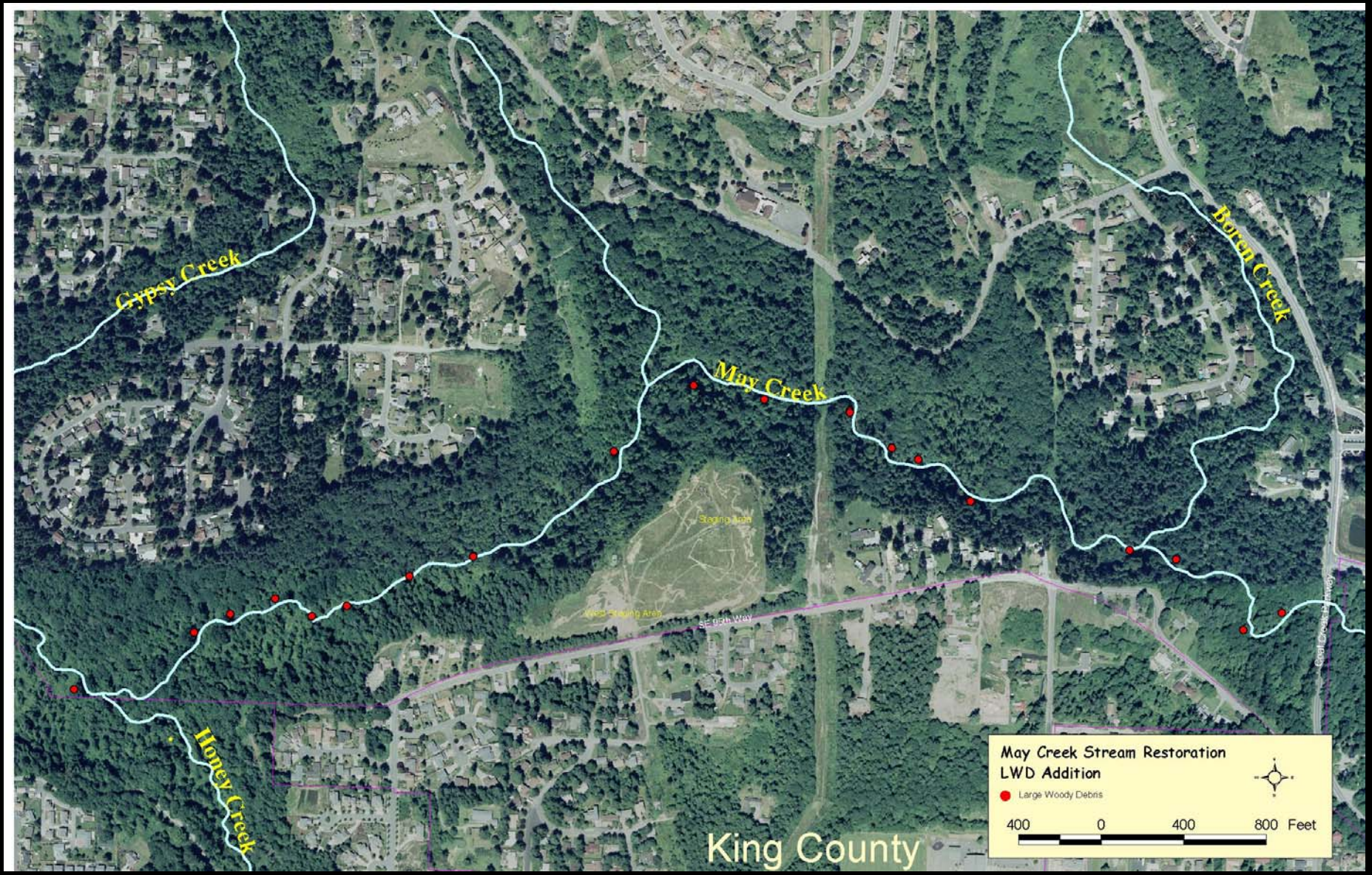
Monitoring of the May Canyon Stream Restoration Project

A Summary Presentation
by the
CIP Monitoring Program

July 2003 LWD Placement Locations



Typical LWD Placement

- All unanchored
- Aggressive in-channel placement
- Most placed in clusters of 2-3 logs
- Some individual “Key” pieces placed
- Primarily targeted homogenous reaches with minimal LWD or hydraulic complexity
- Also in incised reaches upstream of Newcastle Creek

Benefits of LWD

What can we expect?

- Hydraulic complexity
- Habitat complexity
- Scour pools and slow water
- Effect on sediment regime
- Added roughness
- Nutrients for aquatic life

Purpose of this Monitoring Project

- **To collect and present data that will inform staff and improve the design of LWD placement projects in the future.**
- **To document the effects of this and other similar LWD placement projects in urbanizing regions.**
- **To generate powerful graphics that can be easily and visually interpreted and presented to CPOSA staff, WLRD staff, regulatory staff, clients, council members, other restoration professionals and the general public.**
- **To demonstrate King County's overall commitment to monitoring and understanding the effects of our restoration projects.**

Goals and Objectives of Monitoring

Primary Goal

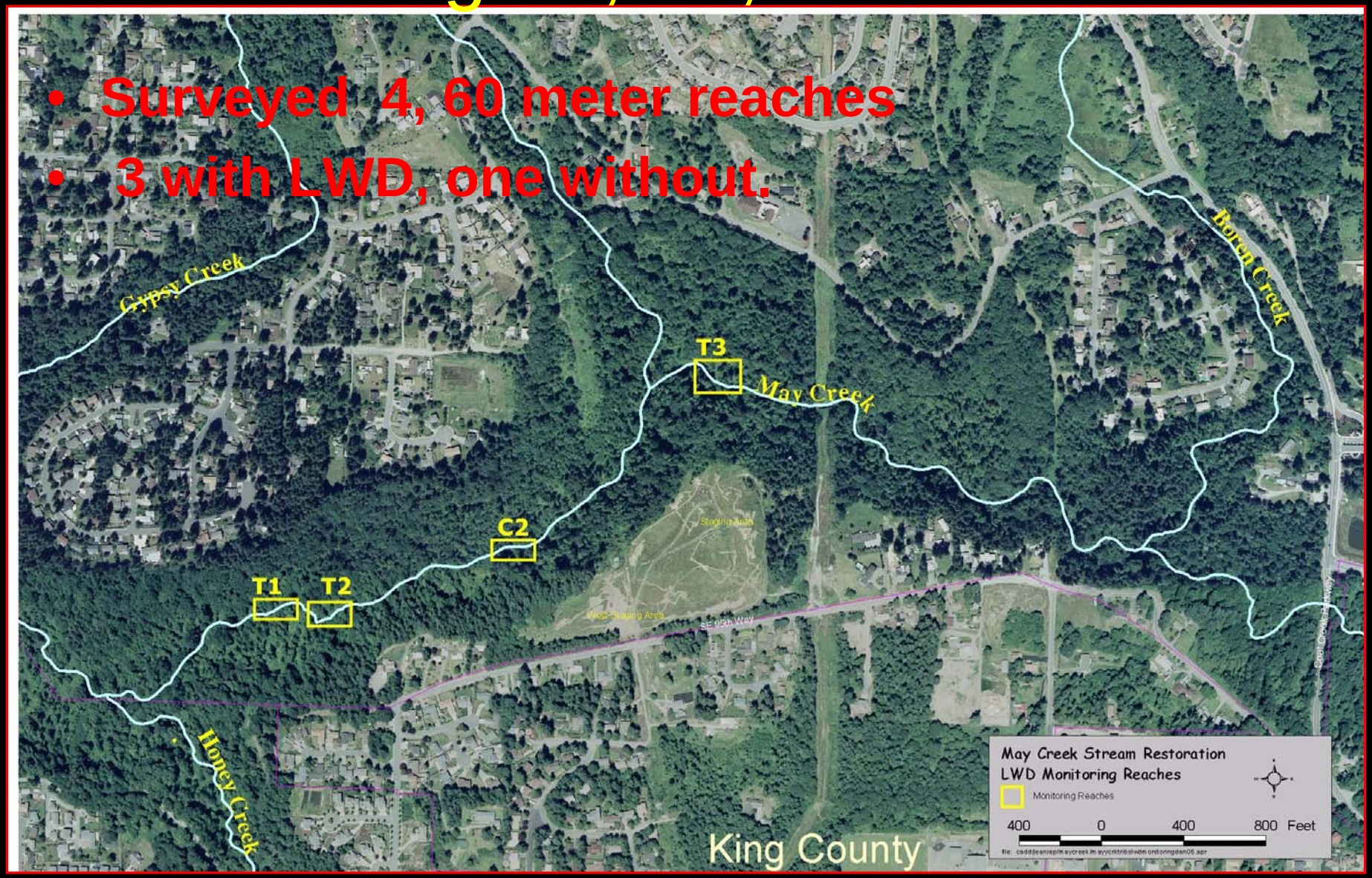
To clearly document and understand geomorphic processes and aquatic habitat changes in small/medium sized stream channels where Large Woody Debris has been added as a restorative measure

Secondary Goal: To document any changes in fish distribution that may be correlated with the changes in aquatic habitat caused by LWD placement.

