an estimated 300,000 acres of the Everglades. Approximately 70,000 acres of tall, monospecific sawgrass marsh was converted to agriculture in the EAA. Urban encroachment from the east and development within other portions of the Everglades has consumed an additional 125,000 hectares of sawgrass-dominated communities. In addition, invasion of sawgrass marshes by exotic woody species has led to the conversion of some marsh communities to forested wetlands.

Wet Marl Prairies. Wet marl prairies occur on marl soils and exposed limestone and experience the shortest hydroperiods of the slough/marsh/prairie wetland complex. Marl prairie is a sparsely vegetated community that is typically dominated by muhly grass. Periphyton mats that grow loosely attached to the vegetation and exposed limestone also form an important component of this community. Marl prairies occur in the southern Everglades along the eastern and western periphery of Shark River Slough. Approximately 59,000 hectares of the eastern marl prairie has been lost to urban and agricultural encroachment. In addition, invasion of sawgrass marshes and wet prairies by exotic woody species has led to the conversion of some marsh communities to forested wetlands.

Tree Islands. Tree islands occur within the freshwater marshes on areas of slightly higher elevation relative to the surrounding marsh. The lower portions of tree islands are dominated by hydrophytic, evergreen, broad-leaved hardwoods. Tree islands typically have a dense shrub layer. Elevated areas on the upstream side of some tree islands may contain an upland, tropical hardwood hammock community dominated by species of West Indian origin. Portions of the WCAs have been flooded to the extent that many forested islands have lost all tropical hardwood hammock trees. Tree islands are considered an extremely important contributor to habitat heterogeneity and overall species diversity within the Everglades ecosystem.

Conclusions. The proposed project would convert various types of wetlands to highway right-of-way or clear those under bridge locations. However, because the proposed project would provide an opportunity for increased flows into ENP, future operation and management of flows could result in improved wetland quality of many tens of thousands of acres of wetlands within ENP.

As part of the restoration of flows to ENP, on-going and future projects are anticipated to provide partial restoration of the ridge and slough geomorphology of NESRS that past projects have altered. Overall cumulative impacts on wetland, upland, and aquatic habitats in ENP, while likely not a complete restoration of historic conditions, are anticipated to be improvements over existing conditions.

Recreation. Recreational opportunities are abundant in south Florida. In addition to the marine based recreation activities of the urbanized east coast, the ENP and WCAs provide high quality boating, fishing, hiking, and nature interpretation activities which annually attract many recreational visitors. The ENP has been designated a World Heritage Site, an International Biosphere Reserve, and a Wetland of National Significance. In addition, 86 percent of the ENP is designated Wilderness under the Wilderness Act of

1964. The State of Florida has designated ENP an Outstanding Florida Water.

Past projects have involved the construction of canals, roads, and levees, which have provided recreational opportunities. Anticipated projects, as well as reasonably foreseeable future actions, may reduce or modify recreational opportunities through the filling of canals and the degradation of levees. Bank fishing along the Tamiami Trail on the south side of the L-29 Canal would be eliminated in the area of a bridge. Any additional future bridges would further reduce fishing from the highway right-of-way.

Airboat Touring Businesses. Effects of the proposed project on airboat touring businesses may include the creation of traffic delays in construction areas that could inhibit visitors. The proposed project would create a potential for the passage of higher flows in association with future projects, thereby increasing the potential for flooding of commercial properties. The Everglades Expansion Act provided authorization to ENP to acquire the properties and also provided ENP with the authorization to enter into concession contracts with business owners. ENP is currently preparing a General Management Plan to guide decisions, among which would be the addressing of airboat touring businesses.

5.20.4 Magnitude and Significance of Cumulative Effects

The primary goal of cumulative effects analysis is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and future actions. One way to analyze this is to determine the separate effects of past actions, present actions, the proposed action, and other future actions. Once each group of effects is determined, the effects can be calculated, keeping in mind that the effects of two or more actions are sometimes complex and not always additive. According to CEQ (1997) guidance, once effects are identified, a table can be used to itemize effects into categories of past, present, proposed, and future actions. ***Table 5-6*** shows the net cumulative effects of each resource.

TABLE 5-6: SUMMARY OF CUMULATIVE EFFECTS

Resource	Past Actions	Present Actions	Proposed Action	Future Actions	Cumulative Effect
Hydrology	Flood and water control projects have greatly altered the natural hydrology of the Everglades.	Federal and state agencies are coordinating on and implementing projects to improve Everglades hydrology.	Bridge construction alternatives would provide a potential for some hydrological restoration.	Additional MWD actions and CERP propose to restore hydrology to more natural conditions	Although it is unlikely that natural hydrologic conditions would be fully restored, improved hydrology would occur.
Water Quality	Water quality has been degraded from development and agriculture.	Efforts to improve water quality from agricultural areas are ongoing. State and federal projects in the Everglades would result in localized and temporary elevated levels of suspended solids and turbidity. However, because the flow rates through the Everglades are relatively low, there would be no effect on the sustainability of water through these actions.	Construction operations would result in localized and temporary elevated levels of turbidity and suspended solids. Highway runoff from bridges would be treated prior to discharge. The TTM project would not have an overall effect on water quality.	Aggressive actions by the State of Florida would decrease pollutant concentration and loadings to the Everglades. If authorized in the next WRDA, the Broward County Water Preserve Areas project, (report approved in 2007) would reduce storm runoff deliveries to WCA 3 and improve water quality coming across into the Trail.	While anthropogenic effects on water quality are unlikely to be eliminated, water quality is expected to improve over existing and recent past conditions.
ENP Parklands	The ENP Protection and Expansion Act authorized the expansion of over 100,000 acres. Over 99 percent of these lands are now in federal ownership.	ENP is preparing a General Management Plan to guide decisions for long-range park management, including decisions regarding further land acquisitions.	Depending on the alternative selected, a small acreage of parklands would be lost to provide a bridge and bridge approaches.	Further modifications to Tamiami Trail are likely to require the conversion of additional parklands to roadways and bridges	Losses of parklands would likely be limited to modifications of the Tamiami Trail. However, additional bridges would improve the quality of remaining parklands.

Cape Sable Seaside Sparrow	The hurricane of 1935, sea level rise, reduced freshwater flows to the area resulting from upstream water management practices, and another hurricane in 1960 are believed to have altered succession of the plant community on Cape Sable from one dominated by freshwater plants to one dominated by salt tolerant plants. The currently preferred nesting habitat of the CSSS appears to be a mixed marl prairie community that often includes muhly grass.	Ongoing projects such as IOP have been implemented to maintain CSSS populations. The USFWS recovery plan is used as a management tool.	The proposed project would have no direct effect on the CSSS or its habitat. The proposed project would provide an opportunity for increased flows into ENP, thereby providing an opportunity for greater flexibility than is now present.	It is possible that future operation and management of flows could enhance CSSS habitats.	Habitat improvement, monitoring of populations and management through the recovery plan are anticipated to enable the survival of the CSSS.
Everglade Snail Kite	Drainage of Florida's interior wetlands, conversion of wetlands to agriculture, and urban development have reduced the extent and quality of habitat for the snail kite and its prey, the apple snail.	The population of the Everglade snail kite has stabilized since 1976 and apparently increased due in part to wet habitat conditions. While the kite was primarily restricted to an area south of Lake Okeechobee 20 years ago, it has reestablished itself in much of its historic range. Kites are now found breeding and feeding in the Kissimmee Chain of Lakes area and the marshes of the Upper St. Johns River. Annual snail kite surveys from 1969 to 1978 indicated population counts of 65 to 267 birds. In the 1990's, surveys produced counts of from 378 to 996 individuals.	Depending on the alternative, the proposed project would fill a small amount of wetlands. However, it is unlikely that this loss would to have an effect on the apple snail or the snail kite. The proposed project would provide an opportunity for increased flows into ENP that would improve the quality of habitat.	Future projects are expected to improve the operation and management of flows and improved habitat quality of many tens of thousands of acres of wetlands. The snail kite may also benefit from the Comprehensive Everglades Restoration Plan, which attempts to create a more natural water cycle.	Habitat improvement efforts through CERP are anticipated to allow snail kite populations to be maintained.

