

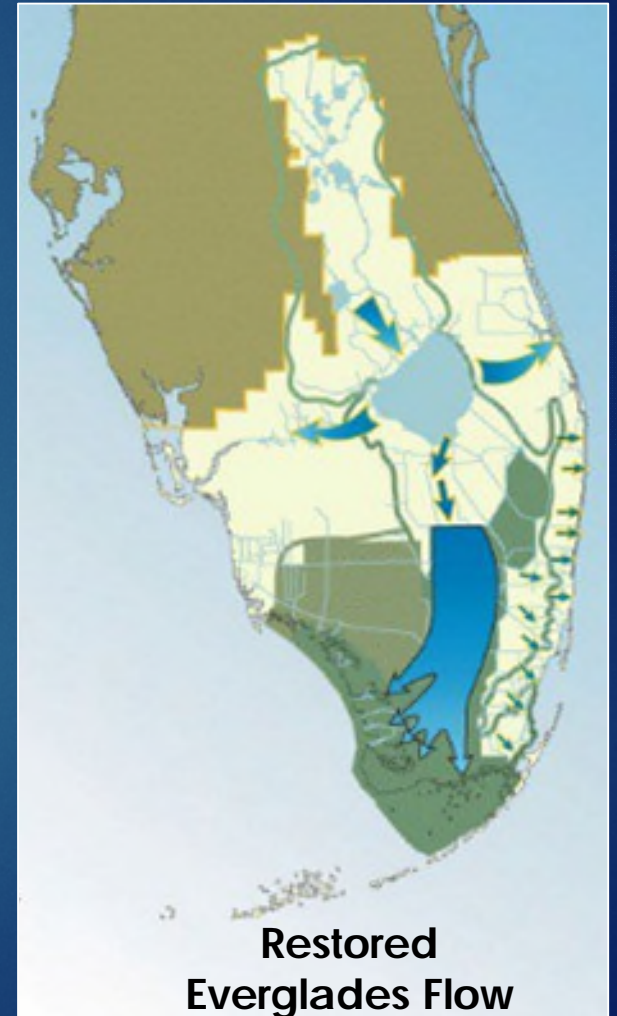
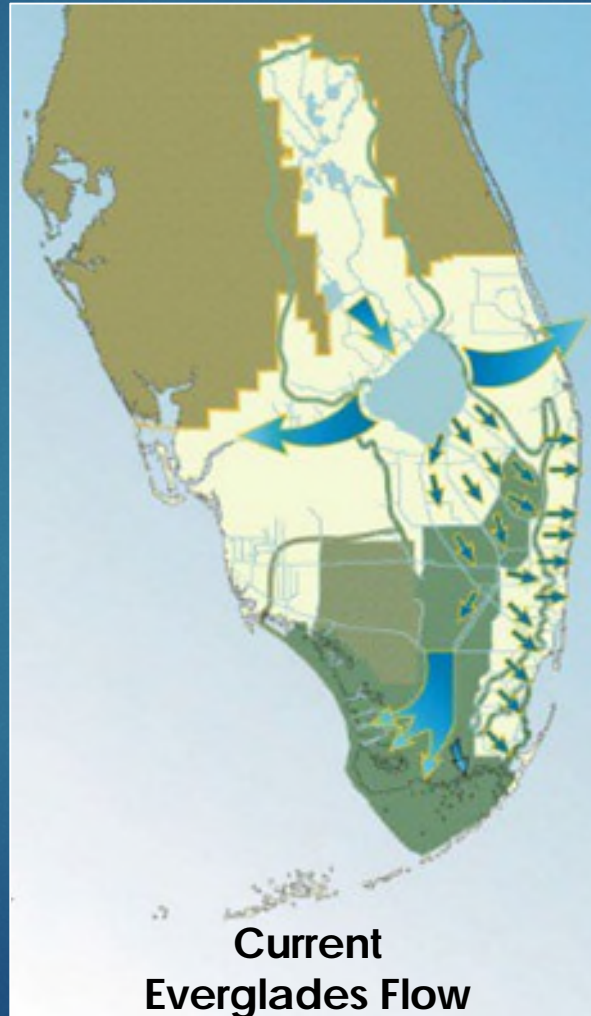
Curtain Walls: A Geotechnical Solution of Water Resource Problem in South Florida

ASCE Palm Beach
October 18th ,2022

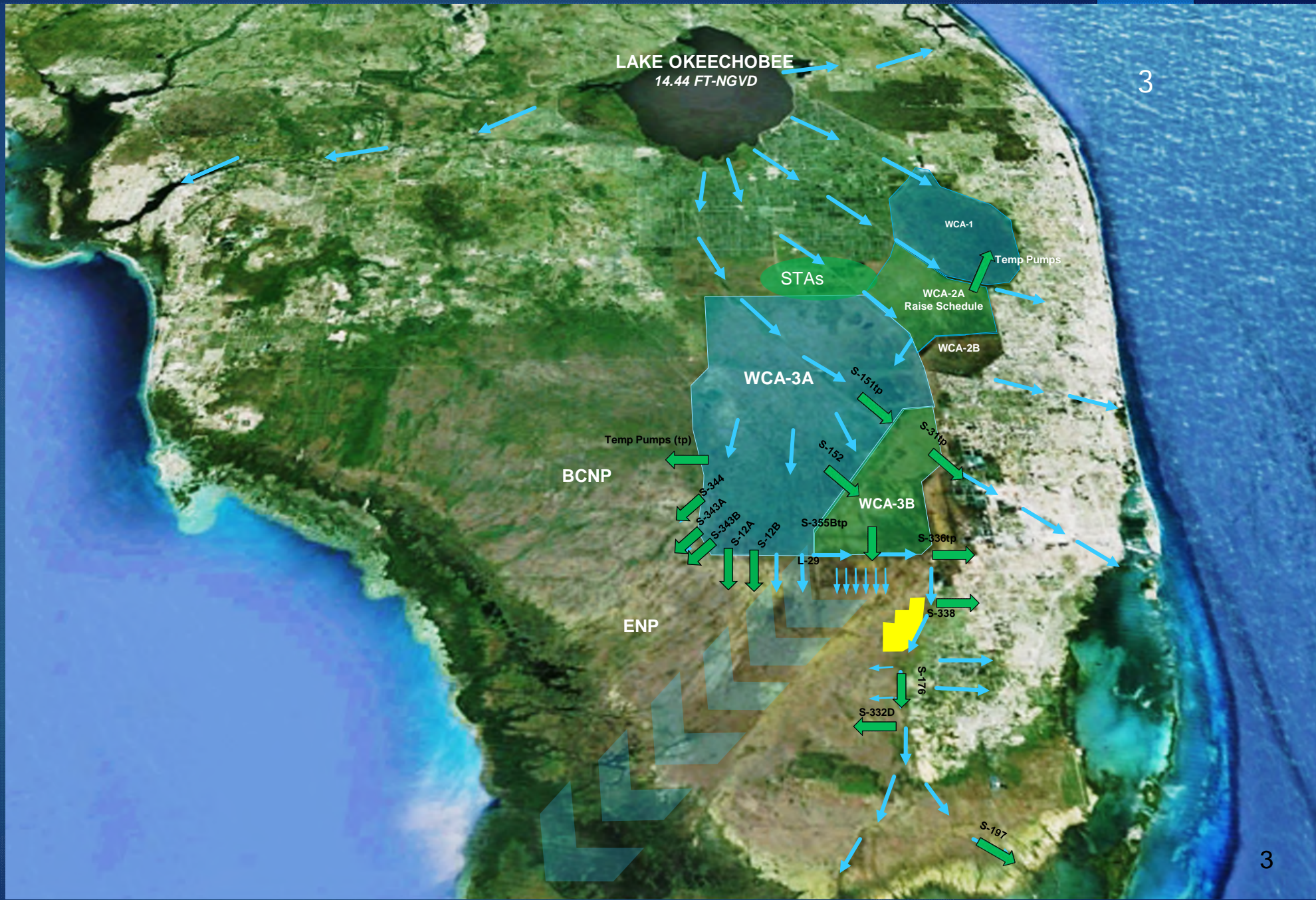
Vijay Mishra, P.E.
South Florida Water Management District



