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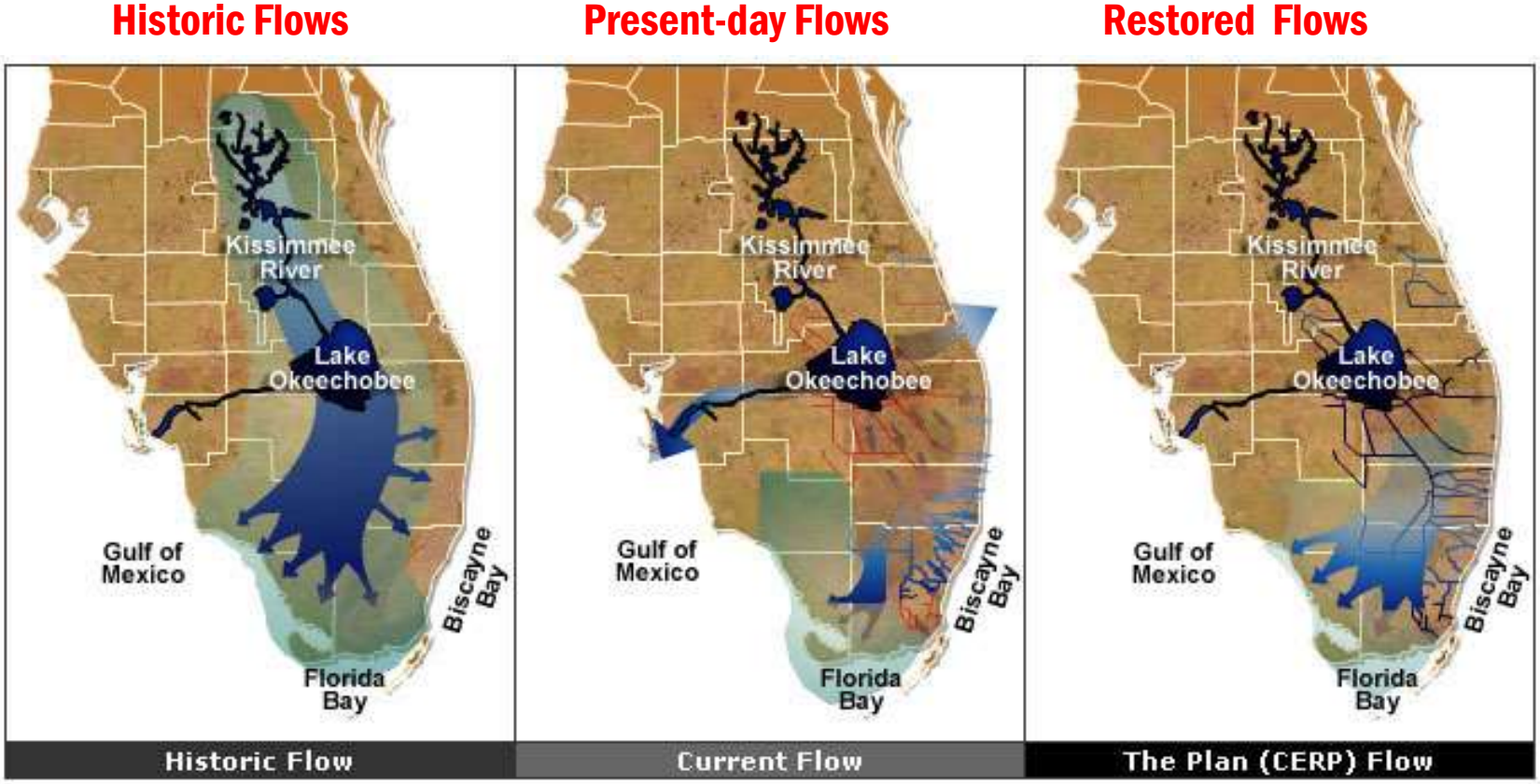
Critical Issues for CERP/CEPP/Check-up:

How much flow does the Everglades need to maintain ecosystem functions provided by ridge and slough landscape?



SOURCE: WWW.EVERGLADESPLAN.ORG

Critical Issues for CERP/CEPP/Check-up:

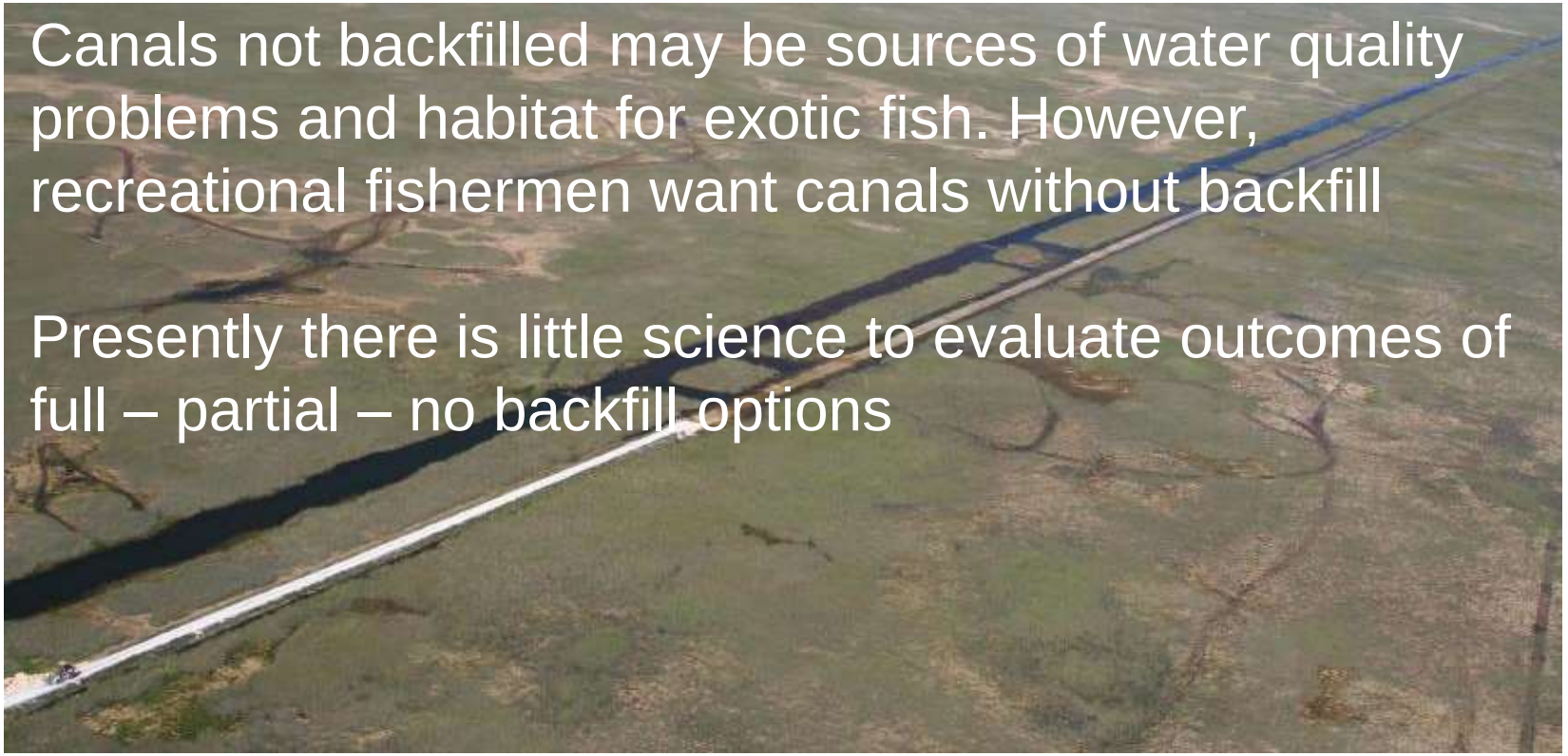
How will restored flow reconnect and restore deep-water sloughs that support dispersal pathways, nursery habitat, prey concentration/feeding areas

Pre-drainage ridge & slough landscape

Degraded ridge & slough landscape

Critical Issues for CERP/CEPP/Check-up:

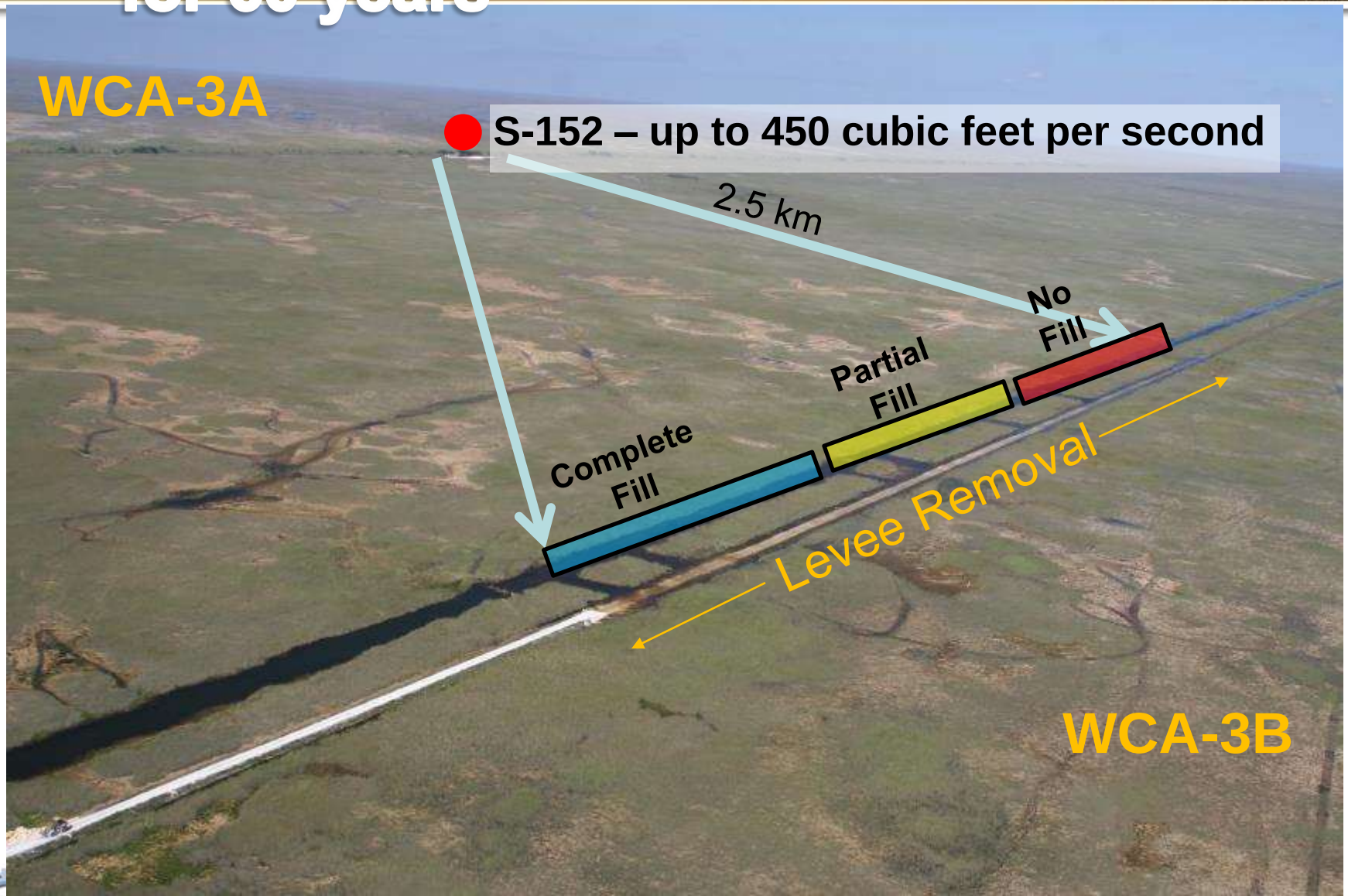
What should be done with canals that are no longer needed for water conveyance?



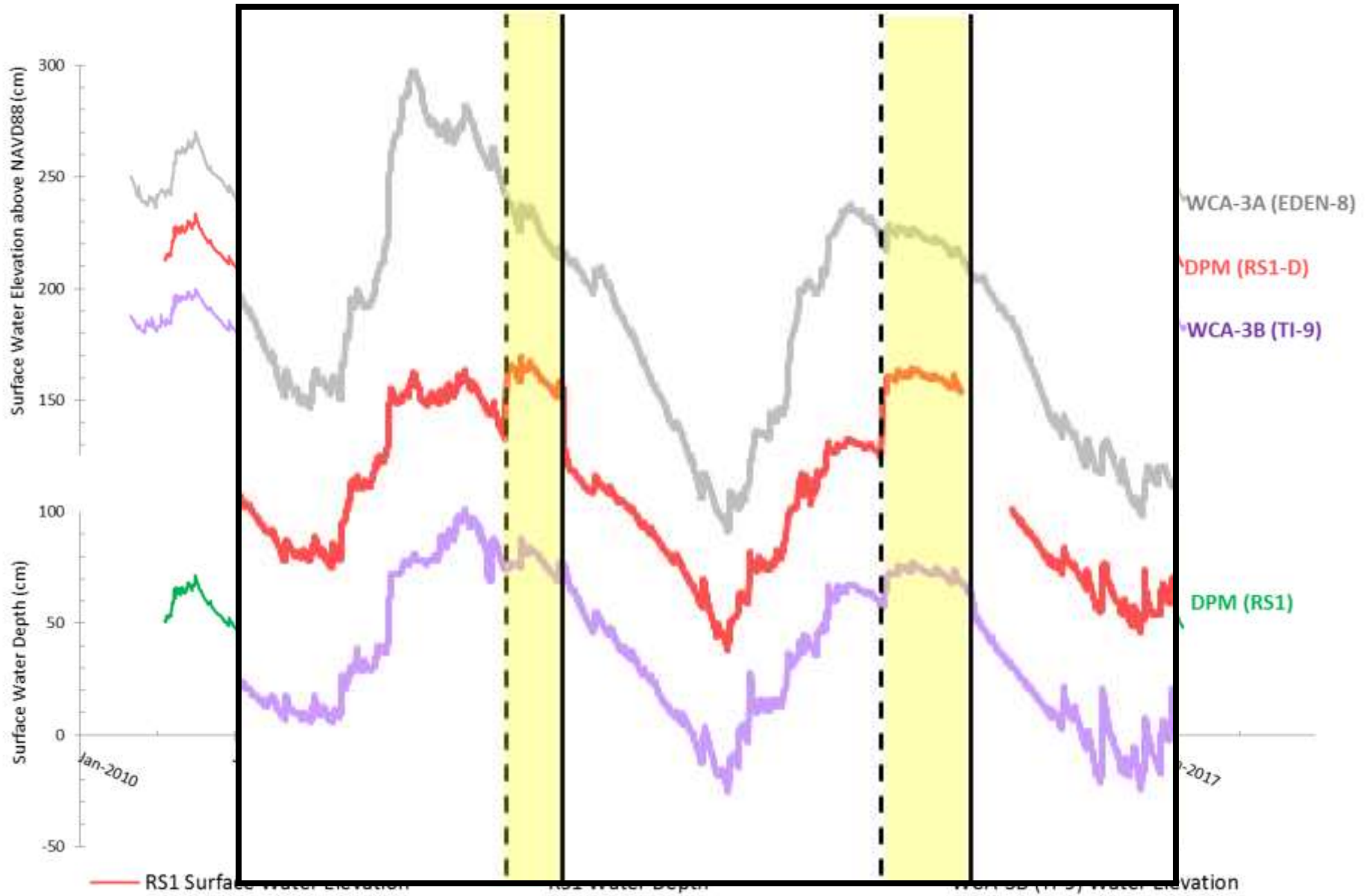
Canals not backfilled may be sources of water quality problems and habitat for exotic fish. However, recreational fishermen want canals without backfill

Presently there is little science to evaluate outcomes of full – partial – no backfill options

The DPM Footprint – isolated from flow for 60 years



Three years of background and four years of flow



TESTING THE RESTORATION OF A FREE-FLOWING EVERGLADES:

The DPM High-Flow Experiments

Jud Harvey[1], Laurel Larsen[2,1], Colin Saunders[3] Sue Newman[3], Barry Rosen[1], David Ho[4] and Jay Choi[1]

1- U.S. Geological Survey-Reston, VA, 2 - U.C.-Berkeley, 3- South Florida Water Management District, 4 - U. Hawaii,

Feedbacks: slough clearing increases flow/sediment transport…more flow

Questions:

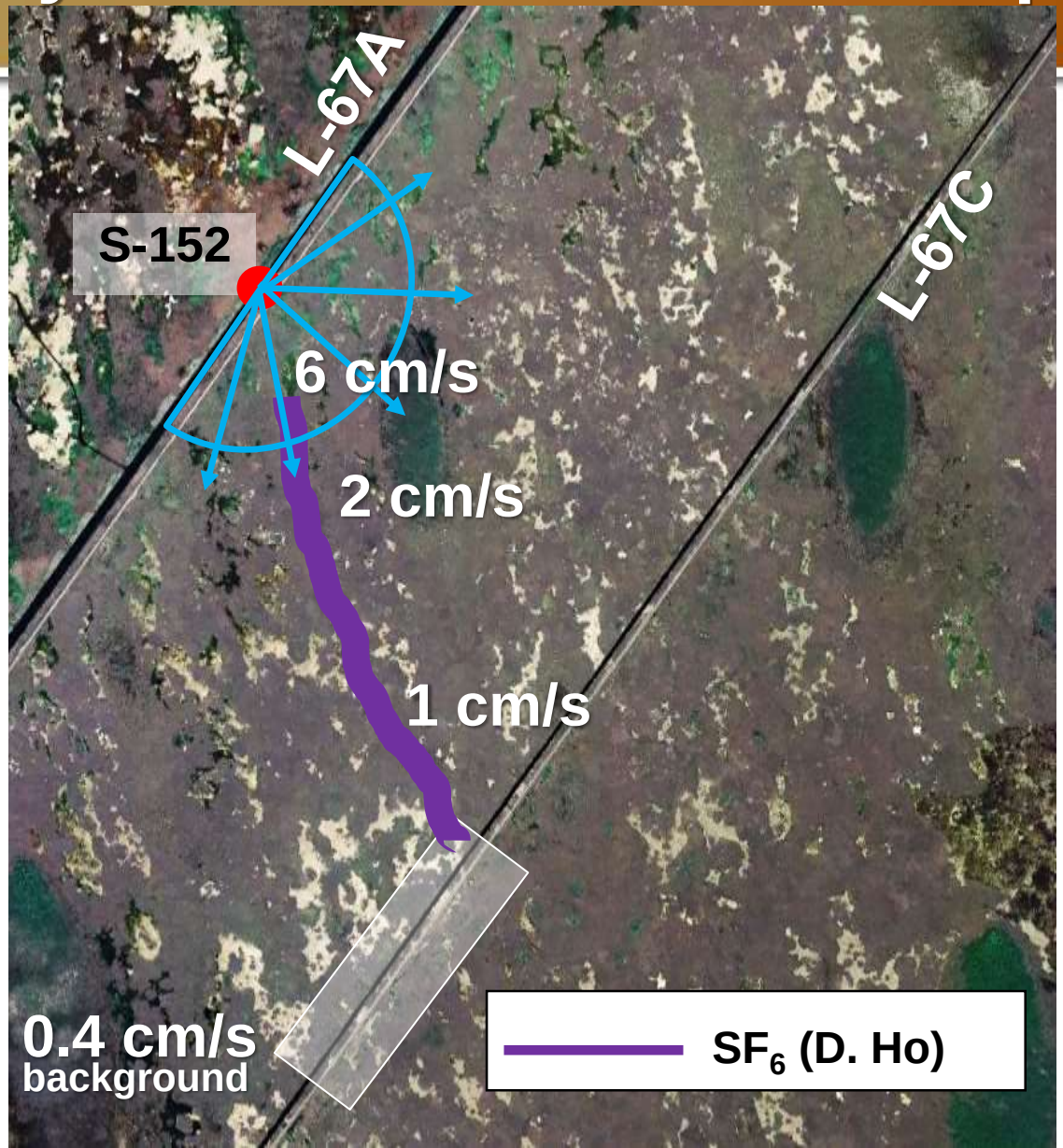
1) How does restored high flow influence remaining deepwater sloughs in a degraded part of Everglades?