Florida Panther	The panther population may have numbered as many as 500 at the turn of the century. The first bounty on Florida panthers was passed in 1832, and another Florida law passed in 1887 authorized a payment of $5.00 for panther scalps. The State of Florida declared the panther a game species in 1950 and an endangered species in 1958. The Federal government listed panthers as endangered in 1967. The UFWS cited heavy hunting and trapping pressures, an inability to adapt to changes in the environment, and developmental pressures as the reasons for the decline of the panther. The Florida Panther Act, a State law enacted in 1978, made killing the panther a felony.	Many of the remaining panthers live in or near Big Cypress National Preserve and ENP. The NPS is cooperating with USFWS, the FFWCC, and other organizations for recovery of the panther. Efforts are centered on research, captive breeding, and public education. Radio-collaring of several panthers has shown what areas and habitat types they use. Other studies have identified white-tailed deer as their principal prey.	Depending on the alternative selected, the proposed project would fill a strip of marginal potential panther habitat. It is concluded that the project is unlikely to adversely affect the panther.	With the numbers so low and suitable habitat in south Florida so restricted, captive breeding and reestablishment in other areas would be crucial for reversing the population decline. Future projects associated with Everglades restoration may offer some improvement to panther habitat in ENP.	Panthers are at considerable risk of extinction. Only 80 to 100 remain, making this one of the most endangered mammals.
Wood Stork	Changes in the hydrologic regime of the Everglades have contributed to the decline in the wood stork population in south Florida. Water management has alternately drained or flooded former wood stork feeding habitat, for flood control and water supply. This affected foraging habitat, food production nesting and rearing. In 1984 wood storks were listed as endangered by the USFWS.	Ongoing efforts have been made by federal and state agencies to implement projects to improve Everglades hydrology. One of the benefits in these restoration efforts is improvement in wood stork foraging habitat, which would lead to greater nesting and rearing success.	There are two nesting wood stork colonies located in the vicinity of Tamiami Trail. The USACE would manage construction activities within the protection zones according to the USFWS "Draft Supplemental Habitat Management Guidelines for the Wood Stork in the South Florida Ecological Services Consultation Area." By so doing, it is concluded that the project may affect, but is not likely to adversely affect the wood stork.	Hydrological restoration planned as part of CERP would further improve wood stork foraging habitat.	Improvement of degraded wood stork populations is expected to be facilitated by the restoration and enhancement of suitable habitat through efforts to restore more natural hydrologic conditions in the Everglades.

Eastern Indigo Snake	The indigo snake was listed as threatened in 1979 because of a loss of habitat associated with farming, construction, forestry, and other land use conversions, as well as over-collecting for the pet trade.	John F Kennedy Space Center has been supporting environmental monitoring and research. Goals of their "include protection, preservation, and enhancement of the natural environment at KSC. Over 60 Indigo snakes in all have been fitted with radio transmitters and tracked to collect data. In 1989, the DOI created a 30,000-acre refuge near Big Cypress National Preserve that provides habitat and protection for many species, including the indigo snake. Active management at military installations in Florida targets the indigo snake.	This species may be in the project area, although there are no known sightings. Because it could potentially be in the area affected by construction activities, the USACE would include the "Standard Construction Precautions for the Indigo Snake" in the project design. The project may affect, but is not likely to adversely affect the eastern indigo snake.	The USACE would continue to incorporate measures for the protection of indigo snakes into their projects in Florida. These would continue to include postings of educational information on indigo snakes in educational kiosks and to implement USFWS Draft Eastern Indigo Snake Standard Protection Measures. CERP projects would contribute to the restoration of habitat that supports indigo snakes	While development and other actions have reduced available habitat for the indigo snake, state and federal facilities and management efforts are likely to enable the indigo snake to survive as a protected species.
Vegetated Wetlands	Large reductions in acreage of wetlands due to development and alteration of hydrology.	Actions are underway to reclaim wetlands from the 8.5 square mile area. Efforts are being taken by state and federal regulatory agencies to reduce wetland losses.	Bridge construction alternatives would result in the loss of some wetland acreage. The project would offer the potential to improve wetland quality through future projects.	Future actions are expected to restore flows to ENP to more natural conditions, thereby improving the quality of wetland habitats.	While the quantity of wetlands would not be restored to historic proportions, the quality of degraded wetlands would be improved.
Recreation	Construction of the Tamiami Trail provided the opportunity for access to the Everglades for recreational purposes.	Present and ongoing actions would not affect recreational opportunities.	Construction of a bridge would reduce the opportunity for fishing from the south side of the L-29 Canal by one mile; however, ample opportunity remains.	Future actions are expected to be fully compatible with recreational opportunities.	ENP would remain one of the world's foremost recreational and tourism sites.

Airboat Touring Businesses	Commercial airboat tours from facilities along Tamiami Trail have been conducted since the 1940s. The ENP Protection and Expansion Act authorized ENP to acquire these commercial properties and further authorized ENP to enter into concession contracts with the tour operators.	ENP is preparing a General Management Plan (GMP) to guide decisions for long-range park management, including a determination on authorization and implementation of airboat tour concessions.	While construction of proposed action may create a nuisance that could temporarily affect airboat tour operations, no other direct effects are anticipated. Temporary easements may be needed to provide access from a reinforced highway to the businesses.	The Record of Decision for the ENP GMP/EIS would include a determination of whether and to what extent commercial airboat concessions would be authorized and implemented. Acquisition of lands and buildings would be deferred until completion of the GMP.	It has not been determined what decisions would be made through the GMP. Therefore, while past and present actions can be determined, future actions are not foreseeable. Airboat tours may remain as ENP concessions or some or all may be eliminated.

Conclusion

Implementation of this project is an incremental component in the restoration of more natural flows into ENP. This project would provide a means for conveying increased flows past the Tamiami Trail and providing higher water levels for the restoration of wetlands to the south. Therefore, the Tamiami Trail Modification project is expected to contribute to a net beneficial cumulative impact on the regional ecosystem.

5.21 Irreversible and Irretrievable Commitments of Resources

No-Action Alternative. No irreversible or irretrievable commitments of resources would be realized.

Action Alternatives

Alternative 2.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.0 Feet). Commitments described for the previous alternatives would be required for reinforcing the road. Additional commitments of labor, materials, and energy would be required for bridge construction. The additional right-of-way on which the bridge and its approaches would be constructed would result in the irreversible and irretrievable loss of approximately 8.5 acres of natural parklands to accommodate the various components of the project.

Alternative 2.2.2b. Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.0 Feet). Commitments described for the previous alternatives would be required for reinforcing the road. Additional commitments of labor, materials, and energy would be required for bridge construction. The additional right-of-way on which the bridge and its approaches would be constructed would result in the irreversible and irretrievable loss of an estimated 9.0 acres of natural parklands to accommodate the various components of the project.

Alternative 3.2.2a. Road Reinforcement and Add a One-Mile Eastern Bridge (Stage Constraint of 8.5 Feet). Commitments described for the previous alternatives would be required for reinforcing the road. Additional commitments of labor, materials, and energy would be required for bridge construction. The additional right-of-way on which the bridge and its approaches would be constructed would result in the irreversible and irretrievable loss of an estimated 8.5 acres of natural parklands to accommodate the various components of the project.

Alternative 3.2.2b Road Reinforcement and Add a One-Mile Western Bridge (Stage Constraint of 8.5 Feet). Commitments described for the previous alternatives would be required for reinforcing the road. Additional commitments of labor, materials, and energy would be required for bridge construction. The additional right-of-way on which the bridge and its approaches would be constructed would result in the irreversible and irretrievable loss of an estimated 9.0 acres of natural parklands to accommodate the various components of the project.

5.22 Secondary Impacts

Primary (or direct) impacts are those that are caused by the action and occur at the same time and place. Secondary (or indirect) impacts are caused by the action and are later in time or farther removed in distance, bur are reasonably foreseeable. The modification of Tamiami Trail is a construction project; the primary impacts of the project are those caused by construction activities.

Secondary impacts involve those linked to the project but occur subsequent to construction, and would include the potential for an increased conveyance of flows under Tamiami Trail. The flow regime would be determined through a new water management plan and NEPA document on the Combined Structural and Operating Plan (CSOP). Work on CSOP could begin in July 2008.

Providing a greater capacity for the conveyance of flows under Tamiami Trail would provide opportunities (See Section 4.2.2) for:

1. The delivery of more water into the eastern ENP and NESRS, restoring the balance of distribution between eastern and western deliveries, as proposed in the MWD GDM.
2. Restore seasonal flooding and timing of deliveries that would enhance suitability for native vegetation and decrease the potential for invasive species colonization.
3. Increase the quantity of water into NESRS, which would increase the quality and quantity of ridge and slough habitat.

Anticipated beneficial secondary impacts of the project are discussed in Appendix E, Environmental Benefits Analysis, and throughout Section 5.0, Environmental Effects of Alternatives. Potential ecological benefits include the restoration of ridge and slough processes, the restoration of vegetative communities, and the restoration of fish and wildlife resources.

Improvements to NESRS inside ENP could be realized through a potential in crease in water levels of up to two feet.

In addition to those benefits within the area downstream from Tamiami Trail, the project would provide greater flexibility for increased water releases. This

would reduce the need for storage of water in WCAs, which would decrease ponding and promote sheet flow. The WCA-3A ecosystem would potentially experience less frequent adverse high stages in its southwestern corner.

Additional water provided to ENP would increase the potential for inundating low-lying areas of businesses, commercial properties, and the Airboat Association of Florida site. The Tigertail Camp was raised in anticipation of higher stages; negotiations are ongoing between ENP and the Osceola family for raising the Osceola Camp to alleviate the flooding potential.

5.23 Compatibility with Federal, State and Local Objectives

This project has been coordinated with agencies of Federal and state governments. Agency representatives have participated in workshops, meetings, and other project-related activities, and have provided reviews of this document. There is no known incompatibility with the objectives of Federal, state, or local entities.

5.24 Conflicts and Controversy

Public meetings and comments received regarding the bridging of Tamiami Trail have identified several areas of conflict and controversy.