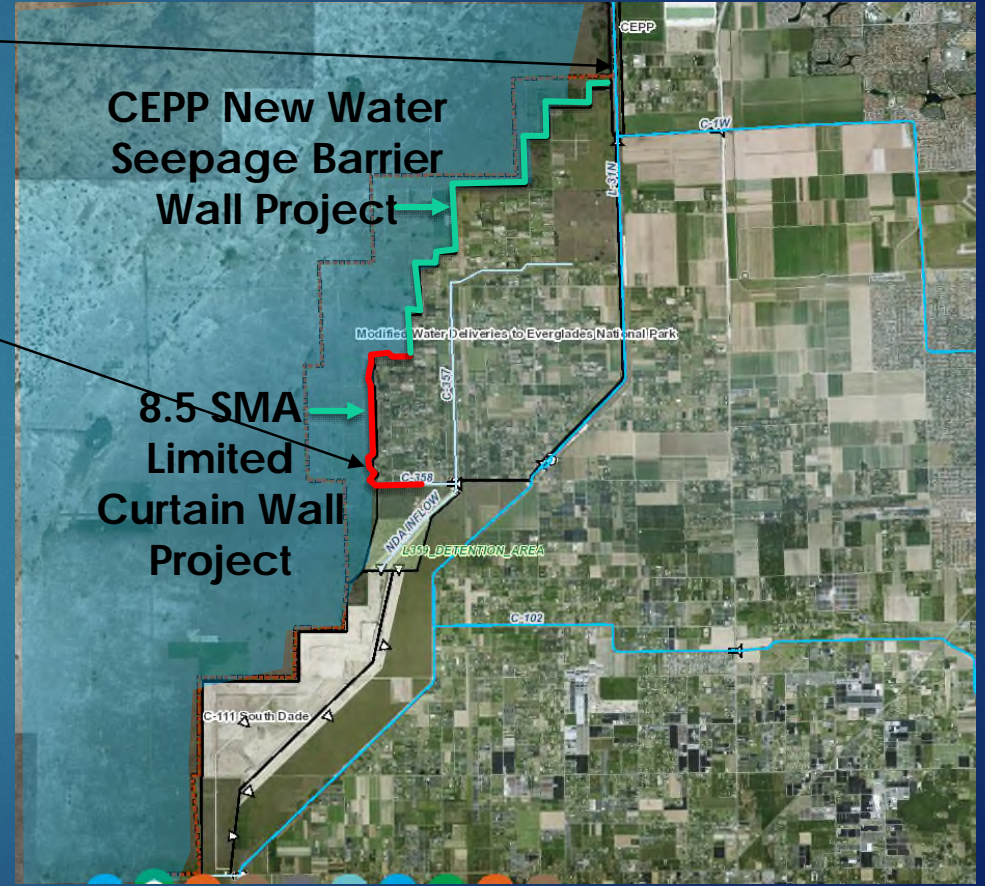
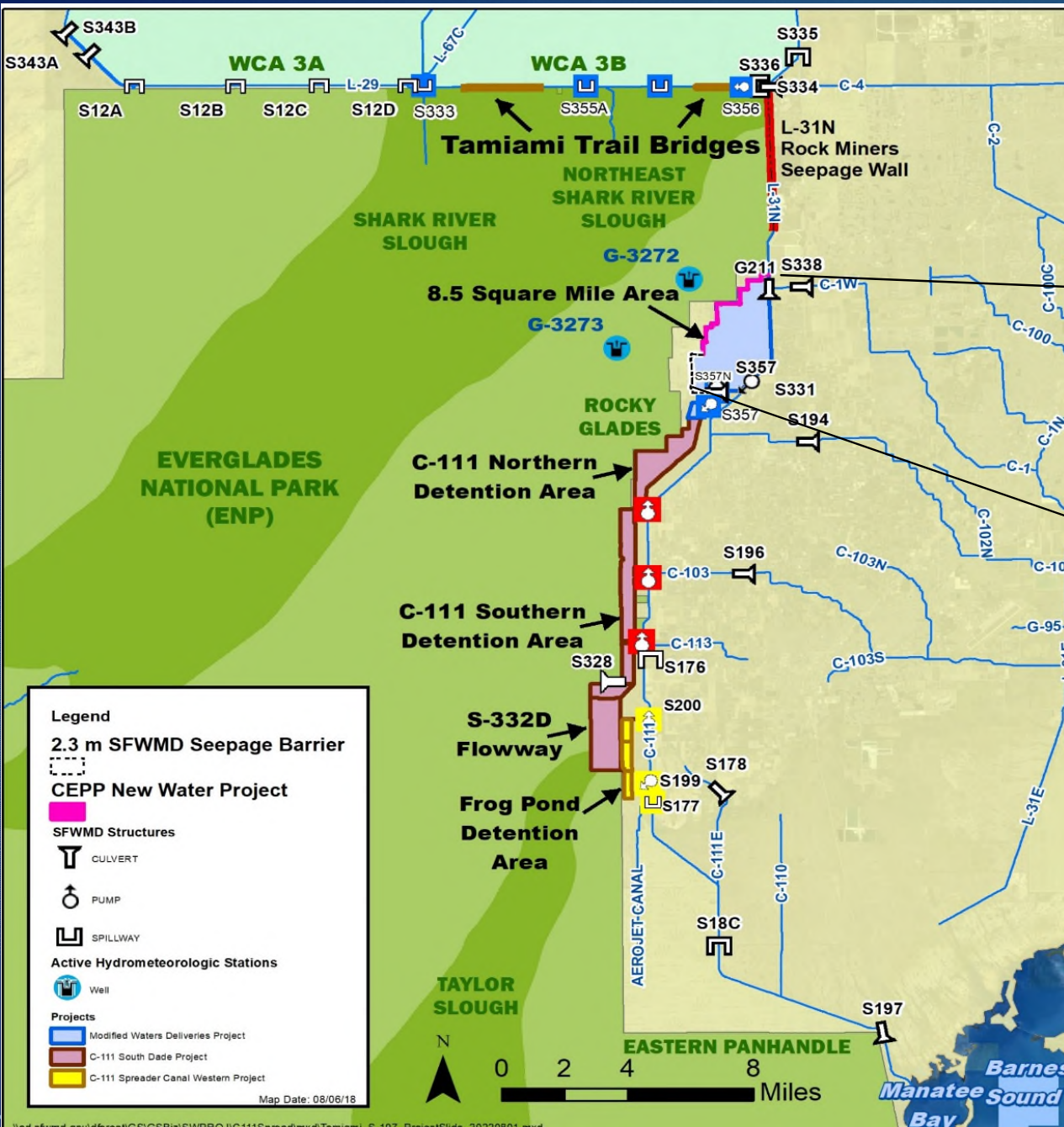
Restoration Depends on Sending Water South



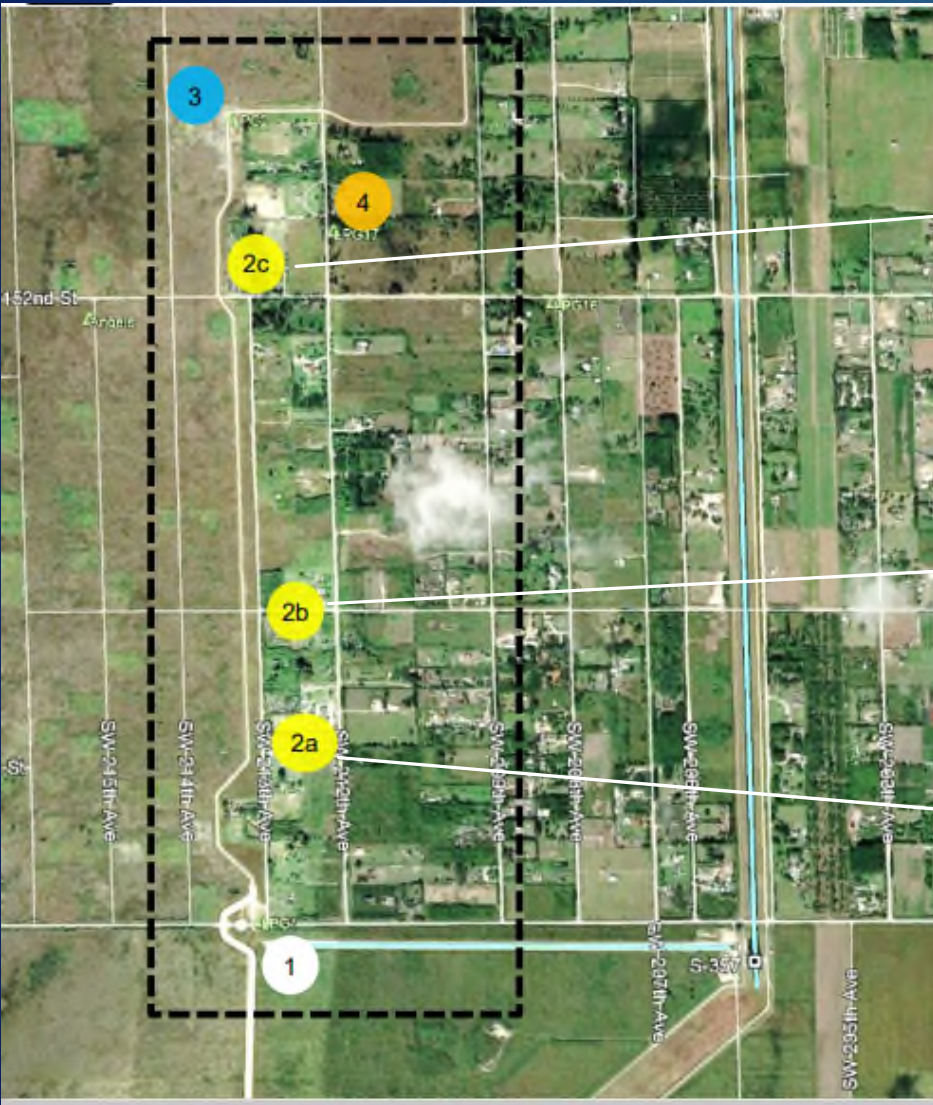
How Does The Water Flow South?



