Recent sedimentation patterns along restored reaches of the Kissimmee River floodplain, Florida, USA

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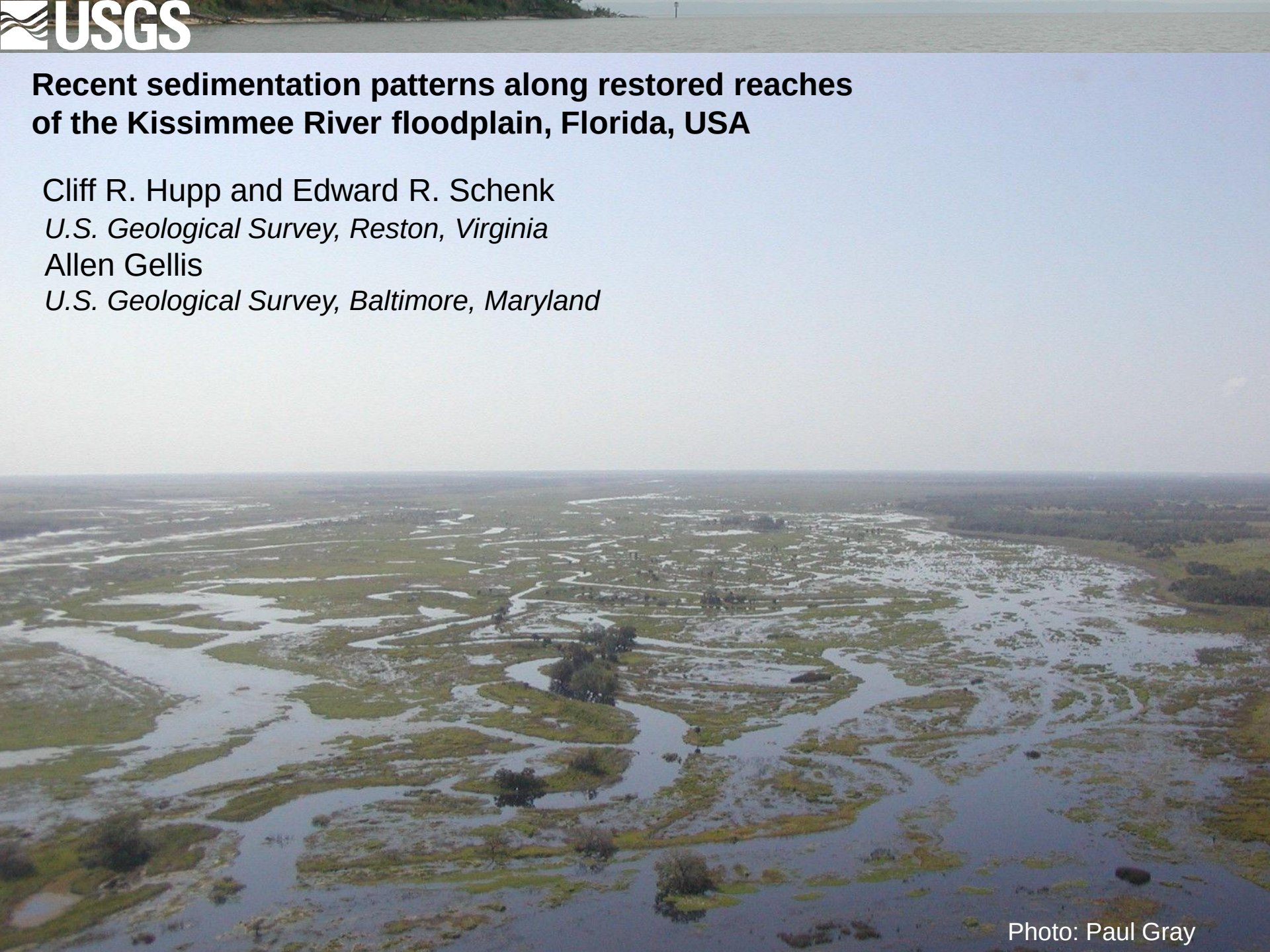


Photo: Paul Gray

Outline:

Site description

Monitoring

Variable impacts of floods

Sediment trapping– amounts and characteristics

Intra- and Inter- Site Connectivity and sedimentation patterns

Short Story……. Connectivity Rules

April 13, 2010

Background

Current wetland restoration efforts are among the largest, worldwide

Prior to chanelization 94% of the adjacent floodplains were inundated > 50% of the time.

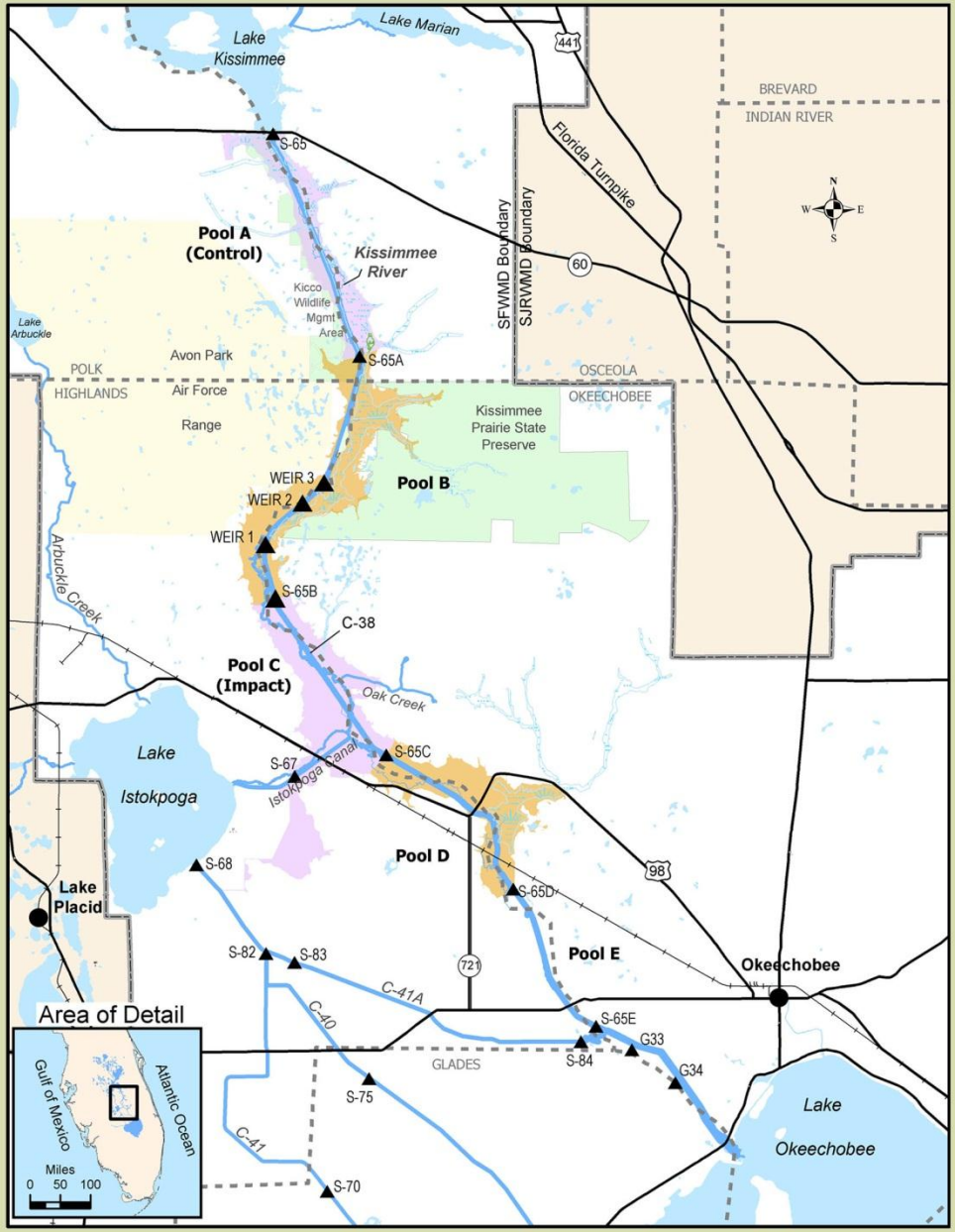
Original floodplain was 2-5 km wide for about 166 km between Lake Kissimmee and Lake Okeechobee.

The floodplain wetlands occupied 18,000 ha (45,000 acres).

Channelization (C-38 canal) removed 12 to 14 thousand ha of floodplain wetlands, winter waterfowl use was reduced by 92%.

About 40% of the C-38 canal will be restored to a meandering river channel with episodic floodplain inundation and will restore10,500 ha of wetlands mostly in Pools B, C, and D.

Our study of geomorphic impacts of restoration began in 2007, was expanded in late 2010, and abruptly ended March 2011.



