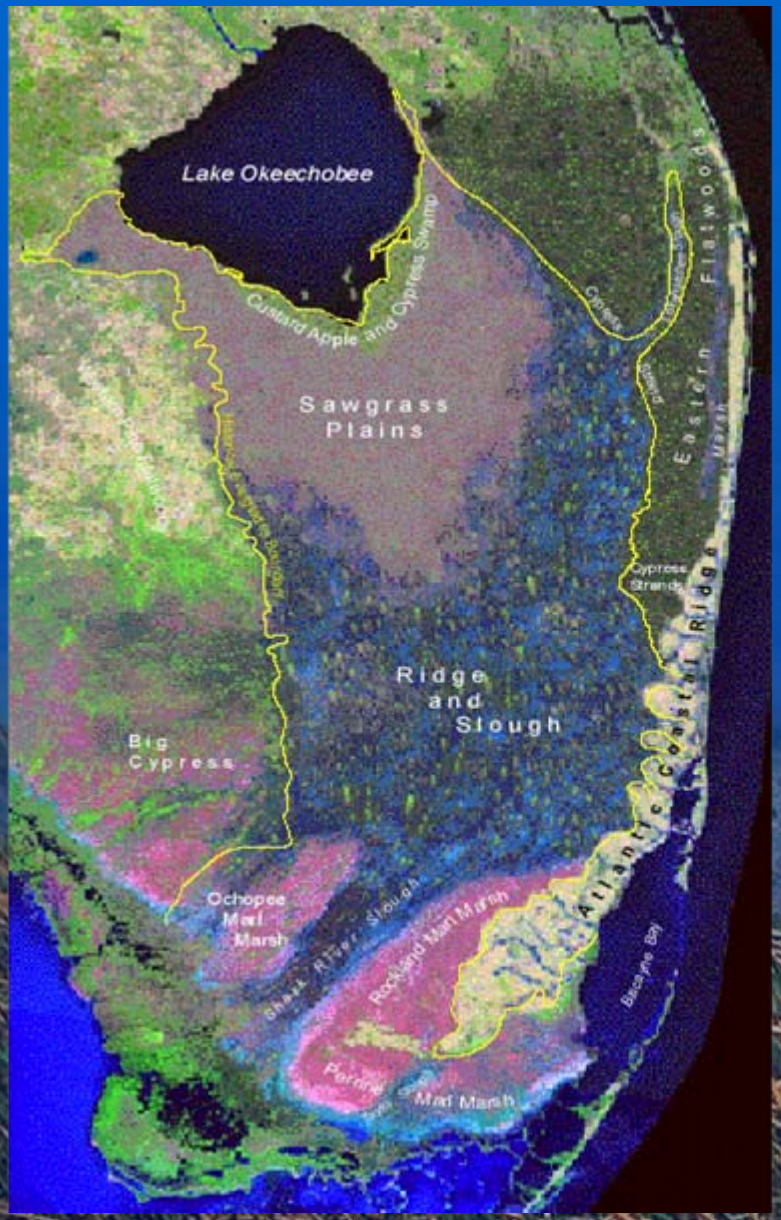
Hydrologic Targets for Everglades Restoration

FDEP/SFWMD Workshop
January 14-16, 2009

DOI Vision for Successful Everglades Restoration

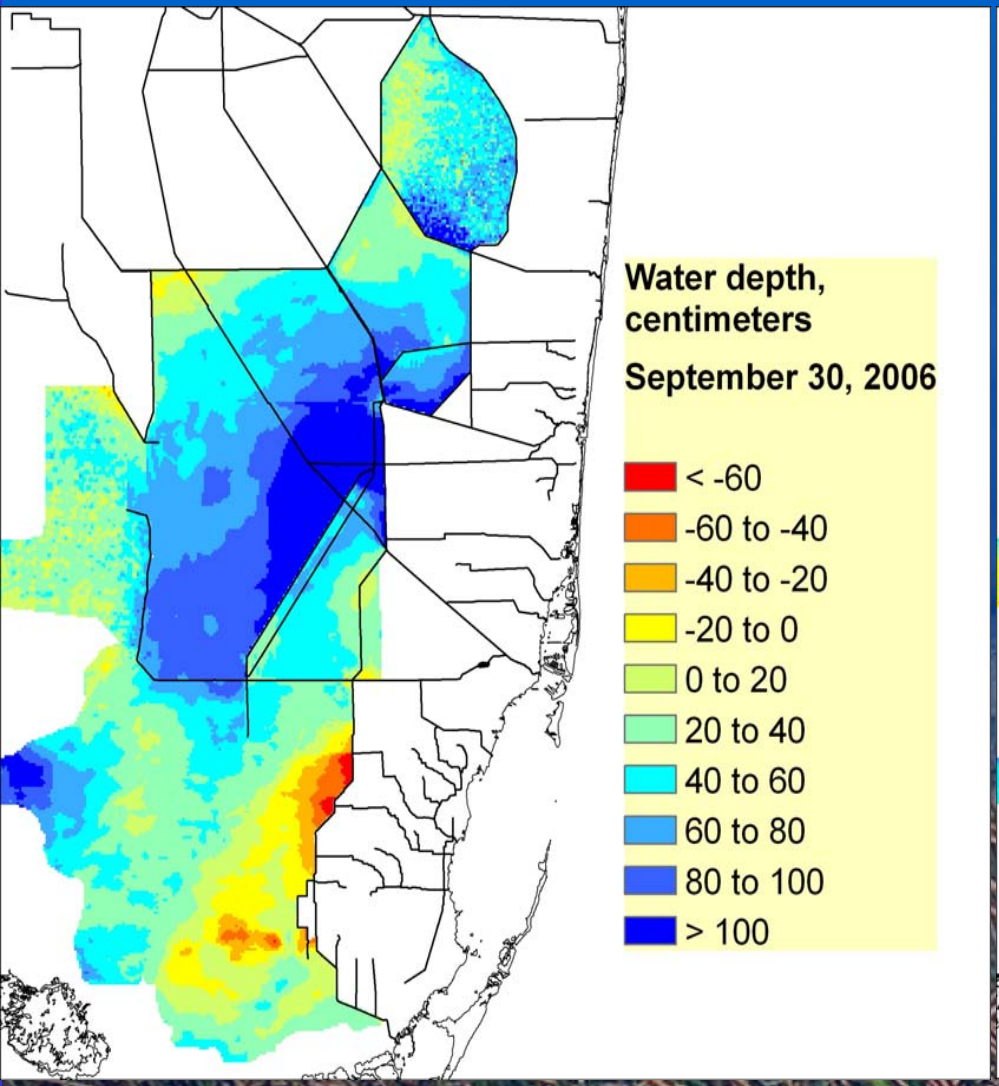


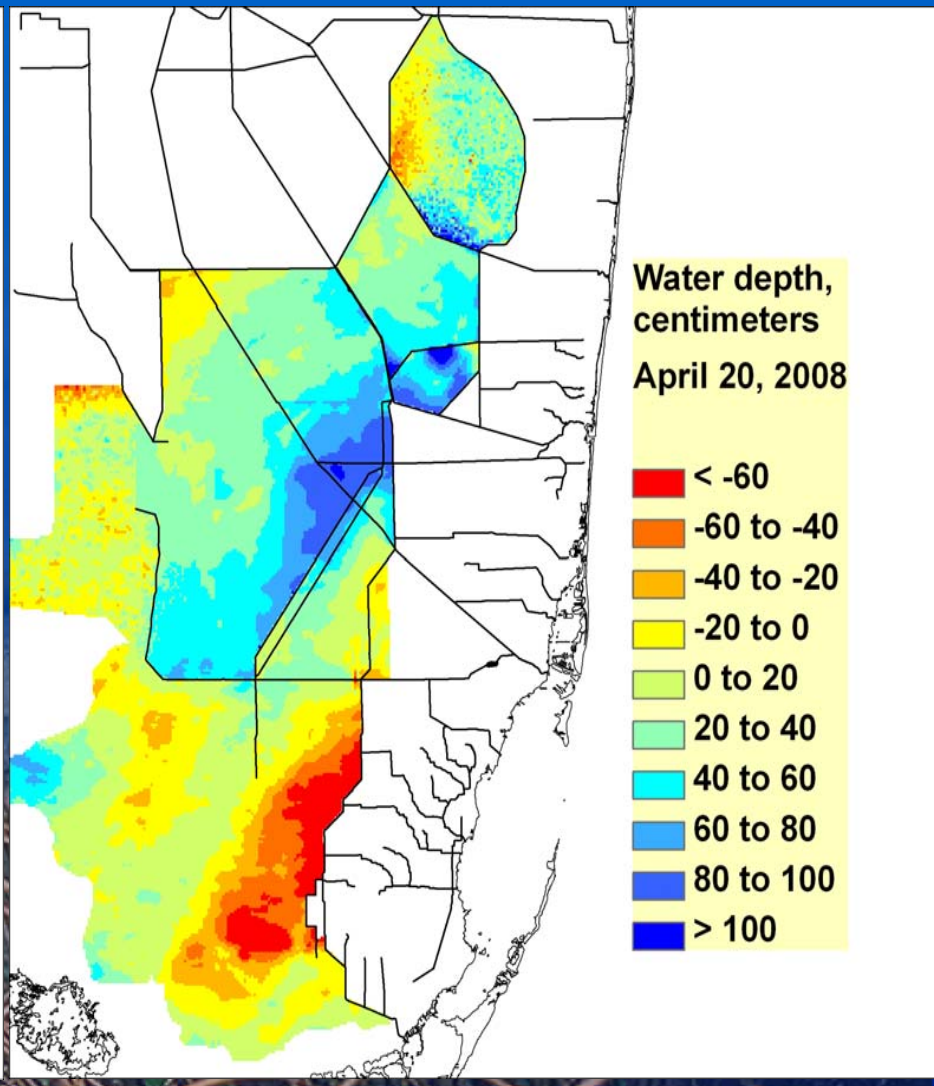
- The restored ecosystem will retain the essential characteristics of the historic “River of Grass”.
- This new system would no longer act like a set of managed, disconnected wetlands but more like a naturally connected ecosystem.
- Reestablishing the hydrologic connection from Lake Okeechobee to the Everglades while eliminating all non-essential water management structures.
- Successful/timely implementation of projects to remove barriers to sheetflow and restore more natural and unobstructed flow is DOI’s highest priority.

