

# LAKE OKEECHOBEE WATERSHED PROJECT

INTEGRATED PROJECT IMPLEMENTATION REPORT  
& ENVIRONMENTAL IMPACT STATEMENT

Project Delivery Team  
Meeting

September 21, 2016

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**U.S. ARMY**



US Army Corps of Engineers  
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# PLAN FORMULATION STRATEGY

## Input from August 31<sup>st</sup> Public Workshop



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- Top ranking objective: reduce Lake Okeechobee contributions to undesirable northern estuary discharges
- Increase operational flexibility of the water management system
- Locate project features in areas that maximize operational flexibility
- Keep all project components as close to Lake Okeechobee as possible
- Only use publically owned lands, maximize use of publically owned lands, exchange publically owned lands and buy more public lands
- Deep reservoirs, deep well injection and ASR reduce land requirements
- Co-locate reservoirs with ASR and deep well injection
- Use deep well injection as a primary component or option for excessive rainfall events, interim measure; some concerns exist





# PLAN FORMULATION STRATEGY

## Determination of Storage Targets



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### RESOPS Summary

- Estuary high discharge exceedance and frequency of estuary high discharge events show nearly linear improvement with reservoir size
- Lake stage envelope relatively insensitive to north of lake storage (considered 0-400,000 ac-ft)

### Recommendation

- For alternatives milestone formulation, use Yellow Book target (250,000 ac-ft reservoir storage)
- Add on Lake Okeechobee ASR increments for storage
  - Yellow Book: 200 ASR (93,605 ac-ft storage)
  - ASR Pilot Results: 80 ASR (37,442 ac-ft storage)



# PLAN FORMULATION STRATEGY



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## Management Measure Categories to Meet Project Objectives

1. Water Storage and recovery  
Reservoirs, ASR
2. High water operational measures  
Deep Well Injection (DWI)
3. Wetland Restoration  
Watershed and in-lake wetland restoration

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# PLAN FORMULATION STRATEGY

## Reservoir Approach



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### Reservoir Formulation Approach

#### 1) Previous Work

Started with MMs in top 10 watershed alternatives (WAs), Yellow Book Alternative and draft Tentatively Selected Plan

Removed STA features and one small reservoir considered not feasible

Compiled reservoir features from each remain in WA

**Result:** Initial list of reservoir features

#### 2) Add New Features

ID locations for potential additional reservoir features in the project footprint

- District Owned Lands
- Operational Flexibility
- Land Use
- Site and Adjacent Constraints
- Scoping Comments and Configuration Exercise

**Result:** 2 New reservoir features added

- 2 K-05 configurations
- Brady Property Reservoir
- Istokpoga Canal Reservoir
- I-01 Reservoir

#### 3) Screen Features

Apply ranking criteria to reservoir configurations

- Storage capacity
- Reliability of water source
- Percentage of land in District ownership
- Co-location opportunities
- Cost effectiveness

Evaluate spatial relationship between reservoirs

**Result:** 8 reservoirs screened and 5 carried forward for reservoir themes

#### 4) Create & Rank Themes

Develop Alternative Themes Based on:

- Prior Study Yellow Book
- Prior Study draft TSP
- Cost Effective
- Greatest Operational Flexibility
- Spatial relationship of reservoirs
- Minimal Additional Real Estate