2) Is the observed "slough clearing" likely to be a self-reinforcing process that will cause sloughs to expand in the future?

3) What is the relative influence of …

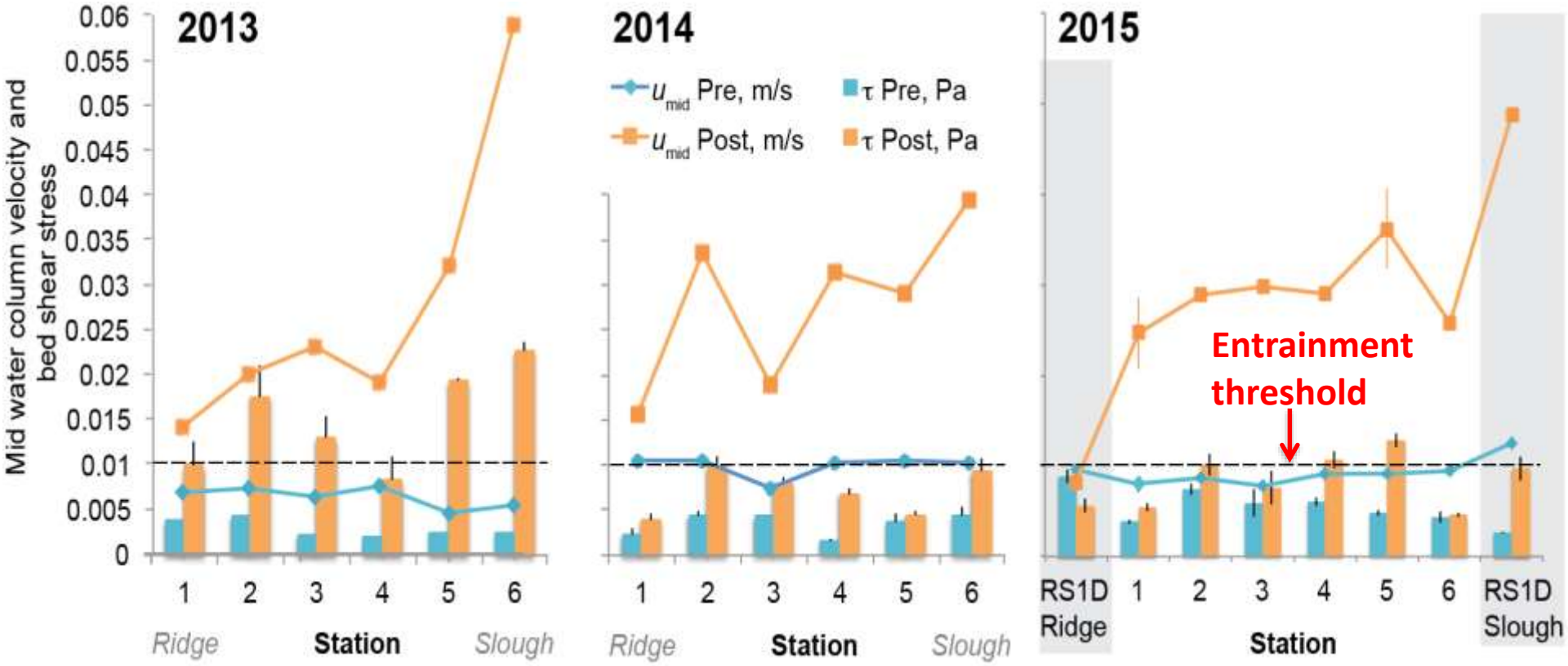
- sediment transport? floc redistribution from sloughs to ridges
- changes in periphyton and floc dynamics driven by …
  - biochemical effects, e.g., greater phosphorus loading
  - flow effects on floc decomposition

Analysis for for southern flow path




Ridge flow speed
before flow release
during flow release
Depth (cm)
Horizontal Velocity (cm/s)
0
10
20
30
40
50
60
1
2
3
4
5
Slough flow speed
before flow release
during flow release
Depth (cm)
Horizontal Velocity (cm/s)
USGS

Flow pulses induce sediment movement



- Shear stress exceed bed floc entrainment threshold in slough during high flow, but only rarely in ridge

Data from L. Larsen

Low Flow

High Flow

Low Flow

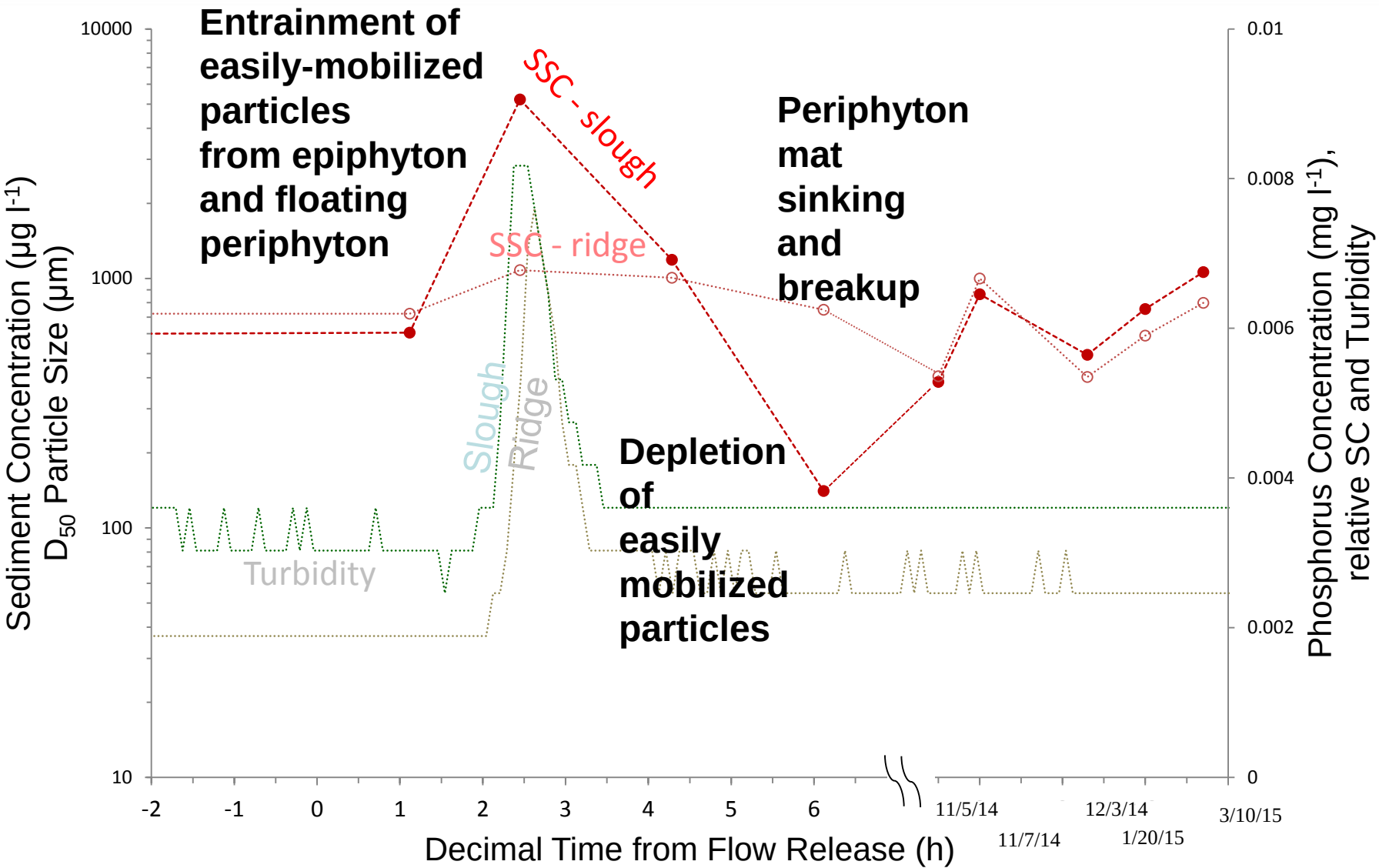
High Flow

Sediment mobilized from Epiphyton

Average Mass Epiphyton	Low-Flow	High-Flow
per stem (grams)	0.090 (0.011)	0.003 (0.0005)
per surface area (grams cm^{-2})	0.004 (0.0005)	0.0001 (0.00002)

data from A. Hurst and L. Larsen

Particles transported in big initial pulse and then later at lower concentrations