Timeline of Events

1920s-1940s Flooding in basin

1962-1971 Const. of C-38 Canal

1976 Kissimmee R. Restoration Act

1984-1990 Pool B Demonstration Project

1992 Restoration Act Authorized

1999-2001 (Pool B/C) Phase I of backfilling

2007 USGS geomorphic monitoring study began

2010 Pool B back filled

2011 Jan. 5-year monitoring project began.

Governor mandated SFWMD budget to be severely reduced

2011 Mar. above project canceled

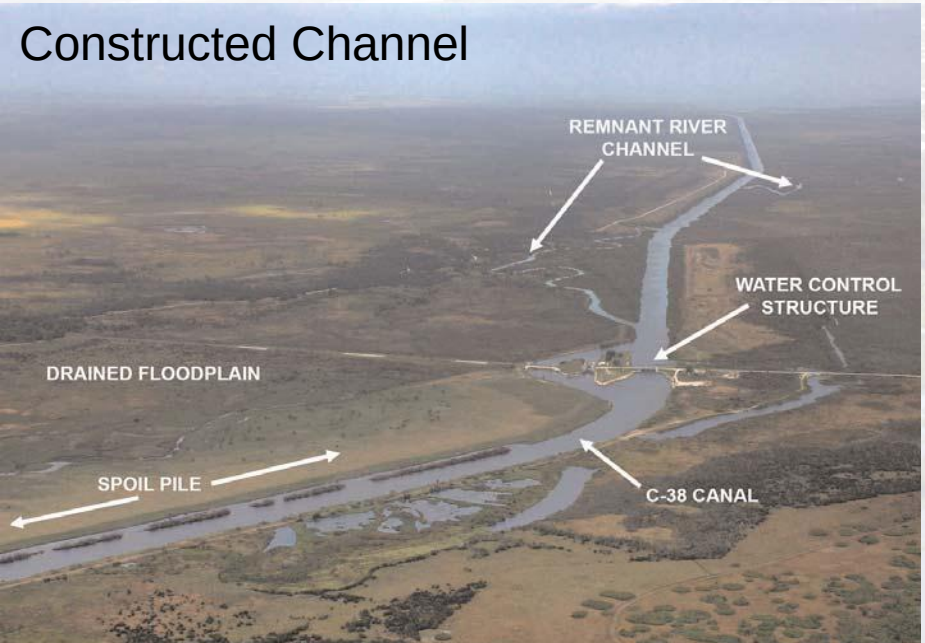
2006- ? (Pool D)
Phase II/III backfilling

USGS

Original Channel

Channelization

Constructed Channel



Backfilling Channel

Objectives

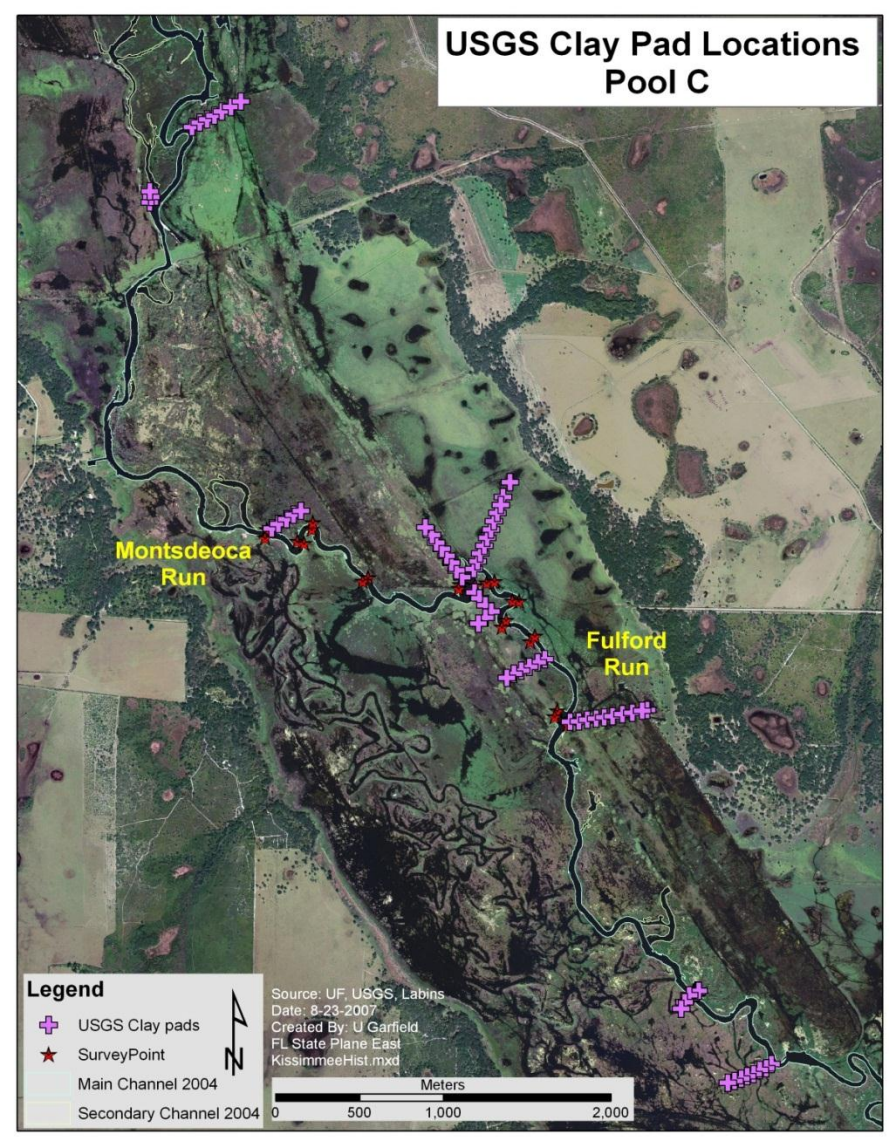
General: to establish a long-term geomorphic monitoring plan for the KRRP and provide the SFWMD with data to implement comprehensive adaptive river management approaches

Specific:

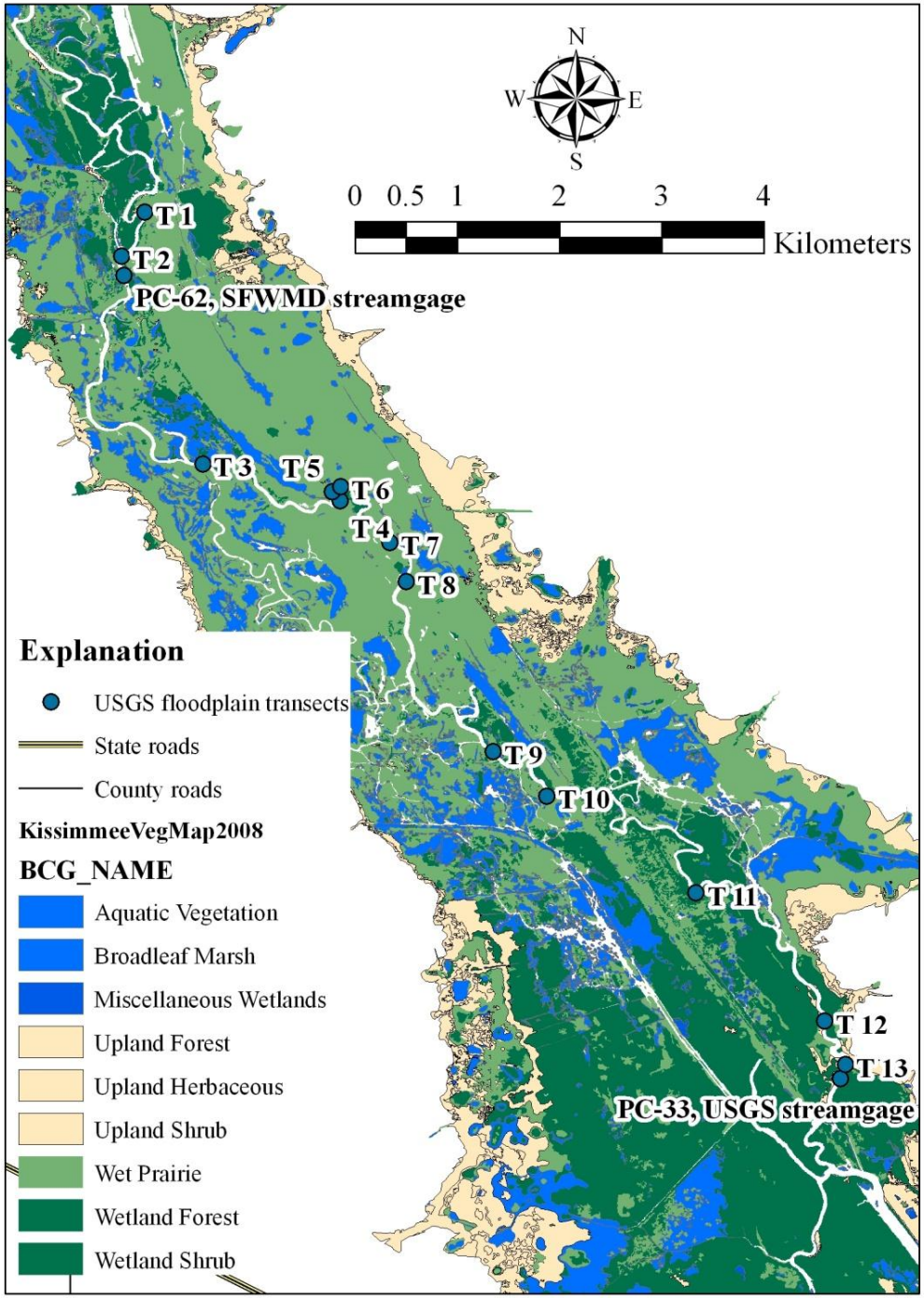
1) to quantify and interpret floodplain sedimentation patterns, fluxes, and character (size class, bulk density, organic material content---carbon)

- relative to flood frequency and magnitude (hydroperiod), landform,and dominant vegetation type.