Apply ranking criteria to the 7 themes developed

**Result:** Top two reservoir themes carried forward



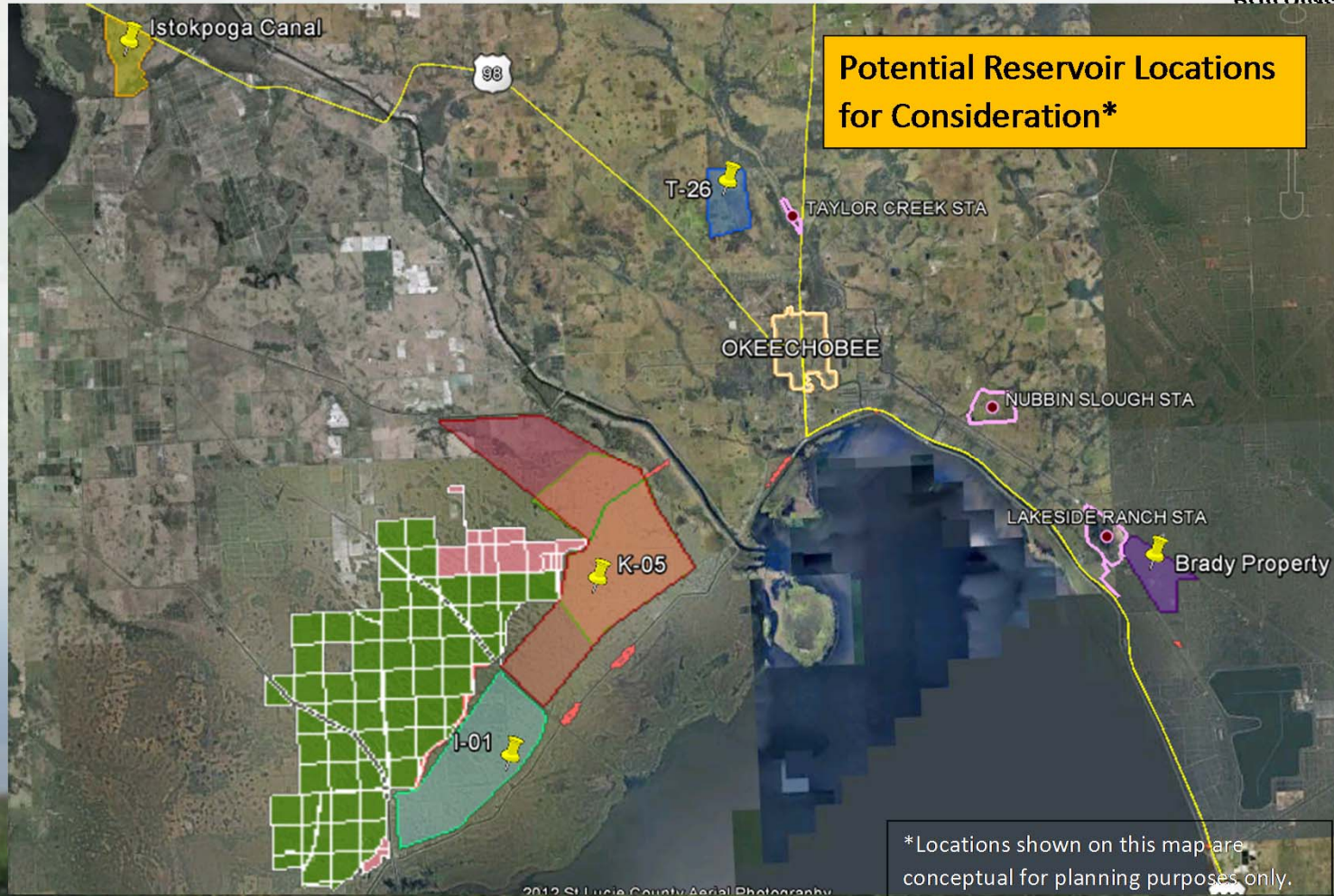


# PLAN FORMULATION STRATEGY

## Reservoir Approach



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# PLAN FORMULATION STRATEGY

## Reservoir Approach



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### Alternative 1

- Selection Criteria: Most cost effective (lowest cost/ac-ft) while exceeding the 250,000 ac-ft reservoir storage goal
- Component: Reservoir K05 Big
- 263,584 ac/ft storage capacity for total cost of \$1,374,653,727

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# PLAN FORMULATION STRATEGY

## Reservoir Approach



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### Alternative 2

- Selection Criteria: Spatial location of reservoirs allows for exceptional operational flexibility while nearly achieving 250,000 ac-ft reservoir storage goal
- Components: Reservoir K05 Big and reservoir I-01
- 248,822 ac/ft storage capacity for total cost of \$1,449,983,959

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# PLAN FORMULATION STRATEGY ASR



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- CERP ASR regional study identified suitable ASR locations
- 80 ASR wells associated with Lake Okeechobee
- Analyzed increments of 20, 40, 60, and 80 ASR to suite of reservoir storage capacities and determine best-buy based on flow reductions and cost

# of ASR	Injection/Recovery Limit (ac-ft/mo)
20	9,431
40	18,682
60	28,023
80	37,364





# PLAN FORMULATION STRATEGY ASR



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Add the maximum ASR wells possible (80) to the top two reservoir alternatives to get as close as possible to the original storage target of 200 as the Yellow Book intent.