Objectives: To answer the following questions and others as the data allows:

1. **What type and degree of physical changes can we expect?**
2. **What type and degree of changes in aquatic habitat can we expect?**
3. **How mobile is LWD relative to pre-project predictions? How far does it typically move downstream? Under what flow conditions and timeframe does it move?**
4. **Are there particular configurations of LWD that are more effective than others?**
5. **How does LWD placement affect sediment transport and storage?**
6. **Is there a shift in distribution of fish in May Canyon towards reaches with placed LWD?**

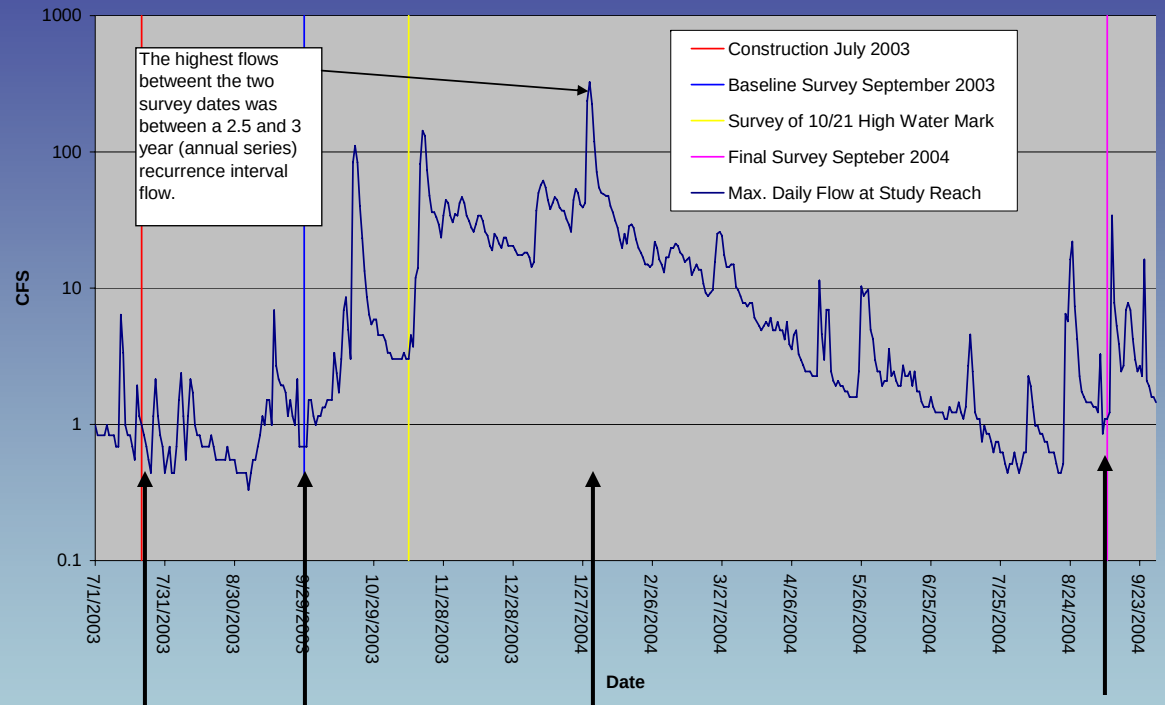
Aerial Photo of project reach showing T1, T2, T3 and C2



- **Surveyed 4, 60 meter reaches**
- **3 with LWD, one without.**

Monitoring Timeline

Figure 6: Maximum Daily Discharge at Study Reach Relative to Project and Survey Dates



LWD placement July, 2003

Baseline Survey Sept, 2003

~2.5 yr. flood event Jan. 2004

2nd Survey Sept. 2004

No Survey Activity in 2005 or 2006

High Resolution Topographic Survey

- High density of shots throughout streambed and banks
- Extensive permanent control points established to assure repeatability.
- Surveyed beyond immediate stream channel to capture surrounding topo.
- LWD position and size surveyed and recorded each year
- Edge of water surveyed during low flow period each year (Aug/Sept)

Additional Data Collected

- Habitat surveys to delineate boundaries between pool and riffle habitat
- Fish abundance (e-shocking) survey (2003 baseline only)
- Substrate composition (2003 baseline only)

Graphics Generated From Surveys

- Plan view, color graphic showing water depth, LWD position/size and the location of pools and riffles in each of the 4 reaches for each survey date.
- Corresponding thalweg profiles with stationing.
- Plan view graphic showing LWD movement between survey dates.
- Plan view, graphic showing the amount and location of scour and deposition throughout each reach between survey dates.

Descriptive Statistics

Only T1 data presented today

1. Total pool & riffle volume for all reaches, each survey yr.
2. Residual pool depths and volumes
3. Total thalweg length.
4. Quantity of scour/deposition (net).
5. Distance LWD moved between survey dates
6. Change in parameters 1-4 between survey dates can be compared between treatment reaches and control reach.

Results to Date

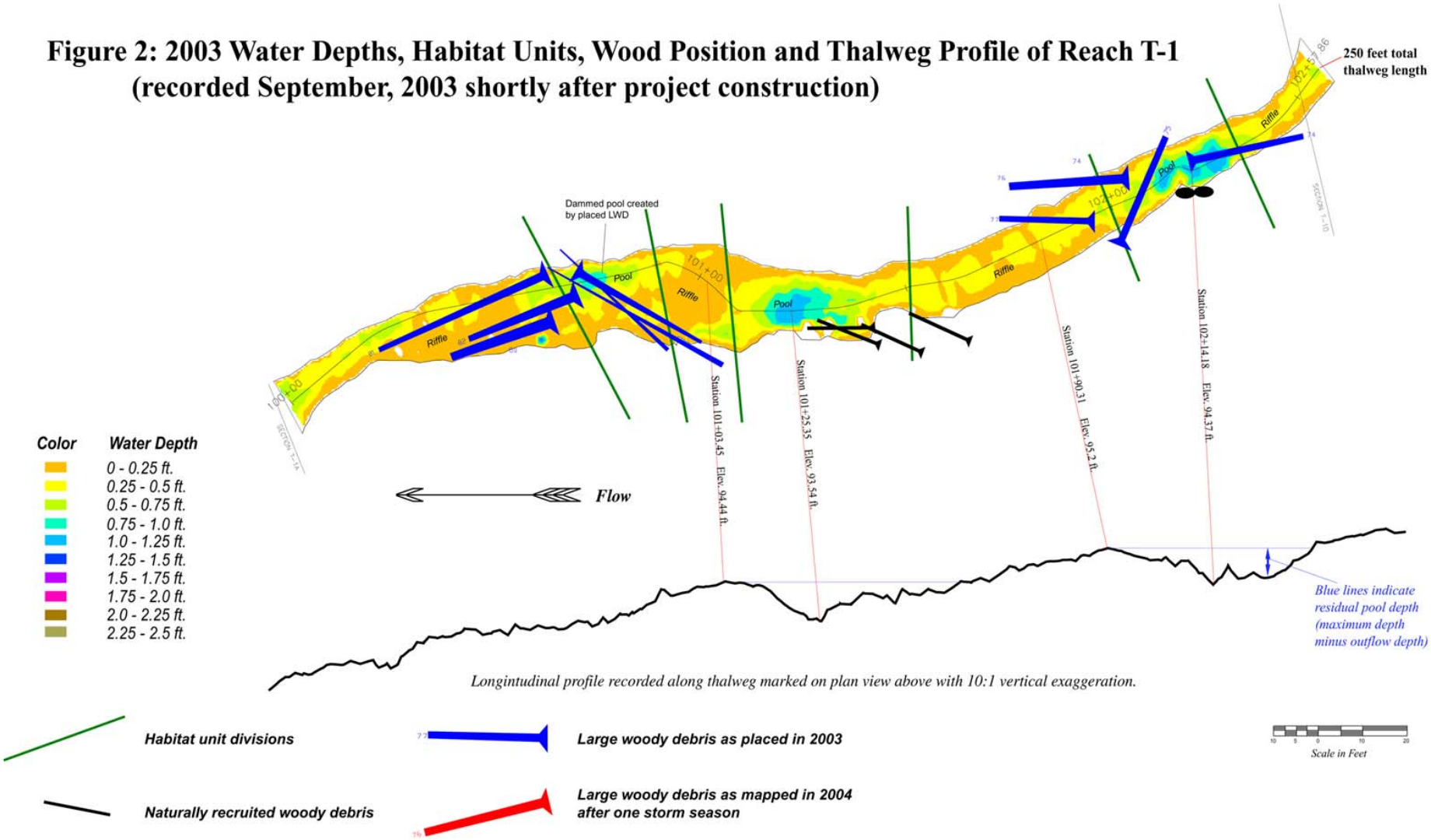
A comparison of 2003 and 2004 survey statistics