Pre-Drainage System (1850’s)

DOI Vision Document, (draft 12/2008)

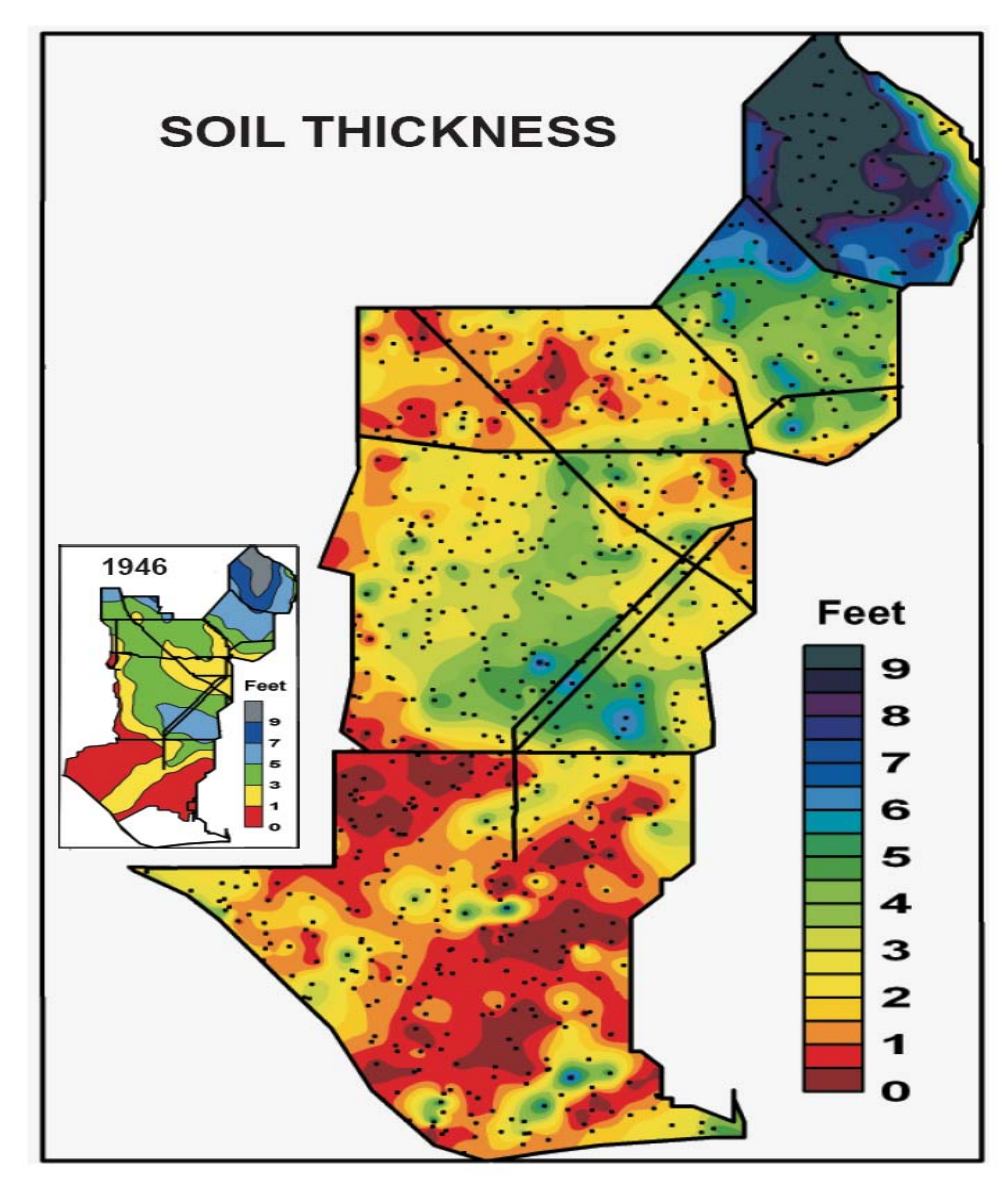
Managing the Central Everglades as a Series of Reservoirs





Courtesy of Everglades Depth Estimation Network (EDEN), USGS, 2008.

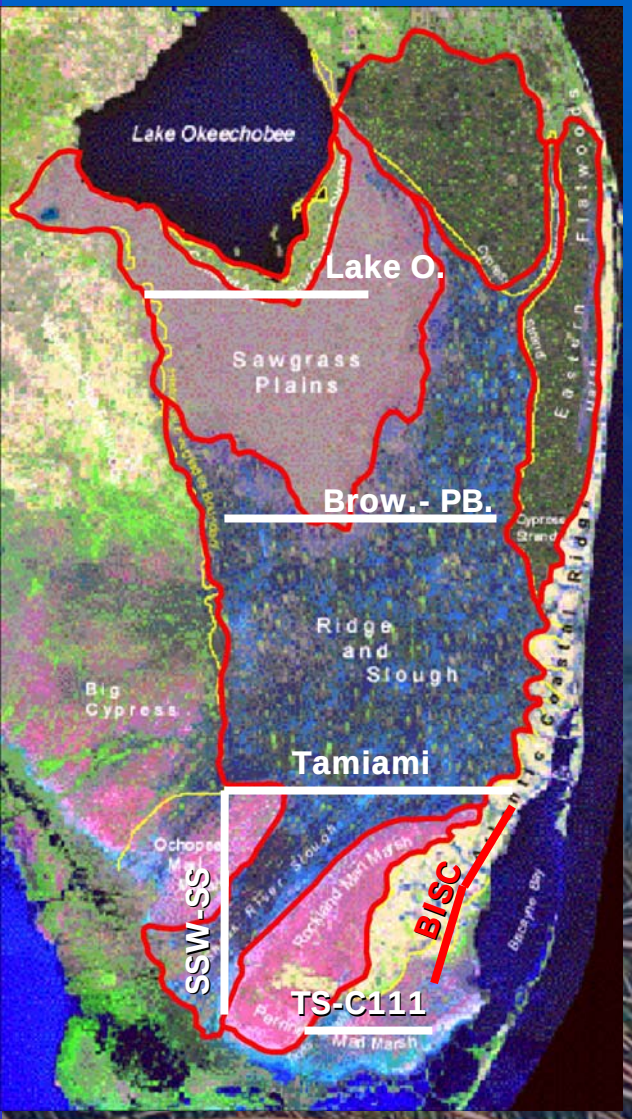
Soil Subsidence due to Flow Diversions



- There has been a dramatic loss of organic soils throughout the Everglades.
- The areas of greatest soil loss correspond to the areas where the current levees and canals have blocked the natural sheetflow.
- This is most obvious in northern WCA 3A, and in WCA 3B, and Northeast Shark Slough (NESS).