Slough clearing of floating periphyton within several weeks

CONTROL - C2

Treatment - RS1D

Pre-flow

CONTROL - C2

Treatment - RS1D

Flow Release
10/17/16 12:30 PM

CONTROL - C2

Treatment - RS1D

1 Day Post Flow

CONTROL - C2

Treatment - RS1D

1 Week Post Flow

CONTROL - C2

Treatment - RS1D

2 Weeks Post Flow

CONTROL - C2

Treatment - RS1D

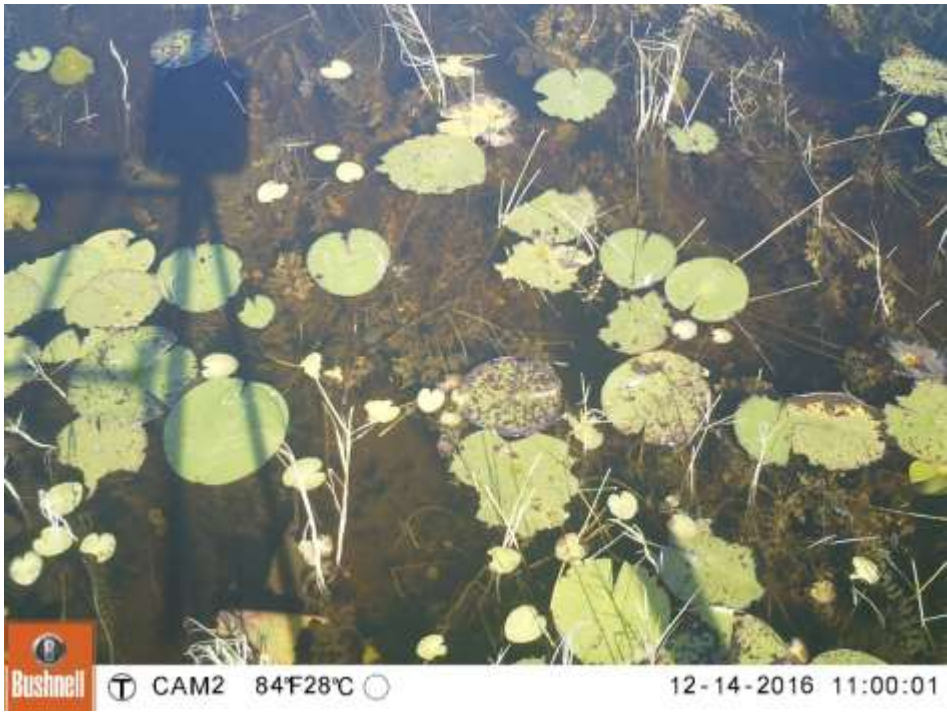
3 Weeks Post Flow

CONTROL - C2