Changes in Aquatic Habitat (T1)

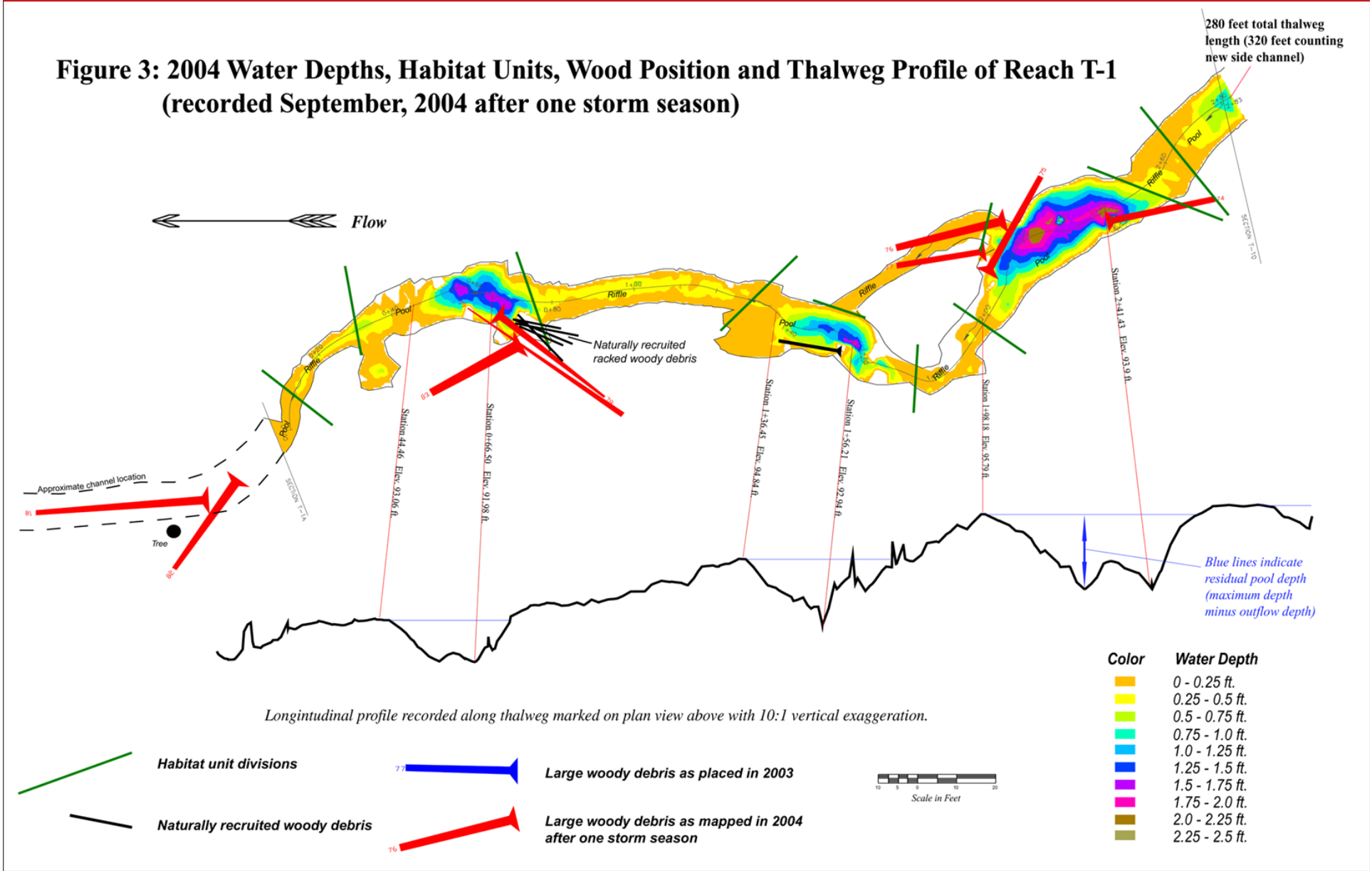
Habitat Parameter	2003 Channel	2004 Channel	Change Between Survey Dates
Total Residual Pool Volume	257 cubic feet	730 cubic feet	+ 473 Cubic Feet Pool V.
Maximum Residual Pool Depth (Average)	0.87 feet	1.57 feet	+ 8.4 Inches in Max. Pool Depth (average)
Total Number of Pools	2	5	Three Additional Pools
Total Number of Riffles	3	5	Two Additional Riffles
% Pool per Unit Volume	51%	88%	+ 37% in Pool / unit Volume
% Riffle per Unit Volume	49%	12%	- 37% in Riffle / unit Volume
Total Active Channel Length	~240 feet	~320 feet	Additional ~70 feet of Active Channel Length (including 40' side chnl.)

2003 Survey Results – T1

Figure 2: 2003 Water Depths, Habitat Units, Wood Position and Thalweg Profile of Reach T-1 (recorded September, 2003 shortly after project construction)