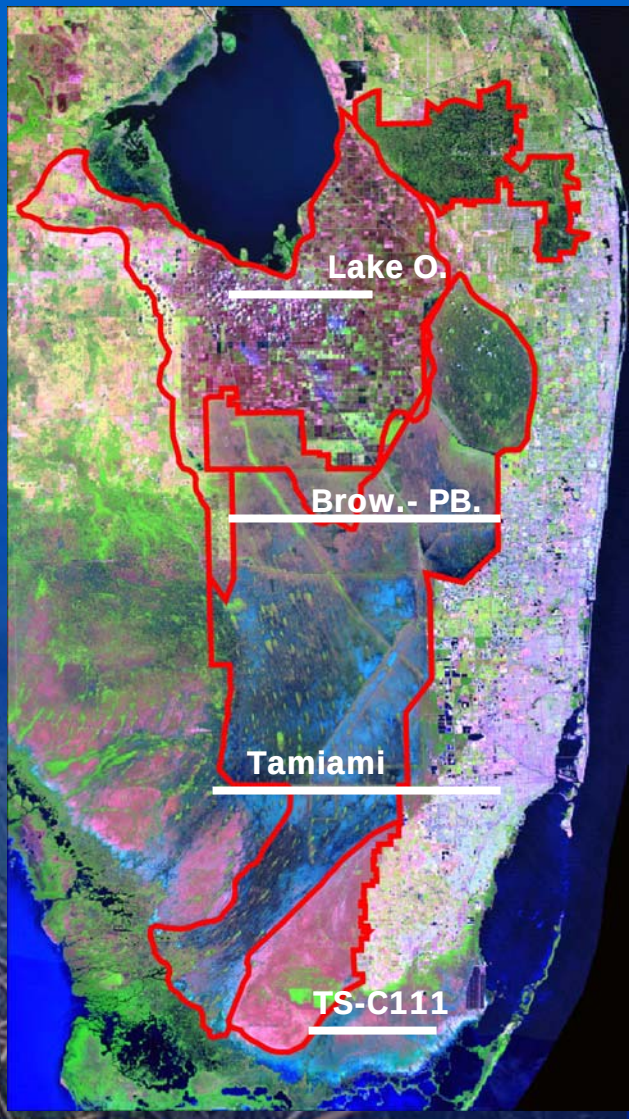
Source: Everglades Ecosystem Assessment, EPA, 2007

Recreating Water Flow Characteristics as a Prerequisite to Everglades Restoration



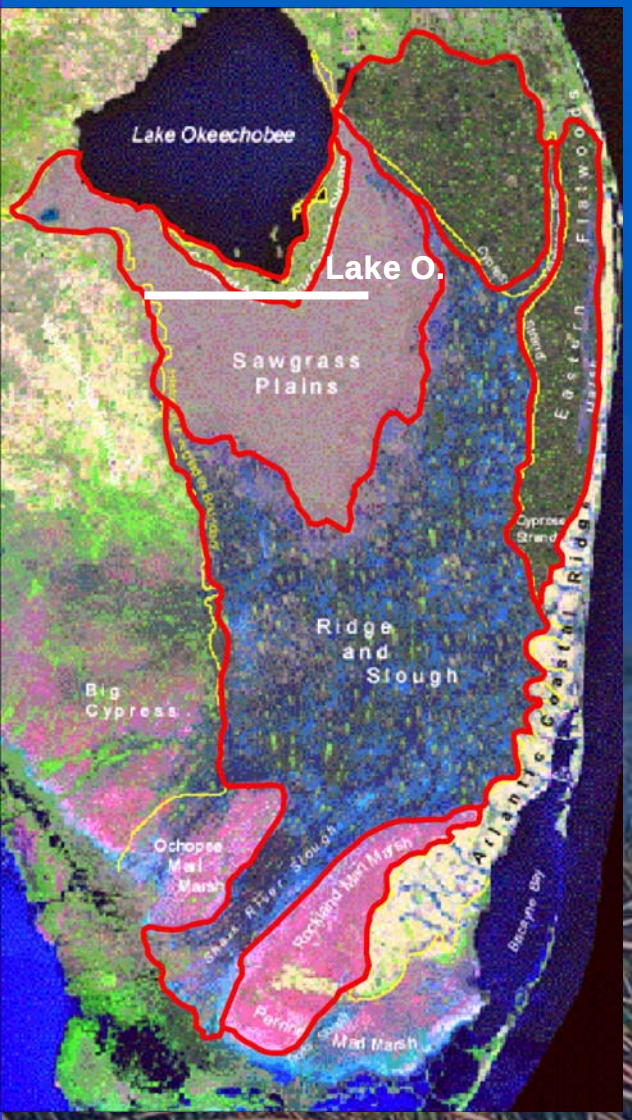
Pre-Drainage System (1850's)

- Reestablishing a more free flowing ecosystem (nearly continuous flow with minimal obstructions).
- Depends on a substantial increase in the flow of clean water from Lake Okeechobee and the northern Everglades.
- Define water flow targets (volume, distribution, timing) using flow transects from the 2X2 and Natural System Models.
- Compare NSM flow estimates to historic flows (where available), and to general ecological targets.
- NSM Flow Transects
  - Lake Okeechobee
  - Broward-Palm Beach
  - Tamiami Trail
  - Shark Slough
  - Taylor Slough/C-111



Current System (1995)

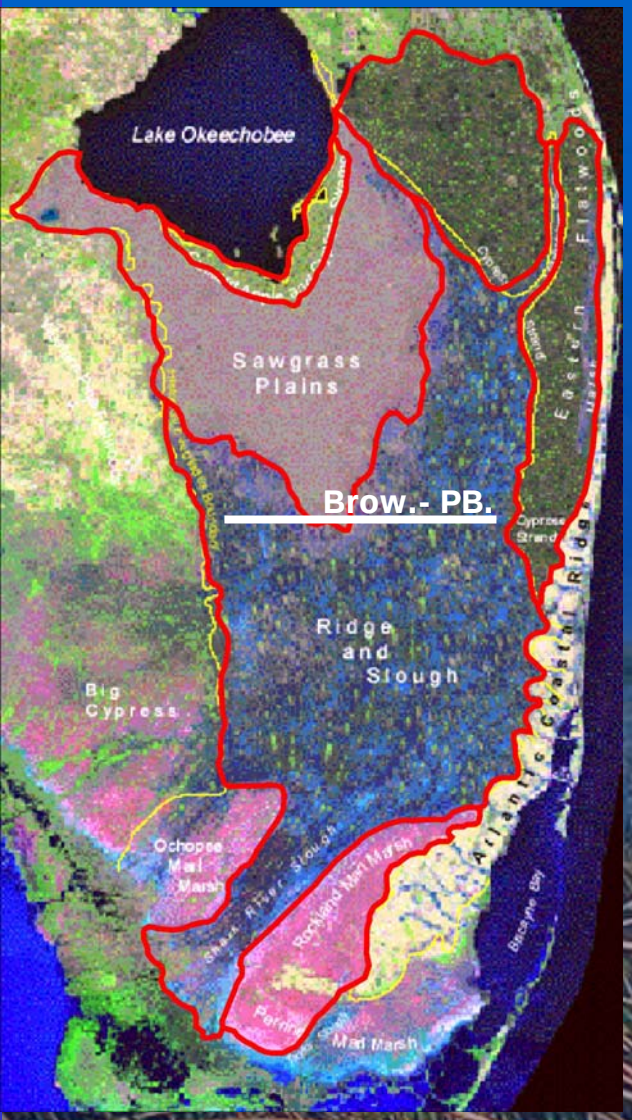
Flows from Lake Okeechobee to the Everglades



Pre-Drainage System (1850's)

- The earliest drainage of Lake Okeechobee began in 1883. Major drainage began in 1912 (North New River and Miami Canals), and all six of the current drainage canals were operational by 1928.
- Regular flow measurements began in 1935, so we have no direct information on pre-drainage flows. Pre-drainage flows to the Everglades can be estimated using early post-drainage data, and assuming that all of the Lake outflows went to the Everglades (from Heilprin, 1887).
- The USGS (Hartwell, 1970) examined Lake O. outflows using two 12-year periods that bracket the completion of the eastern protective levee system in 1952.
  - 1940-1951 Avg. annual outflows 1.2 million ac-ft.
  - 1952-1963 Avg. annual outflows 1.9 million ac-ft.
- The NSM predicted outflows from Lake O. to the Everglades are: (1965-2000 simulation period).
  - NSM4.6.2 Avg. annual flow 720,000 ac-ft.
  - NSM5.1 Avg. annual flow 1.2 million ac-ft.
- For Comparison, modeled outflows toward the Everglades under managed conditions are:
  - Alt7R5 Avg. annual flow 740,000 ac-ft.
  - CERP0 Avg. annual flow 680,000 ac-ft.
  - Excludes Caloosahatchee/St. Lucie flows of 550K (Alt7R5) and 150K (CERP0)