Treatment - RS1D

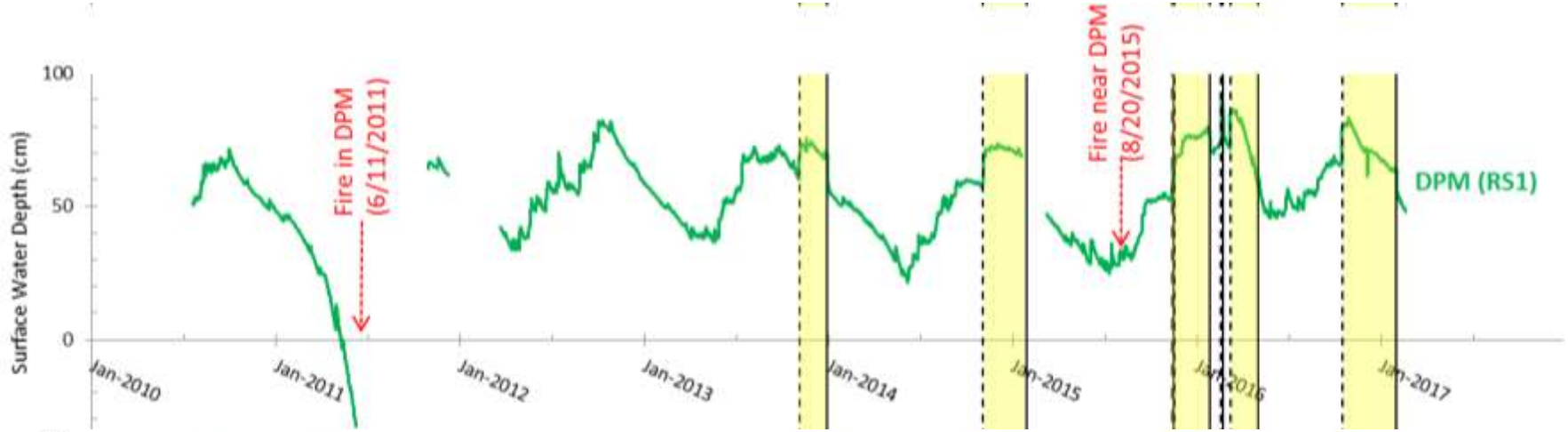
4 Weeks Post Flow

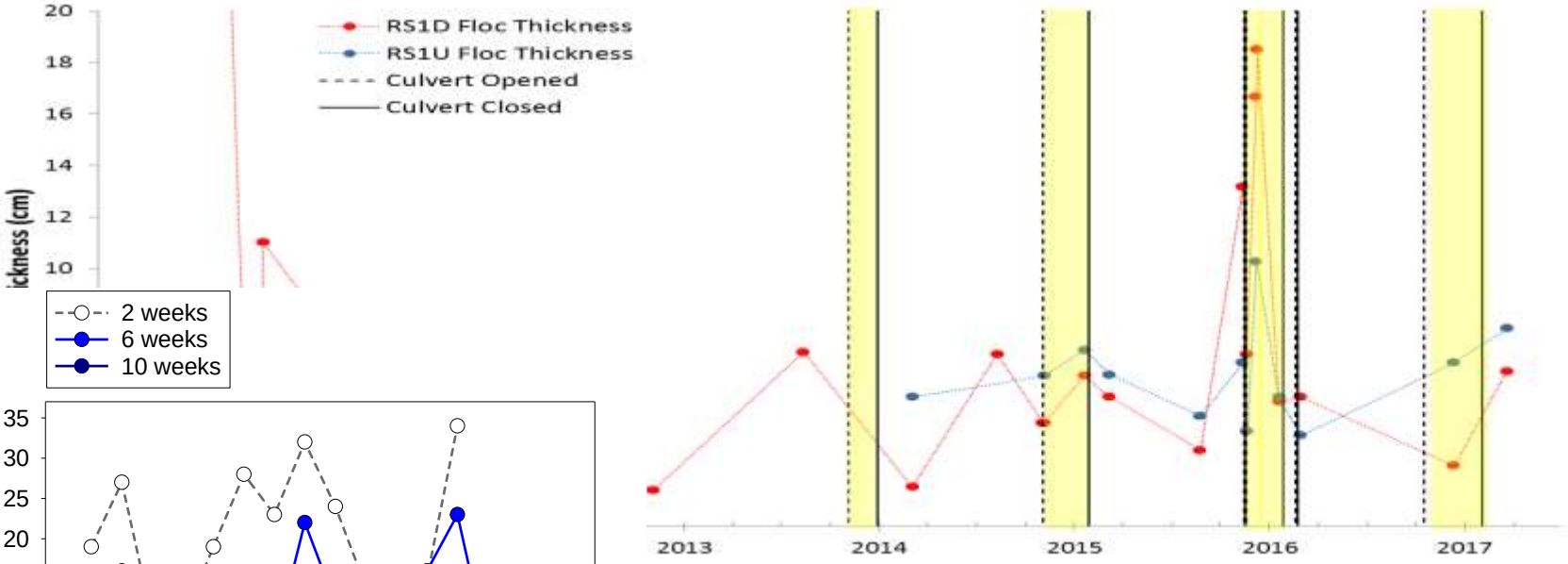
CONTROL - C2



Treatment - RS1D

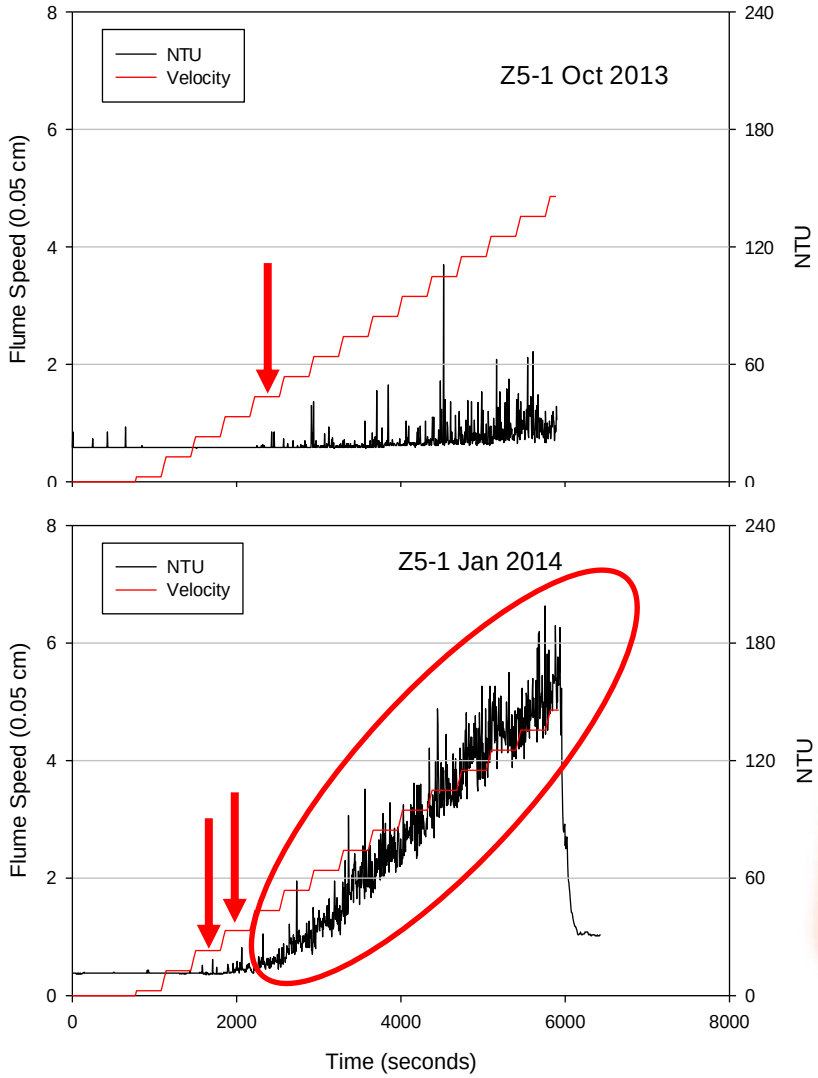
8 Weeks Post Flow





data from Colin Saunders

Bed floc became more erodible with flow

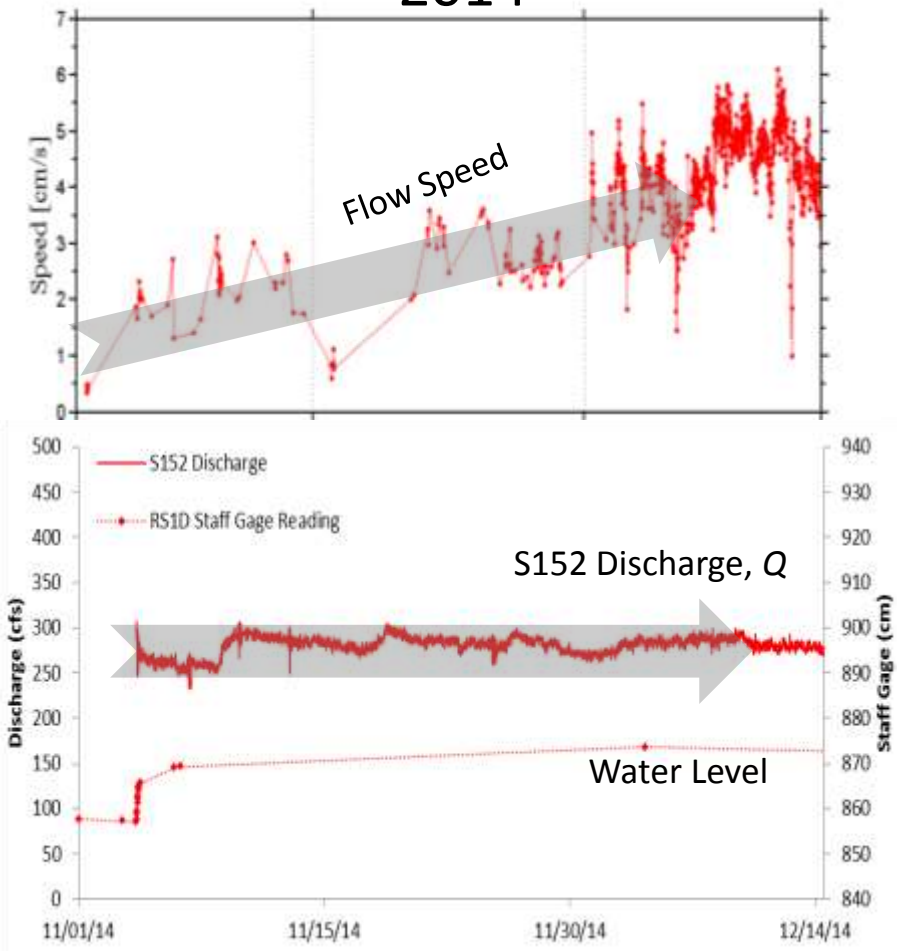


150-m

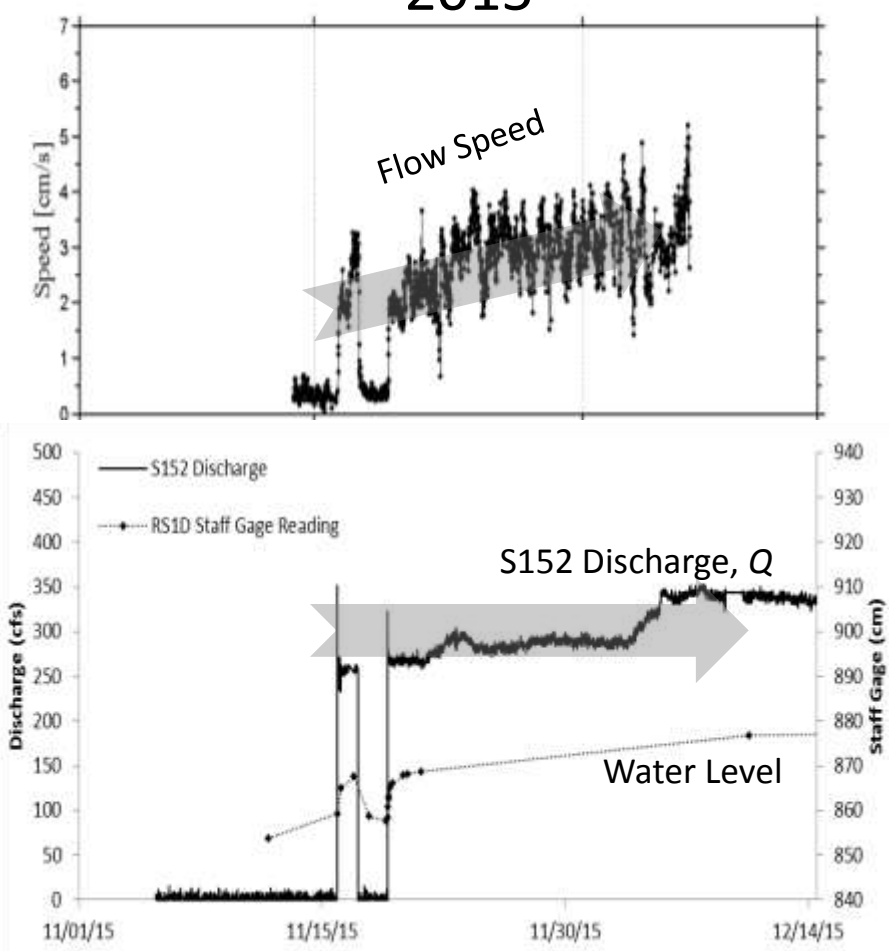
S. Newman and C. Saunders (SFWMD)