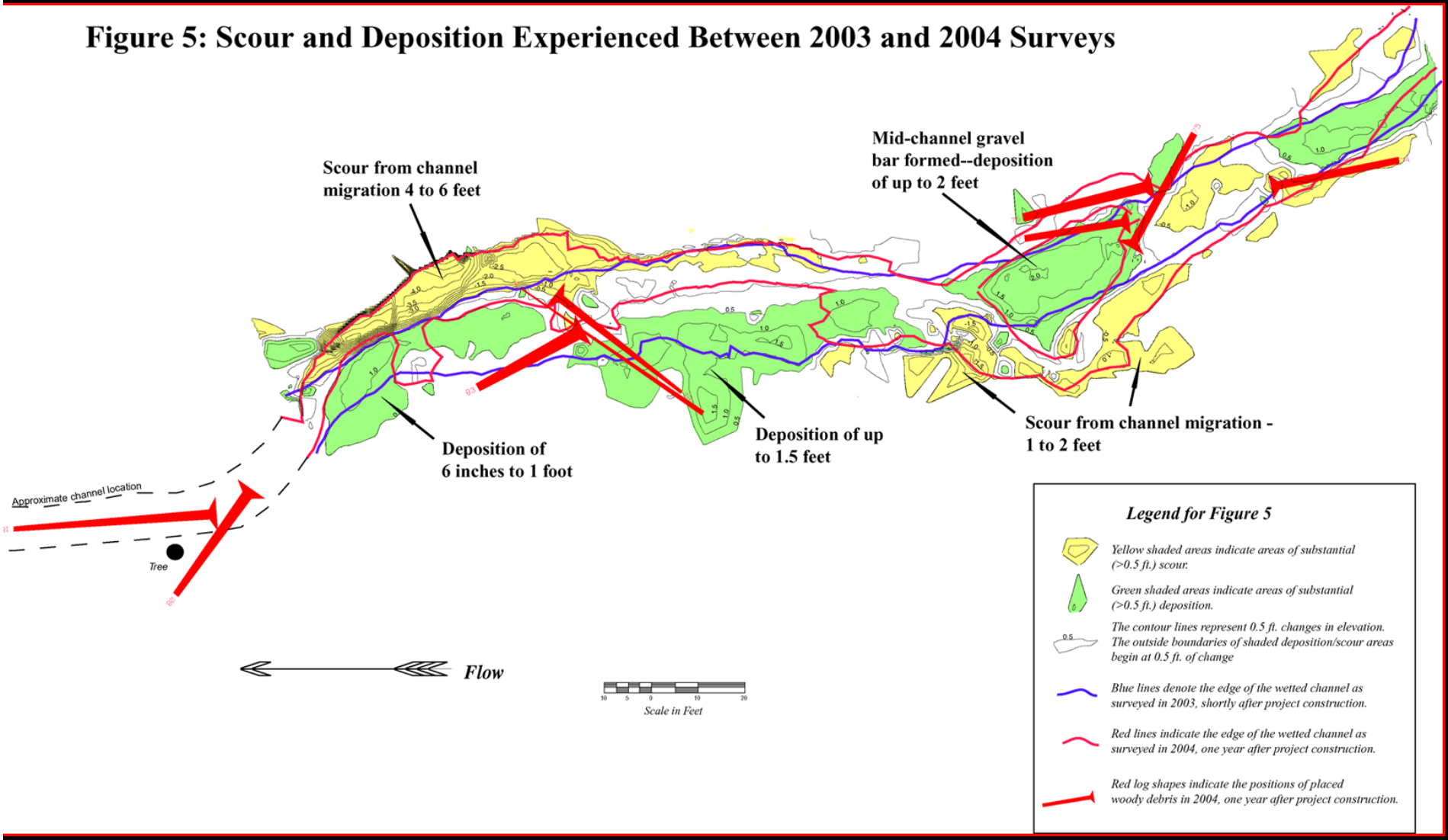


2004 Survey Results – T1



2004 Survey Results – T1

Figure 5: Scour and Deposition Experienced Between 2003 and 2004 Surveys



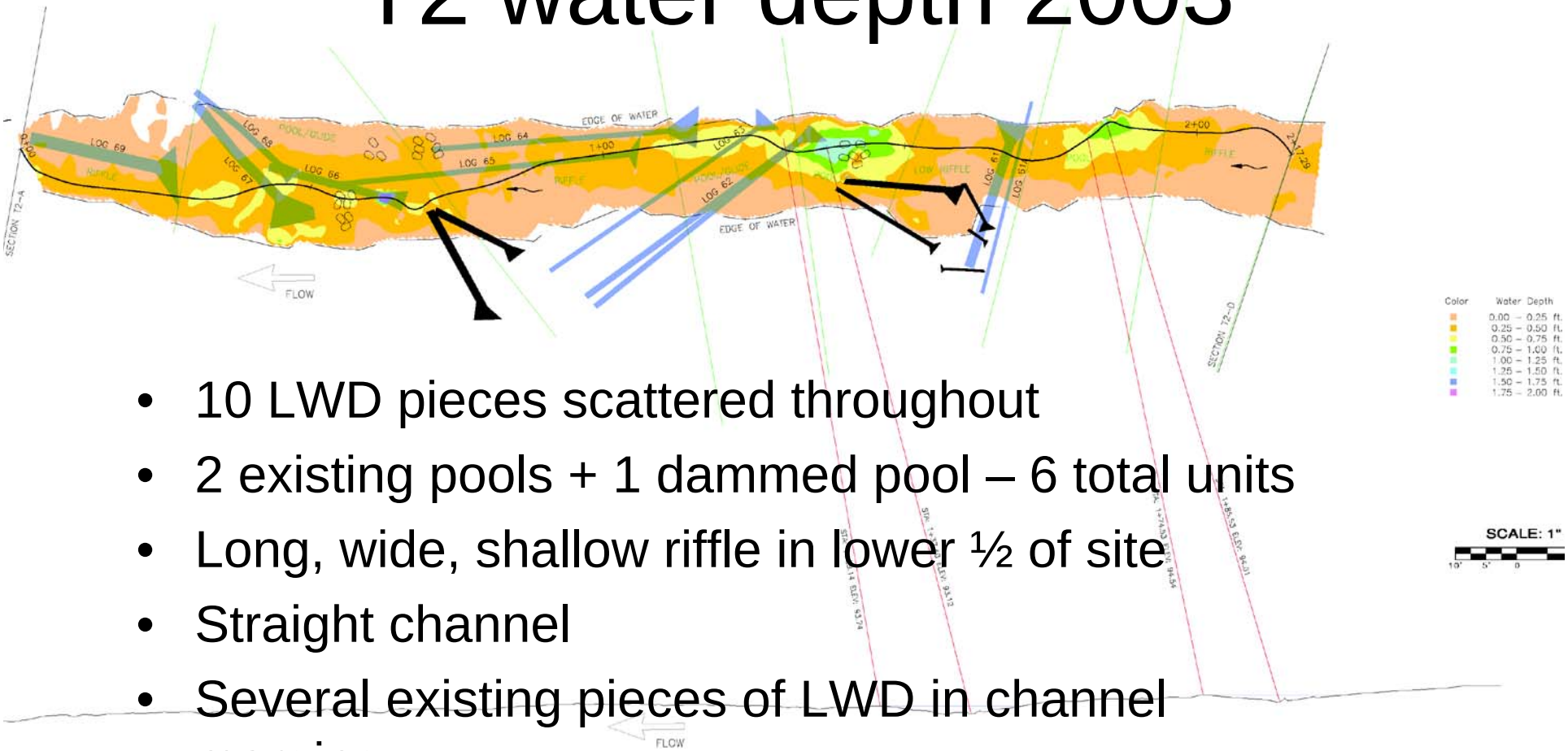
T1 2003 - Lower reach looking upstream

T1 2004 Lower Jam looking downstream

T1 2003 upper pool looking downstream

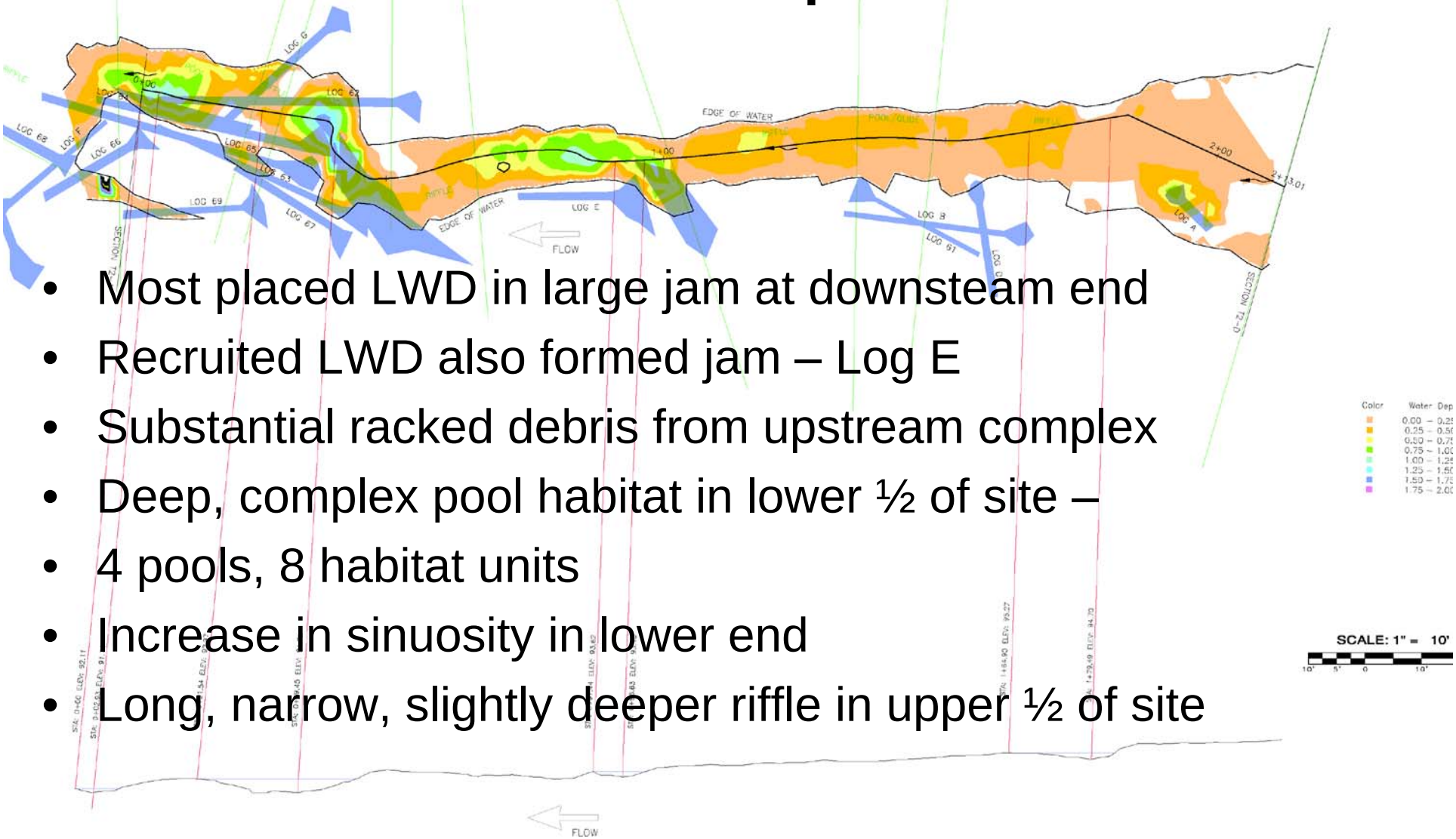
T1 2004 upper pool looking downstream

T2 water depth 2003



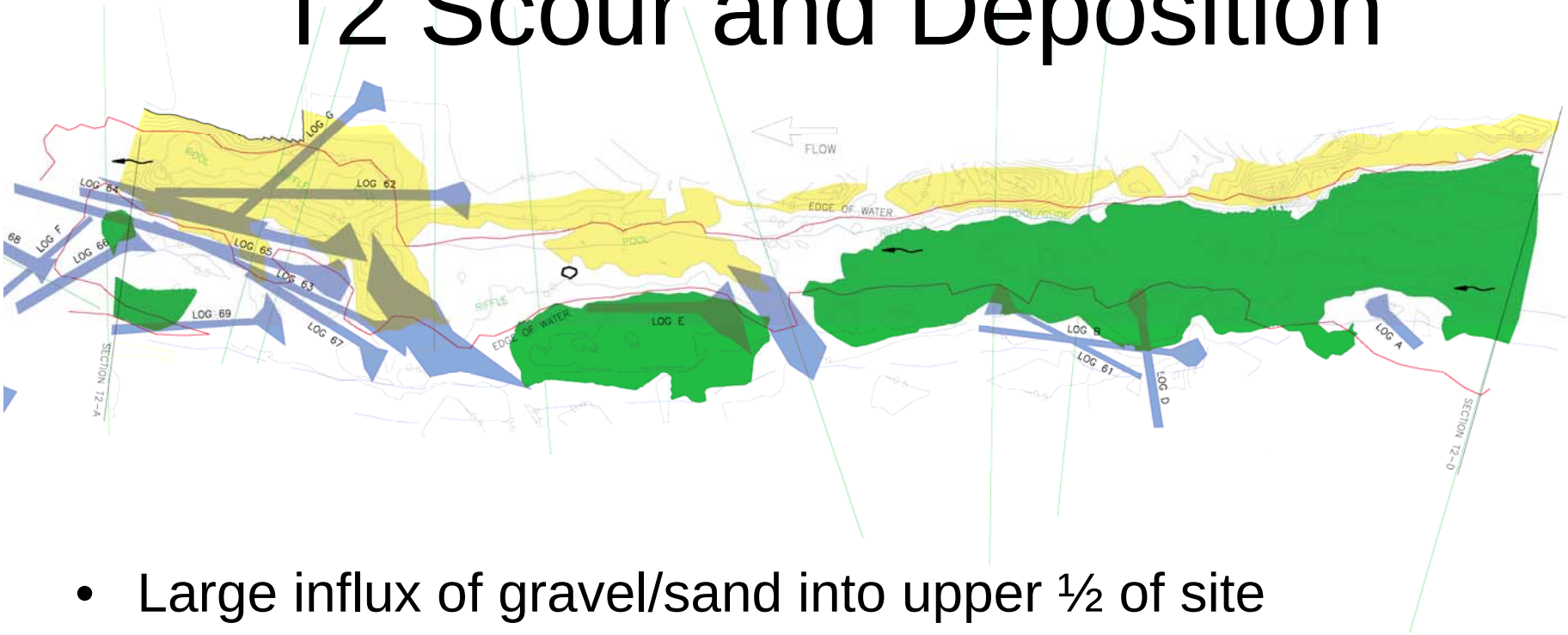
- 10 LWD pieces scattered throughout
- 2 existing pools + 1 dammed pool – 6 total units
- Long, wide, shallow riffle in lower ½ of site
- Straight channel
- Several existing pieces of LWD in channel margins

T2 water depth 2004