Location



Recent 8.5 SMA Conditions



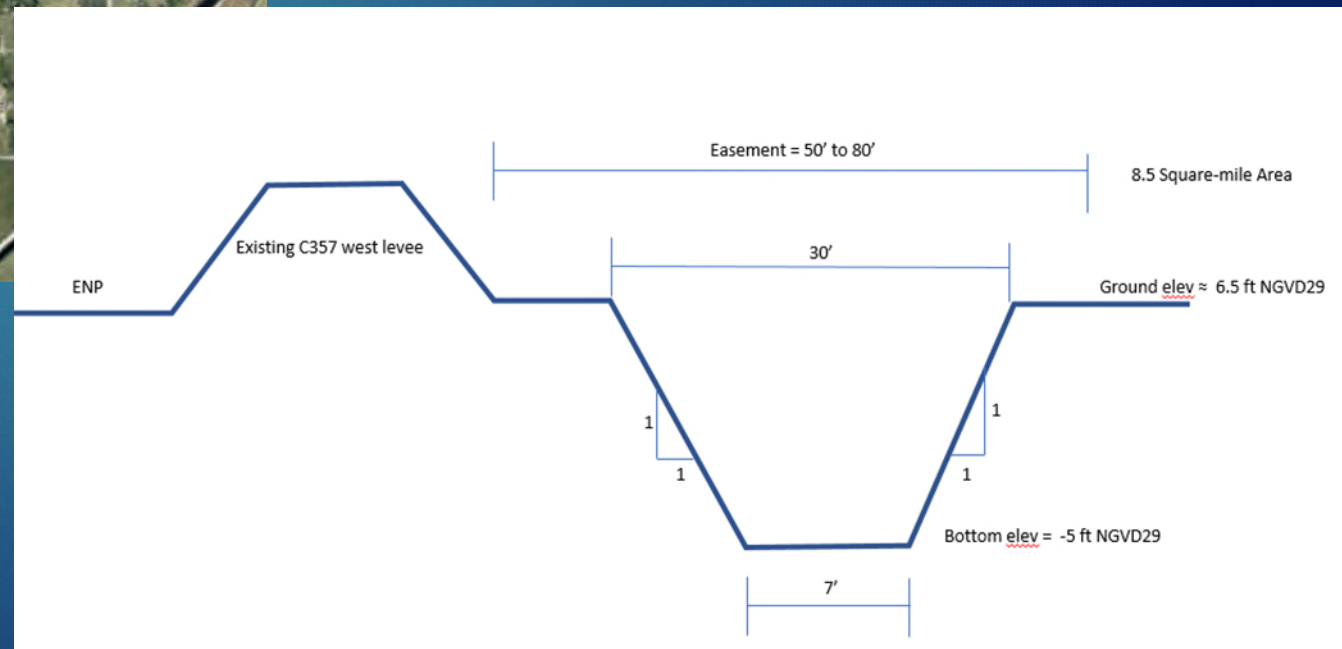
Photos taken 10/23/2020



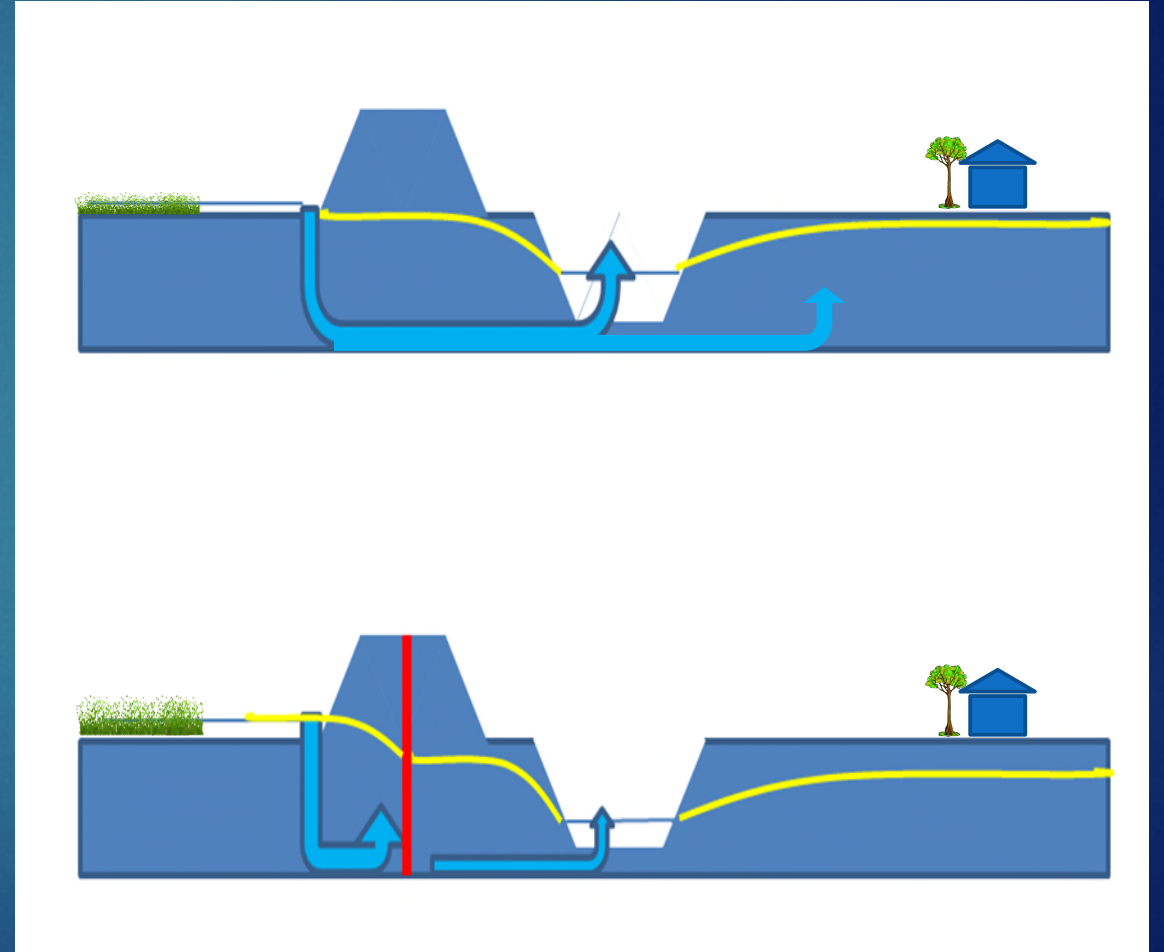


Preliminary siting assessment indicates a 50' to 80' easement east of the 8.5 SMA levee which could accommodate a 30' top-width canal

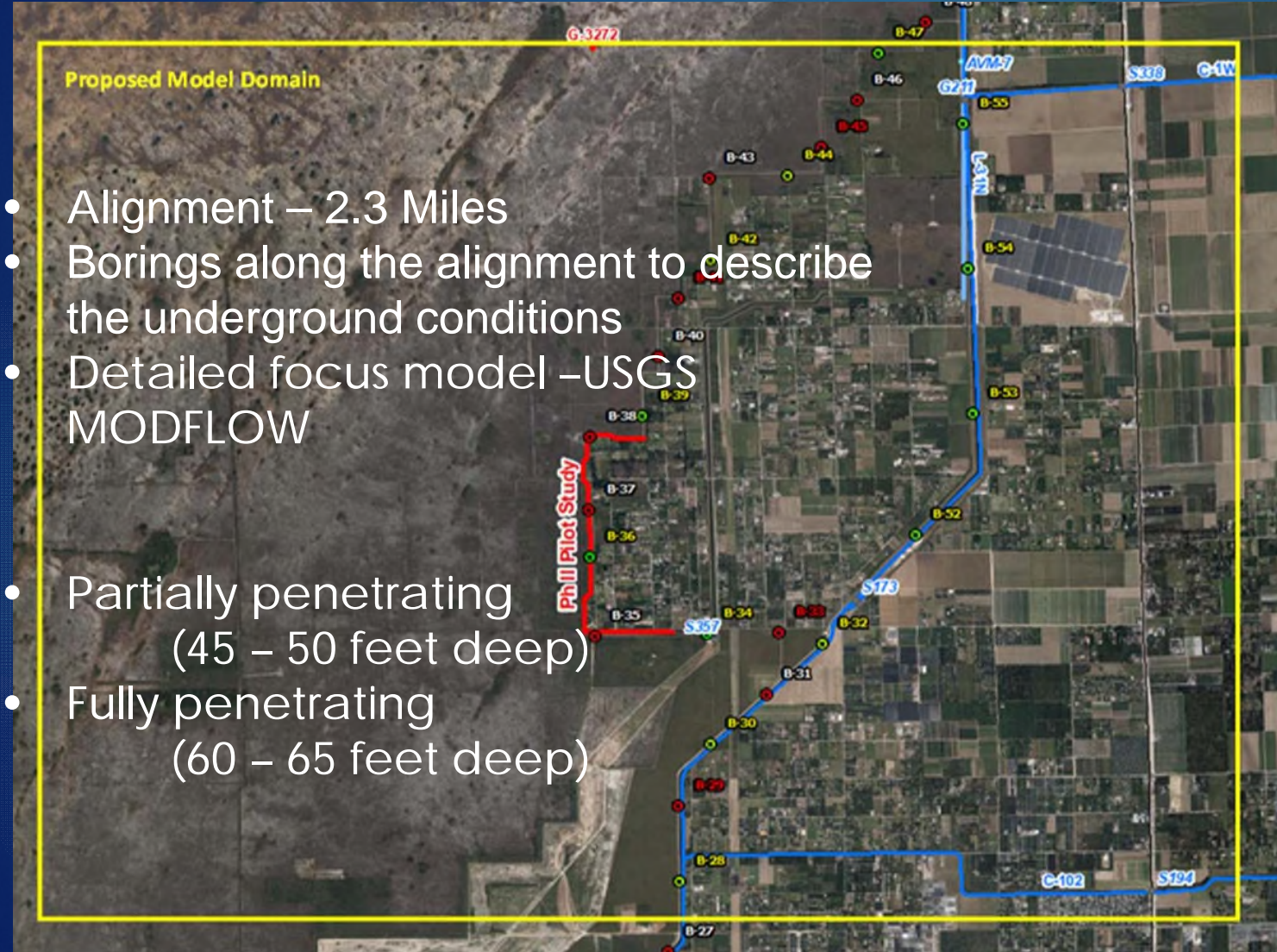
Assumed Canal Cross Section Similar to existing C-358 Canal