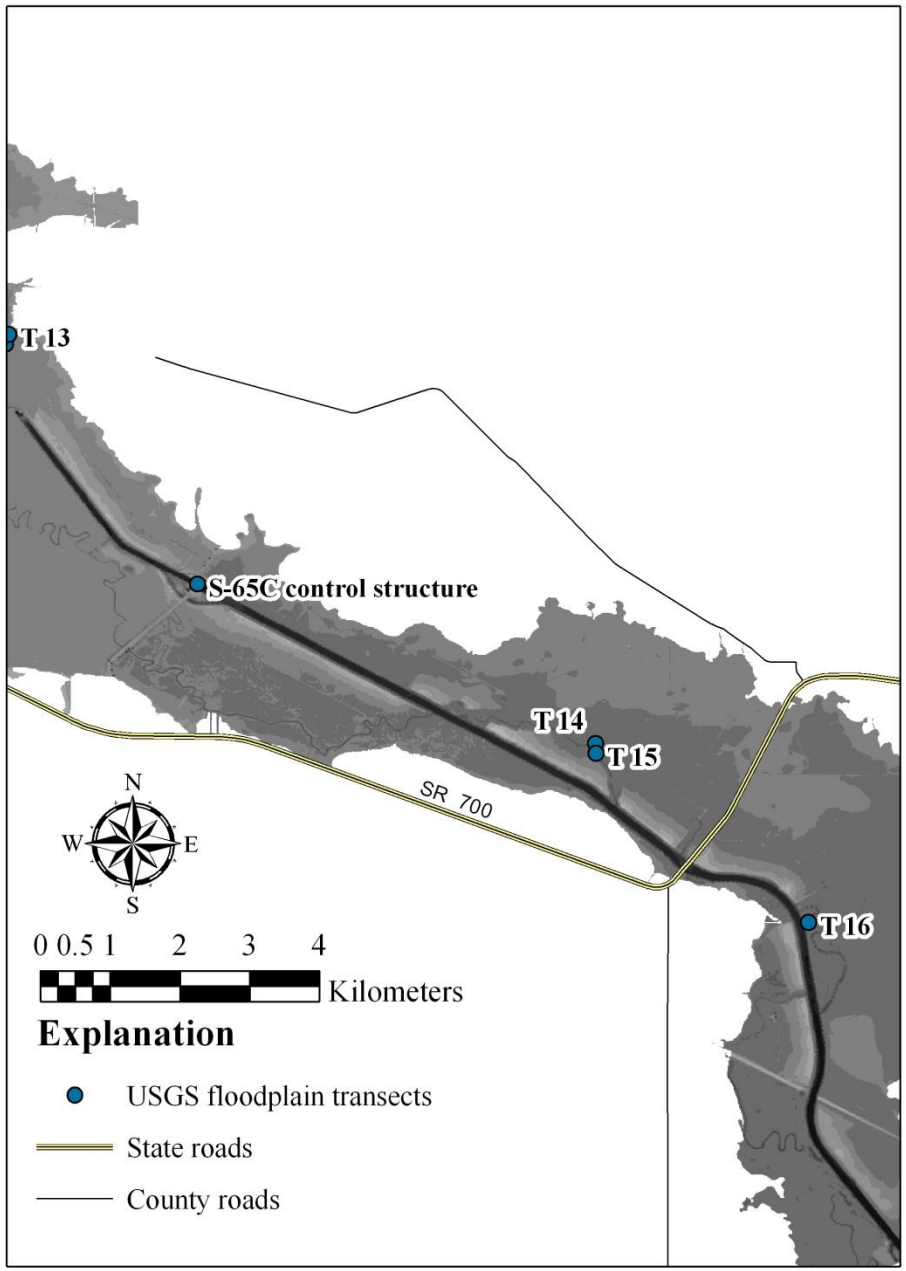
2) to facilitate the development of a sediment budget, including floodplain sediment trapping and carbon sequestration (ecosystem services).