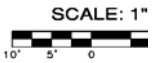


- Most placed LWD in large jam at downsteam end
- Recruited LWD also formed jam – Log E
- Substantial racked debris from upstream complex
- Deep, complex pool habitat in lower ½ of site –
- 4 pools, 8 habitat units
- Increase in sinuosity in lower end
- Long, narrow, slightly deeper riffle in upper ½ of site

T2 Scour and Deposition



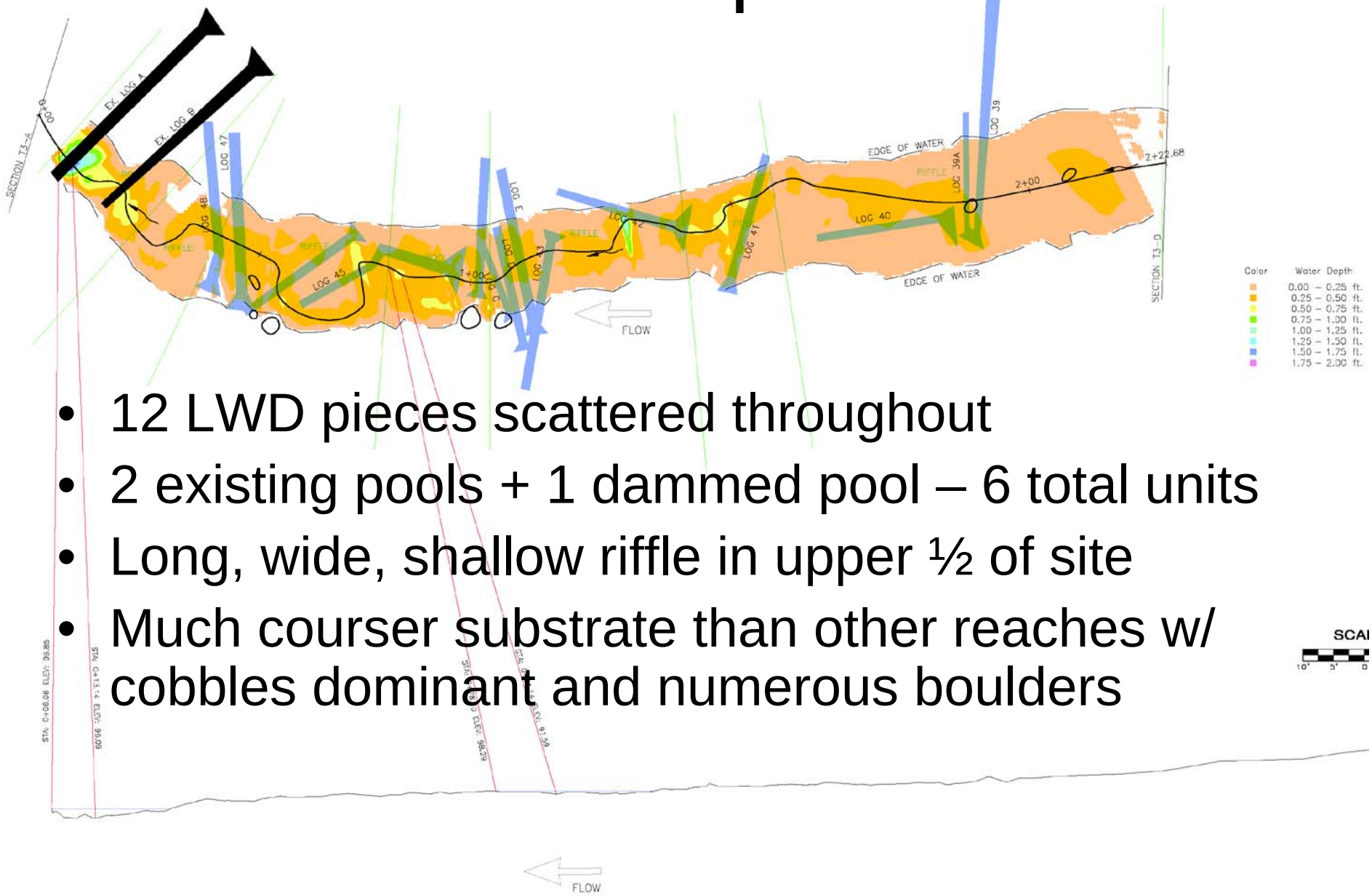
- Large influx of gravel/sand into upper ½ of site
- LWD appears to have temporarily trapped sediment
- Bars of sediment result in a narrower, deeper channel
- LWD jam caused extensive scour of right bank
- Backwater areas formed downstream of jam in old bed
- In general - much more complex topography and habitat