**ASR Alternative 1:** Reservoir Alternative 1 + 80 ASR wells

**ASR Alternative 2:** Reservoir Alternative 4 + 80 ASR wells





# PLAN FORMULATION STRATEGY

## Deep Well Injection



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High capacity wells that inject water into a confined aquifer which is 3,000 feet below the surface.

**Purpose:** Lower Lake Okeechobee water levels before a high discharge event. Water would only be injected when there would be regulatory releases in excess of the estuary needs (i.e. flows that would otherwise go to tide).

30 deep wells each with a capacity of 4,048 ac-ft/month totaling 121,400 ac-ft per month were assumed.

- **Deep Injection Well Alternative 1:** Reservoir Alternative 1 + 80 ASR wells + 30 Deep Injection Wells
- **Deep Injection Well Alternative 2:** Reservoir Alternative 4 + 80 ASR wells + 30 Deep Injection Wells



# PLAN FORMULATION STRATEGY

## Wetland Restoration



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Wetlands Land Suitability Model: Select initial array of suitable sites

**Primary Screening:** soils and land use  
**Secondary Screening:** connectivity to public land, contaminants, economic value, ecologic value, cultural resources, and environmental and economic equity

106 Preliminary Potential Restoration Sites (381,450 acres)

**Ranking and Screening Criteria:** 75% score or higher of soil type, ecologic value, contaminants, economic value, summary score, public connectivity, ecological connectivity, SHCA connectivity

36 sites (99,700 acres)

Condensed and combined into sites with acreage near ~3,500 acre Yellow Book target with focus on increasing connectivity and maximizing wetland size

12 sites (37,375 acres)