Slough clearing increases velocity…more sediment transport…more slough clearing

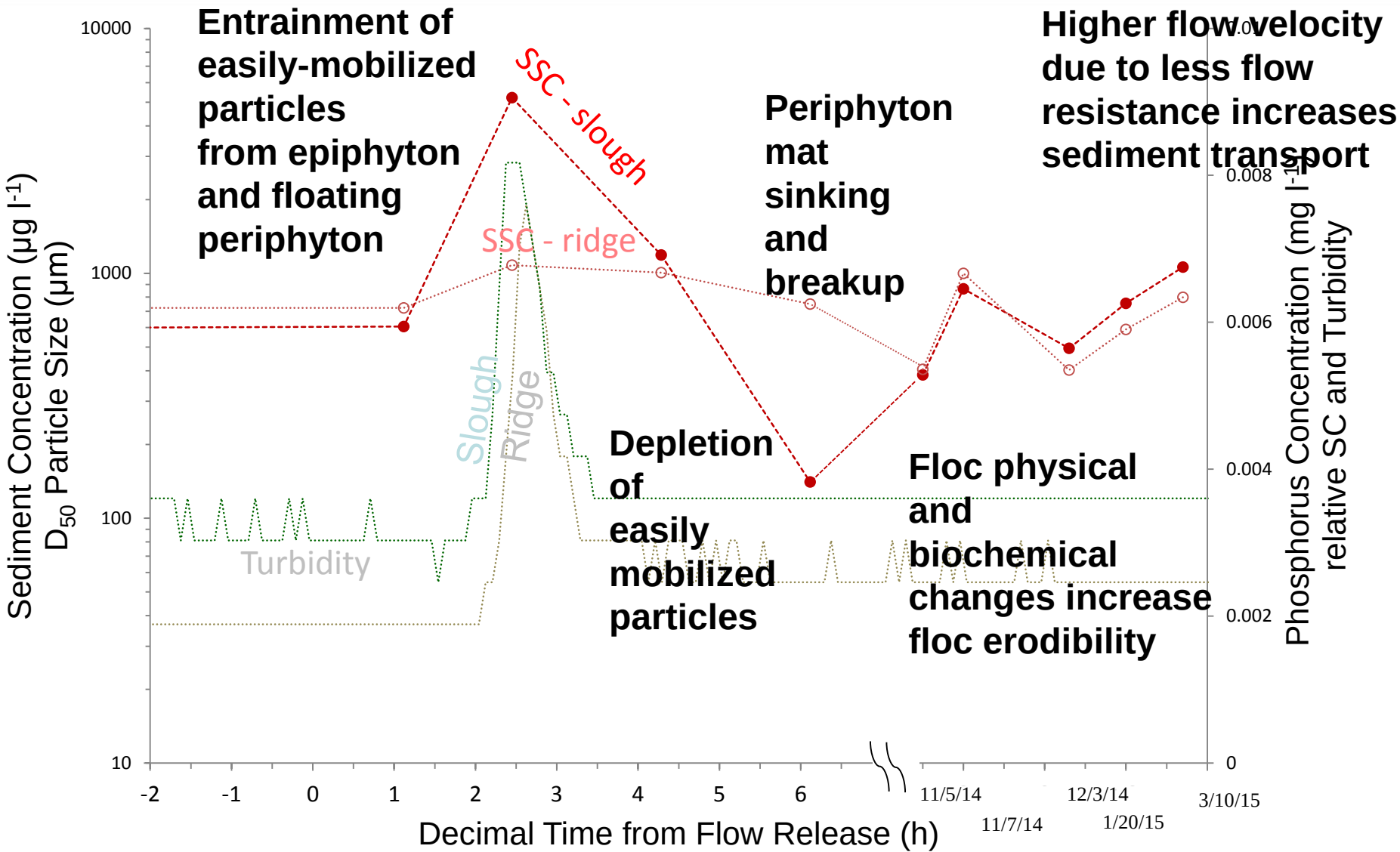
2014



2015



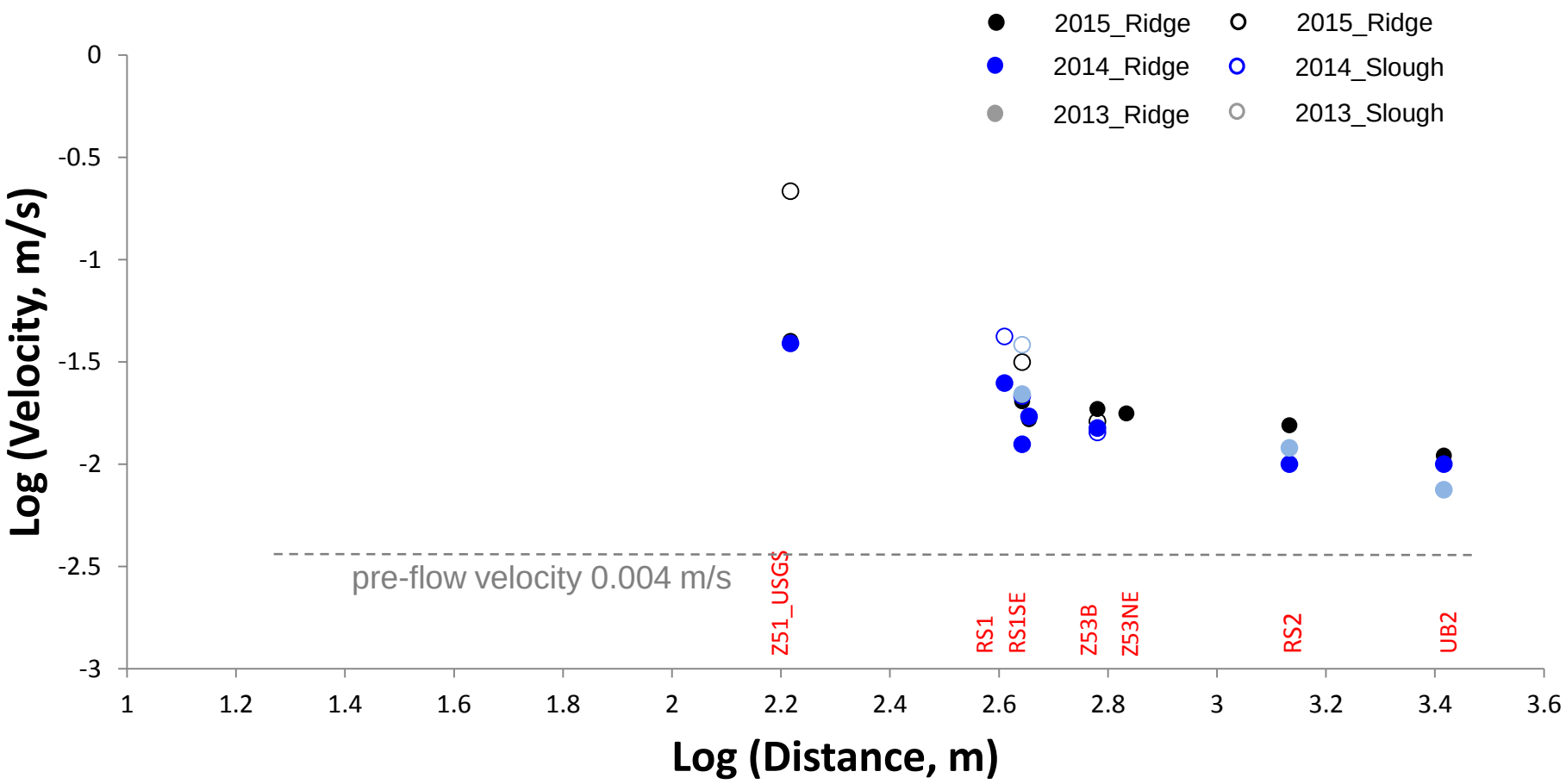
Physical-biological feedbacks increase slough clearing



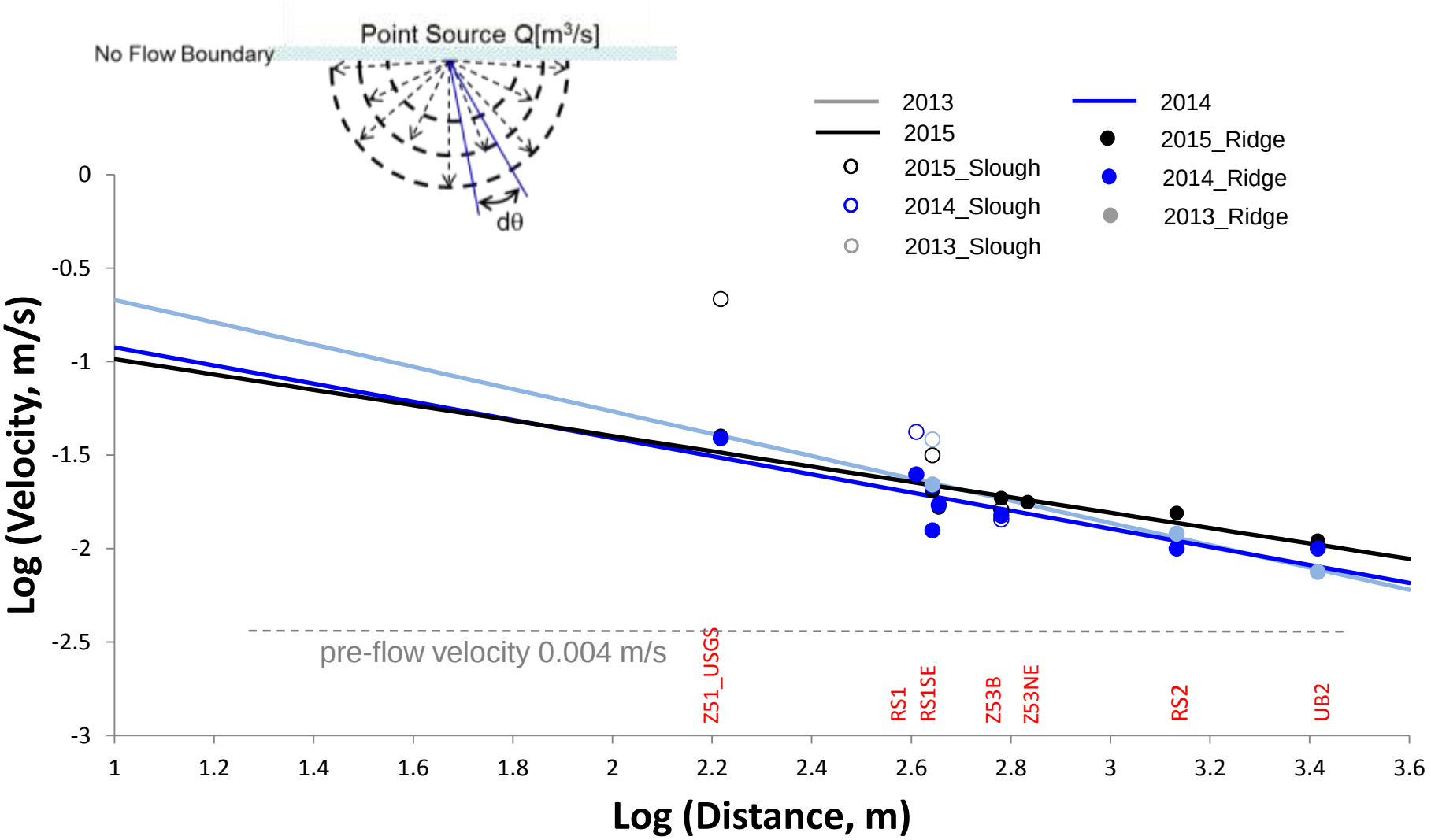
Particles Mobilized from Floc during Sustained High Flow are Deposited on Ridges

Suspended Sediment		Areal rate ($g/m^2/s$) x 10^{-4}	Areal deposition (g/m^2)
Pulse High Flow (day 1): 6-hr pulse repeated every 14-days for 3 months	Slough	3	40
	Ridge	**1**	**10**
Sustained High Flow lasting 3 months	Slough	1	1000
	Ridge	**7**	**6000**