- Numerous organizations and individuals have advocated the construction of a 10.7-mile bridge over the entire road segment to maximize potential re-connection of the WCAs and Park wetlands.
- The suite of studied alternatives includes many that are perceived by some commenters to be incapable of delivering substantial benefits, due to cost constraints.
- Others have expressed concern that construction of features on the south side of the highway results in a loss of wetlands in ENP. Some have proposed that the highway be relocated to the region of the L-29 Levee to avoid impacts to ENP.
- Recreation interests have expressed concern that the project may result in a loss of access for fishing and boating/airboating.
- Representatives of the Miccosukee Tribe have expressed several concerns: that the MWD program has required an excessive amount of time and affected tribal lands; that the dividing of the MWD program into three projects has masked environmental impacts; that construction actions would result in traffic congestion and disruptions to privacy at the Tigertail and Osceola Camps; and that there may be an increased flooding potential.
- Suggestions were made by some commenters that improved maintenance of culverts may be sufficient to provide MWD flows without the necessity for constructing a bridge; the high cost of bridges relative to road repair was one reason for this comment.

- Various individuals have expressed concern that the project would adversely affect local businesses. Others have advocated that the project evaluate the impact of the MWD program on the "Gladesmen culture."
- Concern has been expressed by ENP and SFWMD that reinforcing the water level in the L-29 Canal to an elevation of 8.0 feet would be insufficient to achieve the unconstrained flows needed to provide significant environmental benefits. It has been recommended by ENP and SFWMD that the elevation be increased to 8.5 feet.
- One commenter, representing several non-governmental organizations and herself, objected to concrete bridge construction on the assumption that the cement used would ultimately come from limestone mines in the Lake Belt area.

5.25 Compliance with Environmental Requirements

Coordination and evaluation of required compliance with specific Federal acts, EOs and other policies for the various alternatives was achieved, in part, through the coordination of this document with appropriate agencies and the public. This compliance was established in conjunction with the 1992 GDM/EIS, the 2003 GRR/SEIS, and the 2005 RGRR/SEIS.

5.25.1 Anadromous Fish Conservation Act

Anadromous fish species would not be affected by this project. This act is not applicable.

5.25.2 Bald Eagle Protection Act

No bald eagles are known to occur in the project area. The project is in compliance with the Act.

5.25.3 Clean Air Act of 1972

The proposed project is in full compliance with section 309 of the Clean Air Act. Full compliance was achieved through the coordination and review of this EA with the Environmental Protection Agency. No air permit would be required for the construction. If the contractor has to perform any onsite activity that would require permits, the permits would be acquired by the contractor. Because Miami-Dade County is in attainment with National Ambient Air Quality Standards (NAAQS), the project is in compliance with the Clean Air Act Conformity Rule.

5.25.4 Clean Water Act of 1972

A 404(b)(1) Evaluation has been prepared (***Annex A***) and would be coordinated along with this EA. Full compliance with this Act would be achieved upon the issuance of a Section 401 water quality certification (WQC) and National Pollutant Discharge Elimination System permits by the State of Florida. A

NPDES permit would be acquired for the construction activity. No point source NPDES permits would be required for discharges.

5.25.5 Coastal Barrier Resources Act and Coastal Barrier Improvement Act of 1990

There are no designated coastal barrier resources in the project area that would be affected by this project. These acts are not applicable.

5.25.6 Coastal Zone Management Act of 1972

A federal consistency determination in accordance with 15 CFR 930 Subpart C is included in Annex A. The State's consistency review for this project would be performed during the coordination of this draft EA. Full compliance would occur with the issuance of the WQC by the State of Florida.

5.25.7 Endangered Species Act of 1973

This project would comply with the Endangered Species Act of 1973, as amended, 16 U.S.C. 1531, *et seq.;* PL 93-205. The CESAJ has made a commitment to providing ornithological observers during construction, and to stage construction such that it does not interrupt nesting activities at the two wood stork rookeries located in close proximity to Tamiami Trail. The FWS informally concurred with the USACE "not likely to adversely affect" determinations for all listed species except the Florida panther (USACE, 2003 GRR/SEIS). Subsequently (2005 RGRR/SEIS), the FWS concluded that the project may affect, but is not likely to adversely affect the Florida panther. Documentation of compliance with the ESA is provided in Appendix B.

5.25.8 Estuary Protection Act of 1968

No designated estuary would be affected by project construction activities however; operations of the project may benefit Florida Bay. Full compliance with the Act would occur upon review of this EA by the NMFS.

5.25.9 Farmland Protection Policy Act of 1981

No prime or unique farmland would be impacted by implementation of this project. The project is in compliance.

5.25.10 Federal Water Project Recreation Act

This project is in full compliance with the Federal Water Project Recreation Act, as amended, 16 U.S.C 460-1 (12), *et seq.,* P.L. 89-72.

5.25.11 Fish and Wildlife Coordination Act of 1958

This project has been extensively coordinated with the FWS. Fish and Wildlife Coordination Act (FWCA) reports were submitted by the FWS for the 1994 GRR, 2002 IOP FEIS and the 2006 IOP FSEIS. The FWS is currently preparing a

FWCA report for the proposed action which would be included in the final EA. This project would be in compliance with the Act.

5.25.12 Magnuson-Stevens Fishery Conservation and Management Act

This project is inland and not expected to adversely affect Essential Fish Habitat. Full compliance with the Act would occur upon review of this EA by the NMFS.

5.25.13 Marine Mammal Protection Act of 1972

The West Indian manatee is not likely to be adversely affected by the project. Coordination with FWS would continue as construction and operational guidelines are incorporated to avoid impacts to this species. Full compliance with the Act would occur after review of this EA by the FWS.

5.25.14 Marine Protection, Research and Sanctuaries Act (MPRSA)

The term "dumping" as defined in the Act (3[33 USC. 1402] (f)) does not apply to this project. Therefore, the MPRSA does not apply.

5.25.15 Migratory Bird Treaty Act and Migratory Bird Conservation Act

No migratory birds would be adversely affected by project activities. The project would be in compliance with these acts upon review of this EA by the FWS.

5.25.16 National Environmental Policy Act of 1969

Environmental information on the project has been compiled and this EA has been prepared in compliance with NEPA. With signing of the Finding of No Significant Impact (FONSI) this EA is in full compliance with the Act.

5.25.17 National Historic Preservation Act of 1966 (Inter Alia) (PL 89-665, the Archeology and Historic Preservation Act (PL 93-291), Archeological Resources Protection Act of 1979, Native American Graves Protection and Repatriation Act of 1990, and Executive Order (EO) 11593)

Archival research, field work and consultation with the SHPO have been conducted in accordance with statutes protecting archaeological, cultural, and historic resources. The Tamiami Trail and the Tamiami Canal have been identified as eligible for NRHP listing. A Memorandum of Agreement with SHPO would be signed, and documentation of historic structures would be completed. This project complies with the provisions of the above statutes and executive orders.

5.25.18 Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, Comprehensive Environmental Response Compensation and Liability Act (CERLA) as amended by the 5.26.21 Superfund Amendments and Reauthorization Act (SARA) of 1996, Toxic Substances Control Act of 1976

A preliminary Phase I HTRW assessment was conducted in late 2006 to address the potential for the occurrence of HTRW in the study area. No specific sites were identified within the footprint of the proposed project. The project is in compliance with these Acts.

5.25.19 Rivers and Harbors Act of 1899

The proposed work would not obstruct navigable waters of the United States. The project is in full compliance.

5.25.20 Submerged Lands Act of 1953

The project would not occur on submerged lands of the State of Florida. This Act does not apply.

5.25.21 Wild and Scenic River Act of 1968

No designated Wild and Scenic river reaches would be affected by project related activities. This act is not applicable.

5.25.22 Executive Order 11514, Protection of Environment

E.O. 11514 directs federal agencies to "*initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals."* This project is in compliance.

5.25.23 Executive Order 11988, Flood Plain Management

This E.O. instructs Federal Agencies to avoid development in flood plains to the maximum extent feasible. The current project is not a "development" but rather a restoration action. This project is in compliance.

5.25.24 E.O. 11990, Protection of Wetlands

The locations that would be used for construction of bridges, approaches, and construction access areas are a mosaic of wetlands with small tree island uplands. A permanent loss of 2.29 acres of wetlands is expected, but this project would result in an overall improvement in the quality of approximately 63,000 acres of wetlands. This project complies with the goals of this executive order.

5.25.25 Executive Order 12962, Recreational Fisheries

Executive Order 12962 requires the evaluation of federally funded, permitted, or authorized actions on aquatic systems and recreational fisheries. This project is in compliance.

5.25.26 E.O. 12898, Environmental Justice

This E.O. directs federal agencies to provide for full participation of minorities and low-income populations in the federal decision-making process and further directs agencies to fully disclose any adverse effects of plans and proposals on minority and low-income populations. Efforts were made to avoid, minimize, or compensate for any adverse effect of this project on the Native Americans living in the project area. The project would not result in disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. The project is in compliance with this E.O.

5.25.27 Executive Order 13045, Protection of Children

Executive Order 13045, requires each Federal agency to "identify and assess environmental risks and safety risks [that] may disproportionately affect children" and ensure that its "policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks." This project has no environmental or safety risks that may disproportionately affect children. The project is in compliance.

5.25.28 E.O. 13089, Coral Reef Protection

No coral reefs would be impacted by this project. This E.O. does not apply.

5.25.29 E.O. 13112, Invasive Species

The project would help reduce the abundance and variety of invasive plant species in the project area. The project is in compliance with this E.O.

