A Method to Estimate the Fine Sediment Load Reductions Associated with SEZ Restoration

SNPLMA Rounds 8-11
CA State Parks
CTC

Brian Spear, MS
Tahoe Science Consortium
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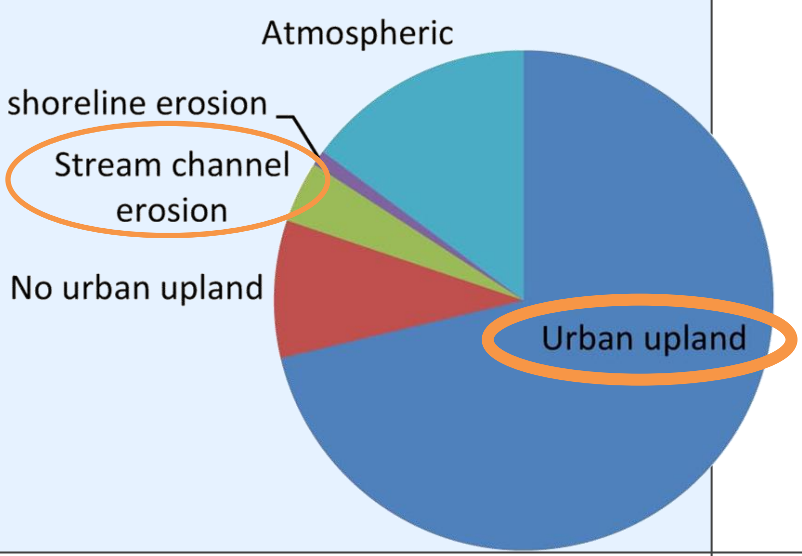
Why does Tahoe need load reduction estimates?

- FSP primary pollutant of concern to Lake Tahoe.
- Reduction of FSP loads into Lake Tahoe a priority.

SCG	Source Control	Treatment
Urban	Road Abrasives	SWT
Urban	Fertilizer	SWT
SEZ	**Channel Erosion**	**Floodplain**

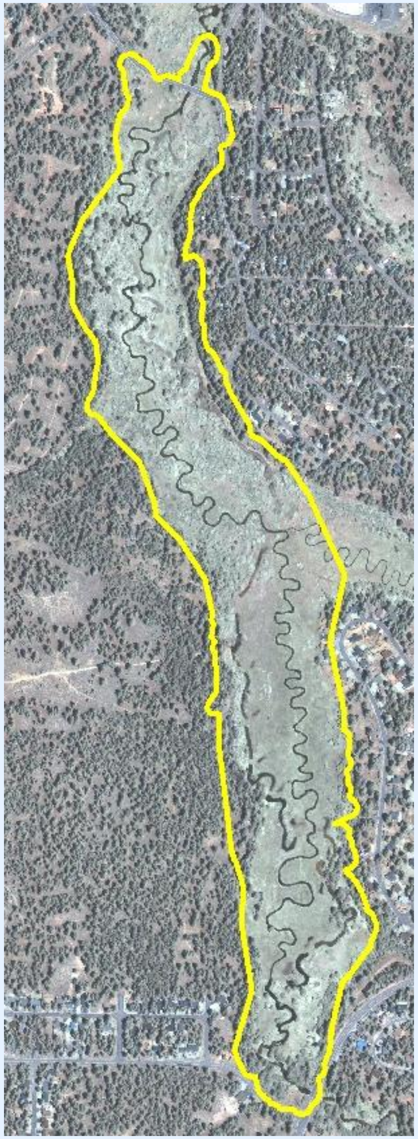
FSP Sources to Lake



Southern Pines SEZ

Osgood SWT

Eloise SWT



Trout Creek SEZ

Scale = 1:9000

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SLRT Goal and Objectives

Method to estimate the average annual pollutant load reduction as a result of SEZ restoration actions: Stream Load Reduction Tool (SLRT)

Objectives

- Develop a reliable, repeatable and cost-effective tool
- Applicable to range of SEZ scales
- Incorporates best available data and hypotheses of system function
- Improvable and adaptable over time
- Consistent with accepted stormwater tools and programs within Lake Tahoe Basin