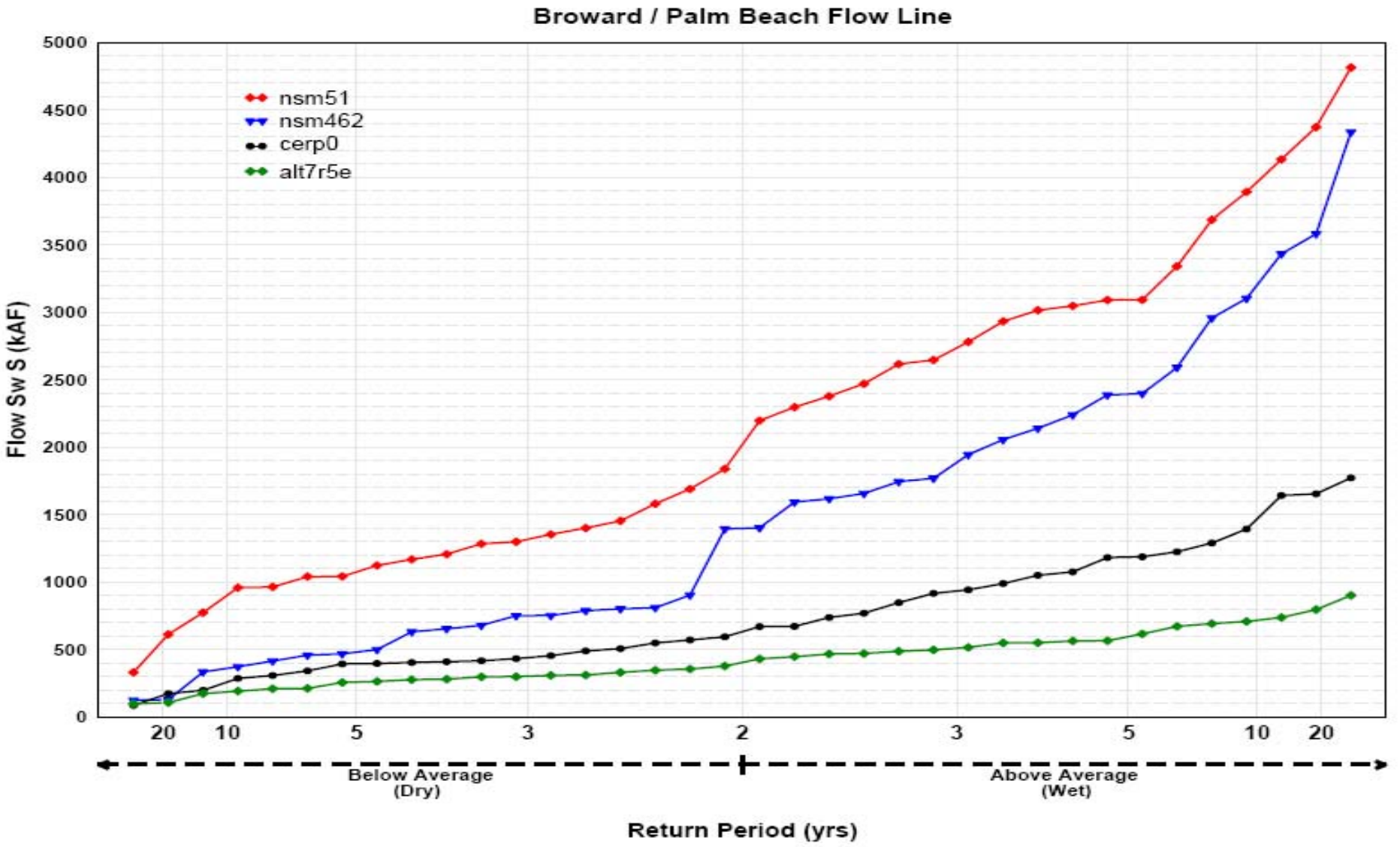
Flows through the Central Everglades



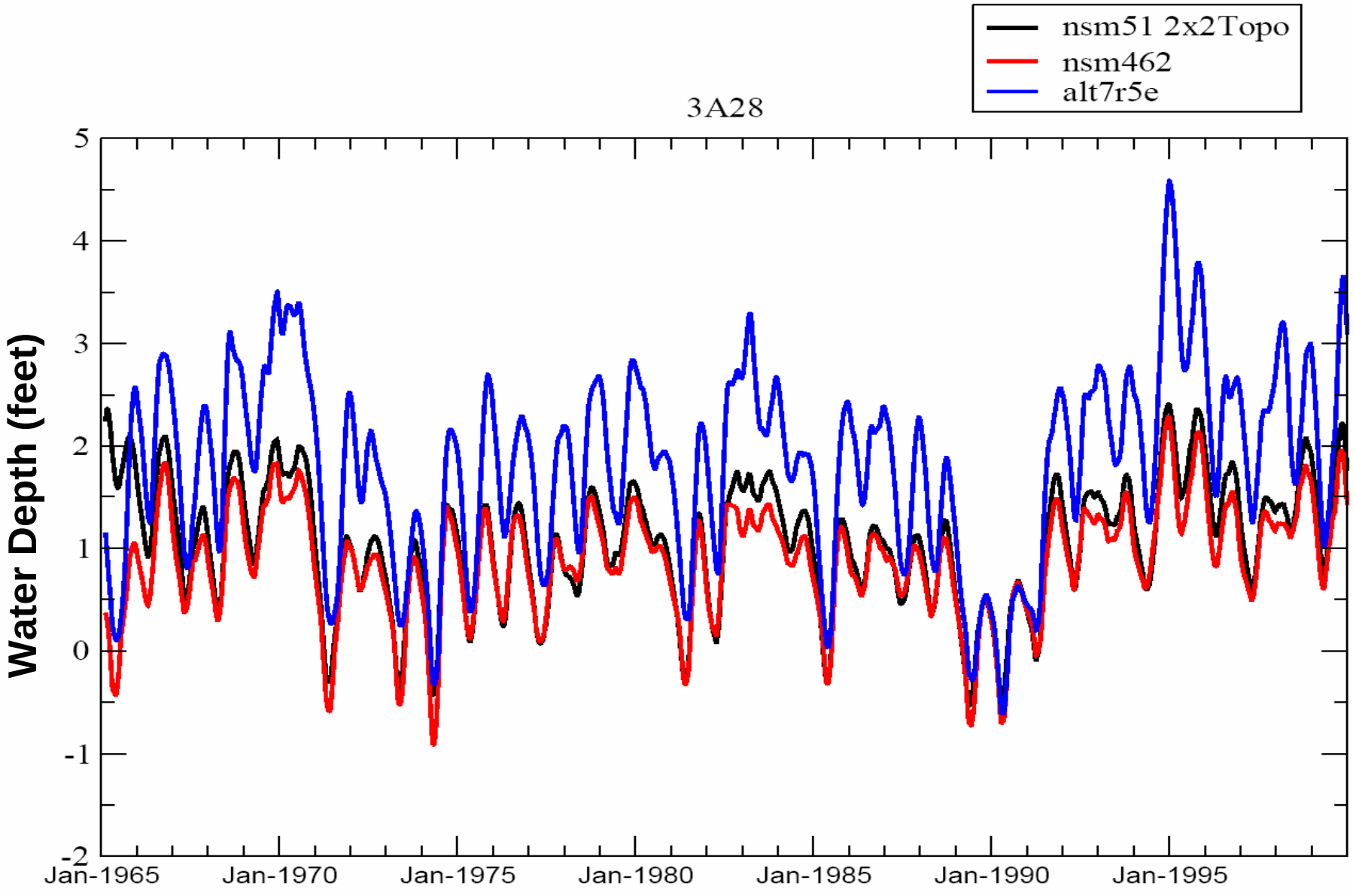
Pre-Drainage System (1850's)

- Flows across the Broward-Palm Beach flow line represent the combined contributions of Lake Okeechobee outflows and localized runoff from the historic sawgrass plains in the northern Everglades.
- This flow transect approximates the flows that would be needed to support the WCA 3 Decompartmentalization and Sheetflow Enhancement project envisioned in CERP.
- This flow line is the location of the primary flow target in the DOI Vision document, since it describes the flows that would be needed as we reconnect the WCAs and ENP, and remove the major obstructions to flow.
- There are no measured flows available for this location, so we can only examine the differences in the modeled flow estimates.
- The NSM predicted overland flows through the Central Everglades transect are: (1965-2000 simulation period).
  - NSM 4.6.2 Avg. annual flow 1.5 million ac-ft.
  - NSM 5.1 Avg. annual flow 2.1 million ac-ft.
- For comparison, modeled overland flows for the Central Everglades under managed conditions are:
  - Alt7R5 Avg. annual flow 400,000 ac-ft. (900K EAA)
  - CERP0 Avg. annual flow 630,000 ac-ft. (725K EAA)