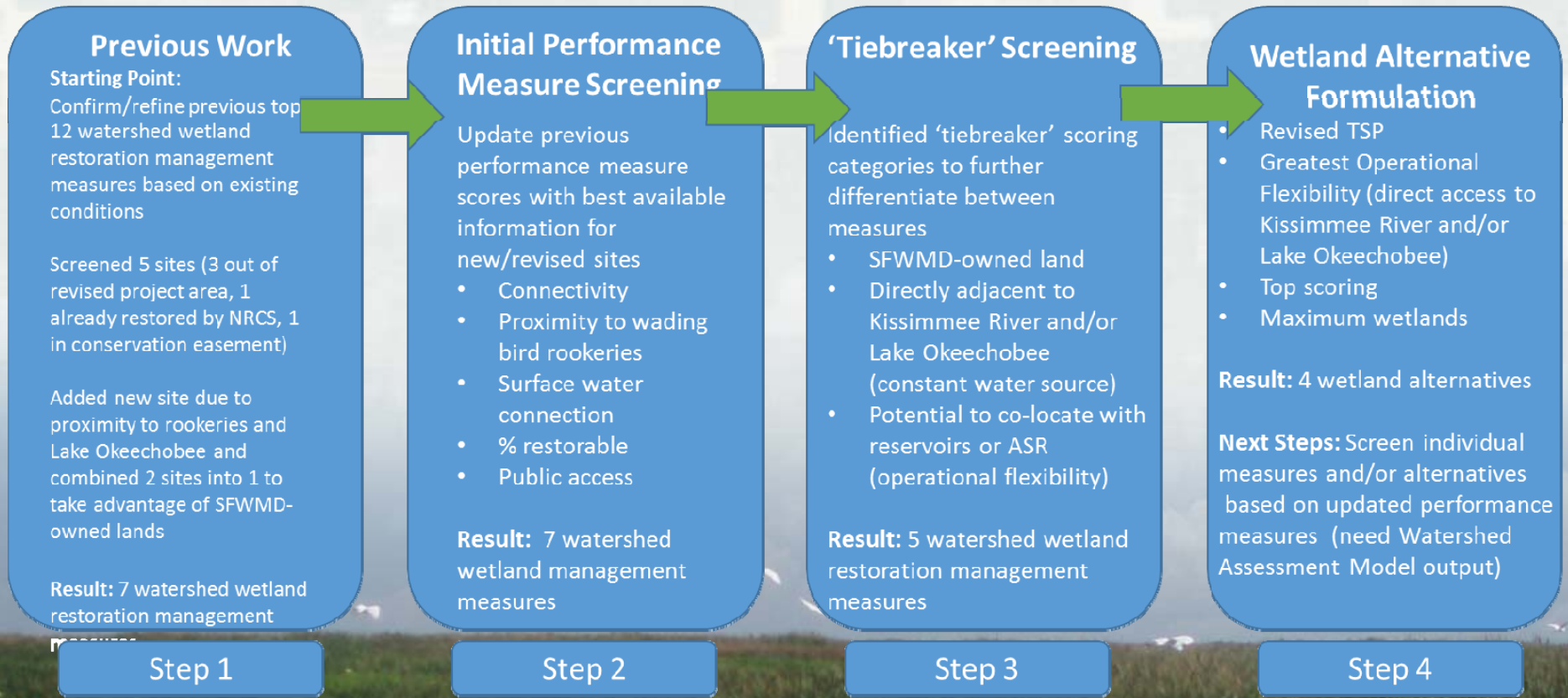
# PLAN FORMULATION STRATEGY

## Watershed Wetland Restoration



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### Watershed Wetland Restoration Formulation Approach





# PLAN FORMULATION STRATEGY

## Watershed Wetland Restoration



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Normalized Scores								'Tiebreakers'			
Scoring from 0 4								Score 0 or 1			
Potential Restoration Site	Acres	Connectivity (% of perimeter)	Wading Bird Rookeries	Surface Water Connection (linear meters)	Percent Restorable	Public Access	Normalized Score	SFWMD Owned Land	Directly Adjacent to Kissimmee River and/or Lake O	Potential to co-Locate with Reservoirs or ASR	New Score
Kissimmee River/Paradise Run	4315	3	4	3	4	4	18	1	1	1	21
Fish Slough	3341	2	2	1	2	2	9	0	0	0	9
Lake O West	2750	3	4	2	4	3	16	0	1	0	17
Lake O East	2693	3	1	1	4	3	12	0	1	0	13
Indian Prairie	3627	1	3	0	3	1	8	0	1	0	9
Bootheel Creek	3393	3	2	1	3	2	11	0	0	0	11
IP 10	2,372	1	4	0	4	3	12	0	0	0	12