5.25.30 E.O. 13186 Responsibilities of Federal Agencies to Protect Migratory Birds

The project has been coordinated with the USFWS. The project is expected to benefit migratory birds by improved habitat and increased availability of forage species (amphibians, fish, aquatic invertebrates) for wading birds. The project is in compliance.

5.26 References

Council on Environmental Quality (CEQ), Executive Office of the President. 1997. Considering Cumulative Effects Under the National Environmental Policy Act. Washington, D.C.

Florida Department of Transportation (FDOT). 1999. Florida Land use Cover and Forms Classification System Handbook. Third Edition.

Ogden, J.C. 1990. Habitat Management Guidelines for the Wood Stork in the Southeast Region. Submitted to the U.S. Fish and Wildlife Service, Atlanta, GA.

USACE. 2003. General Reevaluation Report/Supplemental Environmental Impact Statement (GRR/SEIS) for the Tamiami Trail. Modified Water Deliveries To Everglades National Park, Miami-Dade County, FL.

USFWS. 2003. Final Fish and Wildlife Coordination Act Report, Modified Water Deliveries to Everglades National Park: Tamiami Trail Project, Miami-Dade County, Florida; U.S. Fish and Wildlife Service, South Florida Field Office, Vero Beach, FL.

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6.0 RECOMMENDED PLAN

Based on the limited reevaluation and the review of all existing data and reports concerning the TTM, Alternative 3.2.2a, Raise Canal Stage to 8.5 Feet and Construct a One-Mile Eastern Conveyance Opening, is recommended for implementation under the MWD authorization (***Figure 6-1***).

As part of the Recommended Plan, the federal government would acquire certain real estate rights from FDOT allowing for the conveyance of water as part of the Tamiami Trail project. In order to obtain the perpetual rights to flow water, FDOT would receive compensation. These rights include both a perpetual channel and perpetual flowage easement interests. The channel easement includes conveyance of water for a one-mile-wide stretch of land. Due to the fact that there is an existing roadway at that location, USACE would construct a one-mile bridge that would act as a replacement to the existing Tamiami Trail roadway. In addition, the flowage easement allows for the legal right to flow higher levels of water through and under the property now occupied by the existing Tamiami Trail for the entire expanse of the project area. Placing higher water levels in the L-29 Canal would adversely impact the existing roadway. As such, portions of the roadway would require reinforcing the road and road base to avoid degradation of the road as a result of the higher water stages. Under Substitute Facilities Doctrine, compensation for these real estate rights is based on the cost of a substitute or replacement of the facility that would be lost. Therefore, USACE would construct a one-mile long bridge with approaches as compensation for the loss of the existing Tamiami Trail roadway due to the construction of the channel, and compensation would also be provided to preclude potential damages to the remaining highway resulting from increased stages in the L-29 Canal.

Descriptions of the Recommended Plan and its features are provided in the paragraphs below.

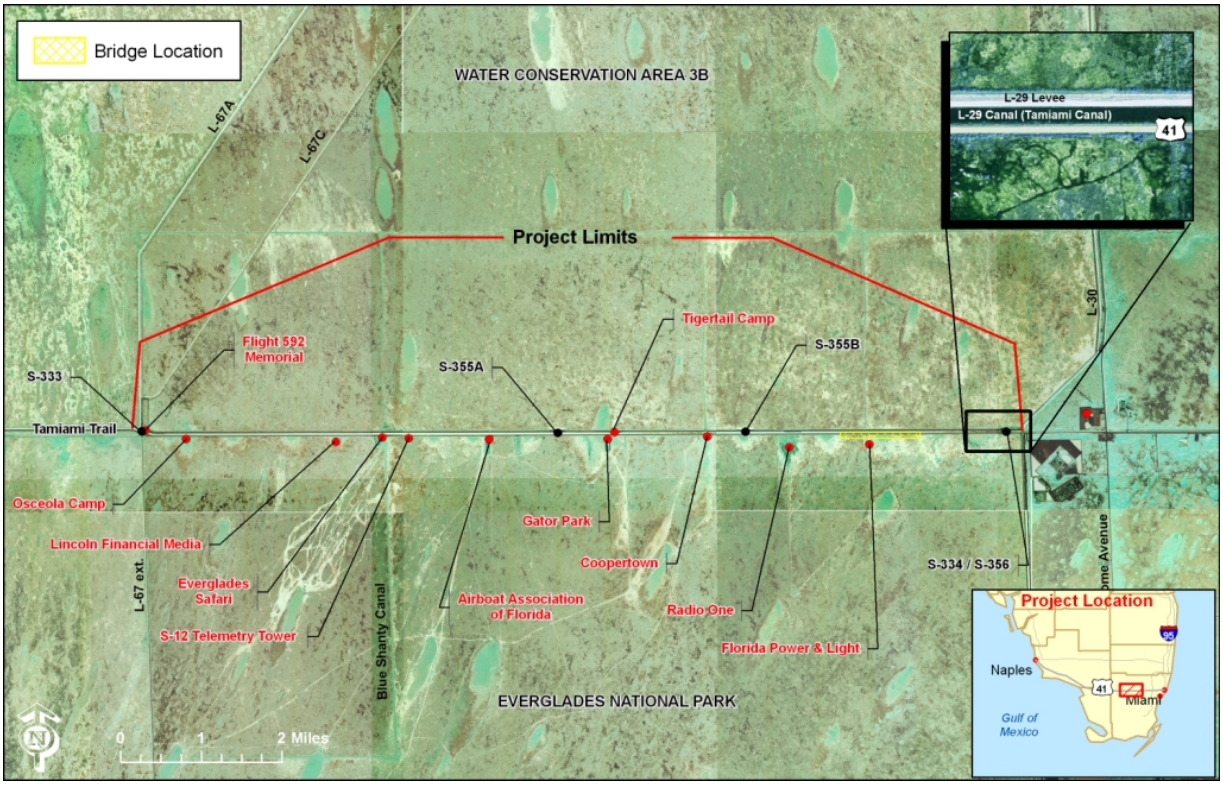

FIGURE 6-1: LOCATION OF THE RECOMMENDED PLAN

6.1 Modifications

6.1.1 Conveyance

The Recommended Plan would enable hydraulic conveyance through Tamiami Trail by removing one mile of the existing highway, embankment and associated culverts. This would allow one mile of connectivity between the L-29 Canal and ENP. A one-mile eastern bridge, coupled with an increased stage of 8.5 feet, would increase annual flow volumes by about 92 percent, to 339,703 acre-feet per year; peak flows would increase by about 48 percent, to 1,848 cfs. Additionally, conveyance over the remainder of Tamiami Trail would be provided through the use of the existing and improved culverts.

6.1.2 One-Mile Eastern Bridge (Location, Length, Height, Remove Culverts, Travel Lane Widths)

A one-mile bridge would be constructed as compensation to FDOT for the real estate rights to remove the one mile of Tamiami Trail and maintain motor vehicle traffic. The bridge would start approximately 3,000 feet east of Radio One and end about one mile west of S-334 (***Figure 6-1***). After completion of bridge construction, the unneeded portion of the highway embankment would be removed. The bridge would provide two 12-foot-wide travel lanes with ten-foot shoulders and outside barriers.

The existing highway would require a transition from the existing alignment to the bridge. The transitions to the bridge would have five feet paved shoulder and five feet of grassed shoulder. Guardrails would be located at the outside edges of these shoulders. The profile would be reinforced significantly for transitioning to the bridge and would be established per applicable drift, maintenance, and navigation bridge clearances, while minimizing humps in the profile. The low cord of the bridge would be at 14.75 feet NGVD.

6.1.3 Raise L-29 Canal Maximum Operating Limit to 8.5 feet, NGVD

Implementing Alternative 3.2.2.a is expected to raise the Maximum Operating Limit in the L-29 Canal to 8.5 feet NGVD, one foot above the existing operating limit of 7.5 feet NGVD. FDOT is allowing USACE to use a new standard (adopted in the March 2008 FDOT Flexible Pavement Design Manual) thereby reducing the required separation (Design Base Highwater Clearance) between the Design High Water (DHW) and the bottom of the road base. Design High Water (also referred to as Base Clearance Water Elevation) is defined as the average October wet season elevation plus the rainfall from a specific design storm event (10-year frequency, with duration (1 hr, 8 hr, or 24 hr) producing the highest stage and drawing down within a specific period). The old standard required either a higher base or a lower DHW. The use of this new standard with its reduced requirements for separation between the base and the DHW makes adherence to the DHW more imperative.

All inflows shall be cut off to the structures that influence this canal once the maximum operating limit of 8.5 feet NGVD is reached and in advance of certain stage and weather events. This one foot increase in the maximum stage elevation, coupled with improved hydraulic conveyance under the bridge, is expected to provide additional meaningful benefits as described in this LRR. In addition no changes (such as passive weirs in the L-29 Levee or removal of the L-67 Extension Levee without adequate engineering justification) shall be allowed which may cause stages to exceed the Maximum Operating Limit.

The benefits described in the LRR/EA are potential benefits associated with the evaluation of the LRR alternatives based on a single constraint of 8.5 feet in the L-29 Canal. The constraints that follow are required by FDOT in order to ensure the stability and safety of the highway. Therefore, when these FDOT constraints are applied to the recommended plan, there will be some change of benefits from those identified in this document. During the Combined and Structural and Operational Plan (CSOP) alternative planning process, the effects of these constraints on benefits will be thoroughly evaluated. In addition, there is an expectation that field monitoring, based on a reconfiguration of existing monitoring activities, will continue following implementation of the LRR features in conjunction with the CSOP operating plan. Such monitoring will

allow for adaptive management to potentially mitigate any loss of benefits from those identified in this document.