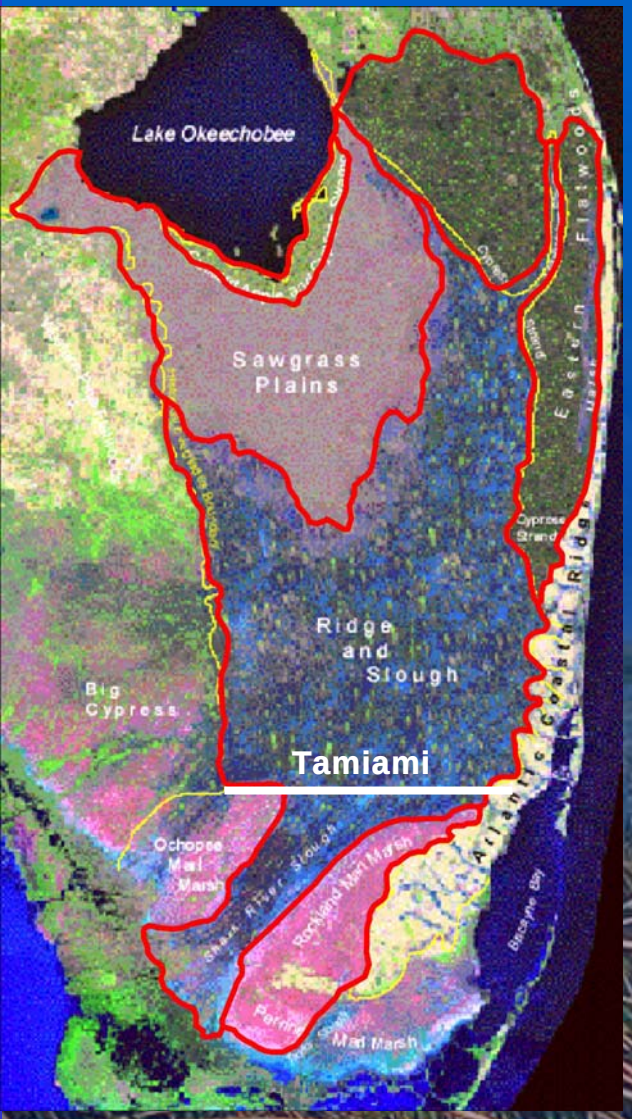
Flows through the Central Everglades



Water Depth Comparisons in WCA 3A



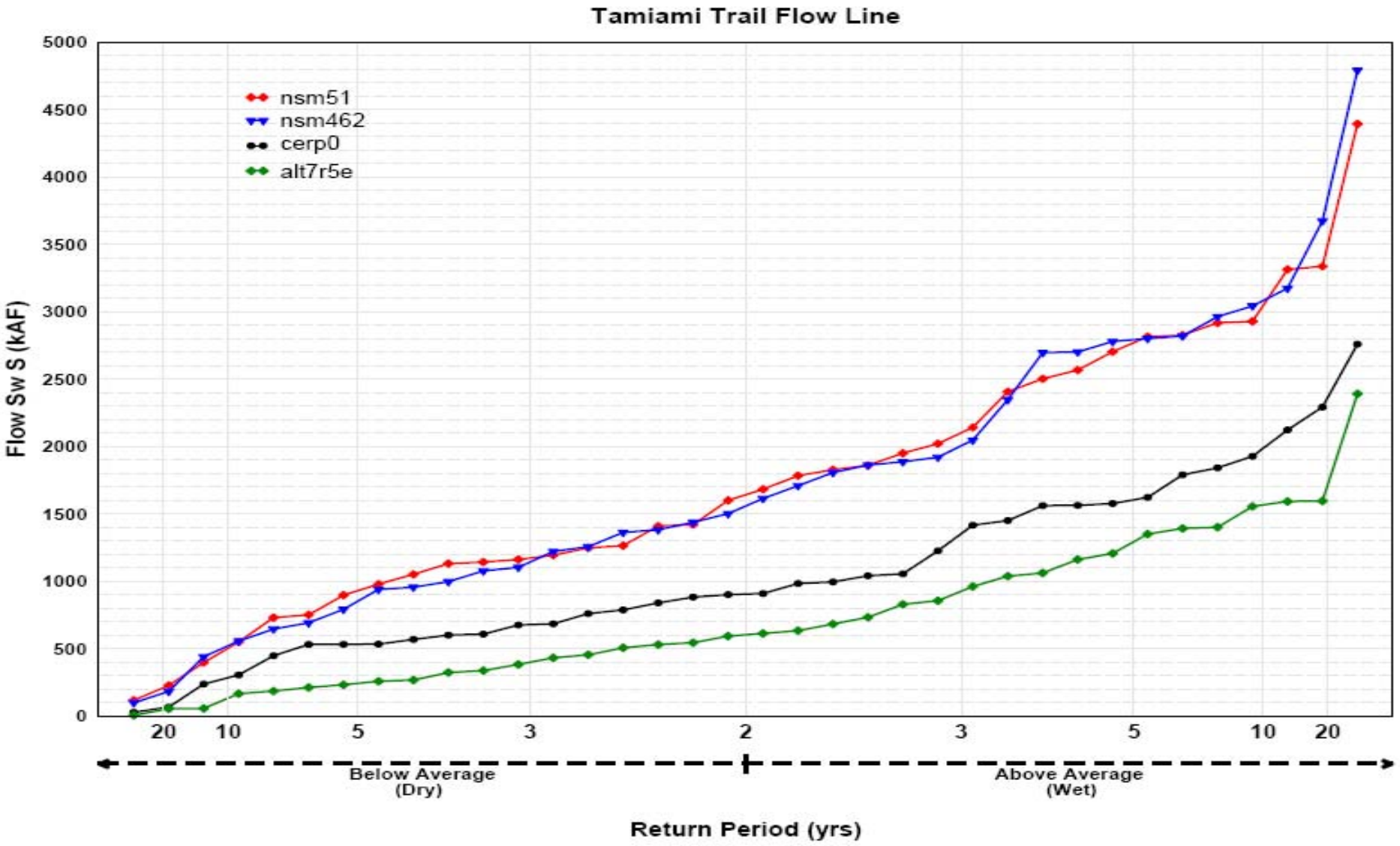
Flows into the Southern Everglades



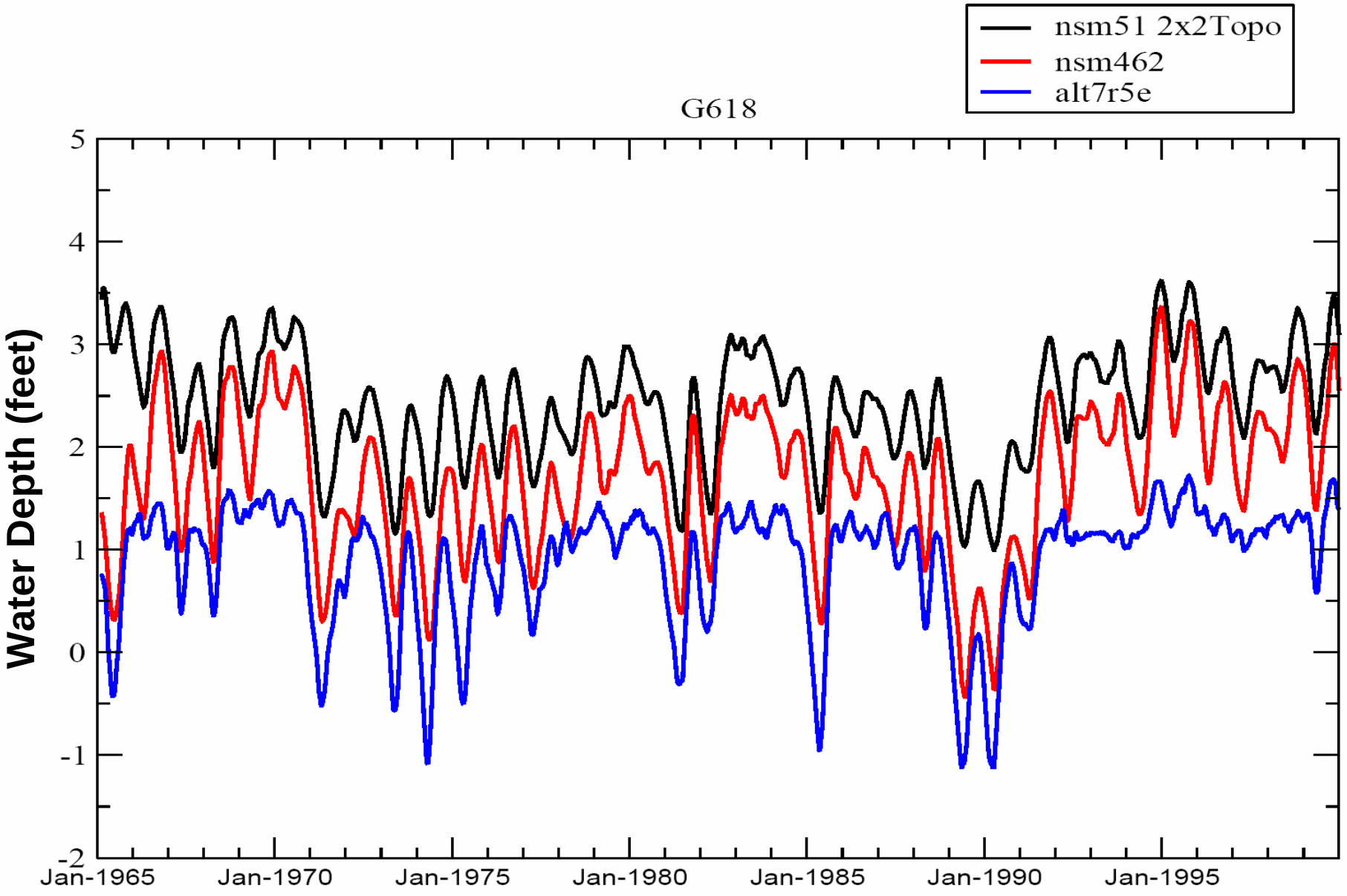
Pre-Drainage System (1850's)