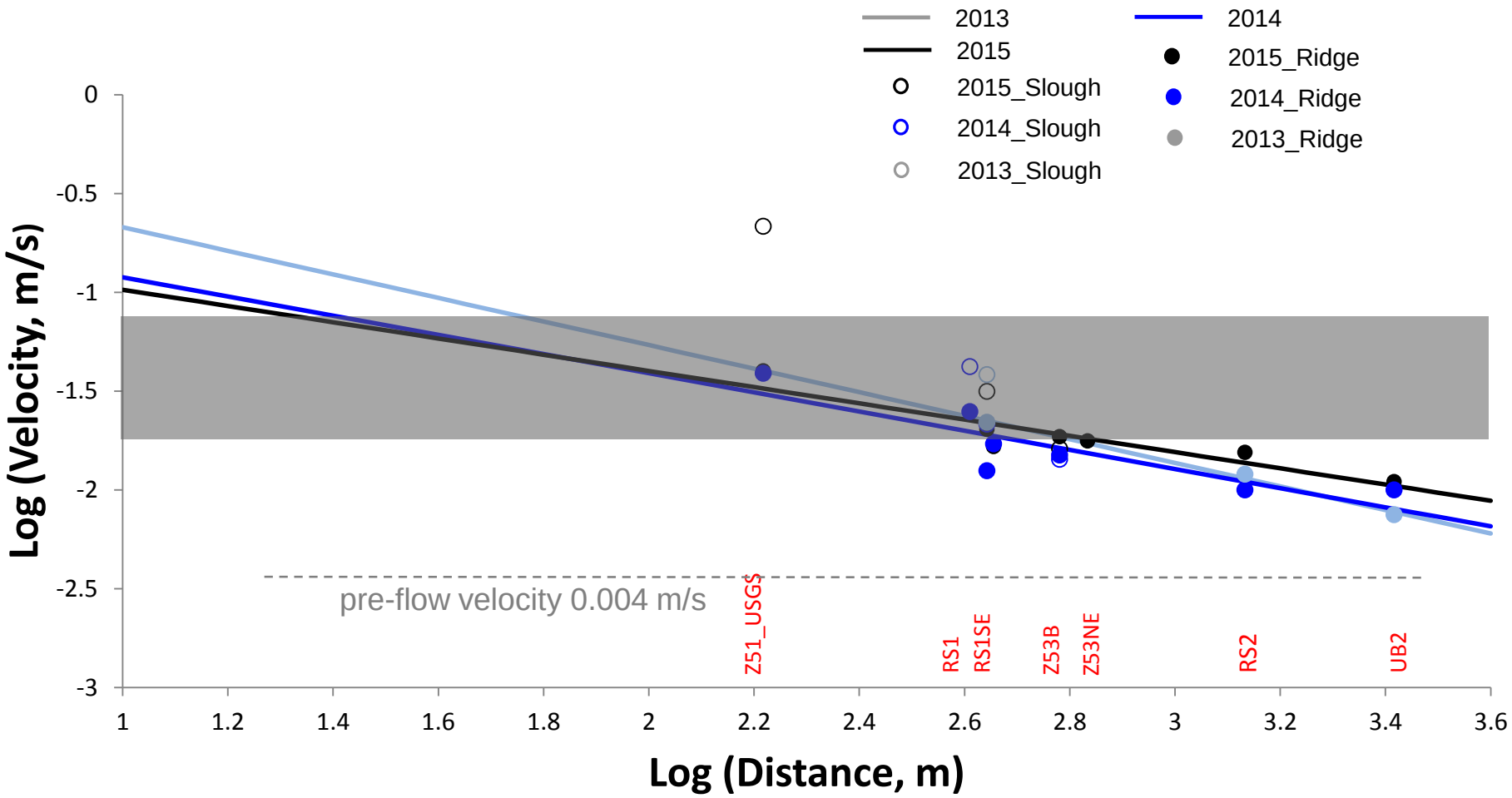
Modeling flow velocity to understand controls and manage outcomes



Modeling flow velocity to understand controls and manage outcomes



“Optimal” velocities that open sloughs achieved in only a very small area



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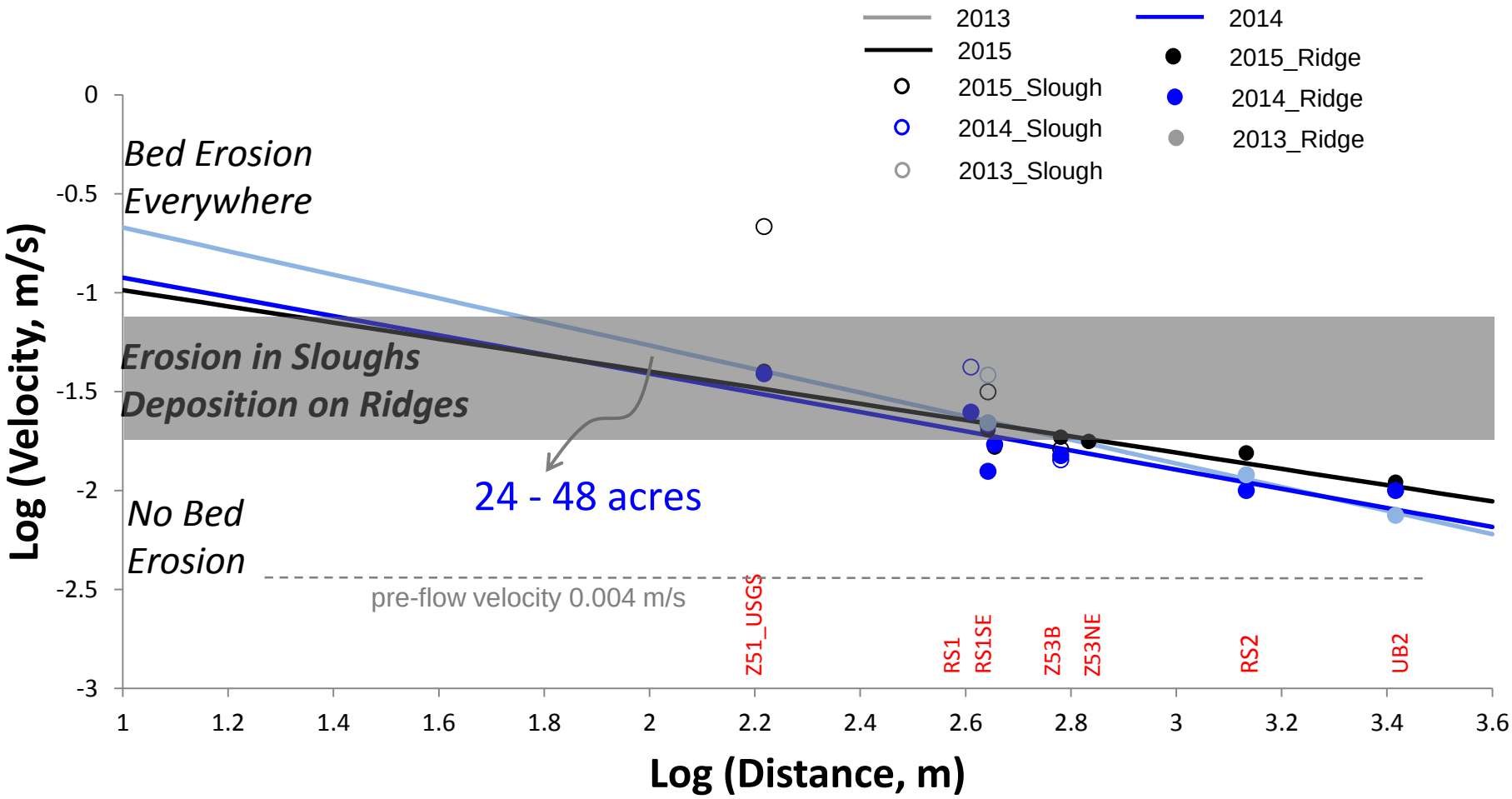
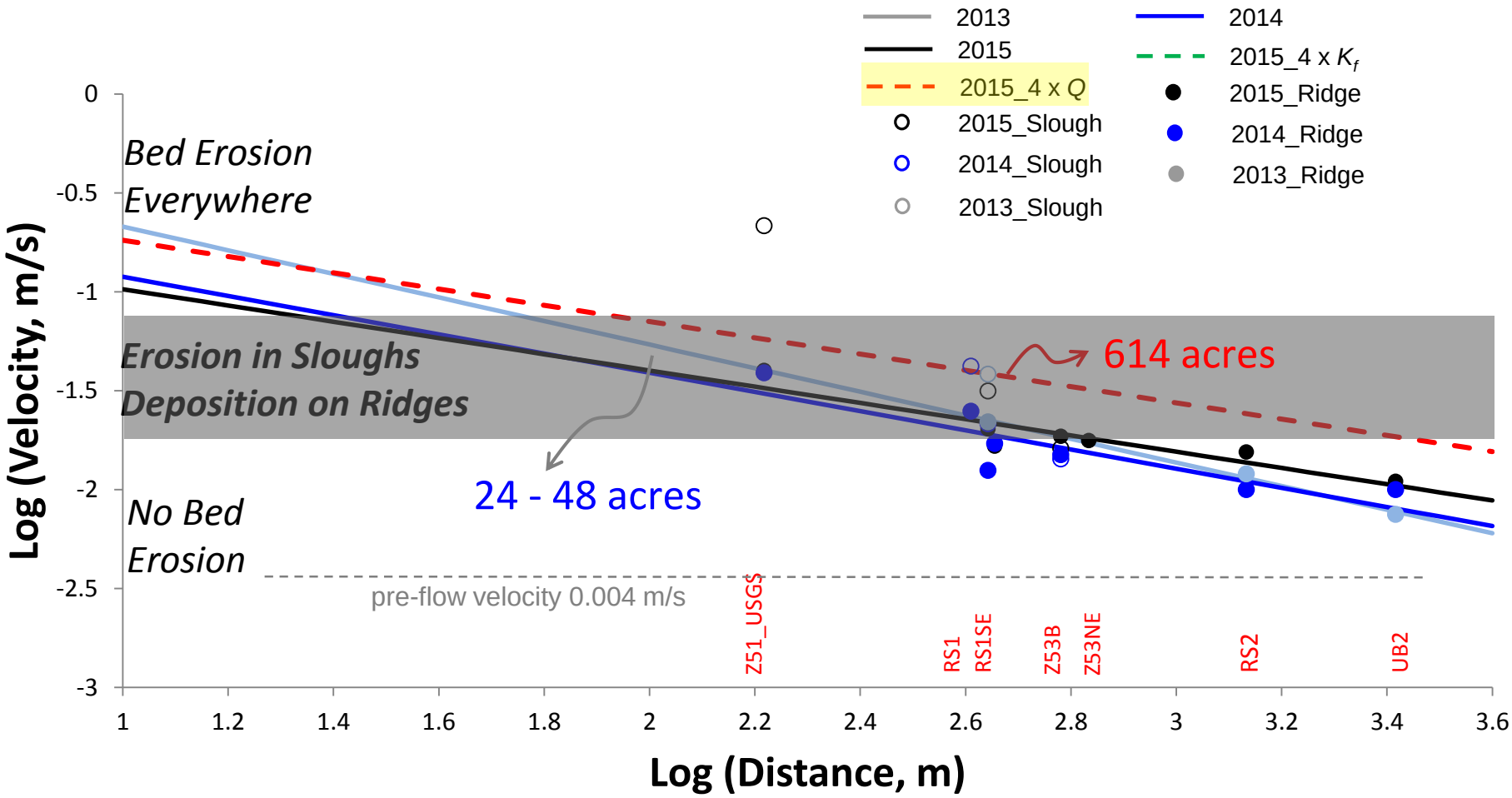
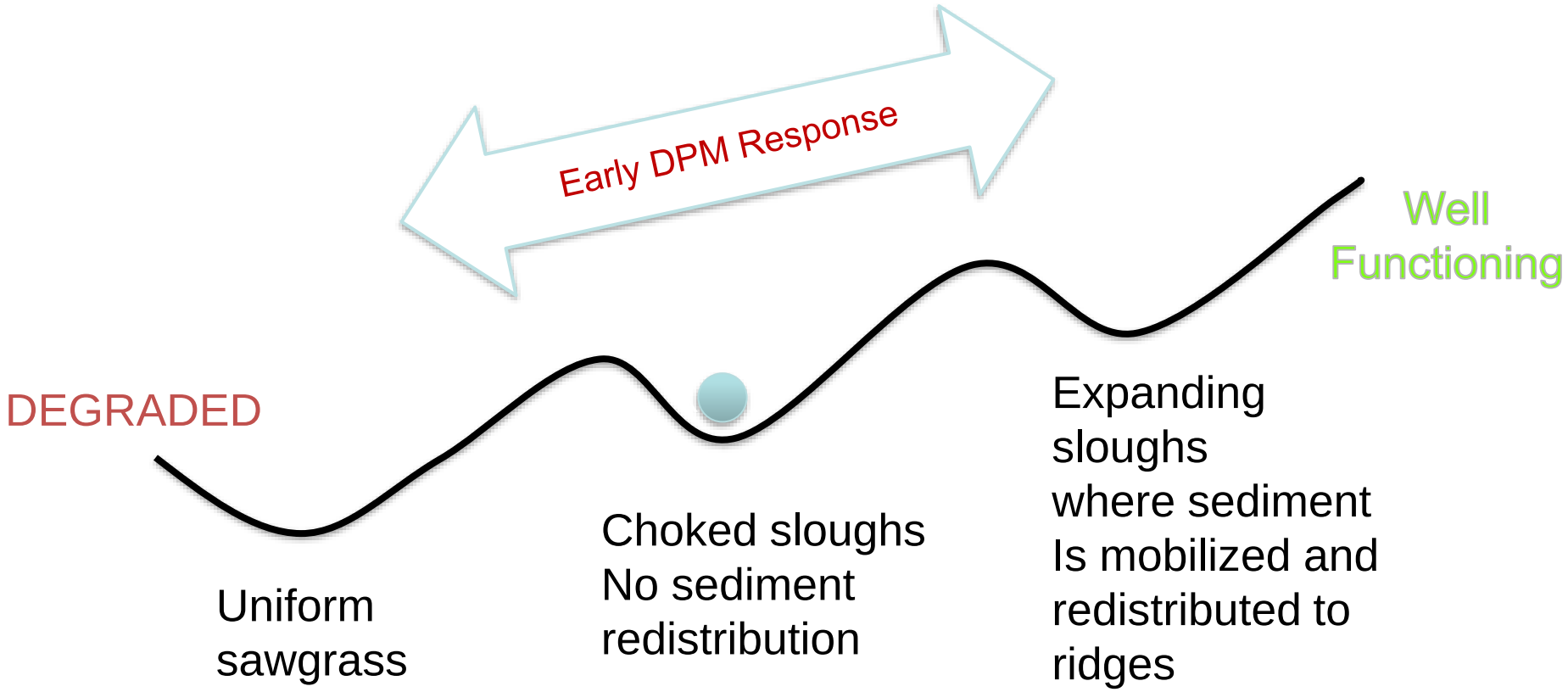