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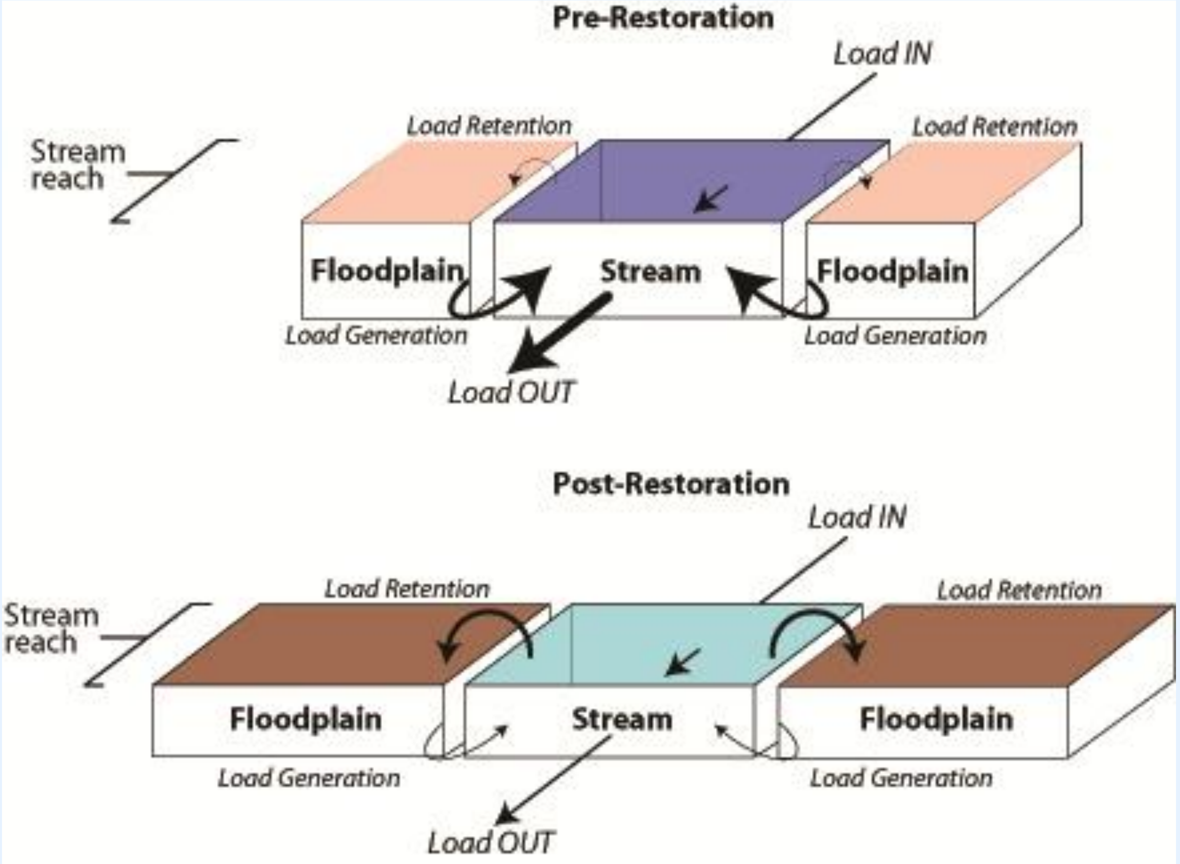
SEZ Restoration Load Reductions Achieved by:

a. Reduce stream bank erosion (source control)

b. Increase floodplain deposition (treatment)