- Flows across the Tamiami Trail flow line represent the contributions of the upstream Everglades to the southern Everglades and the downstream estuaries (Florida Bay and Biscayne Bay).
- The distribution of flows across this flow lines also describes how well we are resolving the long-standing problems of excessive flooding in WCA 3A and the over drainage in WCA 3B and Northeast Shark Slough.
- Historic flow measurements for this location began in 1939. The USGS report (Hartwell, 1970) compares post-drainage flows to Shark Slough for the same two time periods described above.
  - 1940-1951 Avg. annual flow 200,000 ac-ft.
  - 1952-1961 Avg. annual flow 430,000 ac-ft.
- The NSM predicted flows for the southern Everglades transect are: (1965-2000 simulation period)
  - NSM4.6.2 Avg. annual flow 1.8 million ac-ft.
  - NSM5.1 Avg. annual flow 1.8 million ac-ft.
- For comparison, modeled overland flows for the Southern Everglades under managed conditions are:
  - Alt7R5 Avg. annual flow 600,000 ac-ft.
  - CERP0 Avg. annual flow 900,000 ac-ft. *(350K LB)*

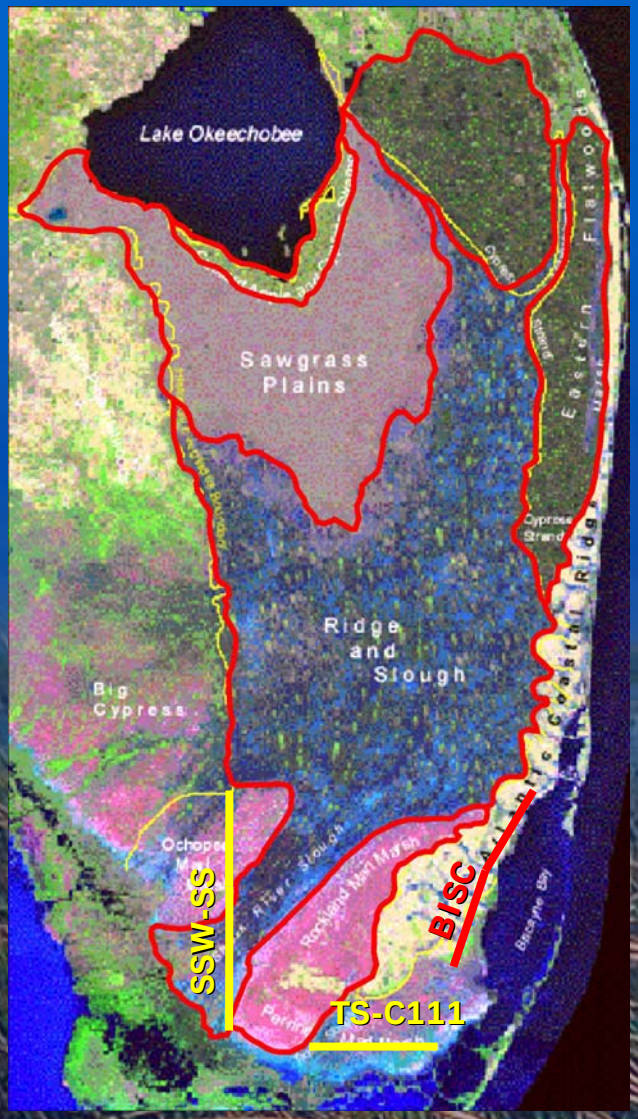
Flows into the Southern Everglades



Water Depth Comparisons in NESS



Flows into the Southern Estuaries

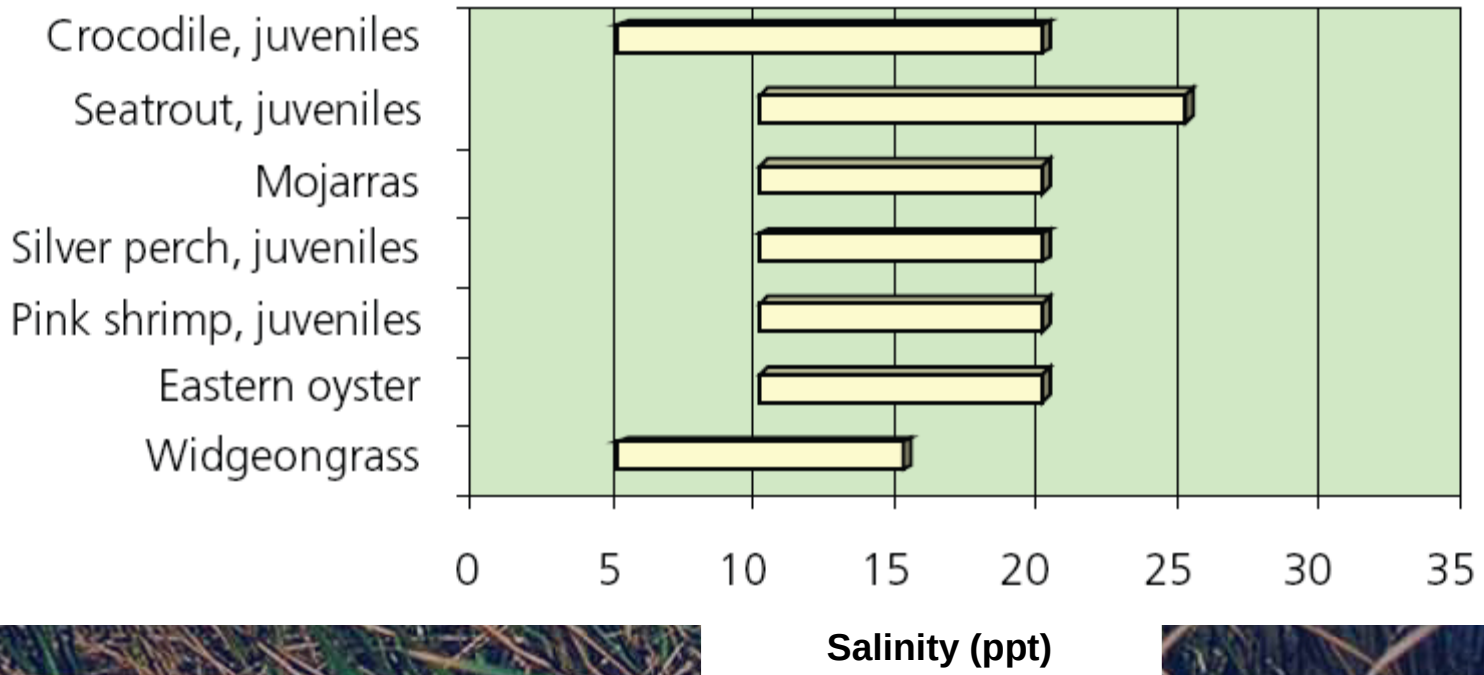


Pre-Drainage System (1850's)

- Since the 1920's, diversions of Everglades flows to the Atlantic and Gulf Coasts have substantially reduced freshwater inflows to Biscayne Bay and Florida Bay.
- Paleoecological evidence and anecdotal information has documented increasing salinities and alterations in nearshore habitats, but historic freshwater flow information is lacking.
- Overland flows through Shark Slough and out of lower Taylor Slough and into Florida Bay can be roughly approximated in the NSM, but NSM flow transects along Biscayne Bay have not been recommended due to model scale issues.
- Freshwater flow targets have been developed for Biscayne and Florida Bays, with the goal of reestablishing healthy seagrass communities that support a variety of desired estuarine faunal species.
- The NSM predicted flows for the southern estuaries in ENP are: (1965-2000 simulation period)
  - NSM4.6.2 Avg. annual flow 1.2 million ac-ft.
  - NSM5.1 Avg. annual flow 1.6 million ac-ft.