T2 lower end pre-placement

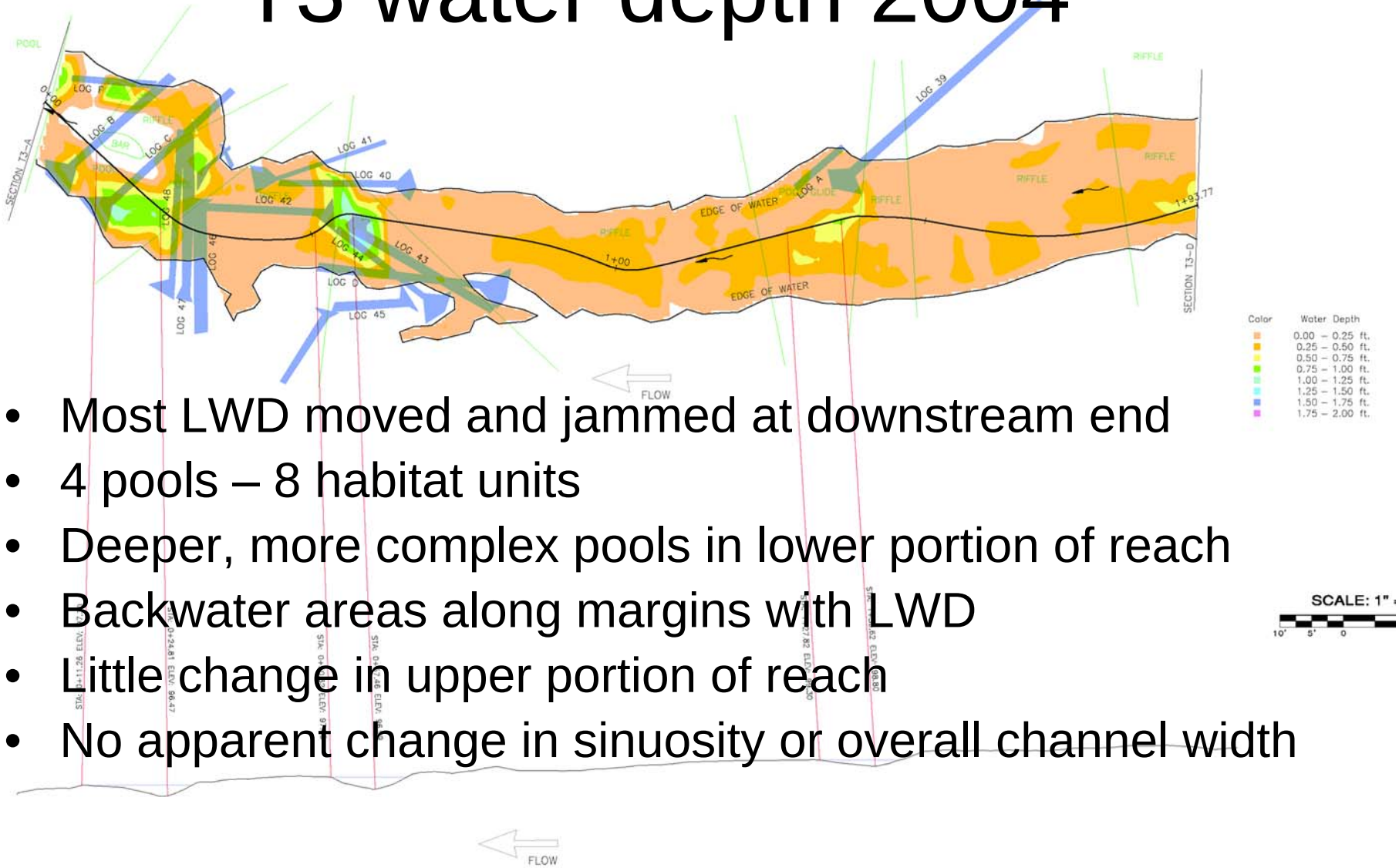
T2 lower end 2006 – moderate flow

T3 water depth 2003



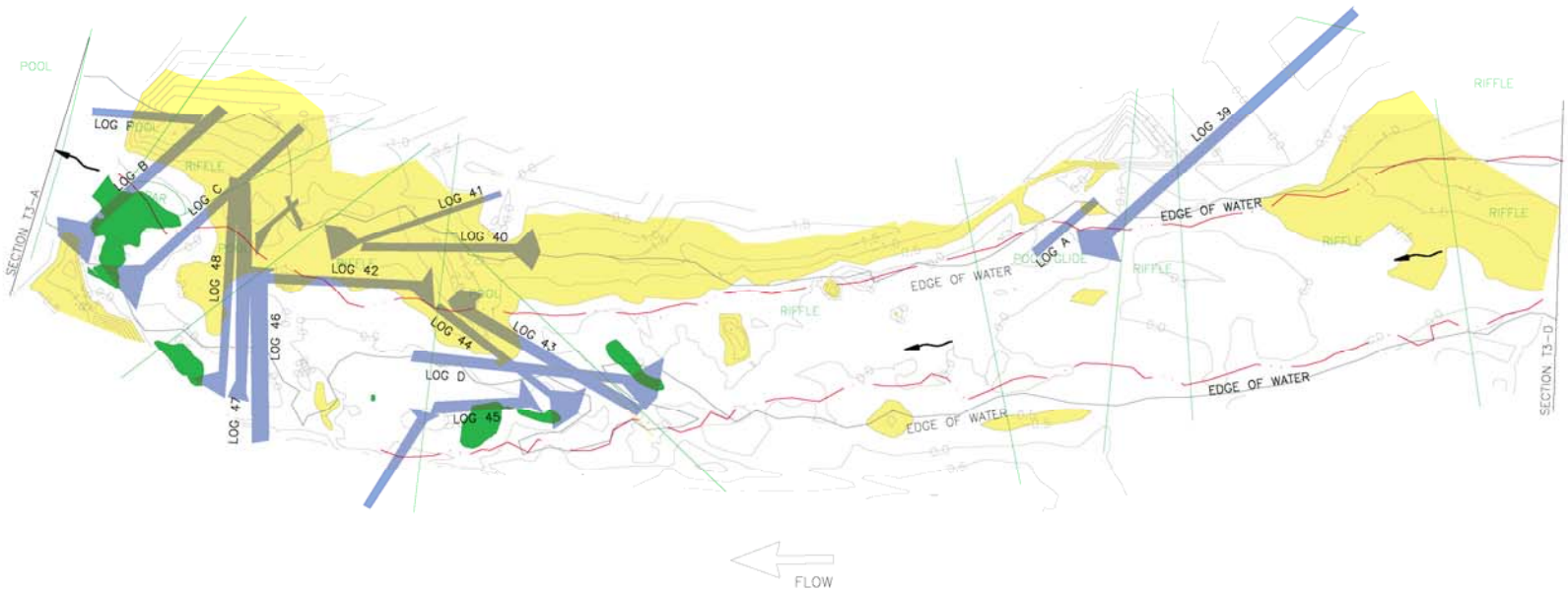
- 12 LWD pieces scattered throughout
- 2 existing pools + 1 dammed pool – 6 total units
- Long, wide, shallow riffle in upper ½ of site
- Much courser substrate than other reaches w/ cobbles dominant and numerous boulders