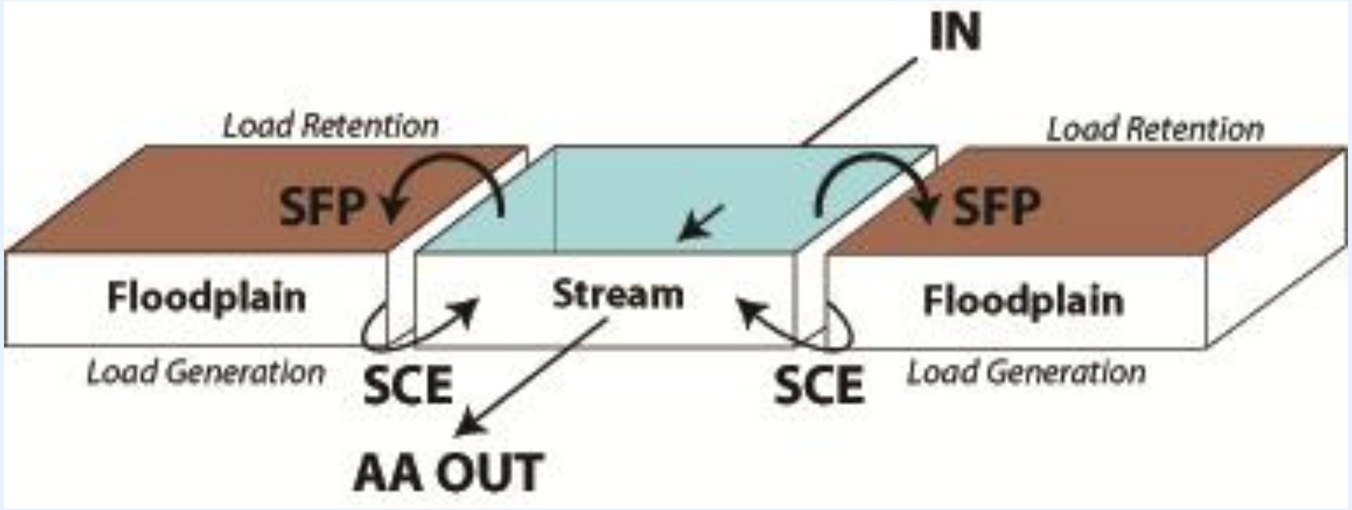


Users: Practitioners, Engineers, Planners
Pollutant: FSP, potential expansion later.
Output: Average Annual FSP Load Reduction at downstream boundary of SEZ.

EQ1.

AA FSP Load Reduction (MT/yr) =
AA OUT Pre Restoration (MT/yr) – AA OUT Post Restoration (MT/yr)

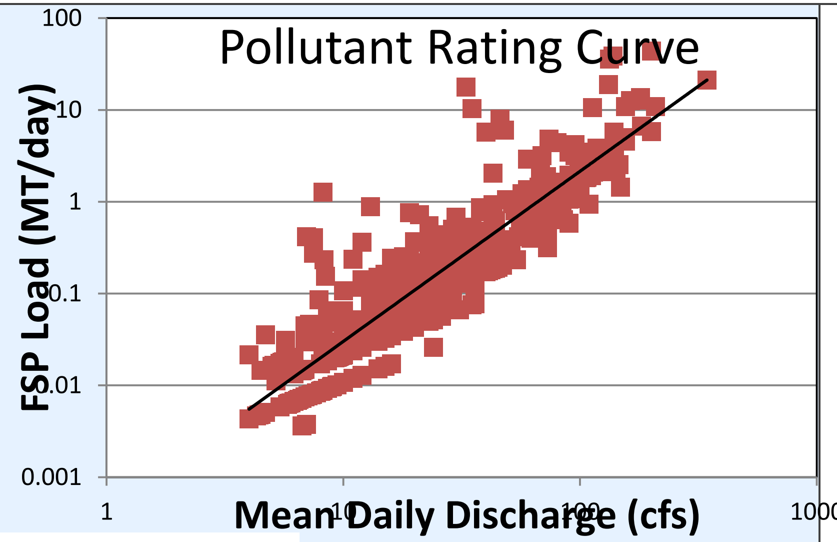
$$\text{AA OUT (MT/yr)} = \frac{\text{IN} - \text{SFP} + \text{SCE}}{\text{\# years}}$$