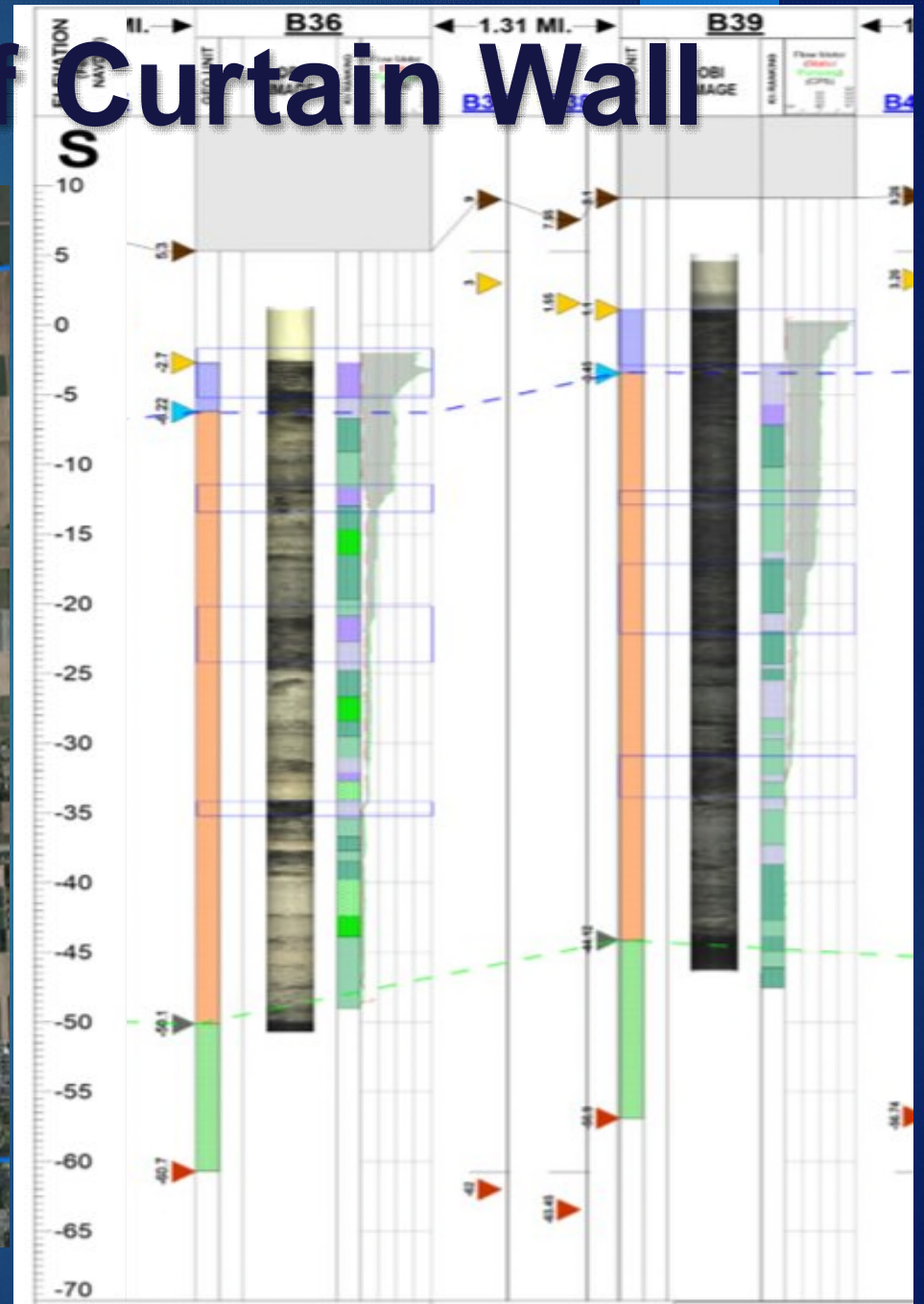
Characteristics of Curtain Walls



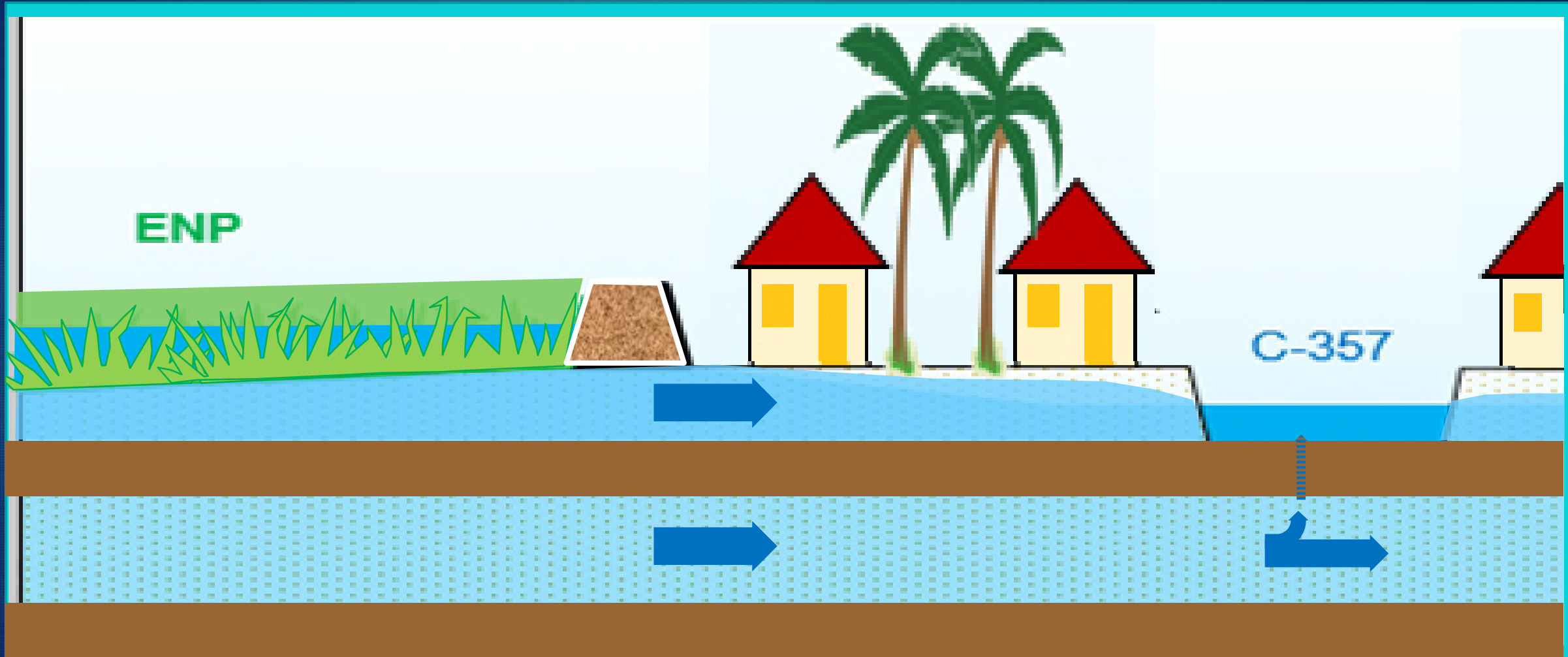
Location and Depth of Curtain Wall



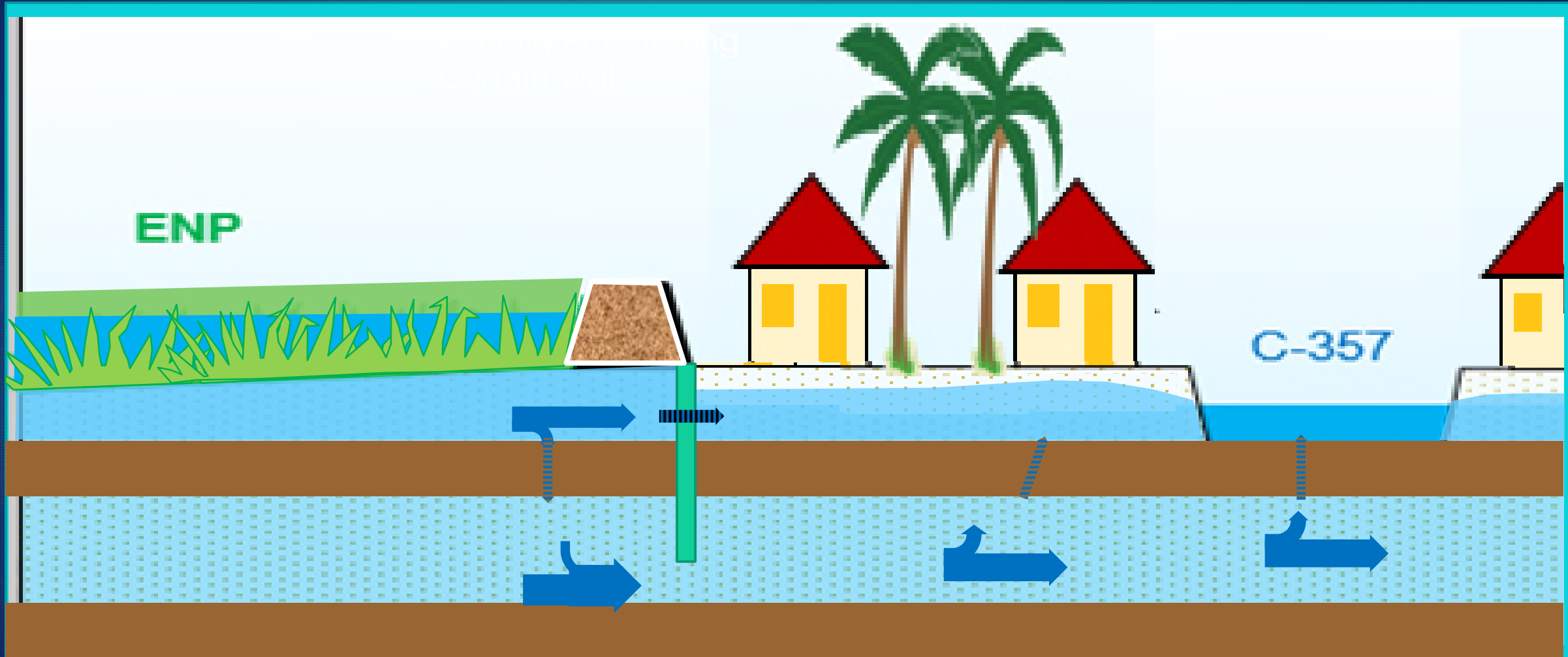
- Alignment – 2.3 Miles
- Borings along the alignment to describe the underground conditions
- Detailed focus model – USGS MODFLOW
- Partially penetrating (45 – 50 feet deep)
- Fully penetrating (60 – 65 feet deep)