Examples of Desired Estuarine Species

Organism	Zone	Importance	Source
American crocodile (*Crocodylus acutus*)	Mangroves	Endangered Species	Mazzotti and Cherkiss,1998; Kushlan and Mazzotti 1989: Kushlan 1988; Mazzotti 1983
Spotted seatrout (*Cynoscion nebulosus*)	Western Bay Zone	Commercial value, Recreational fishing	Pattillo, et al. 1997; Bortone, 2003.
Mojarras (*Eucinostomus spp.*)	Western Bay Zone	Forage base species	Serafy, et al., 1997
Silver perch (*Bairdiella chrysoura*)	Western Bay Zone	Forage base species	Serafy, et al., 1997
Pink shrimp (*Farfantepenaeus duorarum*)	Western Bay Zone	Keystone species, commercial value	Bielsa et al., 1983; Serafy et al., 2001; Browder et al., 1999; Gunter et al., 1964
Eastern oyster (*Crassostrea virginica*)	Mangroves	Commercial value	Meeder et al., 2001; Wells, 1961



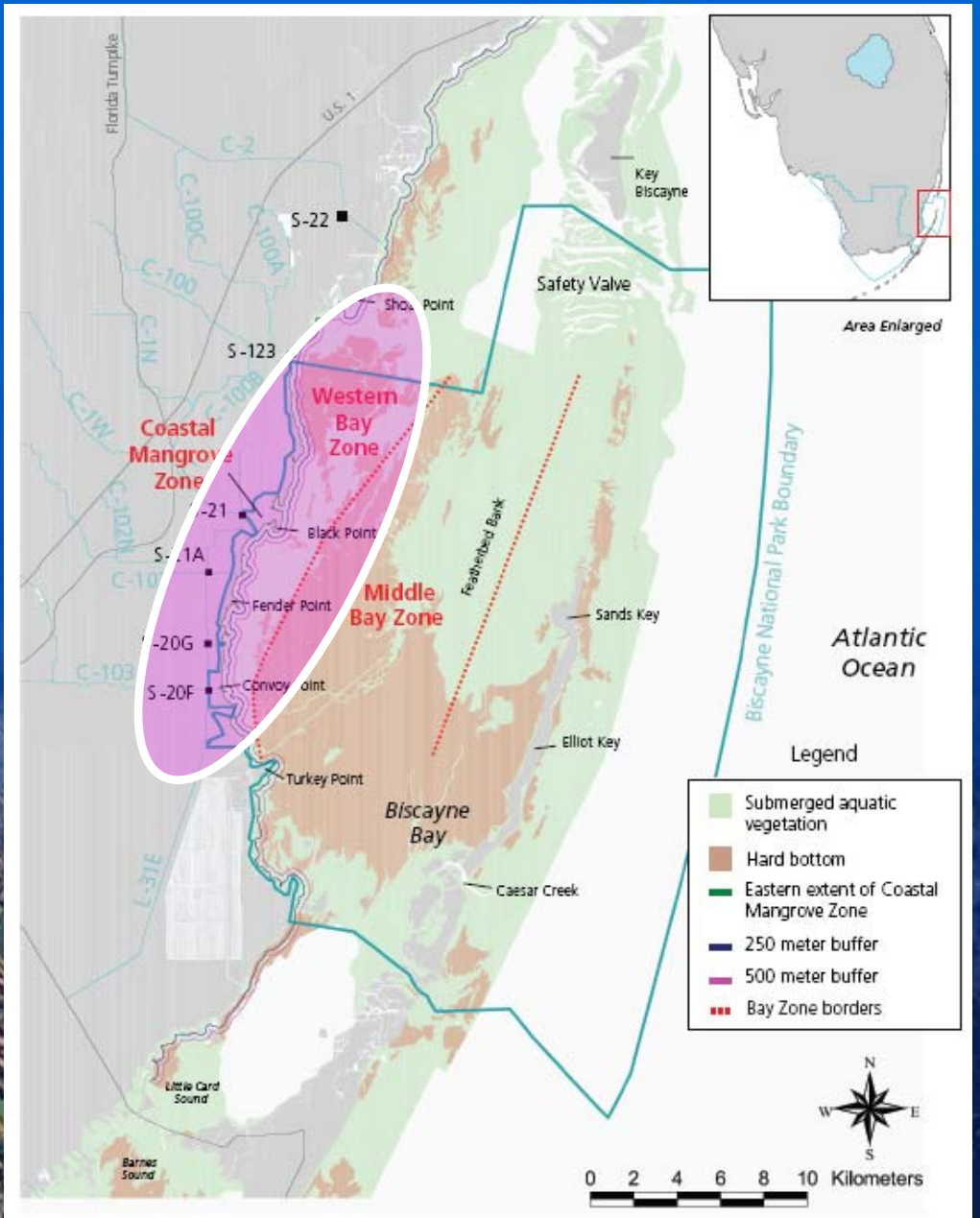
Biscayne Bay Flow Restoration Target

Nearshore Zone
10,000 Acres

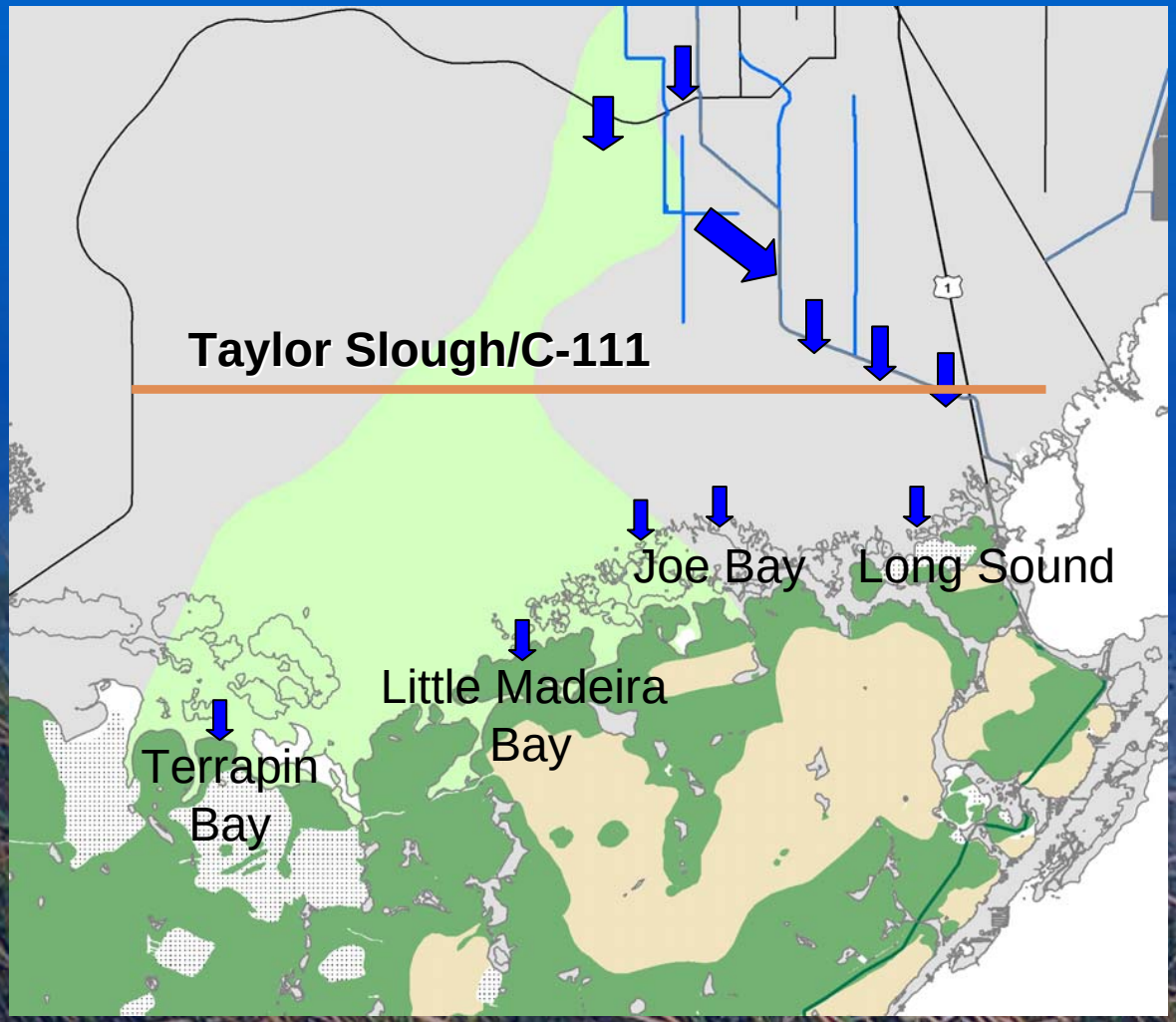
- Shallow Western Bay
- SAV dominated zone
- Adjacent to urban area
- Direct canal inflows
- Moderate tidal exchange

- Freshwater flow target is 1.1 million ac-ft in an average year.