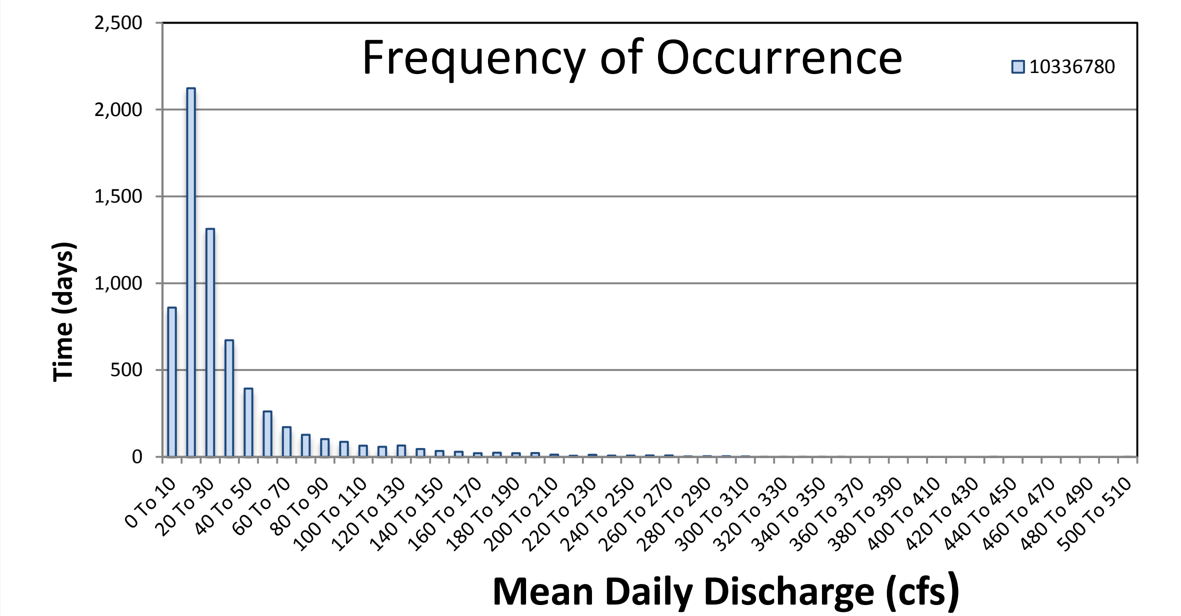


Example Calculation: Trout Creek Restoration Project

Load IN= FSP Load Rating Curve x Frequency

Time Frame: WY89-WY06





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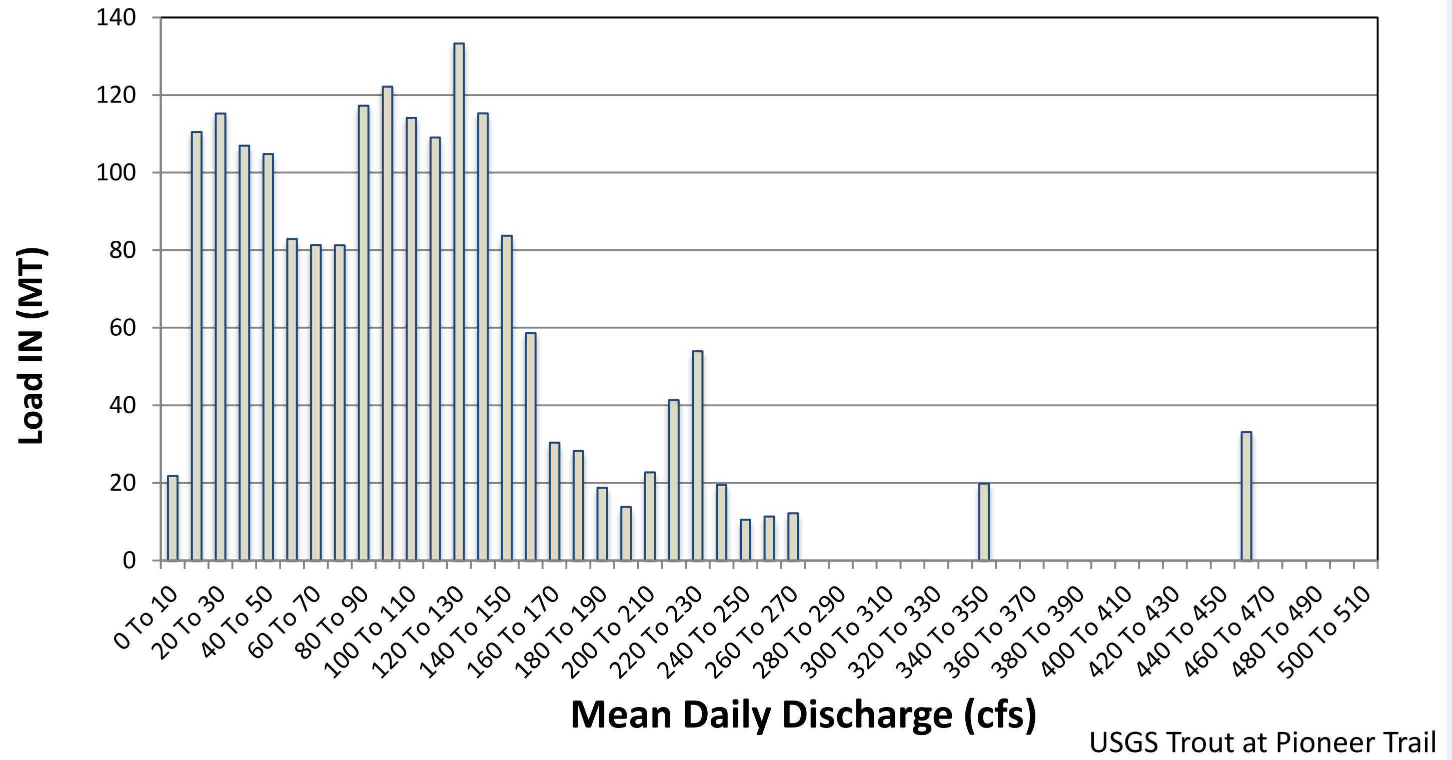
Load IN= FSP Load Rating Curve x Frequency