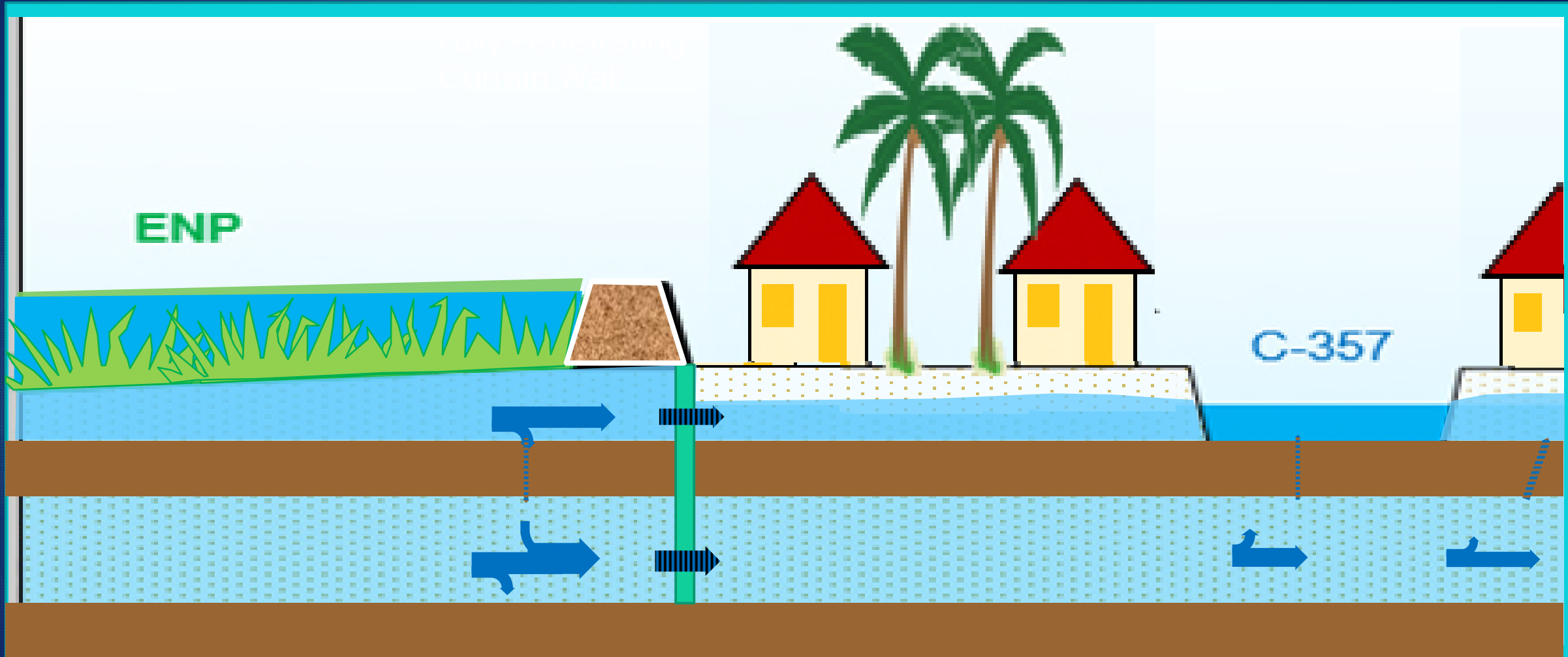
Curtain Wall for 8.5 SMA



Effect of Curtain Wall Depth



Effect of Curtain Wall Depth



Seepage Reduction

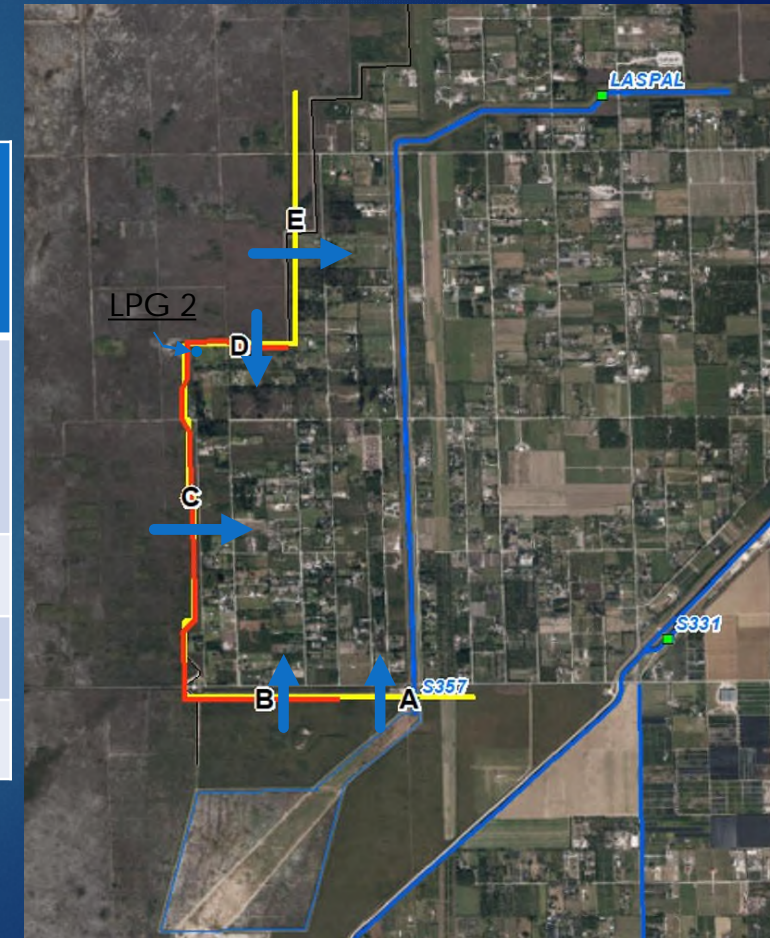
Performance of fully penetrating and partially penetrating curtain wall (wet conditions represented by 2017 rainfall)

Current Condition	Simulated Seepage during Wet Month (Oct 2017) (ac-ft/day)		Simulated Conditions at LPG-2	
	Wall Transect (B+C+D)	Edges Transect (A+E)	Avg Stage October 2017 Ft NGVD	Days with water above ground * Days/year
Without Curtain Wall	400	296	7.26	152
Partially Penetrating Wall	225	305	6.77	142
Fully Penetrating Wall	36	344	4.38	5

* Based on simulated wet year conditions at cell representing LPG2 Well

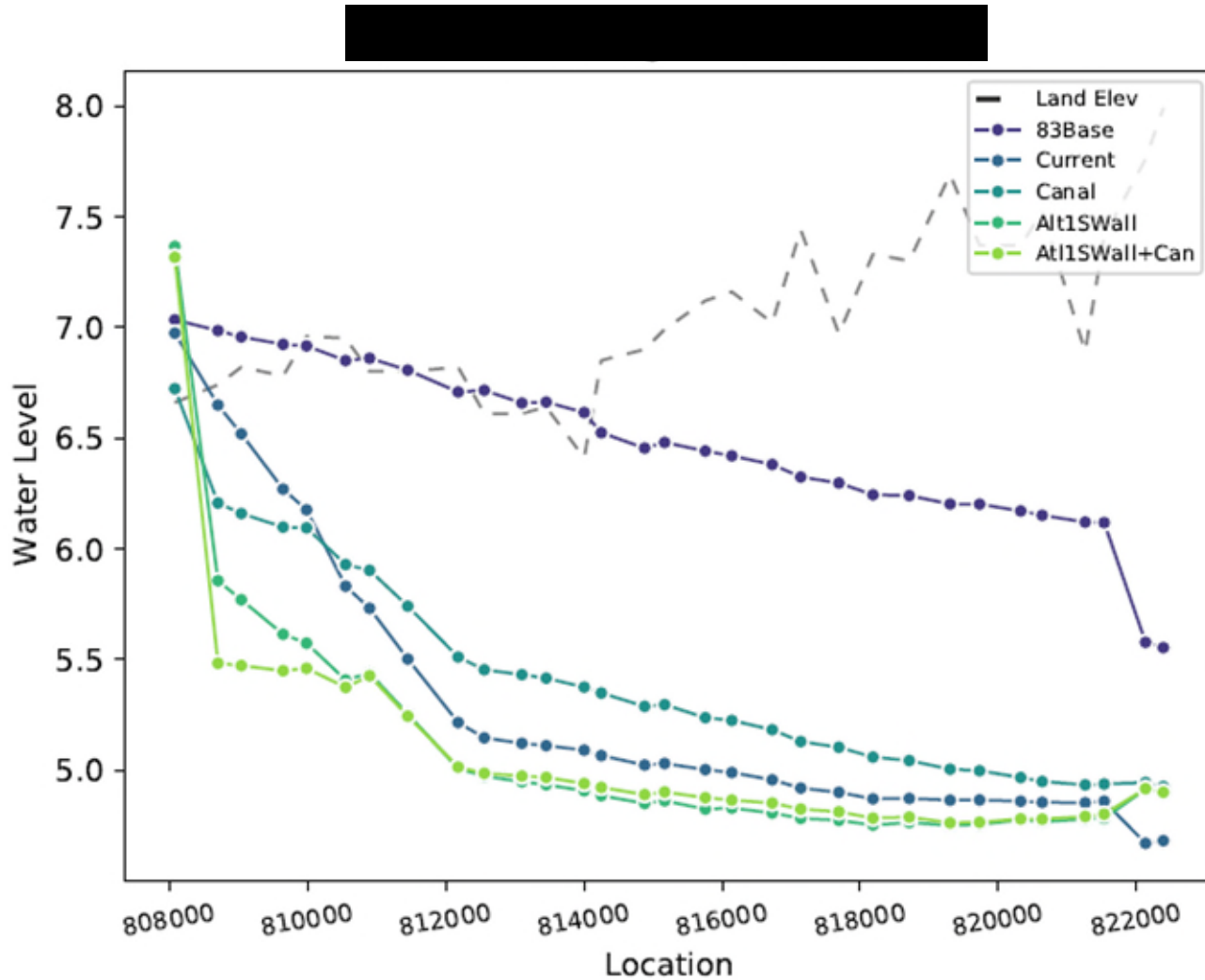
Red numbers = increase in seepage into 8.5 SMA

Green numbers = reduction in seepage into 8.5 SMA



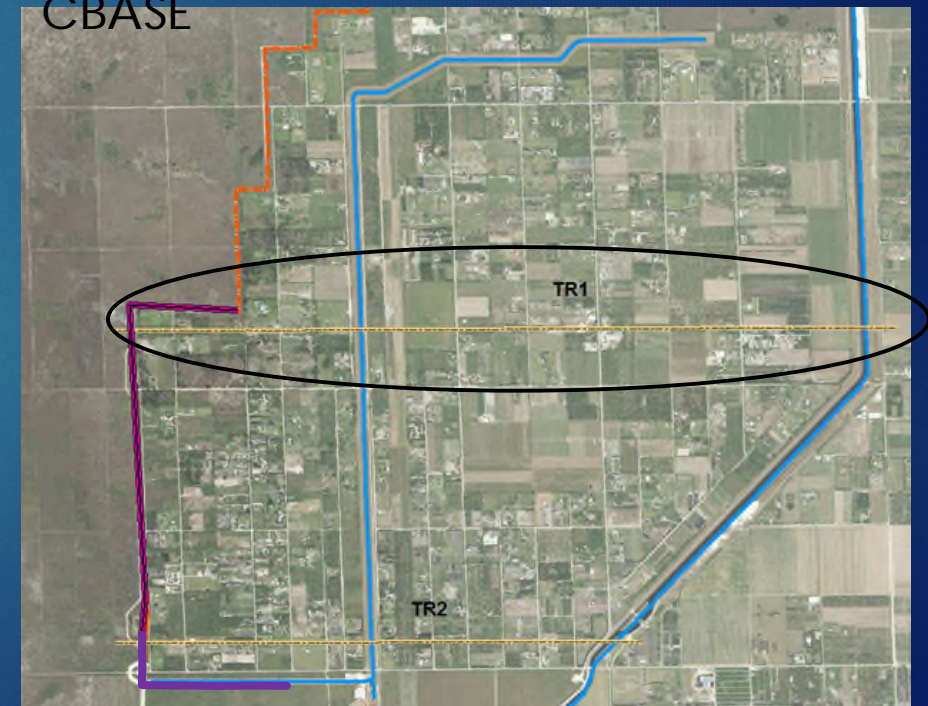
Compared seepage across shown transects A through E