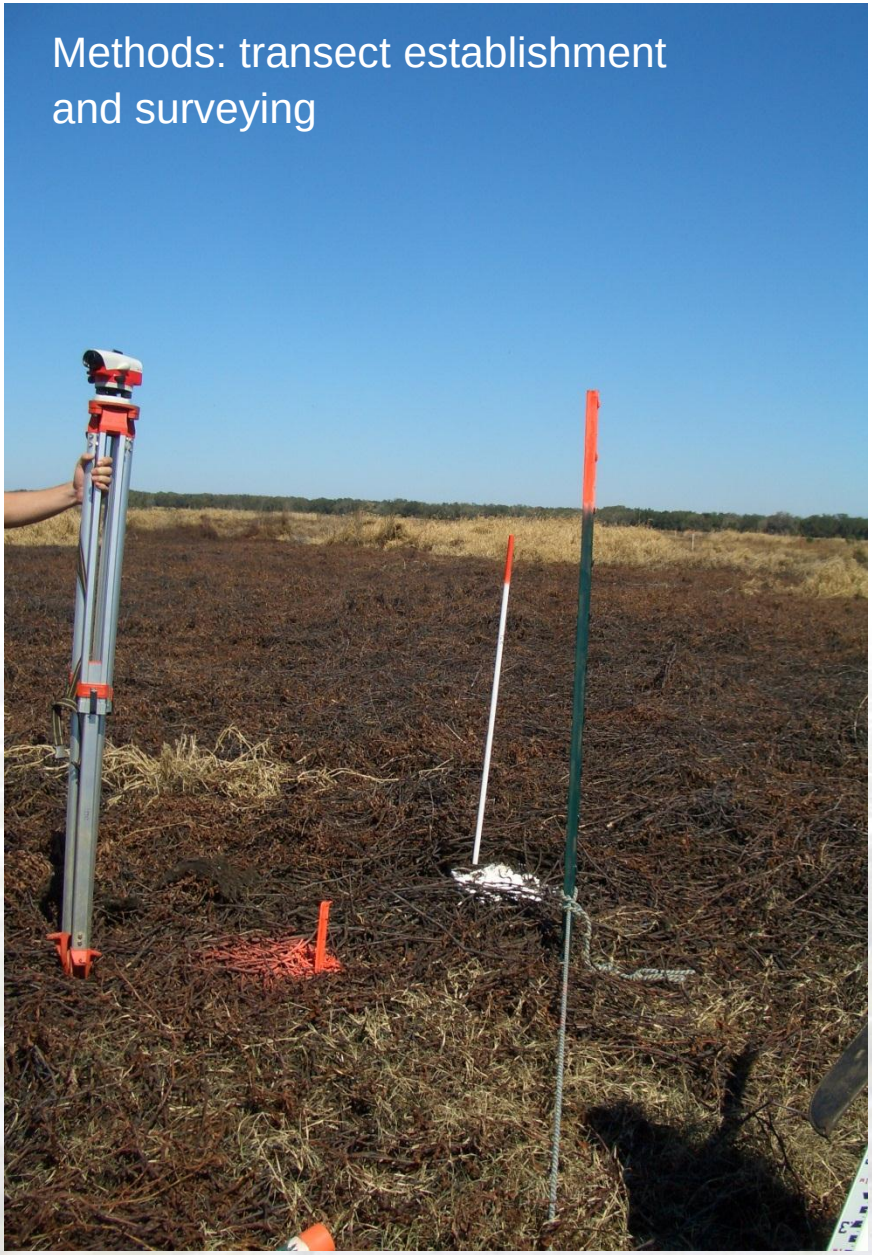
Restored reach



Channelized reach



Methods: transect establishment and surveying

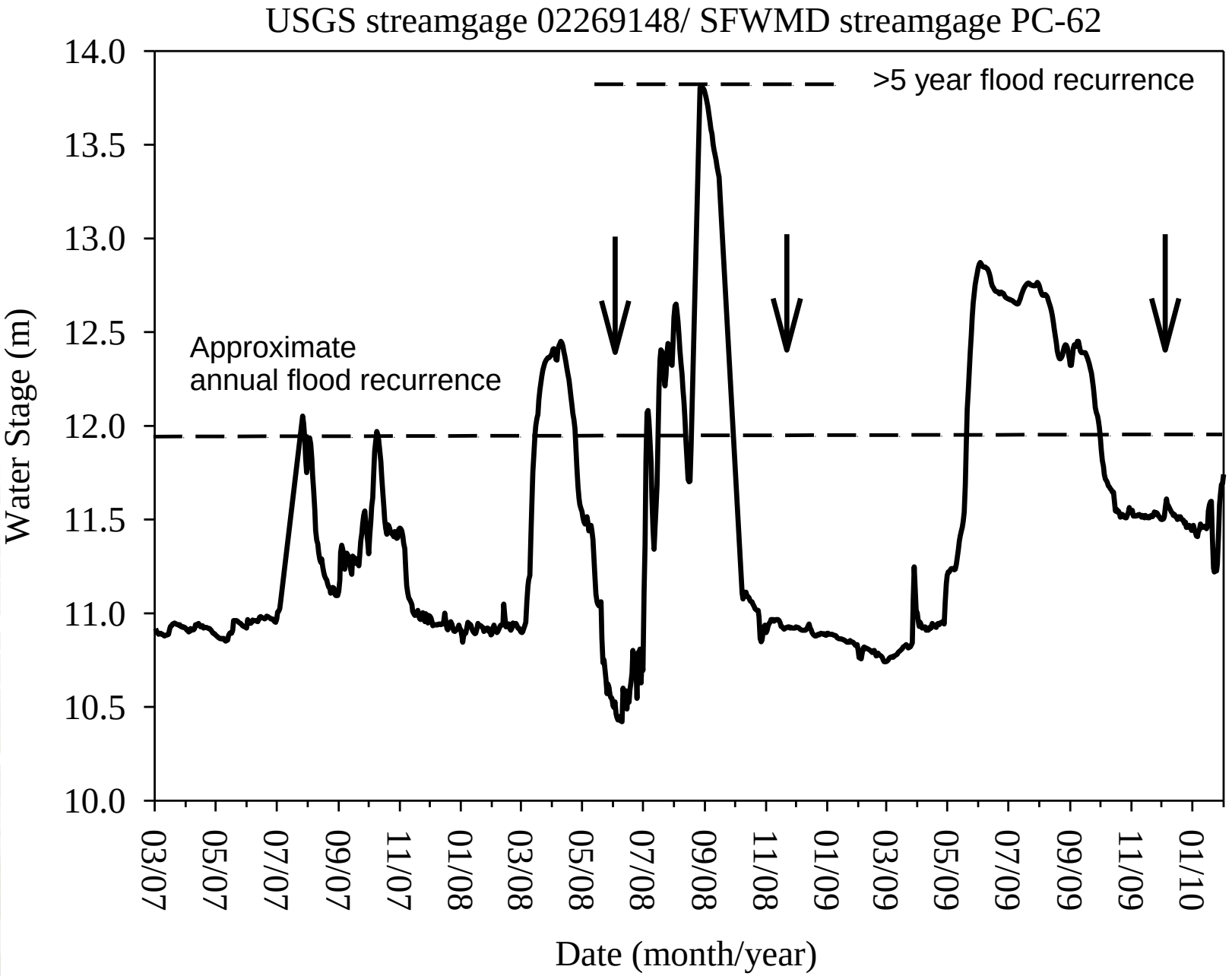


Clay-pad installation at stations along transect

New USGS Stream Gage in Pool C

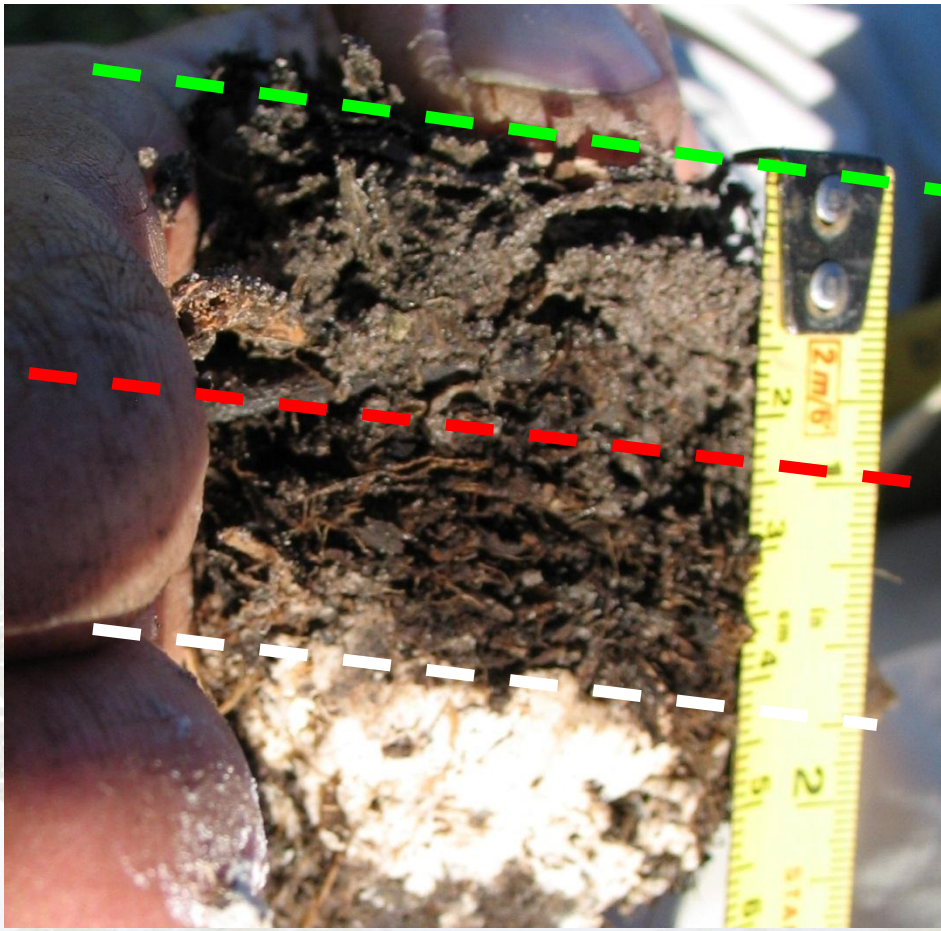
(part of the larger effort)

Suspended sediment sampler


USGS streamgage 02269148/ SFWMD streamgage PC-62
>5 year flood recurrence
Approximate
annual flood recurrence
Water Stage (m)
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
03/07
05/07
07/07
09/07
11/07
01/08
03/08
05/08
07/08
09/08
11/08
01/09
03/09
05/09
07/09
09/09
11/09
01/10
Date (month/year)