Total Load IN = 1,874 MT

Load IN = 104 MT/yr



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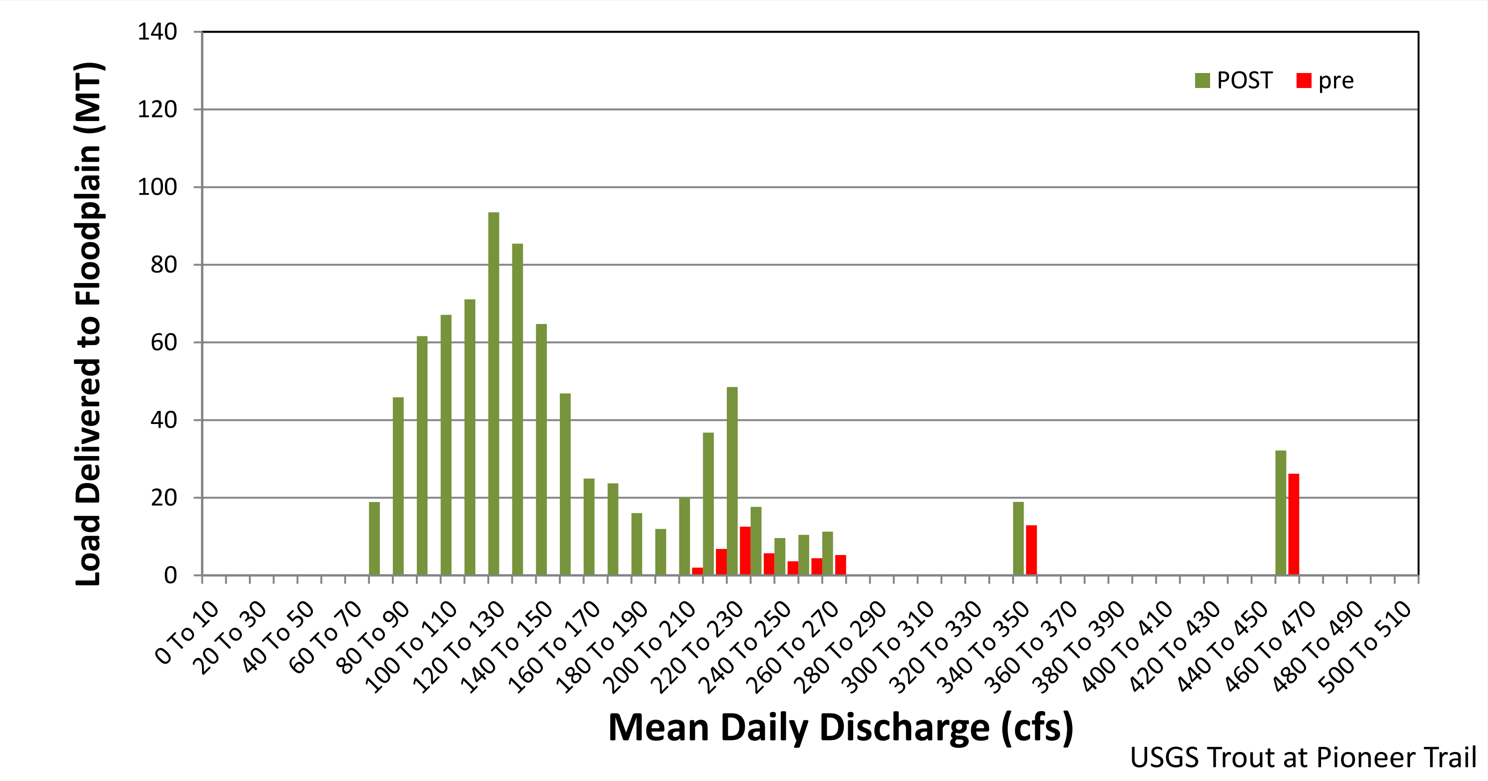
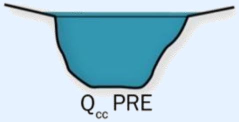
Retention = **Load Delivered to Floodplain** x Percent Retained