Simulated High Water Stage Along Transect 1 (TR1) With Fully Penetrating Wall



Model simulated high water stages along Transect 1 for the base conditions and scenarios

Note depth to water table on eastern half of the transect for 83Base and CBASE



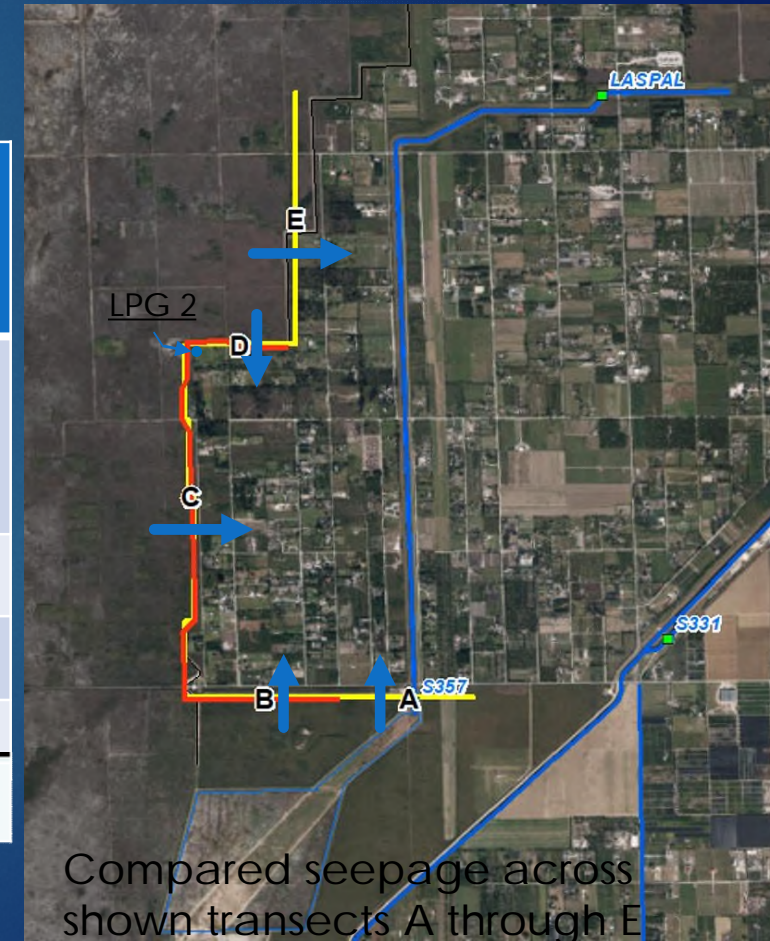
Seepage Reduction

Performance of fully penetrating and partially penetrating curtain wall (wet conditions represented by 2017 rainfall)

Future Condition (Higher water level in NESRS equivalent to CEPP simulated stages)	Simulated Seepage during Wet Month (Oct 2017) (ac-ft/day)		Simulated Conditions at LPG-2	
	Wall Transect (B+C+D)	Edges Transect (A+E)	Avg Stage October 2017 Ft NGVD	Days with water above ground * Days/year
Without Curtain Wall	863	408	8.10	246
Partially Penetrating Wall	299	440	7.33	243
Fully Penetrating Wall	44	484	4.85	44
Current Without Curtain Wall	400	296	7.26	152

* Based on simulated wet year conditions at cell representing LPG2 Well

Red numbers = increase in seepage into 8.5 SMA
Green numbers = reduction in seepage into 8.5



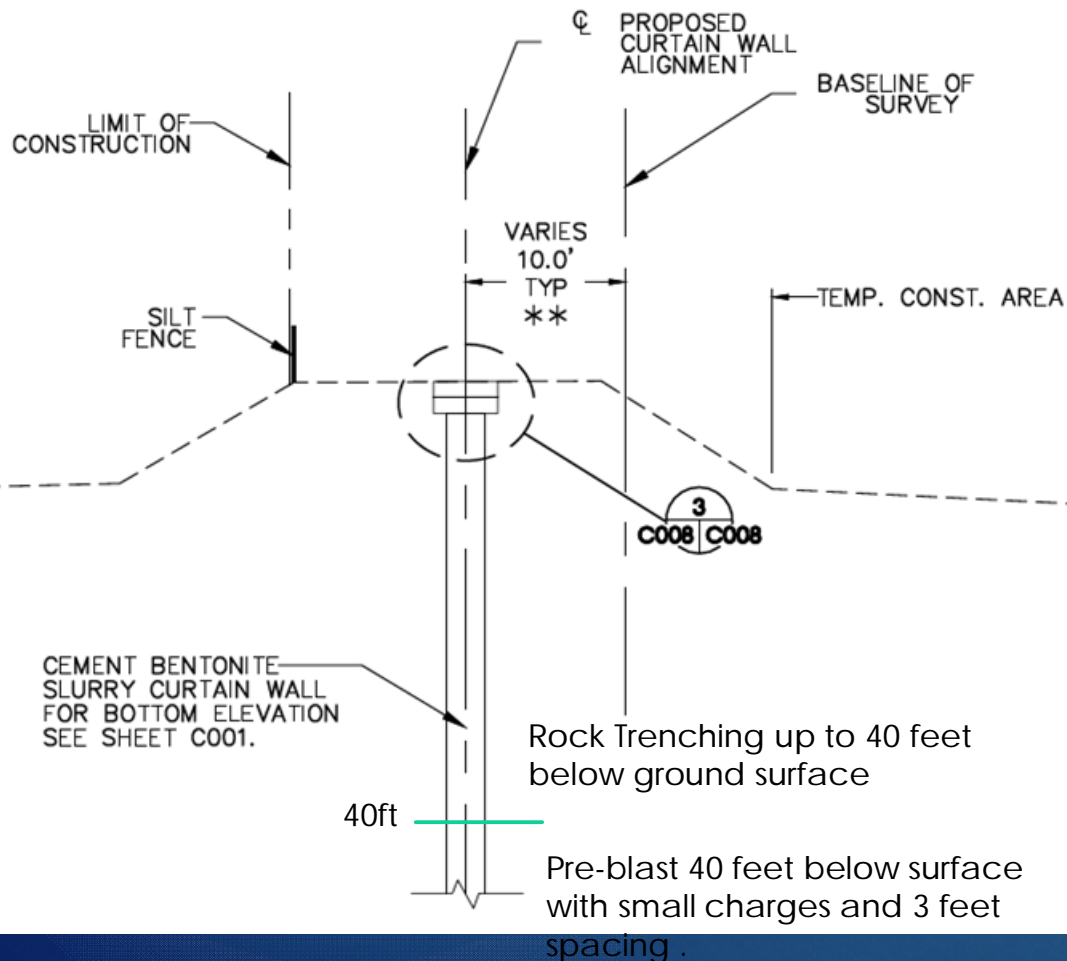
Summary of Curtain Wall Performance

- Both Partially Penetrating and Fully Penetrating curtain wall depths successfully reduce seepage and lower water levels in the 8.5 SMA under current conditions
- The partially penetrating wall reduces seepage relative to future conditions without wall but simulated average stages at LPG2 exceed current conditions
- Important takeaways include:
 1. Both the regional model and the detailed design model show that the curtain wall holds water in the natural areas by reducing seepage to the east
 2. Both models confirm the edge effect – increased seepage due to higher gradient where the wall ends
 3. The addition of a southern (east/west) leg to the curtain wall as part of the design improved overall performance

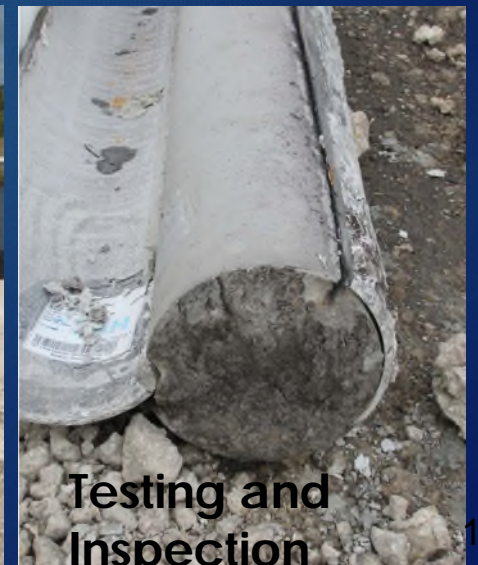
8.5 SMA Limited Curtain Wall Construction

8.5 SMA Limited Curtain Wall Features

- Approximately 63 feet deep and 26 inches wide
- Approximately 2.3 miles long
- Contractor to test means and methods
- Test section – 500 foot long - south of Richmond Dr
 - Pre-blasting and Trenching
 - Excavation
 - Back-fill with cement-bentonite slurry
 - Testing and inspection