Operations of the C&SF system will ultimately depend on the operations of both the MWD and C-111 South Dade projects as defined in the CSOP. The operations of CSOP will have to be adjusted because the alternative recommended by this LRR does not allow stages high enough (i.e., 9.7 feet NGVD as proposed in the 2005 RGRR) to allow uncontrolled flow into the L-29 Canal. Specifically, the CSOP operations will have to be modified to include an L-29 maximum operating limit of 8.5 feet NGVD. Therefore, CSOP is dependent on the constraints set forth by this Recommended Plan. These constraints include:

A. All inflow structures to L-29 Canal will be closed and all inflows terminated, allowing the canal to naturally recede under the following scenarios. For the scenarios requiring a quantitative forecast the SFWMD Daily Quality Precipitation Frequency (QPF) will be used. All L-29 Canal stage references are as measured at the S-333 Tail Water unless this location is unavailable then S-334 Head Water may be used:

    1. Once the stage in the L-29 Canal reaches a stage of 8.5 feet NGVD, input from all structures that discharge into the canal shall be stopped until the level in L-29 Canal recedes beneath 8.5 feet NGVD. The operation of the MWD system, including management of inflows into L-29 Canal, will be determined as part of the CSOP evaluation. The trigger elevation that will allow the recommencement of flows and maintenance of the integrity of the roadway embankment will be determined in a manner consistent with the FDOT or other applicable design criteria and standards in force at the time of the preparation of the LRR.

    2. Two or three days (as soon as forecast information is available) before any named storm or tropical event is expected to impact the area, all inflow shall be stopped.

    3. Two or three days (as soon as forecast information is available) before an approaching rainfall event that is predicted to drop six inches or more inches of rainfall within a 72-hour period if the L-29 Canal stage is at or above 7.8 feet NGVD.

    4. Two or three days (as soon as forecast information is available) that a rainfall event is expected to result in stages that will meaningfully exceed 8.5 feet NGVD. For example, if the forecast is for 2 or more inches of rain and the L-29 stage exceeds 8.4 feet

NGVD; or if the forecast is for 3 or more inches of rain and the L-29 stage exceeds 8.3 feet NGVD; or if the forecast is for 4 or more inches of rain and the L-29 stage exceeds 8.2 feet NGVD; or if the forecast is for 5 or more inches of rain and the L-29 stage exceeds 8.1 feet NGVD.

B. The following information is provided to clarify expectations for development of the final operating plan and how operations will be monitored once implemented. The LRR Recommended Plan used 8.5 feet NGVD as the DHW elevation for purposes of establishing the roadway profile and pavement design. This DHW was calculated from a 36-year POR by averaging all October days within the initial CSOP model simulation. The LRR Recommended Plan assumed a 36-year POR average October wet season elevation of 7.89 feet NGVD to establish the 8.5 DHW. While the target stage for the L-29 Canal is 8.5 feet, it is understood that the average October wet season elevation is expected to be approximately 7.89 feet, NGVD based on multiple years (36-year simulated POR). Since this elevation is an average, during some individual years the average October elevation may exceed the 7.89 feet stage and other years it would be below 7.89 feet. The average elevation will be dependent on the meteorological conditions of that year. However when considering multiple years the October average should be at or below 7.9 feet NGVD. The final CSOP will be developed such that the average October elevation does not exceed 7.9 NGVD in the L-29 Canal for the model's period of record (1965 through 2000).

These evaluations could also result in the identification of additional criteria that may modify the benefits described in this report. It is the expectation of the participating agencies of the LRR that the subsequent CSOP evaluations will thoroughly analyze the impacts of these modifications and attempt to mitigate any adverse impacts to the level of benefits described in this report.

Agreements with FDOT and other State agencies are contingent on this 36-year POR average October wet season elevation of 7.89 feet NGVD. This elevation was based on modeling performed by the Government during the initial development of the CSOP plan. These model runs assumed sufficient road raising and bridges to allow unconstrained flow into the L-29 Canal. This average October stage will be verified in the following manner:

1. The 7.89 feet NGVD stage elevation is based on a simulated 36-year period of record (POR) modeling data which are the best information currently available. The CSOP team will be required to analyze the 36-year POR modeling average monthly water levels during October and compare the calculated DHW to that defined in this report (7.89 feet, NGVD). If the 36-year POR model simulated average October elevation is

above this stage, adjustments to CSOP shall be required operationally or structurally to ensure the design integrity of the roadway embankment and pavement. USACE will consult with SFWMD and FDOT so that the 36-year POR modeling results in an average October stage at or below the 7.89 feet NGVD.

2. Once the Tamiami Trail Modifications are constructed and operational, yearly average October water surface elevations will be computed (S333 tailwater) and shared with FDOT. After three years of operation, the average of the three years will be computed and compared to the predicted 36-year POR October average of 7.89 feet stage elevation. If the average October elevation is found to be more than 0.2 feet above this stage ($\geq$ 8.09 feet NGVD), adjustments shall be required operationally or structurally to ensure the design integrity of the roadway embankment and pavement. The condition of the roadway will be evaluated using the annual Florida Department of Transportation Pavement Condition Survey ratings for Crack, Rut and Ride. USACE will consult with SFWMD and FDOT on needed changes and implement them in a timely manner. After each subsequent year of operations, the average October elevation will be recalculated to include all operational years (e.g., after four years of operation, the average October elevation will use the four years of elevation data).

C. FDOT contemplates executing a Joint Participation Agreement (JPA) in favor of USACE on or about July 1, 2011 in the amount of its deferred maintenance. The present day value of that is $4.716 million and the funding would be provided prior to 30 September 2011. That contribution to project funding is contingent upon and subject to the following:
    1. The availability of funds.
    2. State budget authorizations.

In summary it is important to maintain the integrity and safe conditions for Tamiami Trail. In order to accomplish these conditions, certain assumptions were made on the best available data to predict how the stages in L-29 Canal would change during the wet season and during specific storm events. Certain contingencies were set in place to minimize impacts to the road base and to reevaluate the original assumptions. Potential benefits were based on the best information to date. As stated earlier, final benefits will be thoroughly evaluated and vetted through operating procedures under CSOP.

6.1.4 Highway Modification

During the construction of Tamiami Trail, FDOT placed culverts underneath the roadway. The federal government may not have the legal right to flow water under the road in a manner consistent with the needs of this project. Therefore, it is prudent for the federal government to acquire a flowage easement over the

full length of the project lands. For this project, it would be necessary to increase the water elevation north of Tamiami Trail in order to flow more water to the south underneath the road. This increase of the L-29 Canal stage is expected to adversely affect Tamiami Trail. In a case such as this, the USACE would be required to conduct a facility relocation. This type of transaction is in actuality an acquisition of an interest in real estate. In the present case, the USACE would make the road reinforcements in exchange for the flowage easement. No money would be exchanged between USACE and FDOT. USACE would construct the road reinforcement according to FDOT standards and turn over the operation and maintenance of the road to FDOT while FDOT would execute a flowage easement document to the USACE. The road, as repaired, then becomes known as the substitute facility.

6.1.5 Access to Existing Facilities/Sites

Access to all facilities and sites along Tamiami Trail would be maintained.

6.1.6 Drainage/Treatment of Stormwater Runoff

The grassed shoulders directly adjacent to the existing roadway provide some limited treatment of highway runoff.

The proposed bridge would increase the total impervious surface area (within the bridge footprint), but would have no practicable means of providing grassed shoulders or traditional swales for treatment of stormwater. Therefore, it would be necessary to provide a means to collect and trap contaminants from stormwater runoff (treatment of first flush) from the proposed bridge prior to discharge. There are a number of BMPs sediment removal technologies on the market that would target removal of sediments and gross pollutants from stormwater runoff while minimizing wetland impacts. USACE, in coordination with FDEP and FDOT, in order to meet state water quality standards and FDOT safety standards, has agreed to incorporate into the bridge design a treatment system that removes sediments and hydrocarbons from stormwater runoff as well as complying with the FDOT standard of routing water off traffic lanes. The new bridge deck would include drains that connect to a drainage collection and distribution system that would subsequently connect to separator units. Roadway and bridge specifications would continue to be coordinated with FDEP and FDOT as they are developed to ensure all mandatory requirements of FDOT and FDEP are met in the final design.

6.1.7 Utilities

The placement of utilities within the highway right-of-way is through permits issued to utility companies by FDOT. Utilities within the corridor that may be affected by the new construction include buried telephone facilities beyond the guardrails north and south of the roadway, fiber optic cables, and a 23 kilovolt overhead electric line about 100 feet south of the guardrail. All utilities within

the bridge and transitions would require relocation. The utilities on the roadway may require relocation, depending on the change in the shoulder width. Utility relocations would be coordinated with each utility owner.

6.1.8 Maintenance of Traffic during Construction

Existing traffic flow would be maintained with one lane of travel in each direction, except during paving operations. During paving operations, the travel would have to be one lane only with flag men at either end. This would be due to the work being done in the existing foot print of the existing roadway. The overlay of the existing roadway would be accomplished using a moving operation. For the proposed bridge, the existing traffic would be shifted to the northern shoulder to provide the necessary area for construction.