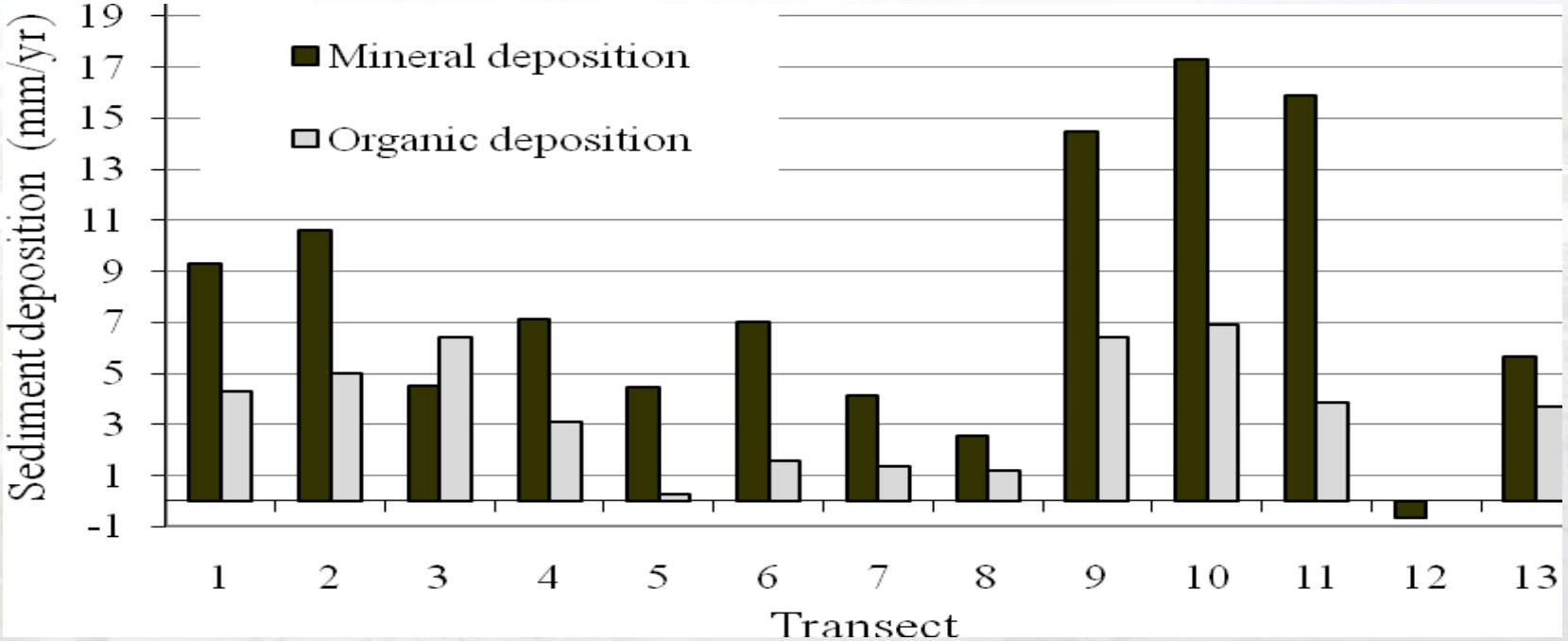
May 2008

December 2008



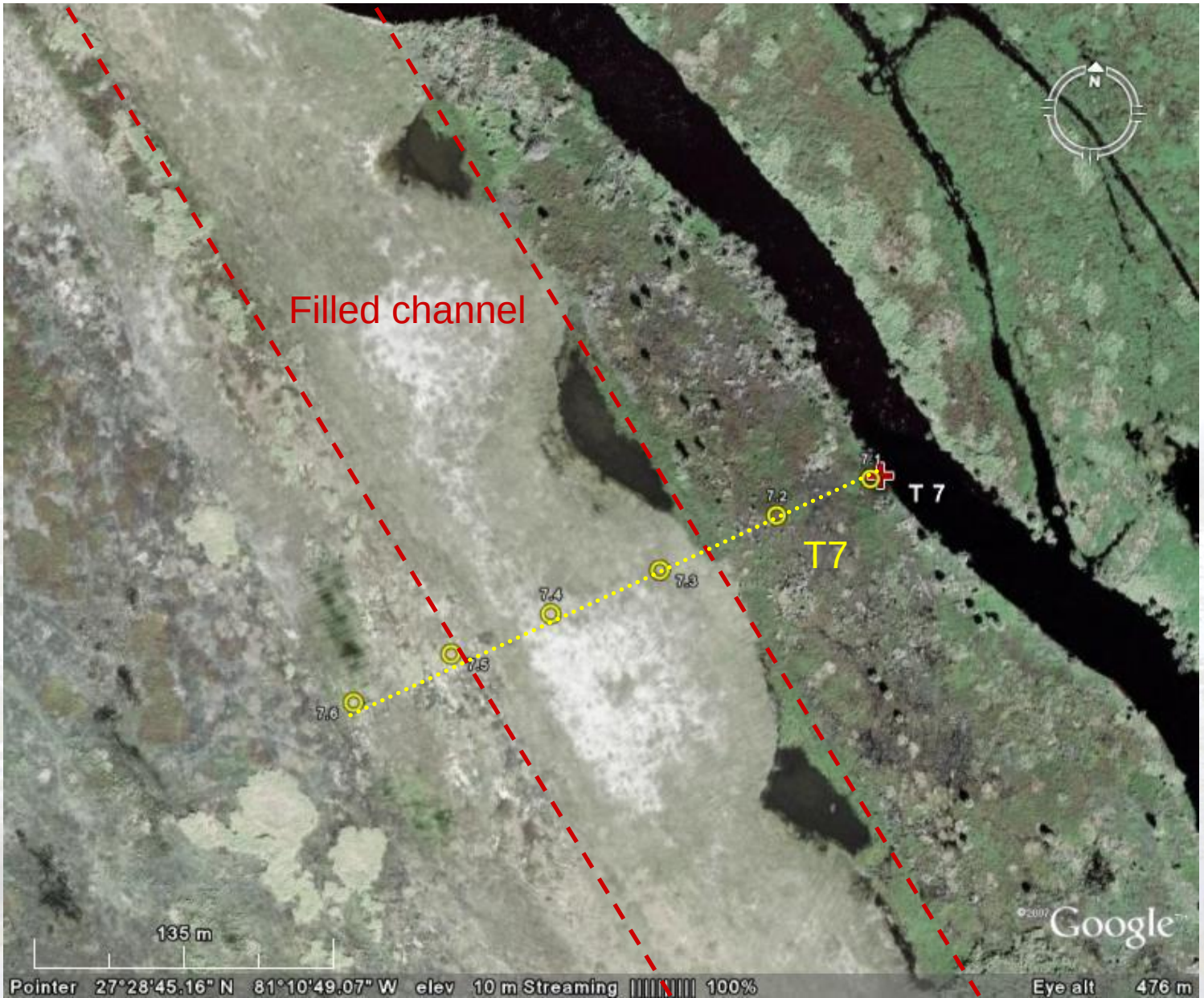
Major factors affecting floodplain sediment deposition amounts and patterns:

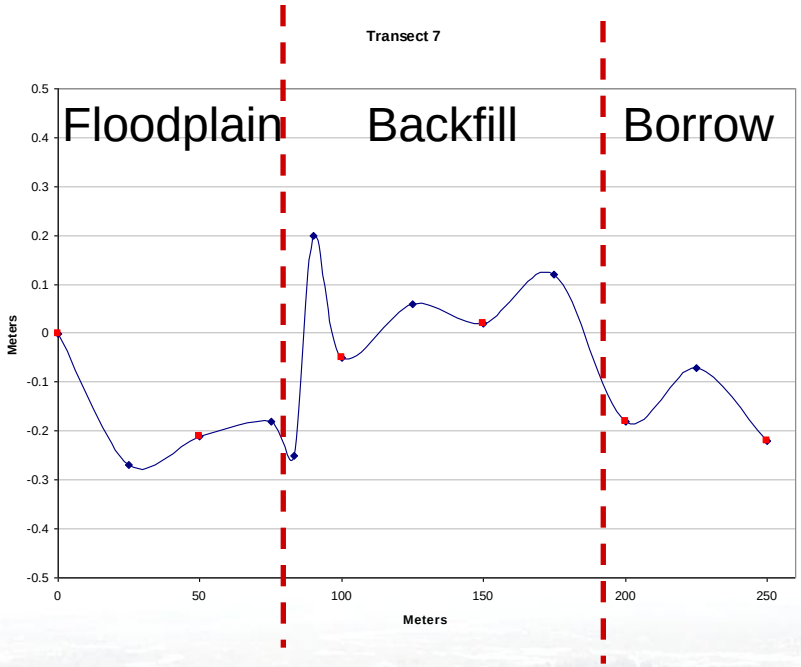
1. Landscape type
2. Longitudinal position, backwater effects
3. Relative elevation, vegetation type
4. Flow paths and connectivity to river water