T3 water depth 2004



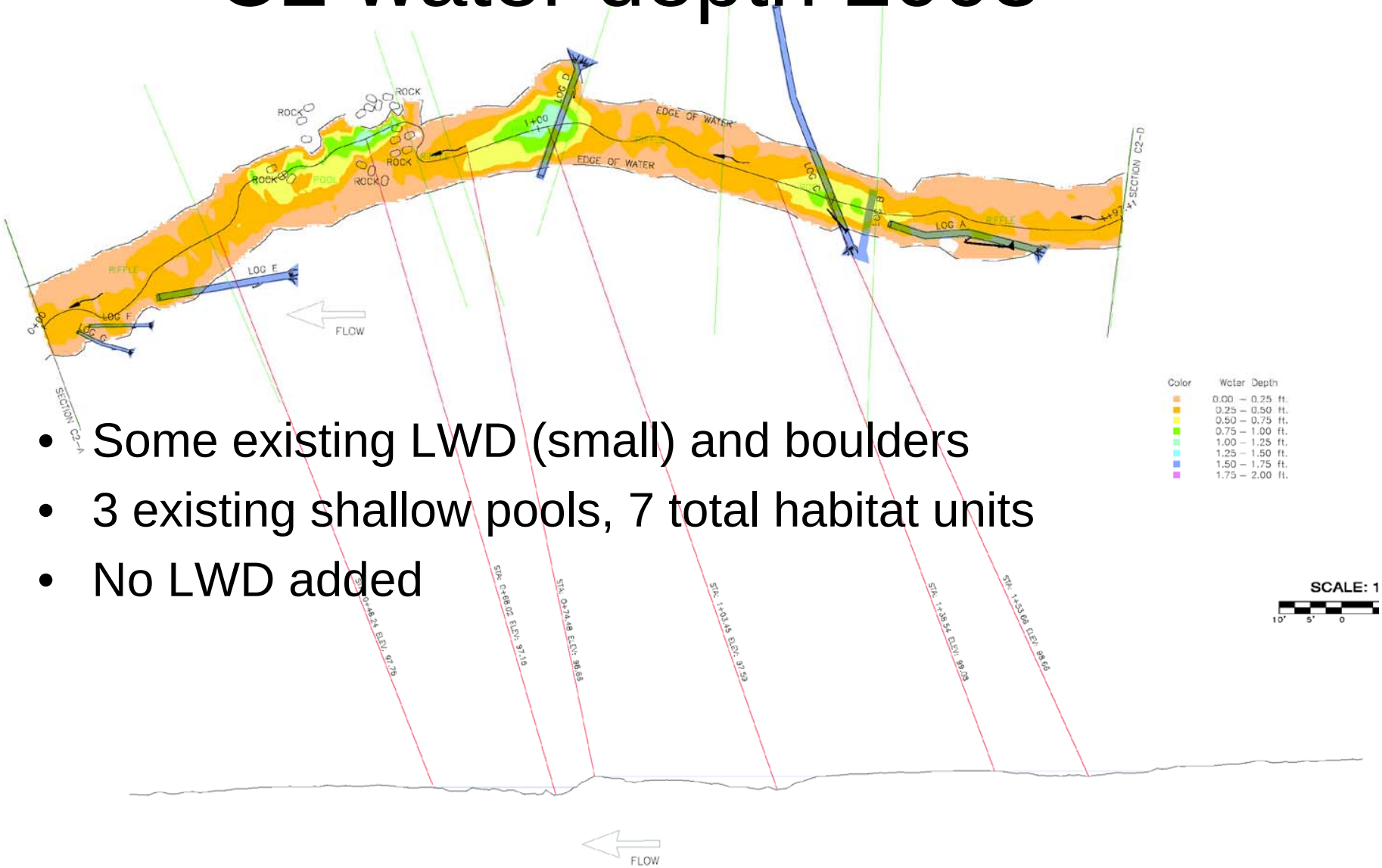
- Most LWD moved and jammed at downstream end
- 4 pools – 8 habitat units
- Deeper, more complex pools in lower portion of reach
- Backwater areas along margins with LWD
- Little change in upper portion of reach
- No apparent change in sinuosity or overall channel width

T3 Scour and Deposition



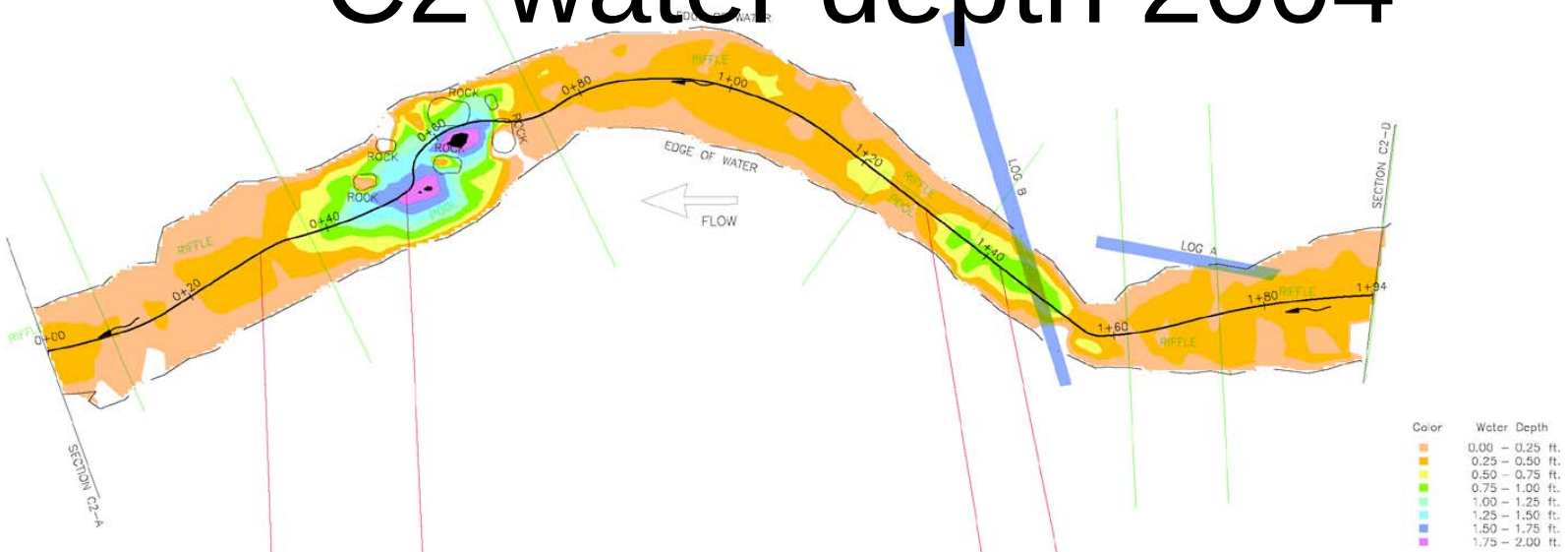
- Extensive scour on right bank due to jam
- Little or no deposition throughout reach – lower bar only
- Very little change in bed elevation in upper ½ of reach
- Slightly steeper reach, upstream of Newcastle sediment source and closer to May Valley.

C2 water depth 2003

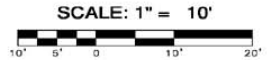


- Some existing LWD (small) and boulders
- 3 existing shallow pools, 7 total habitat units
- No LWD added

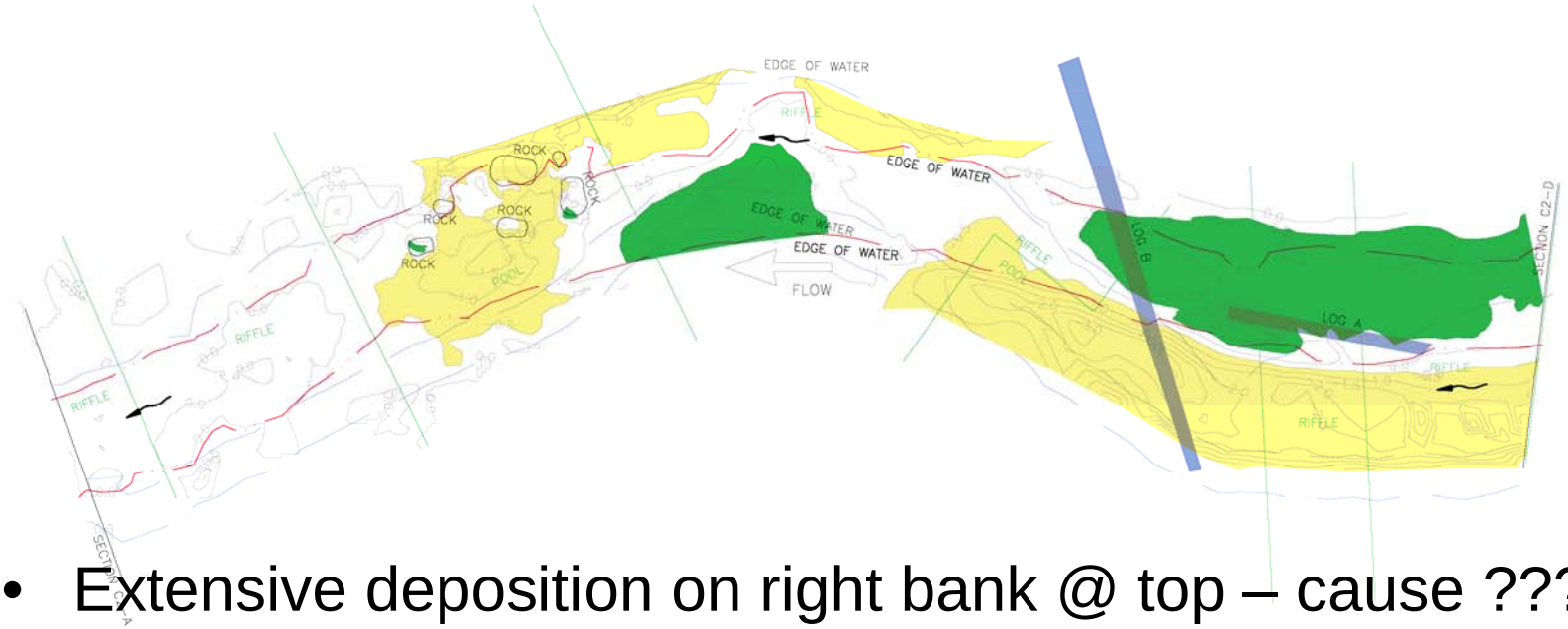
C2 water depth 2004



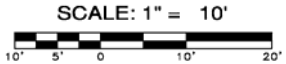
- Increase in pool depth around rocks – similar to LWD
- Lost at least 1 piece of small woody debris
- Change in sinuosity apparent, but not directly caused by LWD
- 6 units, 2 pools –possble simplification of habitat