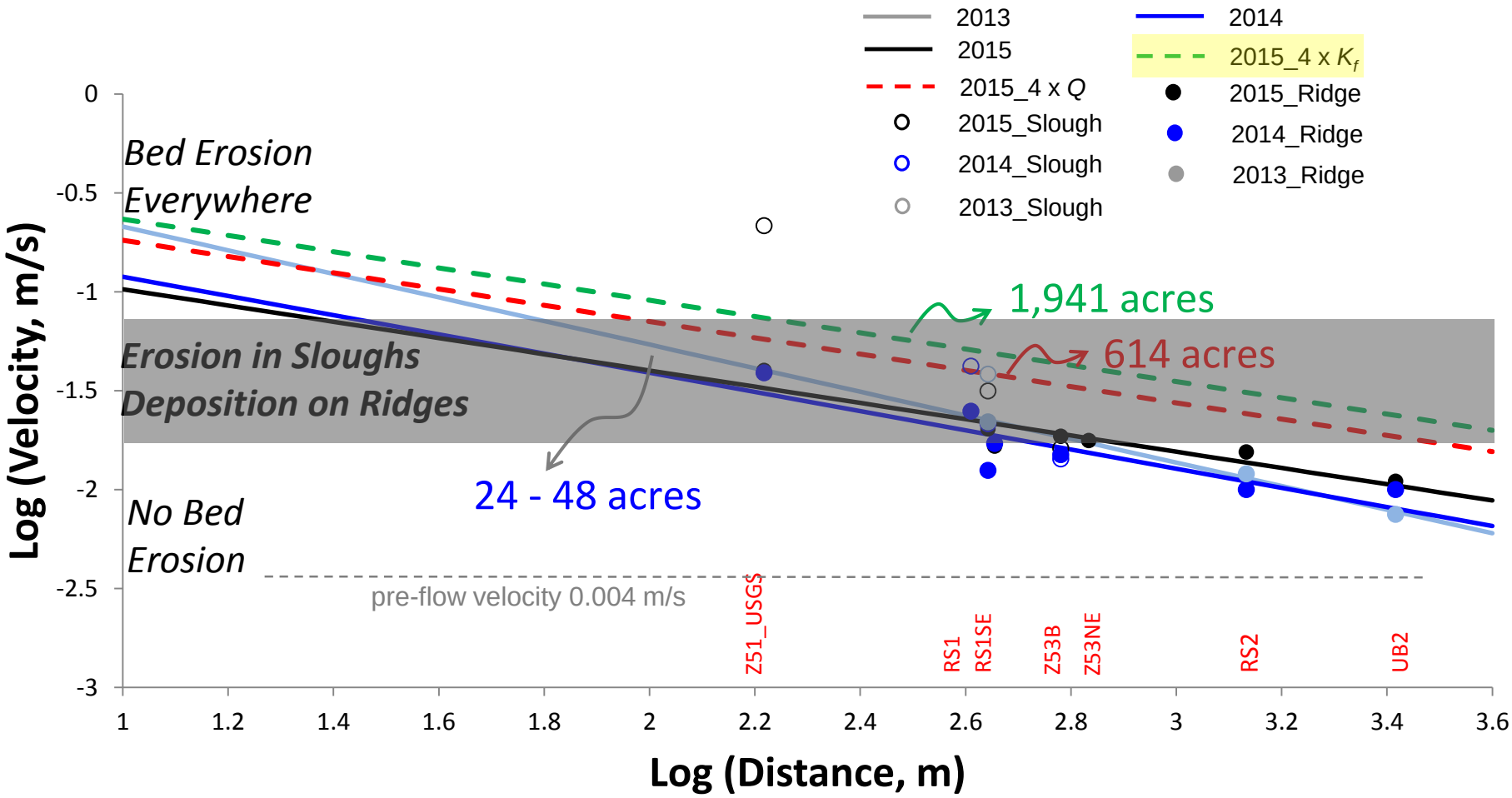
But…"optimal" conditions sensitive to *Q*, discharge at S-152 structure



Thresholds of Slough Regeneration



Even more sensitive to % sawgrass Slough connectivity is self-reinforcing



How will restored flow influence outcomes for ecosystem

- High flow is conducive to preserving and restoring ecologically important deepwater sloughs

- Hydraulic, sediment transport, and biochemical processes contribute to slough clearing

- Short, intense flow pulses momentarily mobilize more sediment but quickly become source depleted.

- Sustained high flow releases lasting several months are most effective in redistributing sediment from sloughs to ridges

- Areas of optimum flow in DPM currently limited, but modeling suggests that slough clearing could be a self-reinforcing process that could progressively reconnect historic sloughs