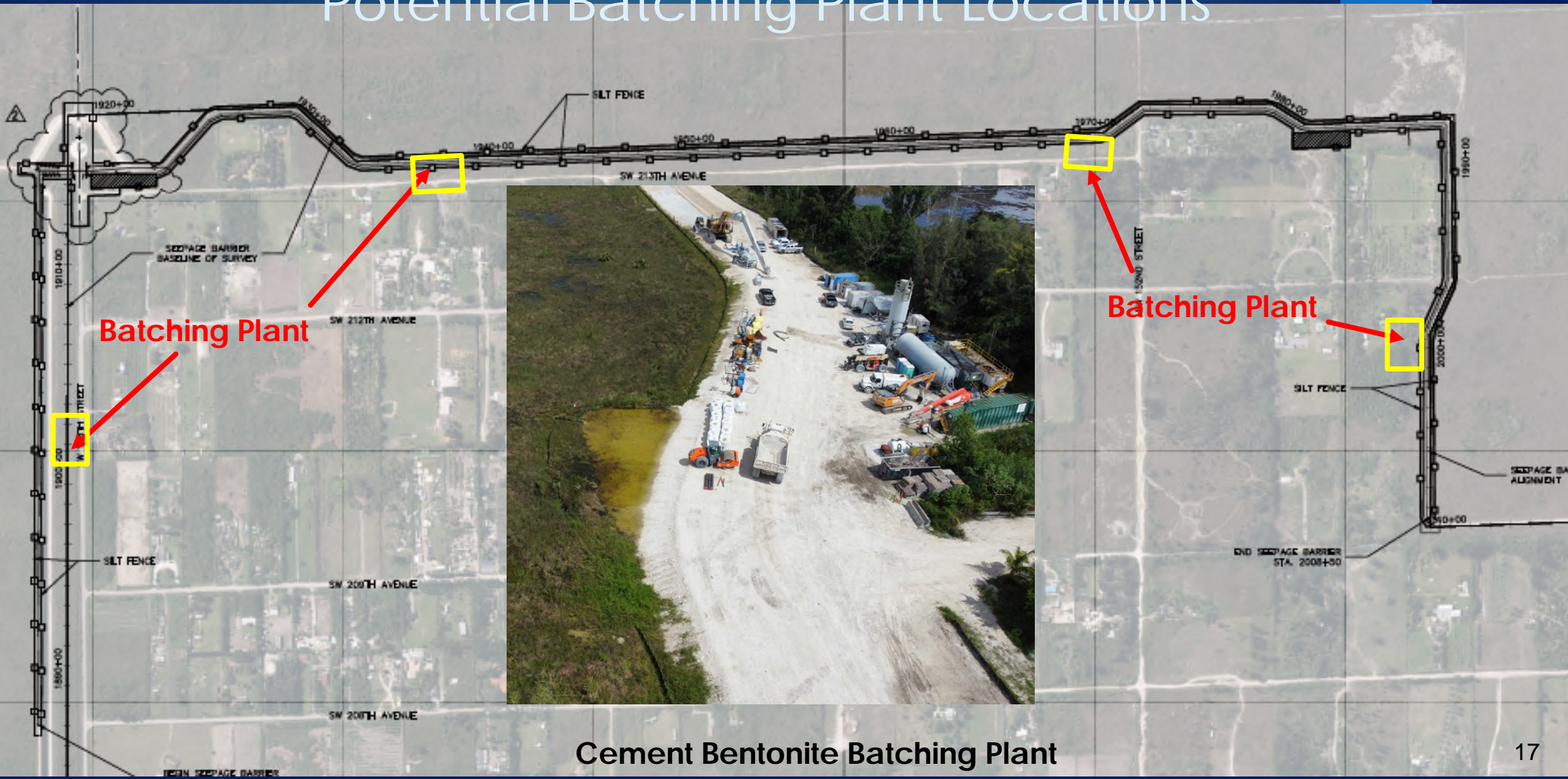


Trenching Equipment



Testing and Inspection

Limits of Construction and Potential Batching Plant Locations



Cement Bentonite Batching Plant

8.5 SMA Limited Curtain Wall Features

BID SUMMARY	
Bid Opening Date	March 3, 2021
Engineer's Estimate Cost	\$15,400,000 to \$17,000,000
STATS SUMMARY	
Total Length	2.3 Mi
Depth	approx. 63 Ft. deep
Thickness	26 inches (min)
Strength	10 PSI (min)
Permeability	9×10^{-6} cm/sec, similar to HDD Cutoff Wall

Map Key

Active Hydrometeorologic Stations

- Stage

Structures

- Culvert
- Pump

Canals

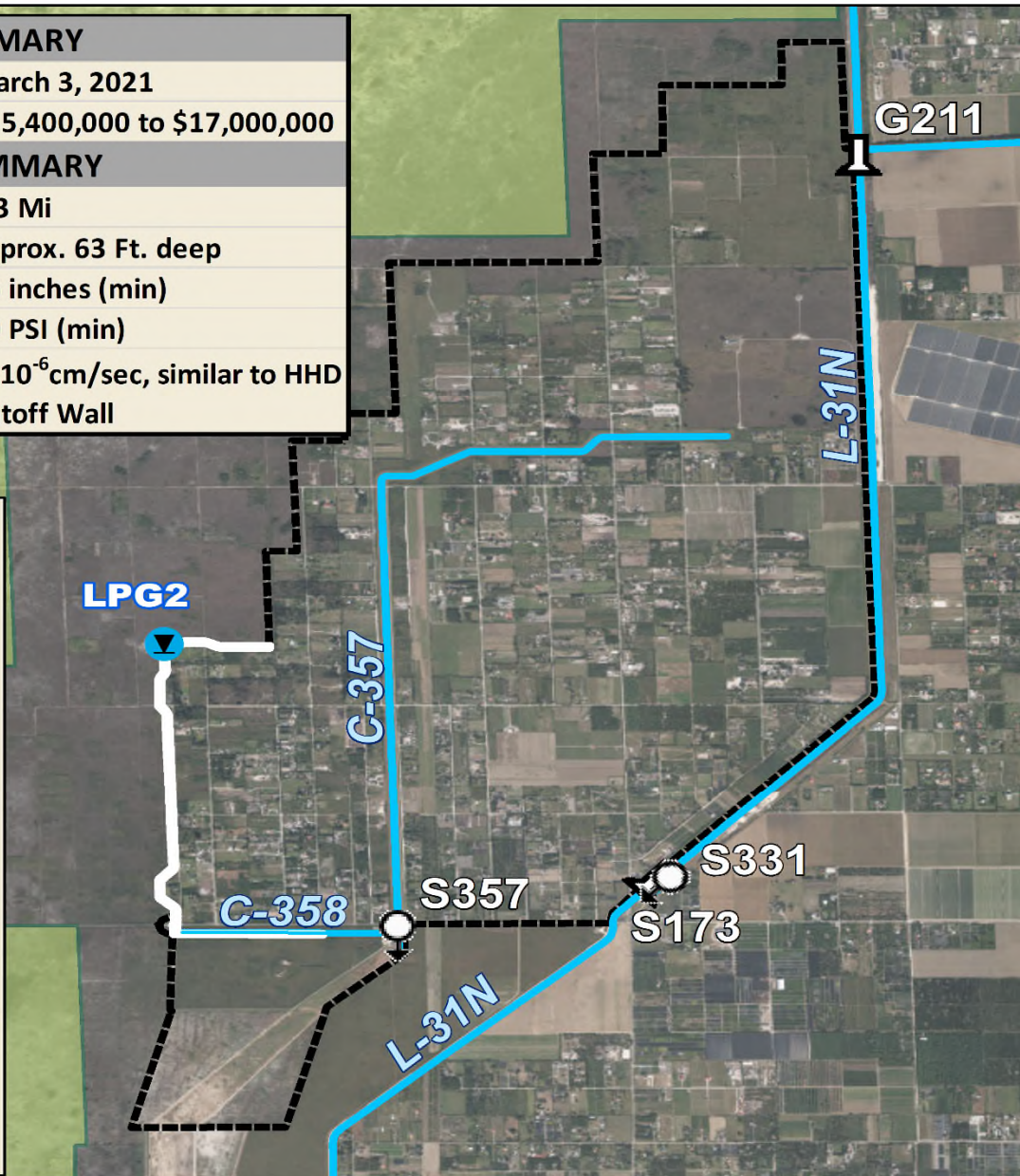
- Canals

State Parks (FNAI)

- Everglades National Park

8.5 Square Mile Area

- Limits of Construction
- Actual Boundary



- **Test Section:** Contractor shall demonstrate 500 feet wall test section with means and methods before proceeding with entire project









Trenching



Curtain Wall Excavation and Filling with Cement-Bentonite Slurry



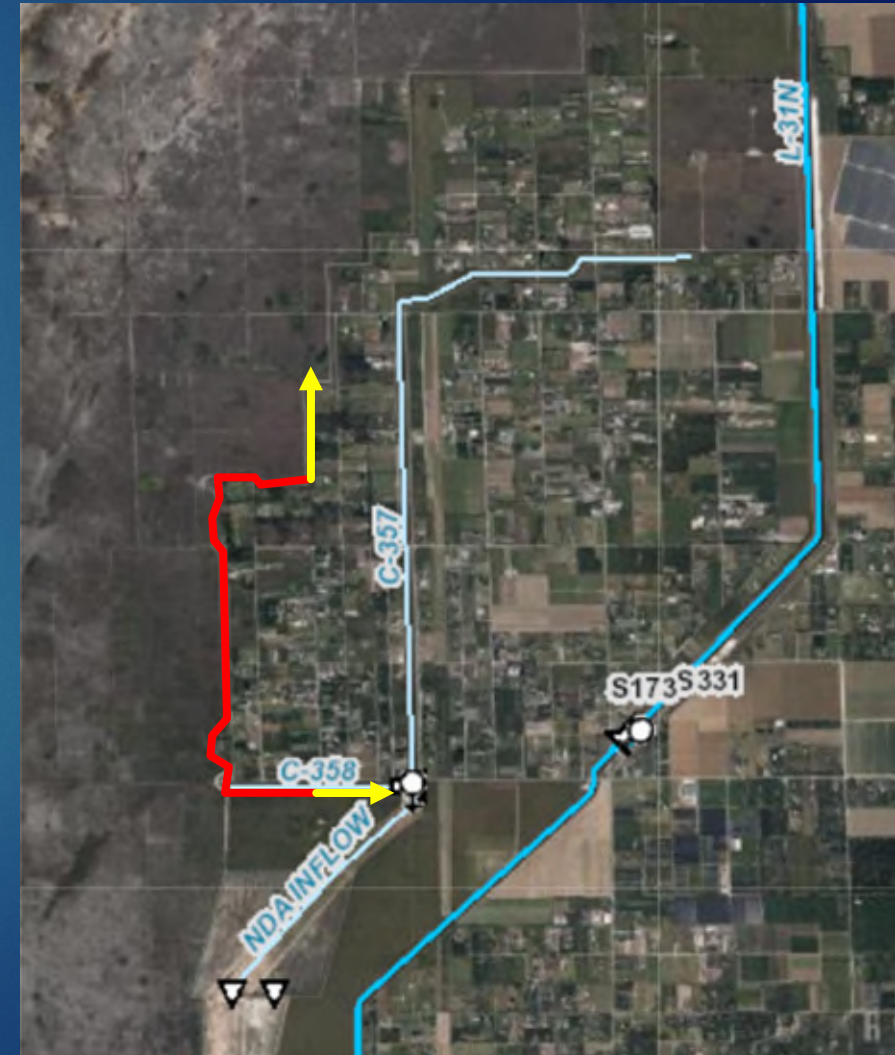
8.5 SMA Limited Curtain Wall Construction Schedule