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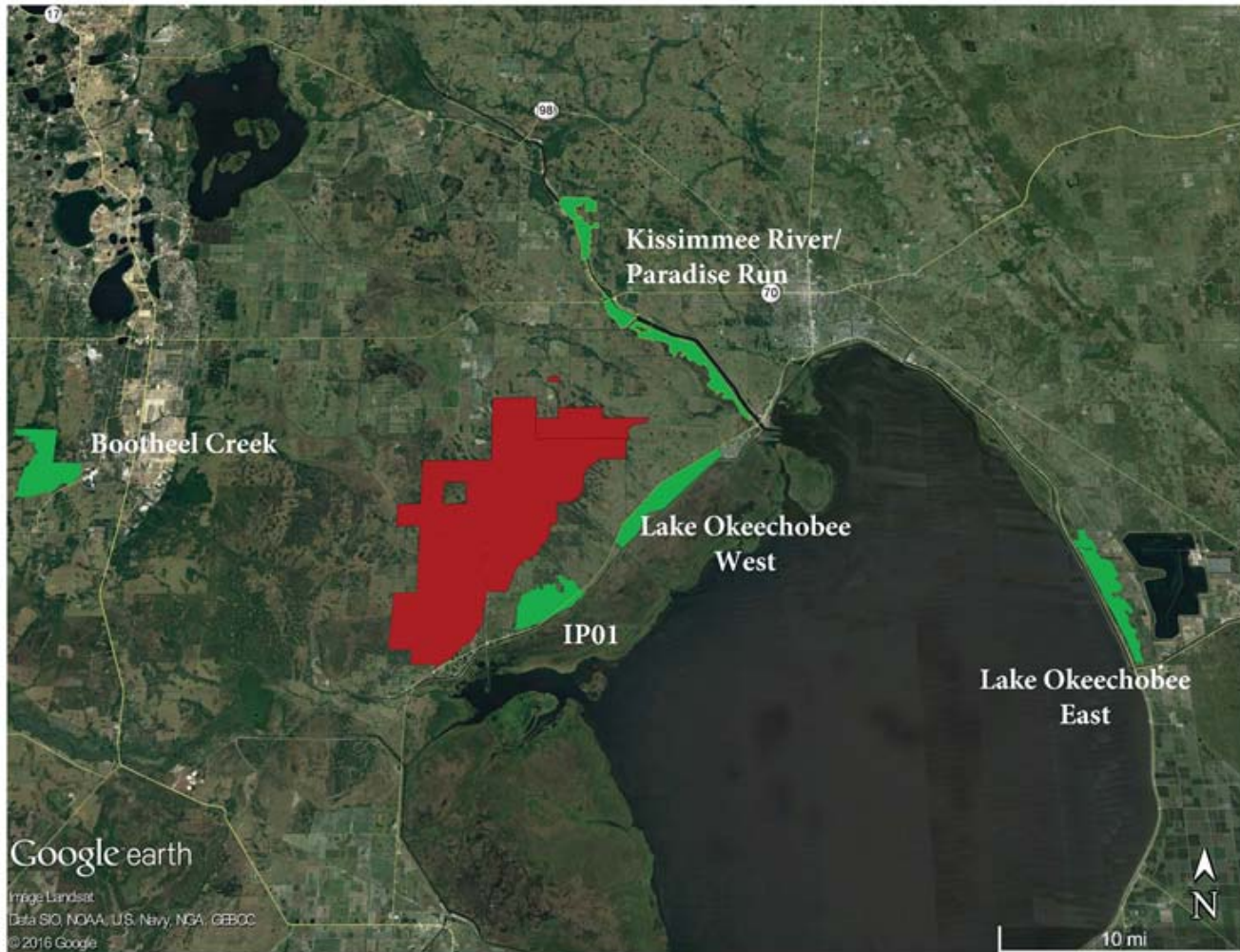


# PLAN FORMULATION STRATEGY

## Watershed Wetland Restoration



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# PLAN FORMULATION STRATEGY

## Watershed Wetland Restoration



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Watershed Wetland Restoration Alternative	Description	Management Measures	Screening-Level Restoration Cost Estimates
Watershed Wetland Restoration Alternative 1	Revised Previous TSP	Kissimmee River/Paradise Run	\$28,047,500
Watershed Wetland Restoration Alternative 2	Greatest operational flexibility (direct access to Kissimmee River and/or Lake Okeechobee)	Kissimmee River/Paradise Run Lake Okeechobee West Lake Okeechobee East	\$63,427,000
Watershed Wetland Restoration Alternative 3	Top scoring measures	Kissimmee River/Paradise Run Lake Okeechobee West	\$45,922,500
Watershed Wetland Restoration Alternative 4	Maximum wetland restoration	Kissimmee River/Paradise Run Lake Okeechobee West Lake Okeechobee East Bootheel Creek IP10	\$100,899,500





# PLAN FORMULATION STRATEGY IN-LAKE WETLANDS



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## Littoral zone restoration opportunities

- Eastern side of Lake Okeechobee
  - Beneficial use of dredged material from dredging of Okeechobee Waterway
- Glades County (Moore Haven Canal Improvement Project)



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# PLAN FORMULATION STRATEGY IN-LAKE WETLANDS



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## Littoral Habitat Creation on Eastern Side of Lake Okeechobee