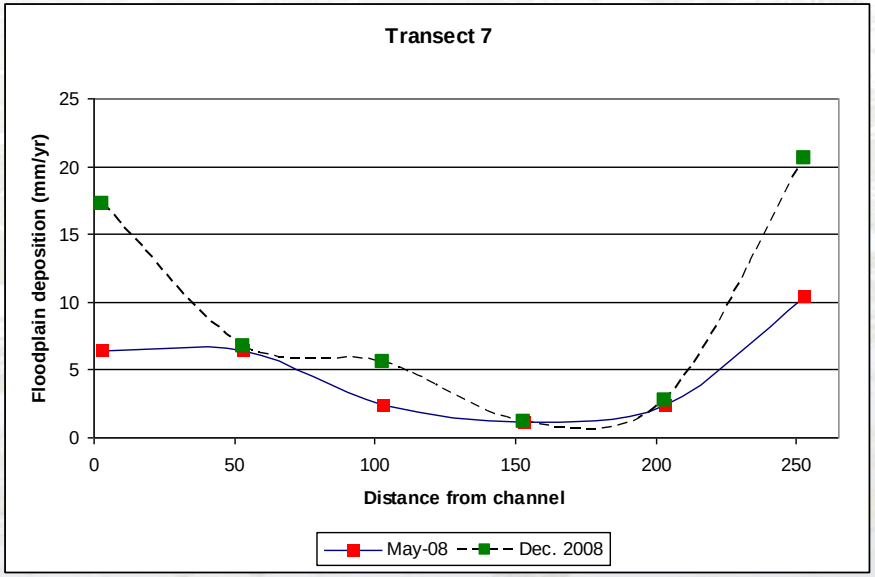


Landscape type

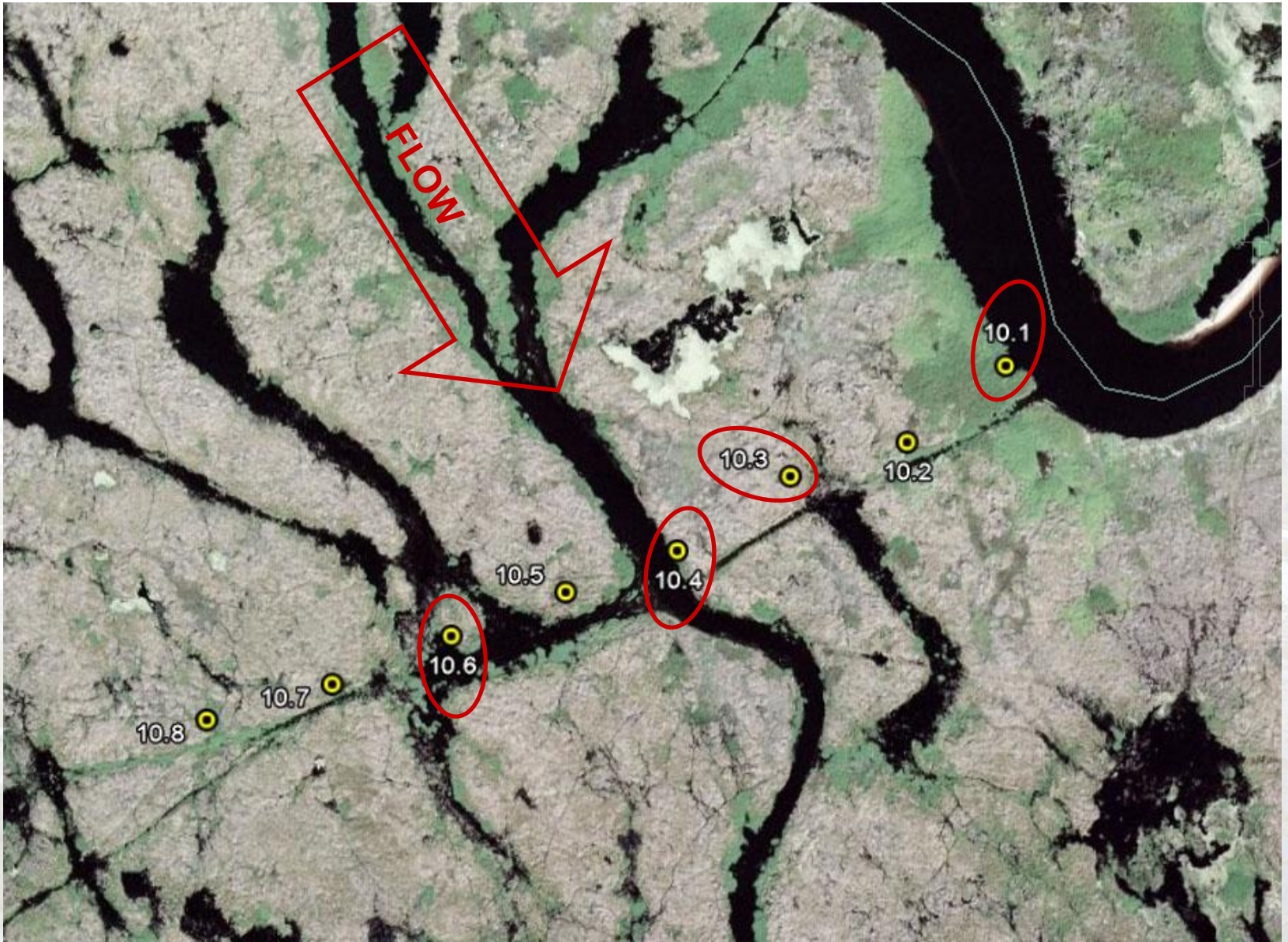
Brent Anderson

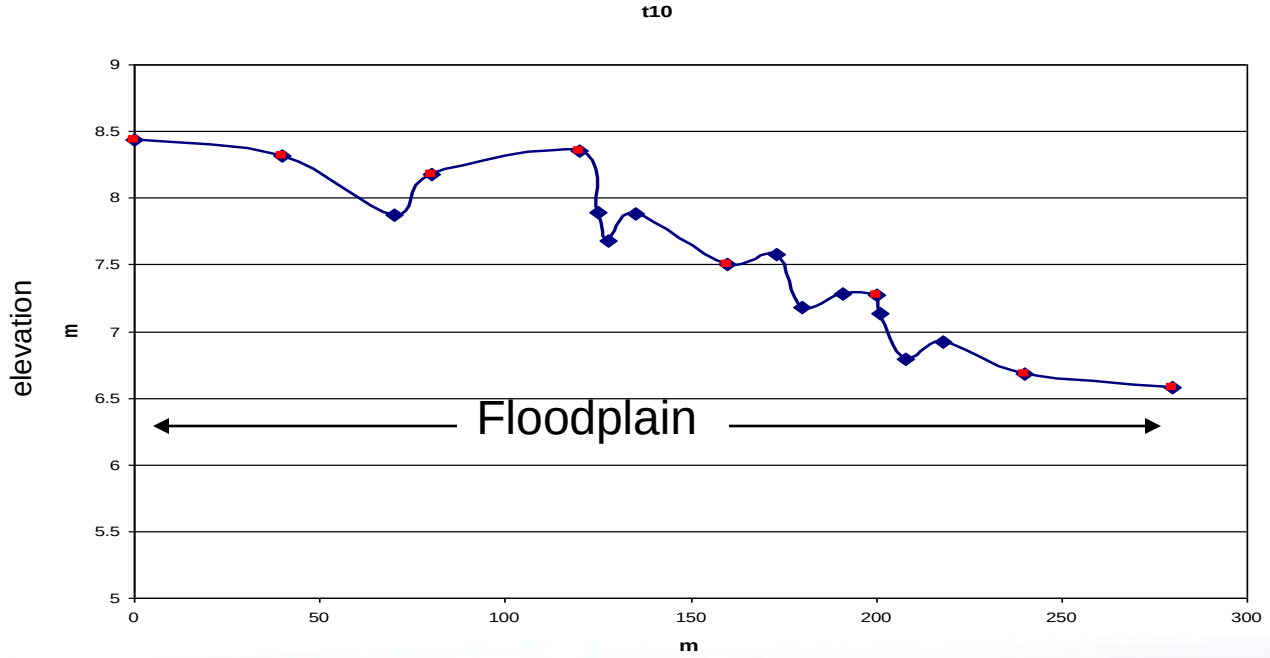

Filled channel
T 7
T7
7.1
7.2
7.3
7.4
7.5
7.6
N
135 m
Google
Pointer 27°28'45.16" N 81°10'49.07" W elev 10 m Streaming 100%
Eye alt 476 m

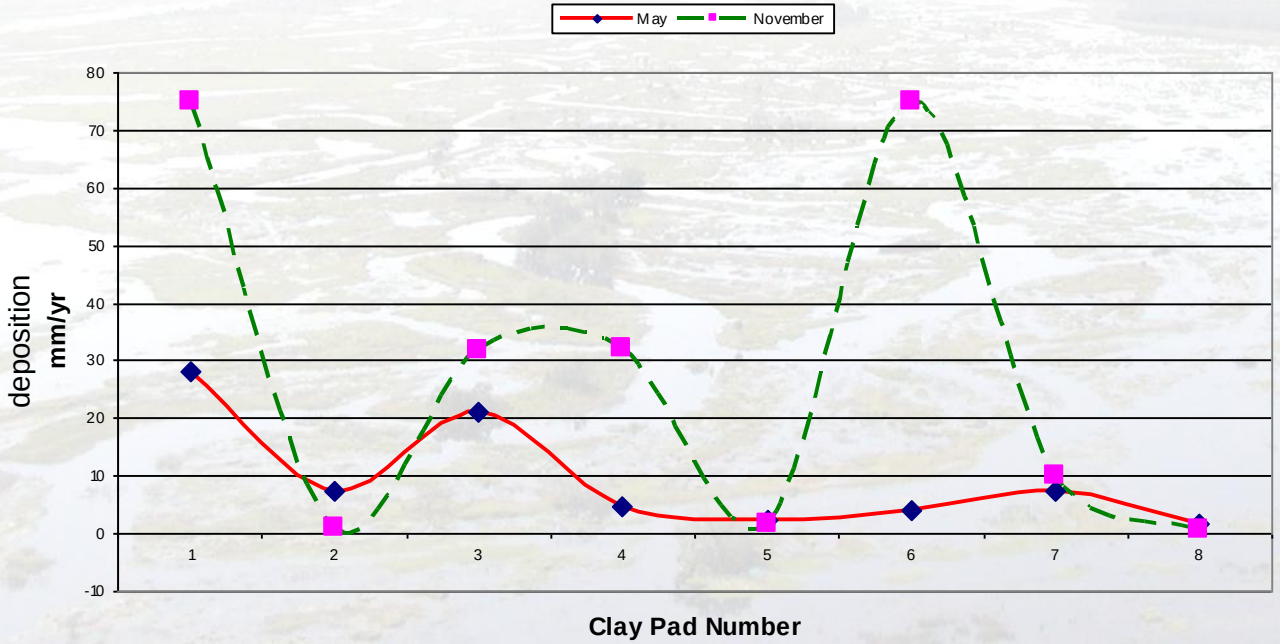

Transect 7
Floodplain
Backfill
Borrow
Meters
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
50
100
150
200
250
Meters