6.1.9 Real Estate

The federal government would require real estate rights in order to create a conveyance channel through Tamiami Trail, raise water levels in the L-29 Canal, and flow additional water through and under Tamiami Trail utilizing existing and improved culverts to NESRS.

The federal government would obtain real estate rights along the entire 10.7-mile project area from FDOT through a relocation agreement. The agreement would provide real estate rights for: temporary construction easement, perpetual flowage easement, and channel easement. The compensation to FDOT for these real estate rights would be a substitute facility – the construction of a bridge and roadway modifications as needed to mitigate for increased water levels.

It would be necessary to acquire real estate interests from FP&L for lands on which the project would be constructed. Efforts are currently under way to obtain an easement for FP&L lands that are needed for the construction of the bridge. Approximately 0.44 acres would be needed for a permanent construction easement and an additional 0.44 acres needed for a temporary construction easement.

Flowage easements are also required from the private parcels located along Tamiami Trail before the higher water stages can be implemented. There are six remaining privately owned parcels located along the Tamiami Trail that are authorized for acquisition by DOI as part of the Everglades National Park Protection and Expansion Act (PL 101-229). Funding and the responsibility for these acquisitions are strictly borne by ENP; hence the costs for those acquisitions are not included in this report. Under the Everglades National Park Protection and Expansion Act, these properties were included within the ENP boundary map that was established by Congress; therefore, the Park is responsible for acquisition of those properties.

A flowage easement is required for the Airboat Association of Florida. This property was explicitly excluded from acquisition under the Everglades National Park Protection and Expansion Act. Acquisition of this easement is a TTM project action and cost.

Real estate requirements and issues are discussed in detail in the Real Estate Appendix (Appendix F).

6.2 Implementation

The following steps would take place prior to full implementation of the recommended plan:

6.2.1 National Environmental Policy Act Compliance

This LRR incorporates information contained in the November 2005 RGRR/SEIS by reference, and is considered to be tiered off the referenced EIS. To comply with the NEPA process, the formal public comment period for the Draft LRR-EA was 30 days beginning on April 9 and ending on May 9, 2008. A public meeting was held on April 22, 2008 in Miami and both written and oral comments were received. Additionally, the documents were posted on the Jacksonville District, USACE Environmental website during the comment period. After the close of the Draft LRR-EA comment period, this EA was revised and a Finding of No Significant Impact was signed by the District Engineer. The non-federal sponsor will present the LRR-EA to the SFWMD Governing Board, which is expected to issue a letter indicating support if the project is accepted.

The ENP is a cooperating agency under NEPA. An official letter inviting SFWMD, FWS, EPA, ENP, FWC and FDEP to be cooperating agencies (as defined by NEPA) was sent in March 2008. These agencies were chosen because of their special expertise in the area. The selection of these agencies to be invited as cooperating agencies does not exclude any other agencies from full participation in the project. ENP accepted the invitation; no other agency has responded to be a cooperating agency.

6.2.2 Preconstruction Engineering and Design

It is anticipated that the PED of the project would be competed by September 2008.

6.2.3 Land Management Agreement

Prior to SFWMD executing a PCA amendment with USACE, DOI and SFWMD must reach an agreement on how to manage the project features where such features extend into lands owned by the ENP. The executed agreement may be an attachment to the PCA amendment executed by SFWMD and USACE. SFWMD has also requested that USACE become signatory to this agreement.

6.2.4 Project Cooperation Agreement Amendment

A PCA amendment would be required between USACE and the non-federal sponsor, SFWMD. The PCA is a legally binding document between the federal government and the non-federal sponsor identifying the sponsor's duties and obligations for this project. The SFWMD is the project sponsor and represents local interests.

6.2.5 Highway Easement Deed

In order to construct the one-mile bridge, the project requires one hundred feet of land (50 feet permanent and 50 feet temporarily for construction) south of Tamiami Trail for the one mile width of the site of the bridge from the DOI. One legal mechanism for DOI to convey these parklands is by means of a HED. The DOI would consent to the deeding of these ENP lands by the FHWA to FDOT since these lands are required for the construction, operation, and maintenance of the project. The HED would be negotiated by DOI, FHWA, FDOT, SFWMD and USACE. In addition to conveying the rights necessary for the construction and OMRR&R of the highway (i.e., the bridge), this HED would also contain a perpetual channel easement and perpetual flowage easement. These additional rights would then allow for the construction, OMRR&R of a channel underneath the bridge and also allow for the flow of water through the channel. As the only grantee to the HED, all of these rights would then issue only to FDOT at this point. The HED is merely a temporary solution for transferring these lands to the state. It is the overall intention of DOI to seek specific legislation from Congress to convey the lands contained in this HED over to the state in fee.

6.2.6 Relocation Agreement

The USACE, not being a party to the HED conveyance, would not have the legal right to enter upon the property of FDOT. Therefore, the USACE would acquire the real estate interests contained in the HED through a separate agreement with FDOT. This separate document is the relocation agreement. The real estate rights that would be obtained in this agreement include: 1.) the right to enter FDOT lands to construct features and modify the existing roadway; 2.) a channel easement at the location of the bridge; and 3.) a flowage easement for the entire expanse of the roadway within the project limits. This flowage easement allows the USACE to flow water through/under the Tamiami Trail utilizing the existing and any improved culverts as well as the area underneath the bridge. As part of the project, water levels in L-29 Canal would be raised one foot to introduce more water into ENP. As compensation for the conveyance of these three real estate rights, FDOT would receive a newly constructed one-mile bridge to replace removal of one mile of existing roadway that is required as part of the channel easement. In addition, FDOT would receive the reinforcing of portions of lower lying roadway in order to offset the adverse impacts due to raised water levels in L-29 Canal as part of the USACE acquisition of 10.7 miles of land covered by the flowage easement. USACE would not only acquire rights

to FDOT-owned lands by this relocation agreement but would also receive rights to those lands that FDOT obtained under the HED from DOI/FHWA cited above.

6.2.7 Real Estate

It would be necessary to acquire real estate interests for lands on which the project would be constructed. In addition to the lands required for construction, it would be necessary to purchase real estate interests in tracts due to increased water levels. DOI, FDOT and private landowners own or hold interests in lands required for the project.

6.2.8 Construction Duration

Construction is scheduled to begin in October 2008. It is planned that a single contract would be awarded for both bridge work and road reinforcement, and work on these two components would occur at the same time. It is anticipated that construction would be completed in three and one-half years.

6.2.9 Monitoring

The project does not include specific hydrologic or ecological monitoring in addition to existing studies; however, there are many existing sampling stations and ongoing studies carried out by the CERP Monitoring and Assessment Plan (MAP) as well as EPA's Regional Environmental Monitoring and Assessment Plan (REMAP), the USGS's Everglades Depth Estimation Network (EDEN), USACE, and SFWMD, among others, that are on the ground and prepared to detect any changes in hydrology and vegetation. A summary of the monitoring network is provided in Appendix E.

6.3 Cost

6.3.1 Project Costs

The first costs for the Tamiami Trail items recommended under the MWD authority are shown in ***Table 6-1*** and are the 90 percent confidence level cost estimates. This confidence level means that there is a 90 percent chance that the final cost for this project would be equal to **or less than** the cost shown. The risk and uncertainty analysis was calculated for the total construction cost; thus the distribution of risk across the project elements is approximate. The entries in this table assume that the cost savings features are implemented and that the agreements among agencies necessary for these cost savings are signed executed. The savings features are listed below. Inability to implement all of these cost saving options would result in a higher cost of the project.

a. Per the FDOT Pavement Design Manual, the following road reinforcement plan is estimated for 8.5 feet high water elevation:
   i. For roadway with crown greater than 11.91 feet NGVD, mill road three inches (3") and replace with three inches (3") of asphalt
   ii. For roadway with crown elevation between 10.91 feet and 11.91 feet NGVD, mill road three inches (3") and replace with five inches (5") of asphalt
   iii. For roadway crown elevation less than 10.91 feet NGVD, mill down existing pavement until it is one foot above design high water. Then add asphalt base and structural course according to the FDOT design manual.
b. Use temporary rights-of-way and staging areas within the ENP property
c. Design optimizations along the bridge
d. Use fill from nearby SFWMD storage areas
e. Accelerate the award of construction contract(s) by one year, with award in late 2008 instead of late 2009

TABLE 6-1: MWD TAMIAMI TRAIL MODIFICATION COSTS

ITEM	Cost Estimate Including Cost Saving Options	Local Market Escalation Risk	Total
Construction			
Bridge	$60,100,000	$16,800,000	$76,900,000
Bridge - Transitions	$20,100,000	$5,600,000	$25,700,000
Road Modifications	$61,500,000	$17,300,000	$78,800,000
Subtotal	**$141,700,000**	**$39,700,000**	**$181,400,000**
Preconstruction Engineering and Design			$0
Engineering During Construction			$3,100,000
Contract Administration			$14,900,000
Lands And Damages			$5,900,000
Subtotal			**$23,900,000**
TOTAL First Cost			**$205,300,000**
Escalation to Mid-Point of Construction			$6,700,000
TOTAL Fully Funded Cost			**$212,000,000**

The risk and uncertainty analysis was calculated for the total construction cost; thus the distribution of risk across the project elements is approximate.