- Beneficial use of dredged material from OWW
- Initial target: 1 square mile for constructability and cost-estimating purposes
- Wind/wave/bathymetry considerations
- Dredged quantities range from 5.5 – 8 million cubic yards
- Materials cost alone may exceed \$150 to \$200 million

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# IN-LAKE WETLANDS

## Moore Haven Canal Improvement Project



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- Dredging ~648,000 cy from Moore Haven Canal and Pig Trail channel to construct Moonshine Marsh Overlook Park (\$14M)
- Permitted and under construction
- 34.51 acres of littoral zone mitigation required, opportunities to add on to littoral zone creation
  - 6 miles of bank with littoral zone and scrub/shrub rehabilitation opportunities
  - FWC- littoral zone plantings
- Potential snail kite habitat
- Ancillary benefits: commercial fishing, eco-tourism



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# PLAN FORMULATION STRATEGY



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## Management Measures and Alternatives Considered but not Carried Forward

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# PLAN FORMULATION STRATEGY

## Screened Alternatives



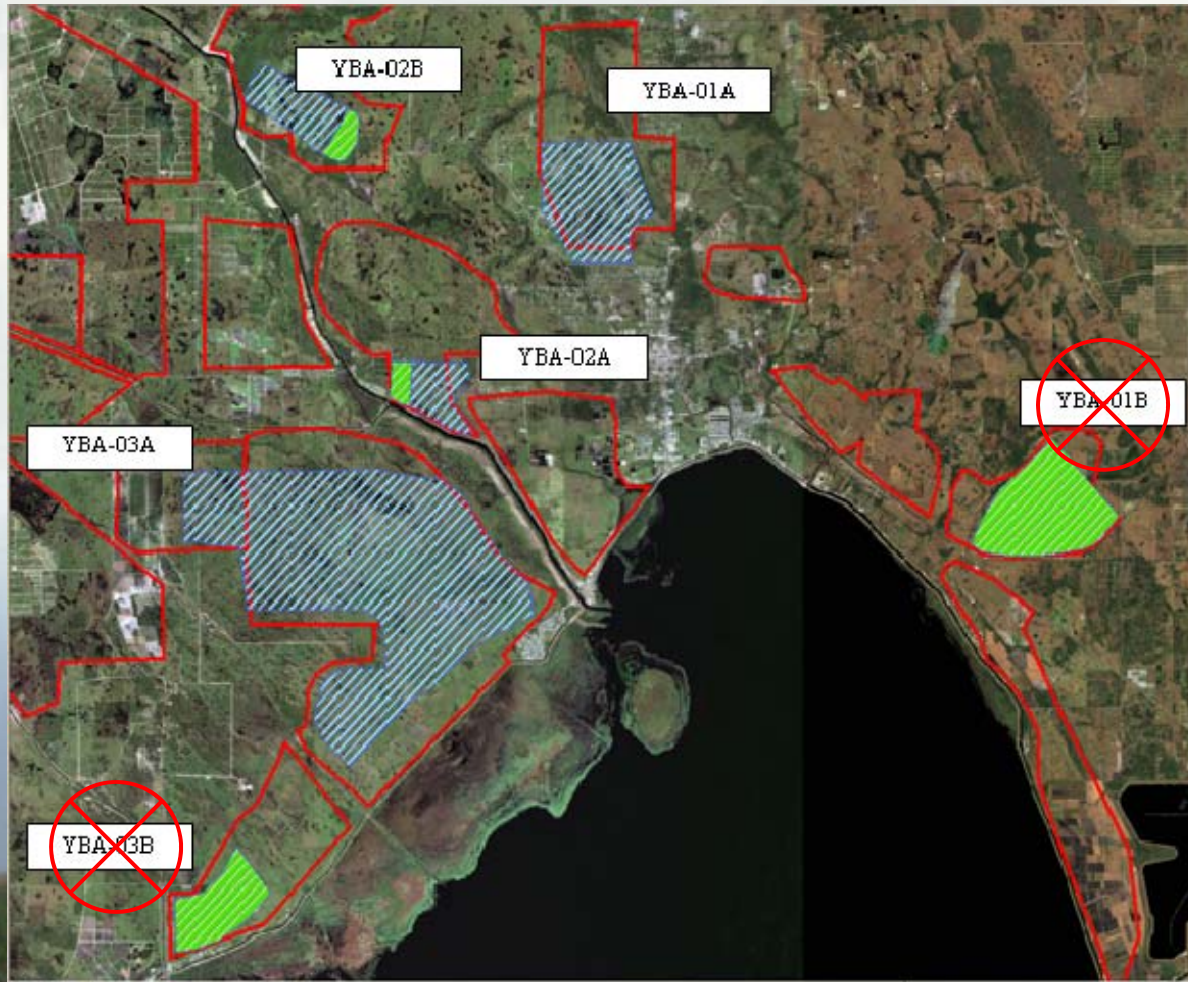
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### Revised Yellow Book Alternative