- ▶ Clearing and Grubbing: May 17, 2021
- ▶ Office Mobilization: May 21, 2021
- ▶ Batching plant mobilization: June 22, 2021 (estimated)
- ▶ Blasting: June 28th, 2021 (estimated)
- ▶ Trenching: July 5th, 2021 (estimated)
- ▶ Cement-Betonite Wall Construction: July 9th, 2021
- ▶ Project Completion: April 2022

8.5 SMA Curtain Wall Extension

25

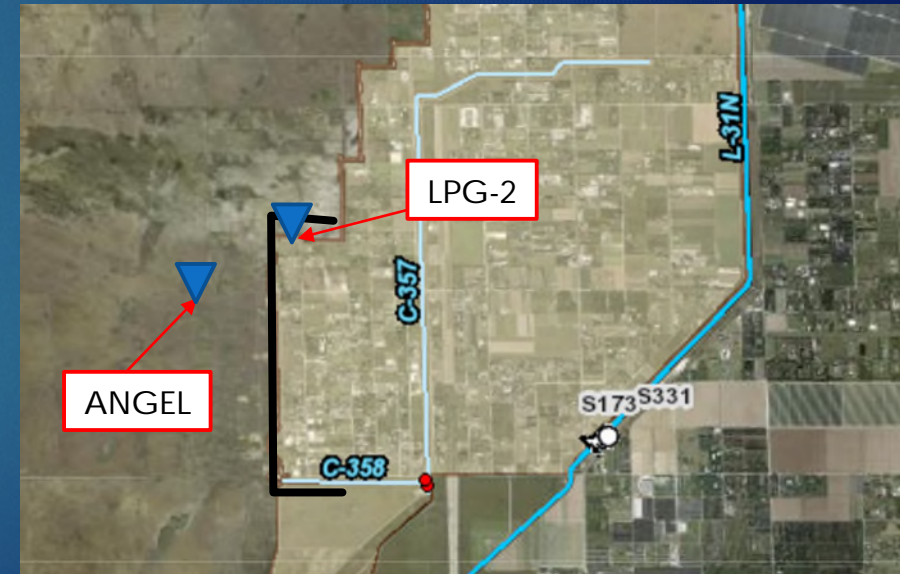
- Current construction contracts allow District to complete 2.3 miles at using low bid lumpsum contract and exercise an option to extend the Curtain Wall beyond the 2.3-mile base wall alignment at per square feet price at districts discretion.
- Extension can proceed in either direction of the limited Curtain wall project.
- This allows the district subject to governing board approval and funding to continue beyond the planned 2.3-mile section advancing necessary mitigation to allow additional restoration flows to NESRS



DBHYDRO Chart



8.5 SMA Limited
Curtain Wall is
working



Provisional data, if present, are indicated by square symbol.

DBKey	Station	Agency	Data Type	Unit	Statistic	Frequency	Strata	Gate/Pump#
07103	ANGEL	WMD	WELL	ft NGVD29	MEAN	DA	0	N/A
37740	LPG2	WMD	STG	ft NGVD29	MEAN	DA	0	N/A



8.5 SMA Limited Curtain Wall is working

CEPP Seepage Barrier Wall

STATS SUMMARY	
Total Length	5 Mi
Depth	approx. 63 Ft. deep
Thickness	26 inches (min)
Strength	10 PSI (min)
Permeability	9×10^{-6} cm/sec, similar to Limited Curtain Wall Project

Map Key

Active Hydrometeorologic Stations

- Stage

Structures

- Culvert
- Pump

Canals

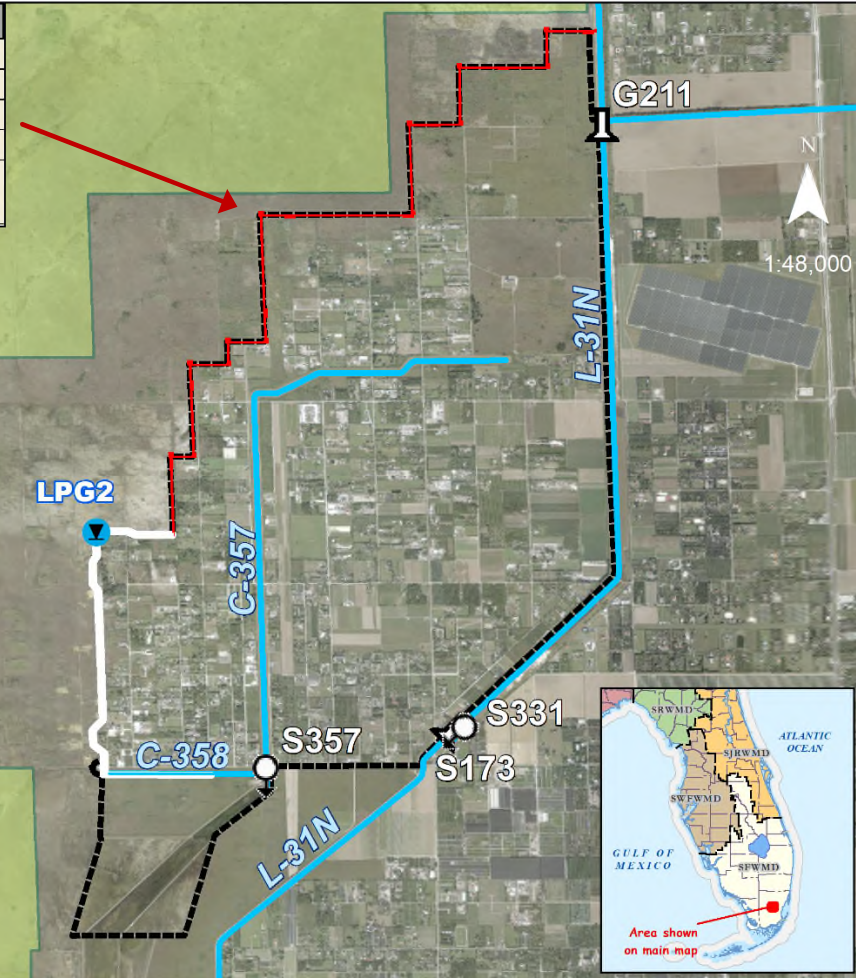
- Canals

State Parks (FNAI)

- Everglades National Park

8.5 Square Mile Area

- Limits of Construction
- Actual Boundary



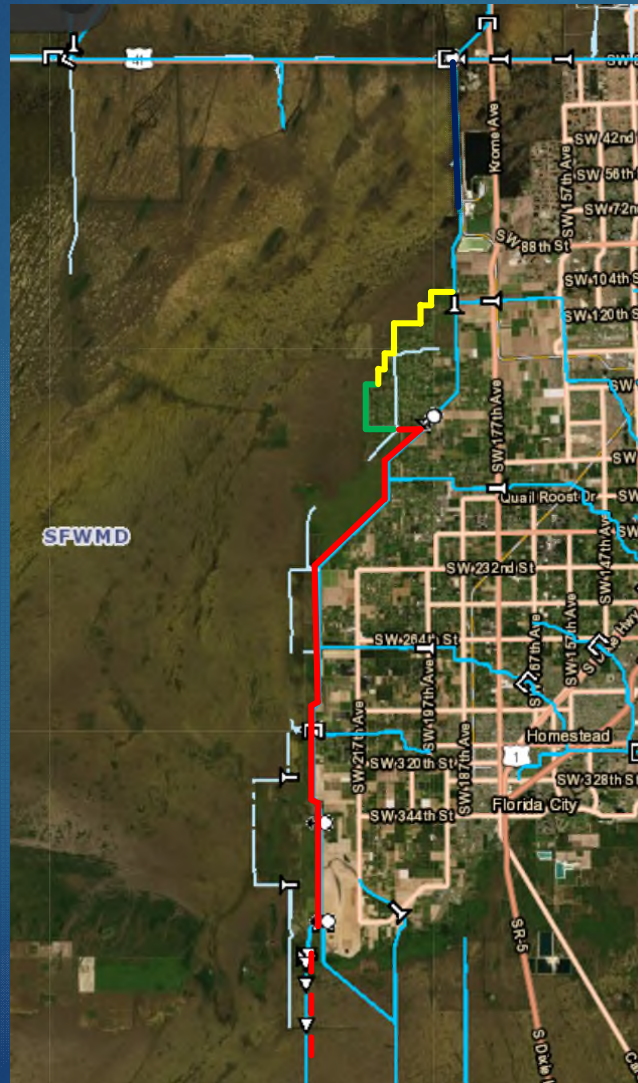
Total Wall Length: 5 miles
 Wall Depth: Approx. 63 feet deep
 Wall Width : 26-30 inch
 Project Duration: 24 months
 Project Completion: October 2024
 Bid Range: \$42,258,301 – 42,592,510



CB Wall Material

Potential Alignment of Curtain Wall

30



Existing Rock
Miners Wall

8.5 SMA CEPP New
Water Seepage Wall

8.5 SMA (Limited
Curtain Wall)

South Dade
Curtain Wall

Questions?