Table 6-1 does not include an entry for PED. USACE, Jacksonville District has already been funded for PED costs through September 2008, and PED is expected to be complete by that date. The total estimated first cost is $205,300,000. The fully funded cost estimate is $212,000,000, with the escalation to the midpoint of construction based on an award date of October 2008 and three and one-half year construction duration.

Comparison of Cost Estimates from the Draft LRR and the Final LRR

The costs in Table 6-1 above differ from the costs presented in Tables 4-7 and 4-10 of this final report, and the costs presented in Section 6 the draft LRR. The team incorporated additional design information, updated cost quotes, and applied a different cost estimating method (MCACES 2nd Generation (MII) software) for this newest cost estimate for the recommended plan. Appendix C provides additional information on the new cost estimate.

The estimated costs of the recommended plan are lower in this final report than they were in the draft report. The fully funded cost estimate decreased from $225,000,000 to $212,000,000. The costs without including escalation subtotal decreased from $177,000,000 to $165,600,000. The First Cost appears to have increased from $177,000,000 to $205,300,000. However, this increase of first cost is due to a different manner of displaying cost risk and cost escalation. The total amount of estimated cost escalation is approximately the same in the draft and final reports. The draft report combined the escalation risks and presented the total separately from the first cost. This final report splits the total escalation into escalation due to local market conditions and escalation captured by the published OMB escalation rate. USACE guidance is that the local escalation risk should be combined with the construction costs and thus become part of the First Cost. The OMB escalation is added to the First Cost to obtain the Fully Funded Cost estimate.

The costs in **Table 6-1** came from the MII estimate in Appendix C, Tables 5 and 7. Table 7 of this appendix displays values for sunk and previously funded PED costs that are not part of the evaluation and are not carried forward into **Table 6-1**.

6.3.2 Cost Sharing

Recent cost sharing for the MWD project has been 50/50 USACE/DOI funding. The proposed funding breakdown is shown in ***Table 6-2***. The Managers' Report for WRDA 2007 states that arrangements in this report for sharing of future costs between USACE and DOI will be tentative only. Thus this proposed cost sharing between the federal agencies may be changed with additional budgetary guidance. The State of Florida, through FDOT, has verbally agreed to provide $4,500,000 to the project.

TABLE 6-2: MWD TAMIAMI TRAIL COST-SHARING

ITEM	Cost
USACE	$100,400,000
DOI	$100,400,000
FDOT	$4,500,000
Total	**$205,300,000**

Because roadway construction is not a major part of the USACE construction authority, it is suggested that both USACE and DOI investigate contributions from other partners to reduce the overall project costs.

Actions that may be implemented in the future under CERP would be cost-shared 50/50 USACE/SFWMD.

6.3.3 Budgeting

The stage increase and the conveyance increase are both necessary to achieve the restoration benefits of the project. The benefits would not be achieved if only one were completed. It is expected that the funds for the entire estimated cost of the project would not be available at the start of construction, but would be budgeted and appropriated over several years. The cost estimate and construction schedule assume an October 2008 start and further assume that funding in future years would be available so that construction actions would not be delayed.

An adaptive management approach has been developed, in conjunction with the incremental adaptive management concept developed by the National Academies of Science in 2006. The monitoring program will rely on existing sampling locations and ongoing studies to test water deliveries and the vegetation response within Shark River Slough. The results of this monitoring would be used to inform the requirements for CERP implementation.

6.4 Operation, Maintenance, Repair, Rehabilitation and Replacement

The conveyance features system would continue to be operated and maintained as part of the C&SF project by SFWMD and USACE. SFWMD would be responsible for the OMRR&R of the conveyance area and the culverts as part of the project cost-sharing agreement. Other SFWMD responsibilities include cost-sharing, records maintenance, and assisting in managing the project in a manner consistent with applicable Federal and State laws and regulations, including the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 USC 9601-9675.

Annual OMRR&R costs for the conveyance are expected to be $30,000.

FDOT would be responsible for maintaining the pollution abatement system, bridges, and roadway since these substitute facilities are compensation to FDOT for real estate rights rather than project features. OMRR&R of these facilities is not a TTM project cost.

6.5 Additional Considerations

6.5.1 Chief of Engineers Actions for Change

The Tamiami Trail study and report are consistent with the Chief of Engineers Actions for Change for Applying Lessons Learned during Hurricanes Katrina and Rita. These actions require a focus on system analysis, sustainability, risk-informed decision making and communication of risks, incorporate professional and technical expertise, and dynamic independent review.

System Analysis: The study is an integral part of the larger Everglades system, and is a priority for any system wide restoration. The project considered compatibility of the proposed features with future potential south Florida restoration efforts, with existing MWD features, and with the purposes and features of the Central and Southern Florida multipurpose project.

Sustainability The recommended plan was developed to be a sustainable restoration feature, and as a foundation for the larger Comprehensive Everglades Restoration Plan. In particular, the following items were considered during the planning:

- Minimizing O&M requirements to help facilitate long term, low cost benefits.
- Engineering flexibility, through the use of design features to help manage water under a variety of future scenarios.
- Stand alone benefits. The project was formulated to provide immediate benefits to the marsh, and work in conjunction with a variety of future scenarios.

Risk: Risk informed decision making was a vital element in the study, and has been integrated through the study process. In particular, two sources of risk and uncertainty were incorporated into the project planning:

- Cost risk and uncertainty: resulting in the potential for cost growth. In order to manage these risks, the study incorporated new risk-based cost estimating methods. Bridge construction and road excavation methods involve relatively low uncertainty. The costs of fuel and oil-based materials, aggregate, concrete, and steel were the major risk factors affecting cost estimates. The proposed early start of construction, autumn of 2008, is the best method to mitigate and minimize these risks.
- Ecological Response uncertainty: there is uncertainty in regard to the landscape changes associated with restored hydrology. This project will

be one of the first major restoration construction projects in the heart of the Everglades ecosystem. Existing hydrologic and ecological monitoring in south Florida will be used to assess the performance of the recommended plan and to aid decisions whether and how to modify operations of the system.

Technical Expertise and Independent Reviews The report was prepared by highly experienced staff from Jacksonville District, Everglades National Park, and other agencies located in south Florida. Draft versions of report were reviewed several times: Independent Technical Review by subject-matter experts throughout the Corps who were not involved in the study; External Peer Review by a panel of independent non-government experts; Model Review by a panel of independent non-government experts; and by the public. The LRR was amended and improved in response to each of these reviews.

6.5.2 Environmental Operating Principles

The project is consistent with the environmental operating principles and is expected to be a benefit to the environment. These principles are listed below along with the project consistency for each principle.

- Strive to achieve Environmental Sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.
  Consistency: The basis of the TTM project is to create a sustainable, healthy and diverse Everglades Ecosystem.
- Recognize the interdependence of life and the physical environment, and consider environmental consequences of USACE programs and activities in all appropriate circumstances.
  Consistency: Project provides both immediate and potential long-term benefits to the Everglades ecosystem. The Recommended Plan has been fully reviewed for environmental impacts in NEPA document.
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
  Consistency: The Recommended plan was formulated to provide larger ecosystem benefits while still considering and minimizing local impacts.
- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.
  Consistency: Project complies with all National Environmental Policy Act guidelines as well as Endangered Species Act obligations

- Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of the processes and work.

  Consistency: TTM is one piece of a larger puzzle of both Modified Water Deliveries as well as Comprehensive Everglades Restoration. Cumulative impacts of all relative projects were considered in the formulation and analysis of the Recommended Plan.
- Build and share an integrated scientific, economic and social knowledge base that supports a greater understanding of the environment and impacts of the work.

  Consistency: The LRR analysis was an inclusive and open process that engaged all stakeholders, interest groups and agencies.
- Respect the views of individuals and groups interested in USACE activities; listen to them actively and learn from their perspective in the search to find win-win solutions to the Nation's problems that also protect and enhance the environment.

  Consistency: Public input was encouraged through scoping as well as public and stakeholder meetings.

6.5.3 Key Social and Environmental Factors

The TSP above is a first step in overall restoration. It is recognized that by selecting a lower cost plan, additional actions would be required for complete restoration at a later date. These additional actions should keep with landscape changes and adaptive incremental restoration.

6.5.4 Stakeholder Perspectives and Differences

There are considerable differences of opinion on the best solution to the Tamiami Trail, which range from merely adding swales to the construction of the 10.7-mile bridge. The analysis presented in this LRR was designed to look objectively at the full range of values, and implement necessary first steps. However, many stakeholders would prefer a longer-term alternative for implementation. As a result, there may be considerable differences of opinion from stakeholders on the best recommended plan.

6.6 Remaining Modified Water Deliveries Project Features

MWD Project consists of major components:

1. 8.5 SMA Flood Mitigation component,
2. Conveyance and Seepage Control component,
3. Tamiami Trail component and
4. Revised operating plan that incorporates the new components.

The 8.5 SMA component is nearly complete, except for exotic and debris removal in the areas west and north of the protection levee. For the Conveyance and Seepage Control component, the following features are completed: S-355 A and

B gated structures in the L-29 Levee; S-333 modifications; four of the nine miles of L-67 Extension Levee degraded; S-356 pump station; and Tigertail Camp elevation raised.