- **YBA-01A:** 50,000 ac-ft reservoir
- **YBA-02A:** 14,200 ac-ft reservoir
- **YBA-02B:** 20,590 ac-ft reservoir
- **YBA-03A:** 201,2050 ac-ft reservoir
- 200 ASR initially associated with Lake Okeechobee in YB (93,605 ac-ft storage)

Yellow Book reservoirs scored lower when ranked against newer reservoir configurations

- Storage goal
- Water source flexibility
- SFWMD land ownership
- Co-location possibilities
- Cost-effectiveness

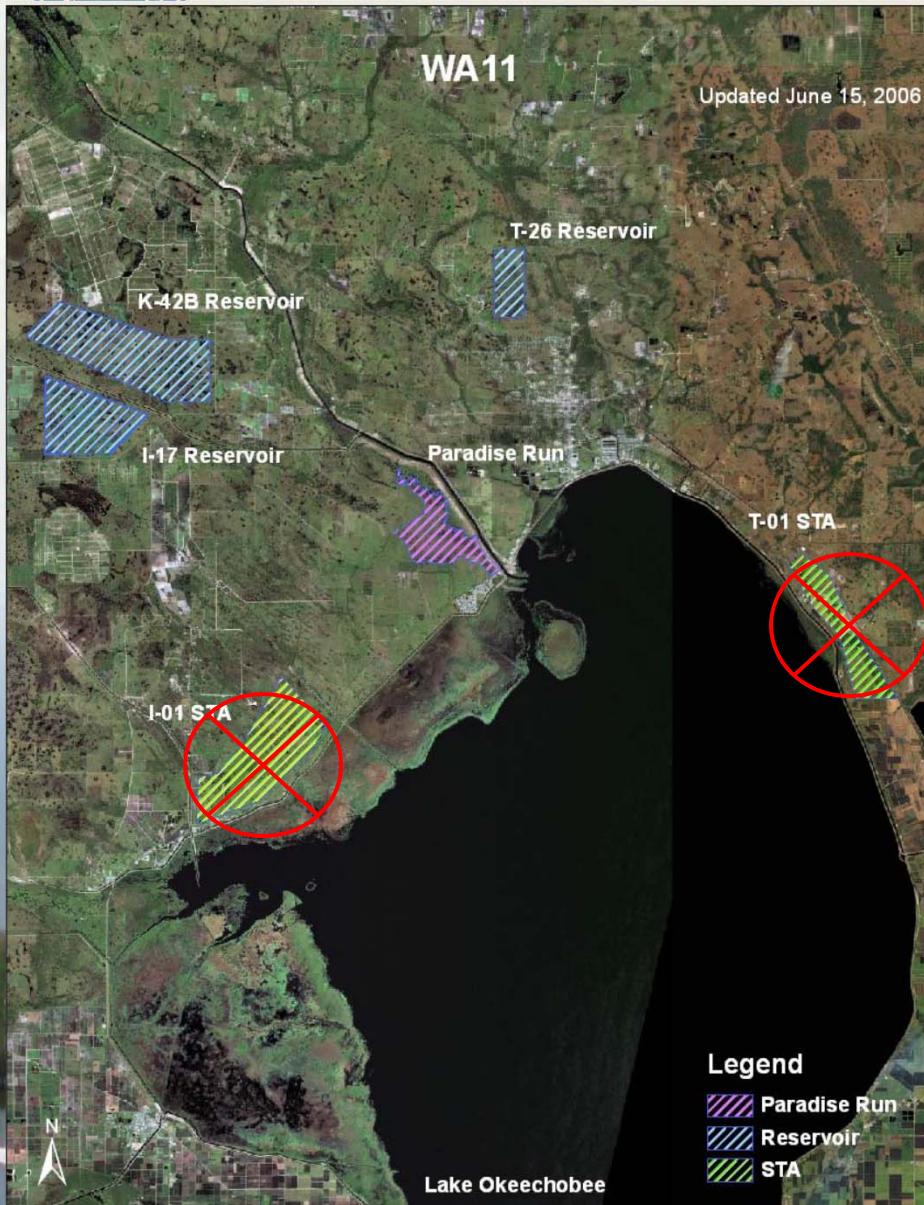






# PLAN FORMULATION STRATEGY

## Screened Alternatives



### Revised Previous TSP BUILDING STRONG

- **K-42B:** 161,263 ac-ft reservoir
- **I-17:** 79,560 ac-ft reservoir
- **T-26:** 32,000 ac-ft reservoir
- **Paradise Run:** 3,730 acres wetland restoration

Previous TSP reservoirs scored lower when ranked against newer reservoir configurations

- Storage goal
- Water source flexibility
- SFWMD land ownership
- Co-location possibilities
- Cost-effectiveness

Paradise Run wetland restoration as an individual management measure is being carried forward





# PLAN FORMULATION STRATEGY

## Screened Alternatives



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### Maximum Reservoir and ASR Storage Alternative

- Maximum storage (18 feet) for all reservoirs and 80 ASR would get 590,765 ac-ft of storage for ~\$4.7B
- Not considered cost-effective (high cost/ac-ft of storage)

### Minimal Real Estate

- Maximize reservoir storage on SFWMD owned lands with minimal additional land acquisition.
- Screened because the total storage possible is only 76,038 ac-ft
- Least cost effective alternative



# PLAN FORMULATION STRATEGY

## Project Risks



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Scoping Choice or Event	Risk and its cause	Consequence
Ecosystem restoration project without water quality improvement objective	Potential for reduced ecosystem lift without WQ improvement features	Risk that project may have limited benefits, potentially leading to reformulation