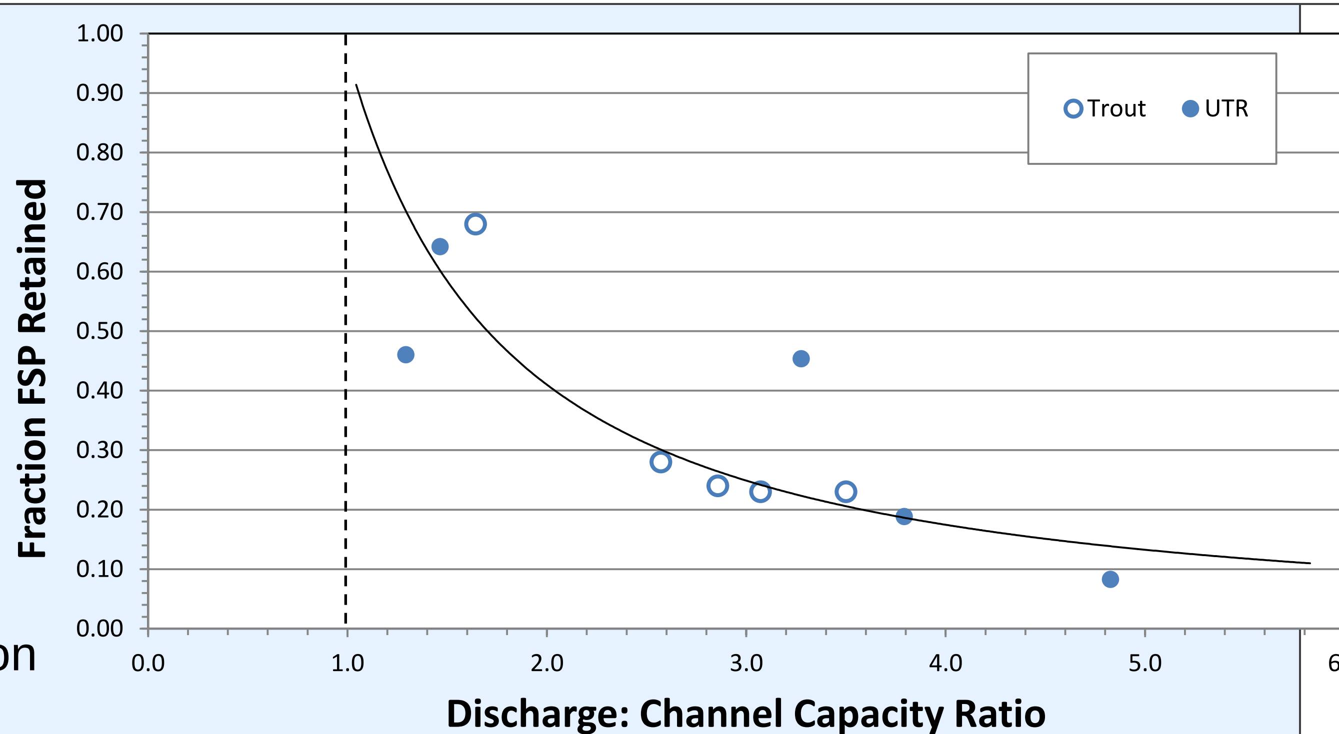
Post Q_{cc} = 70 cfs
Total Load Delivered to FP = 837 MT