Transect 7
Floodplain deposition (mm/yr)
25
20
15
10
5
0
0
50
100
150
200
250
Distance from channel
May-08
Dec. 2008

Connectivity

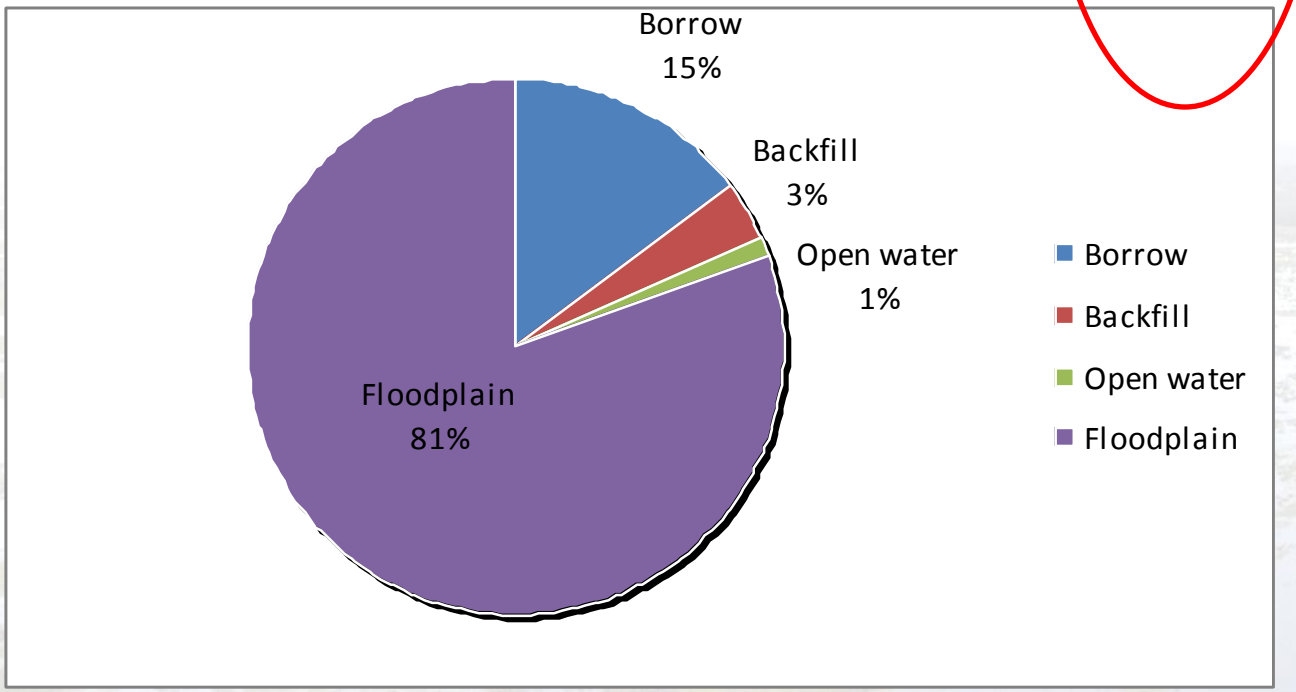



t10
elevation
m
9
8.5
8
7.5
7
6.5
6
5.5
5
0
50
100
150
200
250
300
m
Floodplain

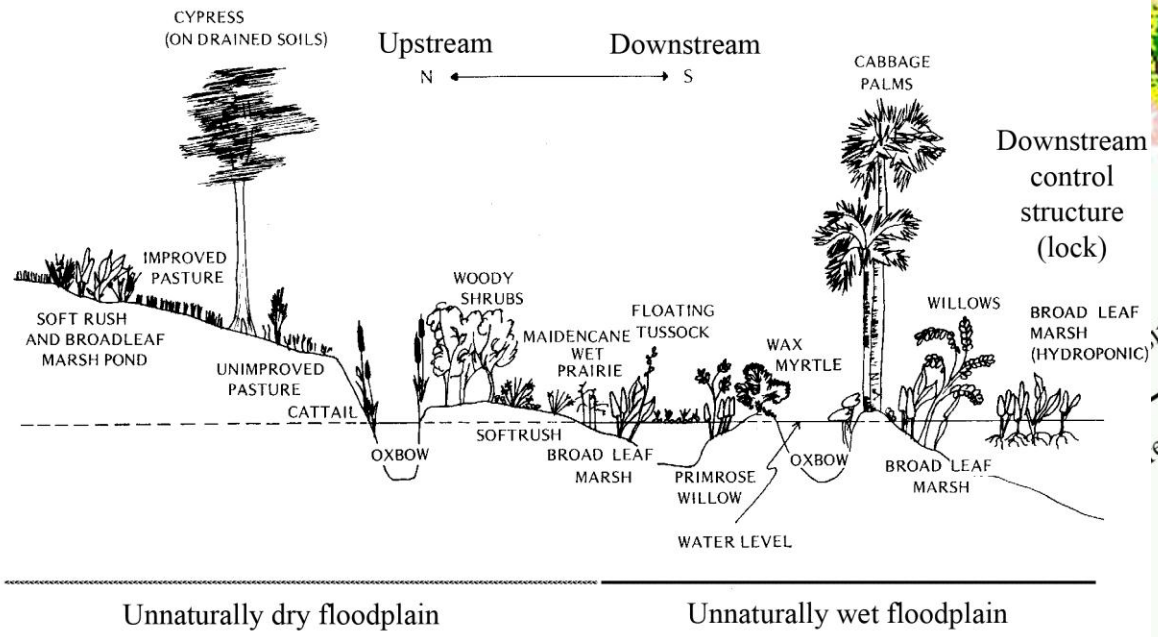

May
November
deposition
mm/yr
80
70
60
50
40
30
20
10
0
-10
1
2
3
4
5
6
7
8
Clay Pad Number

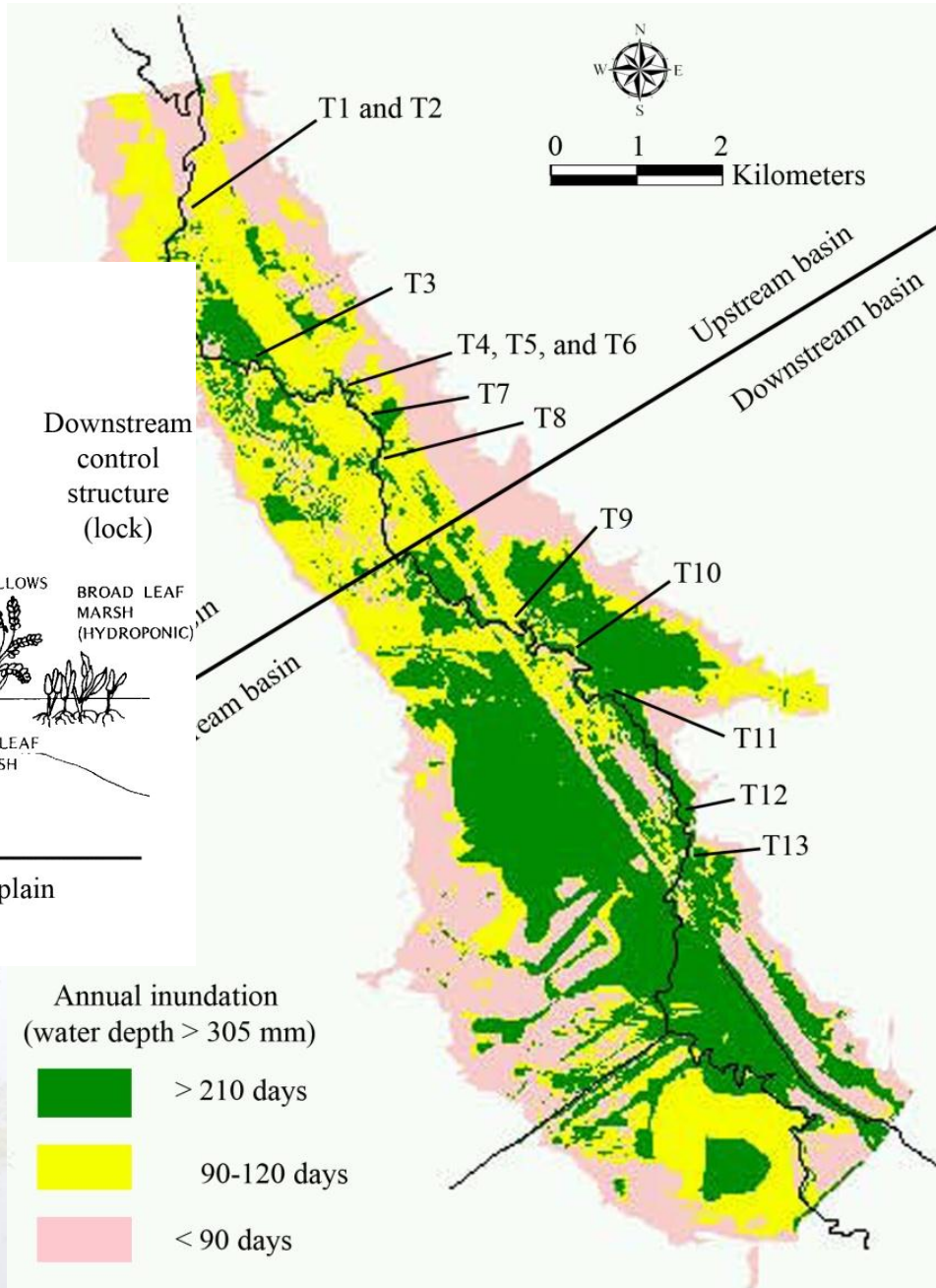
However, for the entire floodpla[illegible] mean particle size decreased and percent organics increased (from 8.1 to 27. 5%) after large flood