Incorporation of 'Deep Well Injections/Boulder Zone ASR' as a management measure into the study	Deep Well Injections/Boulder Zone ASR is considered a 'new' measure for the Corps and the incorporation of this technology may require extensive modeling and coordination with the vertical team. Additionally, there are concerns over how DWI will impact savings clause.	Lack of vertical support/endorsement may remove this measure from this project, thereby reducing effectiveness of the project or leading to reformulation to re-capture benefits with another management measure
Siting management measures prior to cultural resource surveys of project area	There is the potential that a significant cultural resource could be identified in the measure footprint after the measure is sited	Reformulation may be necessary to identify new locations for measures impacting significant cultural resources
Tribal water entitlement update has yet to be quantified	Difficult to determine if storing water north of Lake Okeechobee will impact tribal water supply if entitlement hasn't been updated	May affect tribal support of this project
Limited operations of project features due to possible presence of T&E species	If special-status species inhabit reservoirs during lower water levels there is a risk that the reservoirs can not be used to maximize water storage	Project storage benefits will be limited





# PLAN FORMULATION STRATEGY

## Project Risks



**BUILDING STRONG**

Scoping Choice or Event	Risk and its cause	Consequence
Using existing suite of models	Using a large-scale regional model provides very coarse results	Major changes from scoping phase to TSP phase
Environmental Performance Measures certification and using Non-RECOVER PMs	Potential to not be approved by ECO-PCX since they are new PMs and habitat unit calculations	Underestimating benefits or leaving benefits on the table.
Use existing tools to screen management measures	Original assessment for wetland screening was 2004-2007. Specific areas have changed. May alter benefits calculations from prior modeling.	Underestimating benefits
Reliance on and availability of models.	Not able to model wetland inundation duration in the watershed	Effectively capture all benefits of each alternative.