- Current structure flows are approximately 530,000 ac-ft.

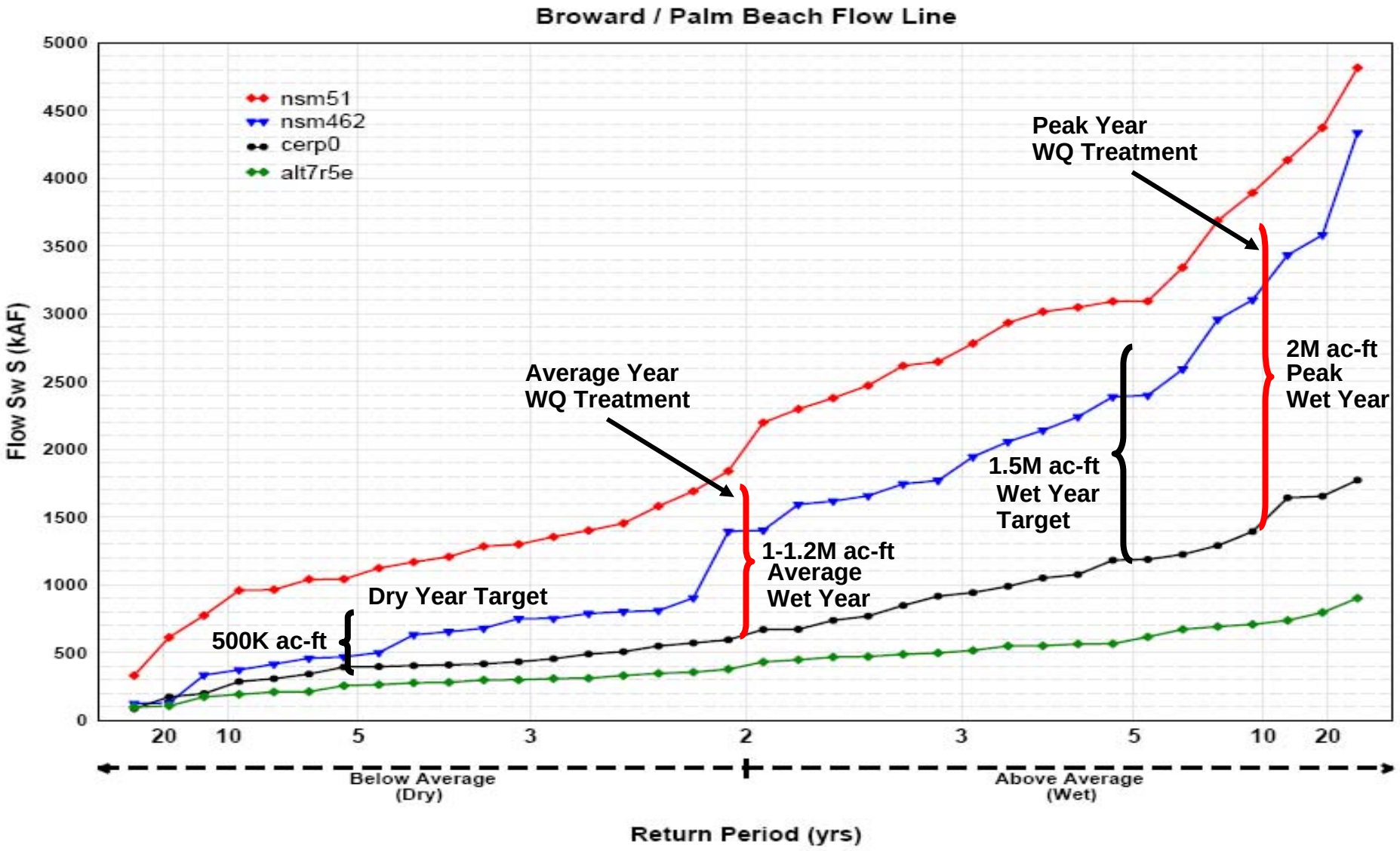


Florida Bay Restoration Targets

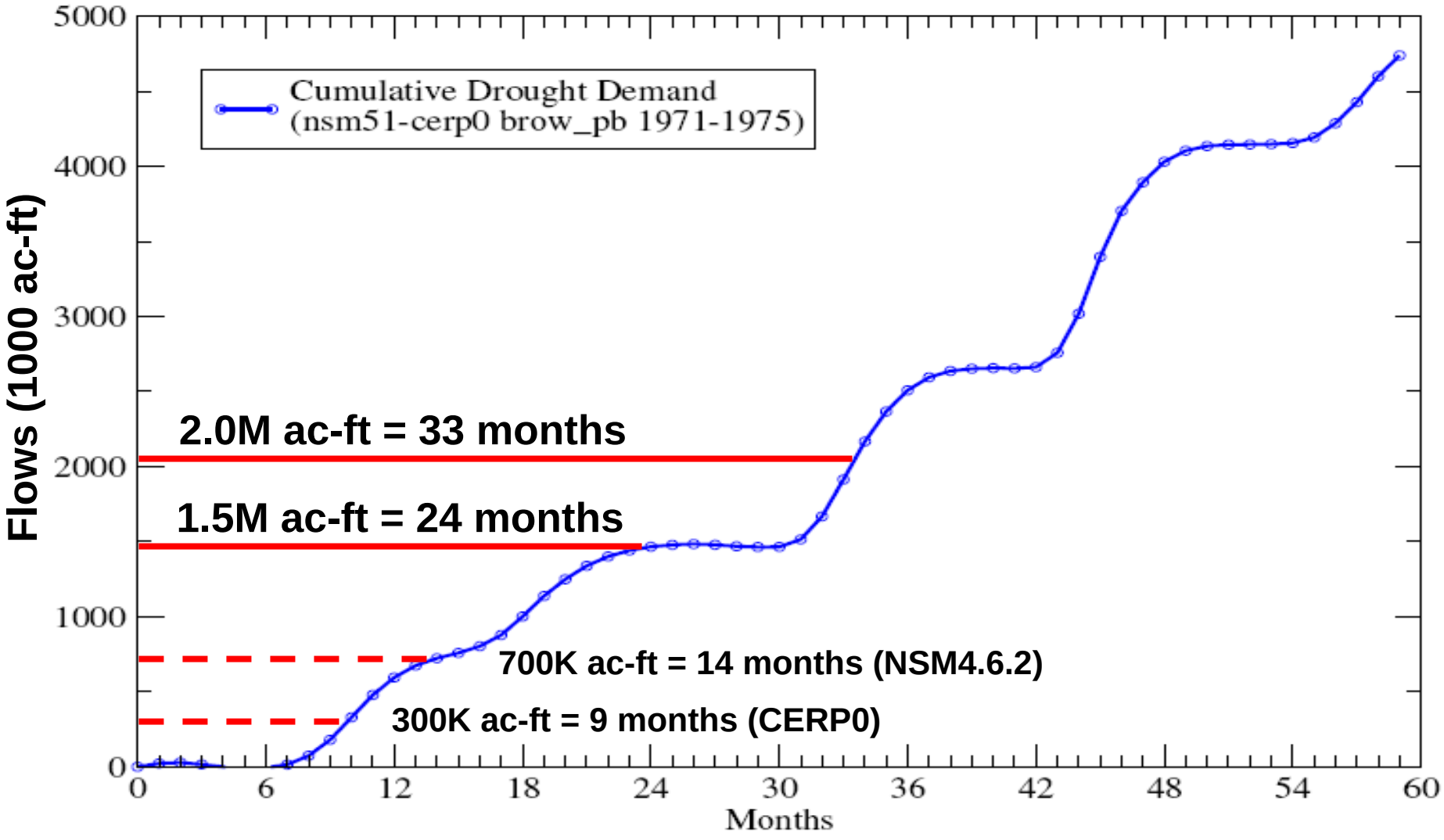


- Nearshore Zone including Embayments
- SAV dominated zone
- Canal inflows in NE
- Poor tidal exchange
- TIME Modeling produces a flow target based on desired estuarine species of 650,000 ac-ft (T23) for an average year.
- NSM Avg. annual flows
  - 120,000 ac-ft (4.6.2)
  - 330,000 ac-ft (5.1)
- Current measured flows in tidal creeks (USGS) average 225,000 ac-ft.

Flows Targets and Storage/Treatment Projections From DOI Vision Document



Regional Storage for Everglades Multi-Year Droughts



Importance of Adjusting for Current Topography