Subsequent to the release of the Tamiami Trail LRR, USACE will address any design modifications for the remaining Conveyance and Seepage Control features in separate a NEPA document and Engineering Documentation Report (EDR). Remaining features include the following:

1. Structures S-345A, B, and C through the L-67A and C levees
2. Structures S-349 A, B, and C in the L-67A Borrow Canal
3. Degradation of five miles of L-67 Extension Canal and Levee
4. Structures through the L-29 Levee

Potential flooding of Osceola Camp will be addressed. ENP and representatives for the Osceola Camp are negotiating the details of the mitigation actions that would be performed.

The Tamiami Trail component (this LRR) has not been constructed.

To complete the MWD project, a revised operations plan will be developed in conjunction with C-111 South Dade project efforts under CSOP.

6.7 Funding Requirements to Complete the Modified Water Deliveries Project

Based on Alternative 3.2.2a for the Tamiami Trail component and completion of the remaining MWD features, the estimated balance to complete the MWD program from FY09 forward is $187.1 million dollars (based on FY08 escalated/fully funded dollars). The funding allocations in ***Table 6-3*** are based on three and one-half year construction duration for the TTM and completion of the remaining features. The estimates are based on engineering information and that may need to be re-examined if the project were to encounter a schedule slip. Because the Administration has not released budgetary guidance, costs beyond FY09 have not been determined between DOI and USACE. The State of Florida has verbally committed to contribute approximately $4.5 million dollars towards TTM. These monies would normally have been spent on their maintenance of the roadway.

TABLE 6-3: MWD REMAINING BUDGET REQUIREMENTS

Modified Water Deliveries Project
Funding Allocations to Complete Alternative 3.2.2a
1 Mile Eastern Bridge/Road Mitigation
($ in millions)
Dollars Reflected are Oct 07 Price Level (inflated/fully funded dollars)

	Through FY07	FY08 Enacted	FY09 Pres Bud	Remaining After FY09		Total Project
Costs						
8.5 Square Mile Area	170.4					170.4
Conveyance & Seepage	30.0		0.2	21.0		51.2
Tamiami Trail Modifications	45.5	18.4	54.6	93.5		212.0
Tamiami Trail Design *	11.0	5.7				16.7
Project Implementation Support	41.5	0.0	5.2	12.6		59.4
Mod Water Total TOTAL:	**298.4**	**24.1**	**60.0**	**127.1**		**509.6**
Funding						0.0
Department of the Interior	230.7	14.3	10.0			255.0
Corps of Engineers	67.7	9.8	50.0			127.5
State of Florida				4.5		4.5
To Be Determined				122.6		122.6
Mod Water Total TOTAL:	**298.3**	**24.1**	**60.0**	**127.1**		**509.6**

* Includes sunk costs for planning, pre-construction, engineering and design.

Under a separate NEPA process from the Tamiami Trail LRR, a pilot project is being considered that would determine the actual effects of spreader swales. ENP would lead the NEPA action for the pilot. If the pilot project demonstrates that the swales are successful, USACE and ENP would consider incorporating the swales as a part of the remaining Conveyance and Seepage Control component.

6.8 Restoration Beyond the Modified Water Deliveries Project

The Recommended Plan of the Tamiami Trail LRR increases water flows to the Park along 10.7 miles of the 20-mile stretch of Tamiami Trail from Krome Avenue to the eastern boundary of Big Cypress National Preserve. This action is consistent with the MWD authority which directs the Secretary of the Army to construct modifications to the C&SF project to improve water deliveries into the Park and, to the extent practicable, take steps to restore the natural hydrological conditions in the Park.

The LRR Recommended Plan would provide significant benefits by:

- allowing the L-29 Canal to be operated at stages up to 8.5 feet NGVD;
- increasing conveyance capacity under Tamiami Trail from 1,250 to 1,848 cfs; and
- increasing flow volumes to the Park by 92 percent.

The remaining activities discussed earlier in this report for the 8.5 SMA would be completed using prior appropriations. Implementation of a plan recommended in the Final Limited Reevaluation Report for Tamiami Trail is contingent upon sufficient appropriations necessary for the completion of the design, engineering, and construction of the features in the plan, to include conveyance and seepage features within WCA-3A and 3B, and the update to the operations and water control plans necessary to account for new project features. The accomplishment of all of these features and updates are in accord with the MWD project, as authorized in the Everglades National Park Protection and Expansion Act of 1989, PL101-229, and the first stage of restoring more natural deliveries into ENP. Future restoration features intended to improve the efficacy of this work and build upon it would be evaluated under other appropriate statutory authority.

7.0 RECOMMENDATIONS

I recommend that the MWD to ENP, C&SF project be modified to allow for improved water deliveries to ENP by modification, construction and implementation of the following items to Tamiami Trail in accordance with the Everglades National Park Protection and Expansion Act (P.L. 101-229, Section 104, 16 U.S.C. Part 410r-5 *et seq.),* December 1989.

The Recommended Plan includes features to convey the additional flows from L-29 Canal, north of the Tamiami Trail, south to the ENP. The Recommended Plan consists of the following components, which are described in Section 6, Recommended Plan.

1. Acquisition of the necessary real estate interests required for construction of the project from the Airboat Association of Florida, FP&L and FDOT.
2. Construction of a one-mile bridge and reinforcement of the remainder of the Tamiami Trail within the project area in order to counteract the project's higher water levels in the L-29 Canal. Road reinforcement is part of TTM and will be paid for by the MWD project. FDOT will contribute $4,500,000 to the road reinforcement as part of their normal maintenance program.
3. Acquisition of real estate interests from FDOT by means of a relocation agreement within the project area to include a channel easement, a flowage easement, a temporary work area easement and a right of entry for construction upon the FDOT lands in order to construct the project features.

The Limited Reevaluation Report (LRR) Recommended Plan's total first cost estimate (excluding escalation) is **$205.3 million**; its fully funded cost estimate, which includes escalation to the mid-point of construction, is $**212 million**.

The above recommendations are made with the provision that prior to project implementation, SFWMD, the non-federal sponsor, shall enter into a binding agreement, most likely in the form of a PCA or PCA amendment, between the Department of the Army and SFWMD for modification of the C&SF project, MWD to ENP project, which provides for the following regarding the conveyance features for the project:

a. OMRR&R of the project, or functional portion of the project, in a manner compatible with the project's authorized purposes and in accordance with applicable federal and state laws and regulations and any specific directions prescribed by the federal government;
b. Provide 25 percent of the cost of OMRR&R the project's conveyance features. The non-federal sponsor shall have no responsibility for OMRR&R of the substitute facilities, those being the modified roadway,

the constructed bridge and its ramps/approaches, the culvert structures underneath Tamiami Trail, along with sediment control within those culverts which shall all become the responsibility of FDOT;

c. Do not use federal funds to meet the non-federal sponsor's share of project OMRR&R costs unless the federal granting agency verifies in writing that the expenditure of such funds is authorized;
d. Give the federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, OMRR&R, or completing the project. No completion, OMRR&R by the federal government shall relieve the non-federal sponsor of the responsibility to meet the non-federal sponsor's obligations, or to preclude the federal government from pursuing any other remedy at law or equity to ensure faithful performance;
e. Hold and save the United States free from all damages arising from the construction, OMRR&R of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;
f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the CERCLA, PL 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the federal government determines to be required for the initial construction, operation, and maintenance of the project that were provided by the Non-Federal Sponsor and for which the Local Sponsor has received a land compensation payment. However, for lands that the federal government determines to be subject to the navigation servitude, only the federal government shall perform such investigations unless the federal government provides the non-federal sponsor with prior specific written direction, in which case the non-federal sponsor shall perform such investigations in accordance with such written direction;
g. Assume, as between the federal government and the non-federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the federal government determines to be necessary for the initial construction, operation, or maintenance of the project that were provided by the Non-Federal Sponsor and for which the Local Sponsor has received a land compensation payment;
h. Agree that, as between the federal government and the non-federal sponsor, the non-federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that would not cause liability to arise under CERCLA;

i. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce the level of protection it affords, hinder operation and maintenance, or interfere with its proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;
j. Not less than once each year, inform affected interests of the extent of protection afforded by the project;
k. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as would properly reflect total costs of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20;
l. Comply with Section 221 of P.L. 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the WRDA 1986, P.L. 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;
m. Comply with all applicable federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, P.L. 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable federal labor standards and requirements, including but not limited to 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act [formerly 40 U.S.C. 276a et seq.], the Contract Work Hours and Safety Standards Act[formerly 40 U.S.C. 327 et seq.] and the Copeland Anti-Kickback Act [formerly 40 U.S.C. 276c et seq.] ;
n. Comply with Section 402 of the WRDA 1986, as amended (33 U.S.C. 70lb-12), which requires a non-federal interest to participate in and comply with applicable federal floodplain management and flood insurance programs, prepare a flood plain management plan within one year after the date of signing a PCA Amendment,, and implement the plan not later than one year after completion of construction of the project; and,
o. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-

646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, necessary for the initial construction, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

The recommendations contained herein reflect the information available at this time and departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Office of Management and Budget (OMB) as proposals for implementation funding. However, prior to transmittal to OMB, any sponsor, the state, interested federal agencies, and other parties would be advised of any modifications and will be afforded an opportunity to comment further.

Paul L. Grosskruger
Colonel, U.S. Army
District Engineer

8.0 INDEX

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