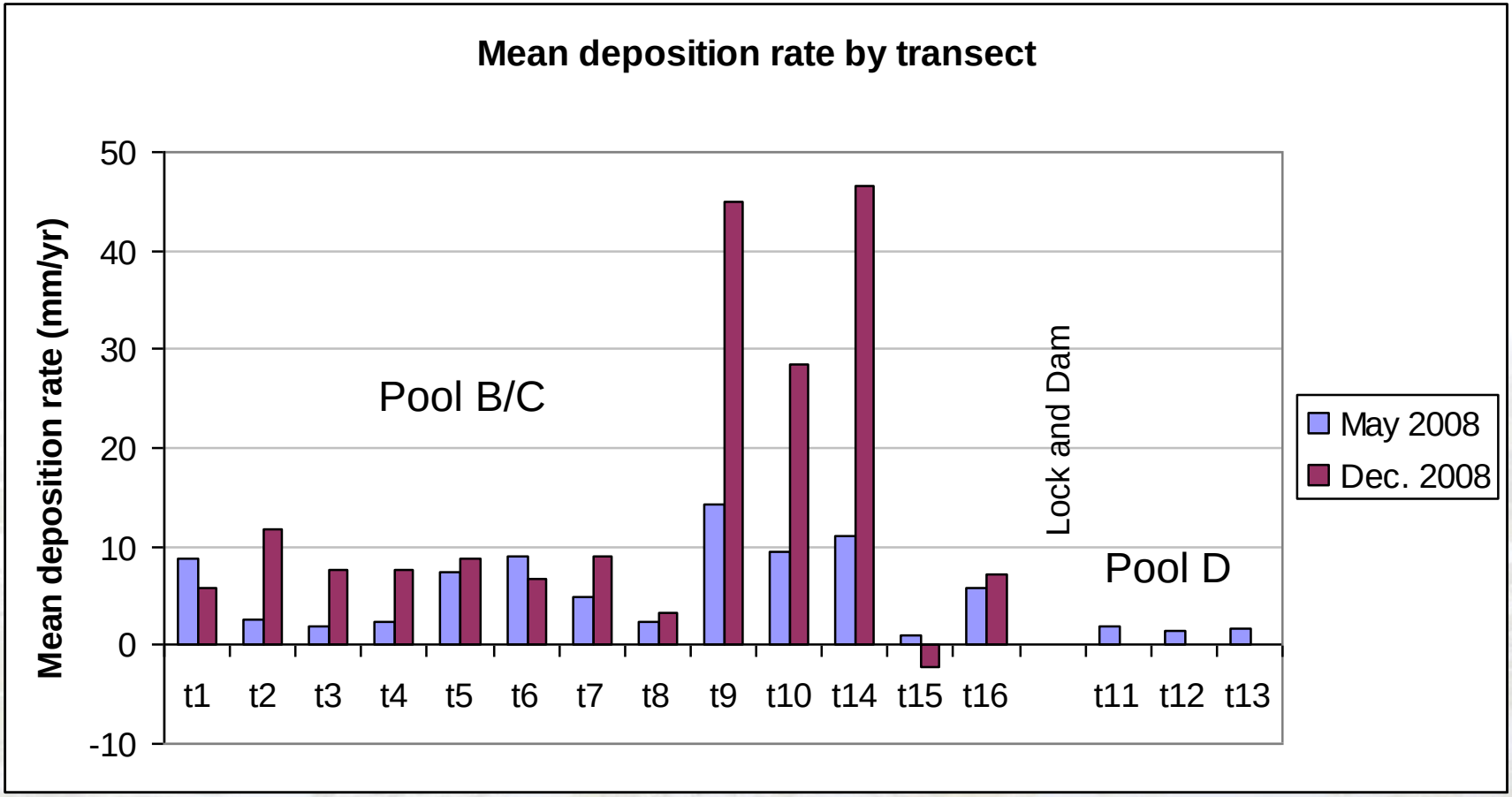
Landscape type	Area m^2	Rate mm/yr	Percent organic	Density g/cm^3	Total mass g/m^2*yr		Total mass Mg/yr	Mineral Mg/yr	Organic Mg/yr
Borrow	4,330,000	7.4	29.8	0.53	3,892		16,853	11,838	5,016
Backfill	1,000,000	**5.0**	23.8	0.85	4,201		4,201	3,200	1,001
Floodplain	23,542,000	10.1	32.2	0.45	4,600		108,296	73,398	34,898
Levee	418,000	27.1	9.0	0.69	18,579		7,766	7,070	696
						Sum:	**137,116**	**95,505**	**41,611**



Longitudinal Position, backwater effects






Mean deposition rate by transect
Mean deposition rate (mm/yr)
50
40
30
20
10
0
-10
Pool B/C
Lock and Dam
Pool D
t1
t2
t3
t4
t5
t6
t7
t8
t9
t10
t14
t15
t16
t11
t12
t13
May 2008
Dec. 2008

3. Elevation/vegetation

Deposition rate

13.9 mm/yr

0.15 m

Relative elevation

5.3 mm/yr

0.27 m

12.1 mm/yr

Reference

11.5 mm/yr

0.09 m

SUMMARY

Many factors may affect deposition amounts and patterns but flow paths and connectivity to sediment laden water may be the most important.

Low elevations and high flood stage usually generate high deposition, regardless of landscape type or vegetation type

Deposition is greatest low (downstream) in pool

Small floods (annual to 3-yr) may be mostly organic material redistribution events, while large floods > 5-yr move considerable mineral sediment near channel and even larger amounts organic material away from channel.

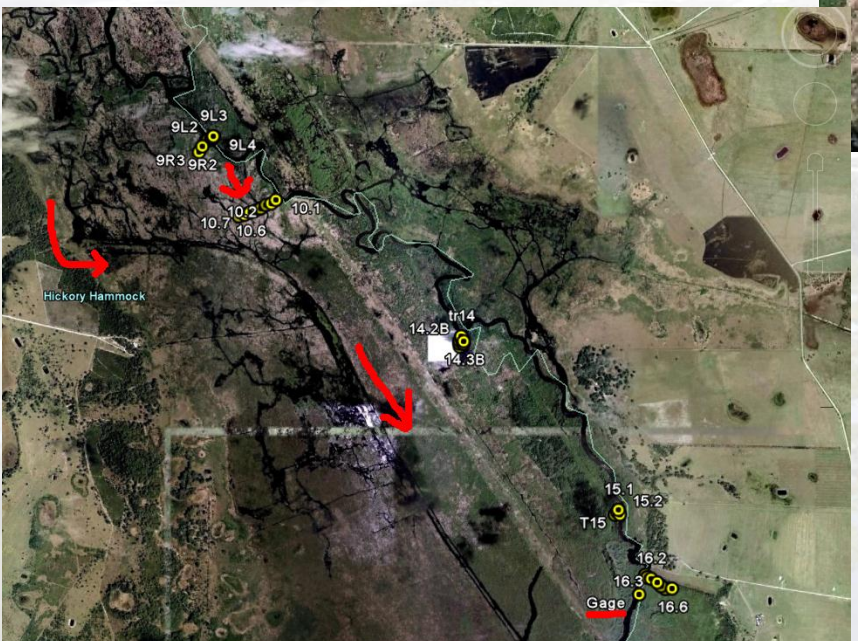
About 25% of all sediment trapped, annually, is organic

There are three orders-of-magnitude difference in sediment trapping rates depending on selected landform--- thus care must be used to estimate sedimentati dynamics (stratification)

Conclusion:

Restoration has been partly successful. Landscape artifacts (borrow/backfill), the remaining control structure, and remaining drainage ditches may be hindering restoration.

Channel migration/avulsions on the floodplain are not monitored and may become highly significant



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As of time of meeting…. All of the above are either laid off, retired, or moved to another state.

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