C2 scour and deposition



- Extensive deposition on right bank @ top – cause ???
- Related scour on left bank – possibly due to deposition
- Channel movement has downstream effect on hydraulics and associated sediment transport
  - Inside meander bend bar
  - Scour around boulders



C2 upstream end 2003

C2 upstream end 2004

Log Movement Throughout Entire Project Reach (2003→2005 Observations)

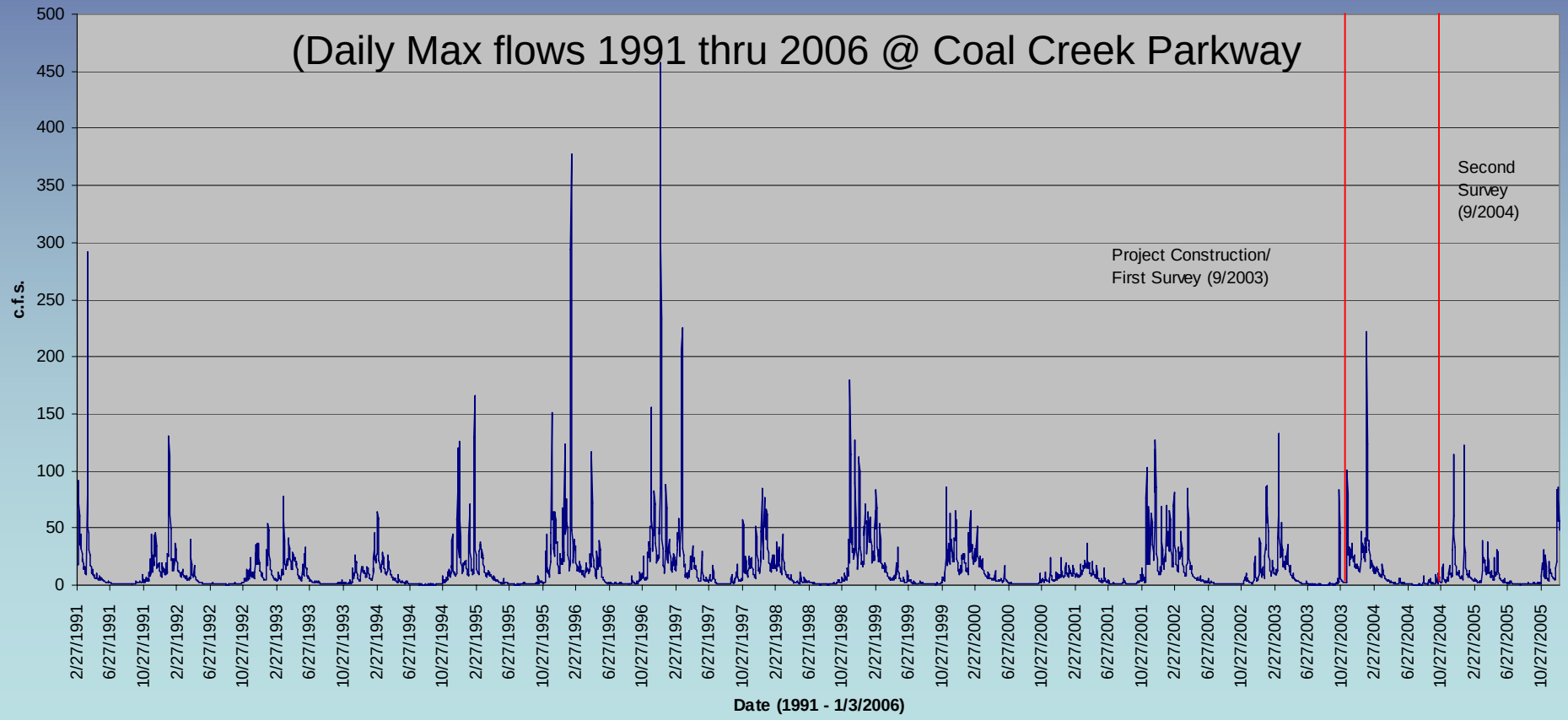
- No logs moved beyond downstream structure
- 172, 182 and 339 CFS events in 2003/2004 water year resulted in substantial movement
- Minimal movement during 2004/2005 water year.
- 64 of the 89 (72%) tracked logs moved < 30 feet
- Of the 25 logs that moved > 30 feet downstream
  - 13 moved only 30 to 100 feet downstream,
  - 10 moved 100 to 200 feet downstream
  - 2 moved more than 300 feet downstream.

Conclusions to Date

- Deposition and scour around LWD increased physical complexity of the streambed in treatment reaches
- Corresponding increase in hydraulic complexity and habitat complexity (e.g. +2.33 pools, + 3 units, large increase in pool volume and quality)
- Substantial change also observed in control reach, but the end result was simplification of the channel & habitat
- Very large pieces of LWD were mobile even under moderate flow conditions, but only during the 1st yr. floods and they did not move far.
- This methodology is an effective means of communicating the effects of these projects to interested parties.

More To Come!!!

- We have only seen results of several moderate flood events
- Survey will be repeated after a very large event and after more time.
  - Is LWD still stable under highest flows and after some decay?
  - Are habitat improvements persistent?



Acknowledgements

- May Canyon Project Team
  - Kathryn Neal, John Bethel, Kerry Bauman, Ingrid Haynes, Paul Adler, Abel Eckhardt and WCC crews
- May Canyon Monitoring Team
  - John Bethel, Kathryn Neal, Laird ORollins, Laura Hartema, Meredith Radella, Lucy Traxinger, Beth Carpenter, Larry Goulet, Hans Berge
- ESM Civil Engineers
  - Stephen Phillips and survey crews
- Management
  - For supporting this and other monitoring projects

May Canyon LWD life to Date Expeditures compared with Original 2003 estimate

last updated 1/18/2005

Proposed and Approved by management prior to project initiation

Phase 1 - Baseline Survey (2003)

2003		**Actual Expenditure**	**Original 2003 estimate**	
ESM Baseline survey - 4 reaches	$	31,500		
CPOSA Contract set-up (1), and mgt (lydna)	$	2,500		
CPOSA Project management and senior ecologist	$	13,000	**$64,000**	Original estimate for detailed topo, habitat and fish abundance surveys with no substantial analysis this year.
CPOSA support staff	$	7,500		
subtotal	**$**	**54,500**		

Phase 2 - 2nd survey & analysis/presentation of 1st and 2nd survey results (2004, 2005 and 1st qtr 2006)

2004		**Actual Expenditure**	**Original 2003 estimate**	
ESM Repeat Survey of 4 reaches	$	10,900		
CPOSA Project manager and senior ecologist	$	5,500		
CPOSA support staff	$	1,500		
CPOSA Contract set-up (2) , and mgt (lydna)	$	3,000		
subtotal	**$**	**20,900**		
2005				
ESM Data Processing and graphics production	$	13,400	**$61,000**	Original estimate for detailed topo, habitat and fish abundance surveys and interim analysis and presentation of results showing changes between survey dates
CPOSA Project management	$	1,900		
CPOSA staff support in analysis and poster production	$	15,600		
CPOSA Contract set-up (1), and mgt (lydna)	$	1,000		
subtotal	**$**	**31,900**		
2006				
ESM Final Data processing and graphics production	$	6,200		
CPOSA presentation preparation	$	8,700		
subtotal	**$**	**14,900**		

		Actual Expenditure	**Original 2003 estimate**	
TOTAL Life to Date	**$**	**122,200**	**$125,000**	orginal estimate for first two phases.
Summary stats.				
CPOSA labor	$	60,200		
ESM survey, compilation , analysis and graphics	$	62,000		
ESM survey alone	$	42,400		
ESM data compilation and graphics	$	19,600		

Phase 3 = 3rd survey after very large event (>10 yr)

	Actual Expenditure	**Original 2003 estimate**	
PHASE 3 not initiated yet - possibility in 2006 after large storm on Jan 11th		**$70,000**	original estimate for 3rd survey, analysis of 3rd survey and final analysis and presentation of results of all three surveys.