Pre Q_{cc} = 200 cfs
Total Load Delivered to FP = 79 MT

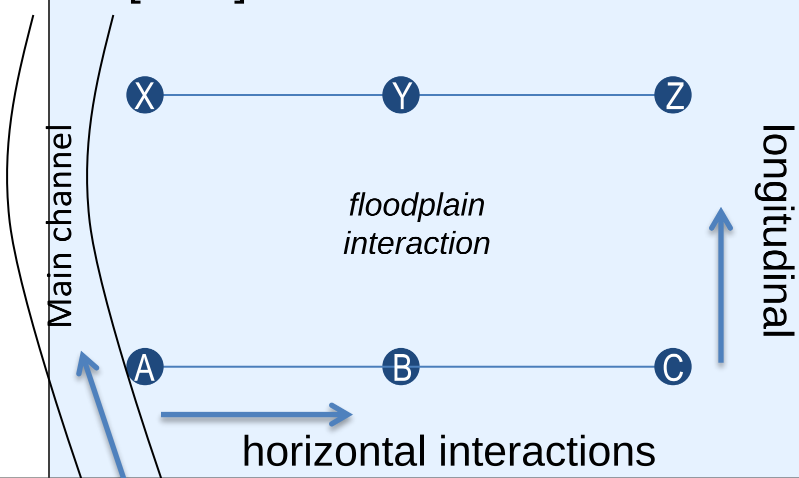




Retention = Load Delivered x **Percent Retained**



[FSP] % reduction

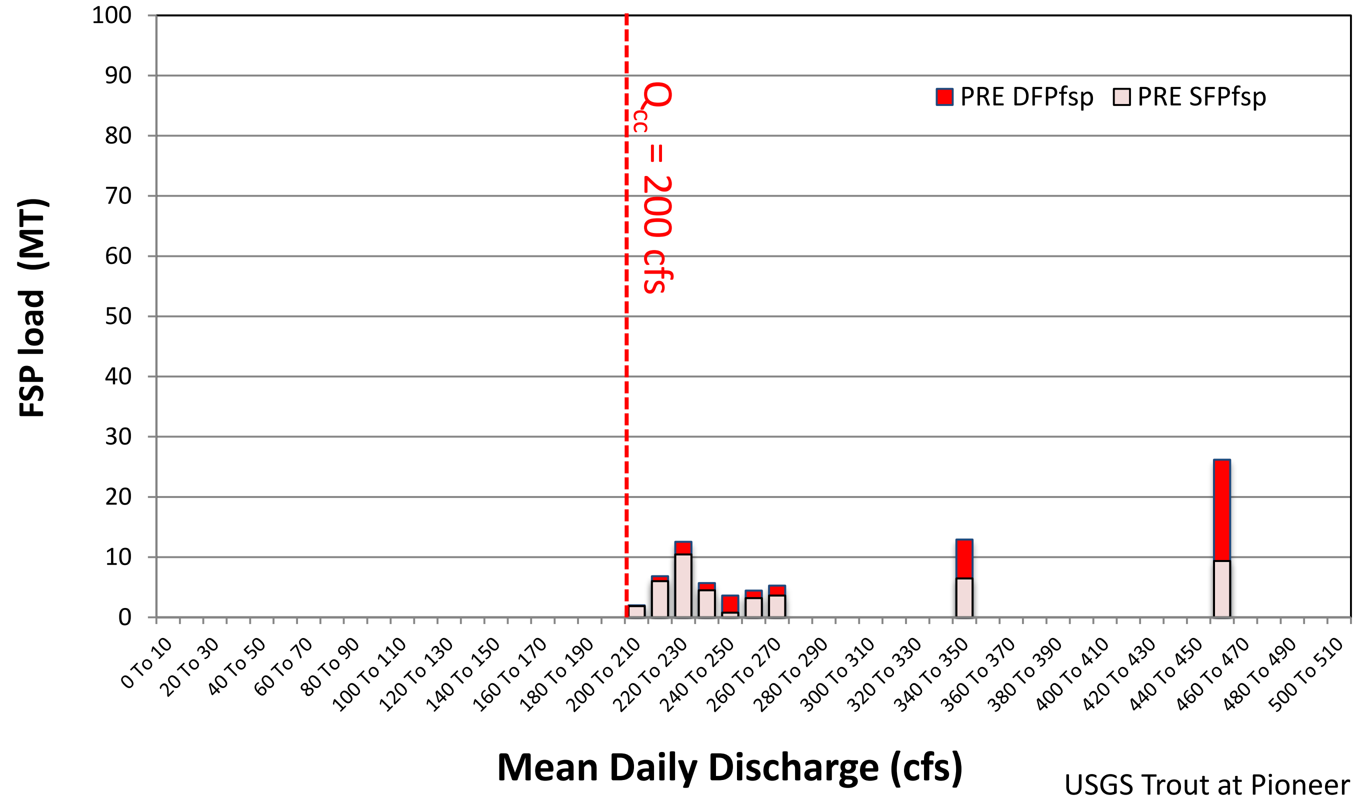


Retention = Load Delivered x Percent Retained

Delivered to Floodplain = 79 MT

Retained on Floodplain = 46 MT

Pre restoration



USGS Trout at Pioneer Trail

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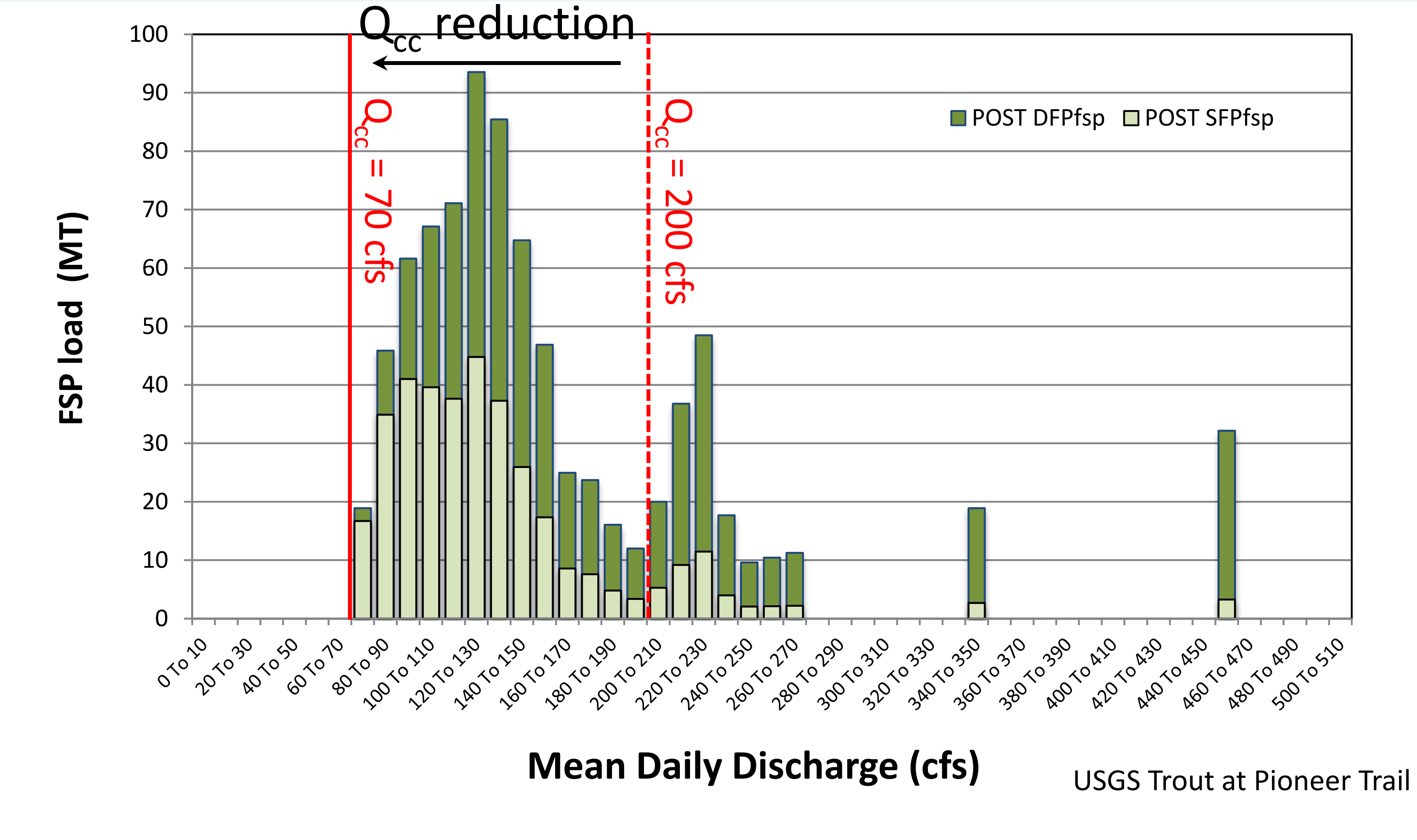
Retention = Load Delivered x Percent Retained

Post restoration

Delivered to Floodplain = 837 MT

Retained on Floodplain = 362 MT



Load Reduction of Floodplain Retention

Trout Creek Example Summary:
Load IN = 104 MT/yr

Pre restoration
SFP = 2.6 MT/yr

Post restoration
SFP = 20 MT/yr

PRE AA OUT=	101.5 MT/yr
POST AA OUT=	84 MT/yr
FSP load reduction from FP retention only =	17.5 MT/yr

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Next Steps

- **SCE** - collaboration with A. Simon and V. Mahecek to incorporate BSTEM modeling
- **SFP** – How can retention coefficient be adjusted for floodplain characteristics (inundation depth, complexity, vegetation, etc)
- Apply SLRT to urban SEZ project
- Final Technical Report expected Fall 2013
  - Data collection summary
  - SLRT Technical Document
  - SLRT Guidance Document


QUESTIONS/COMMENTS

QIN. Complete estimates and then compare to measured datasets.
How well can we predict annual flow volumes?

FSP(Q). Compile available data and create best estimations.
Document assumptions and provide guidance on how continue in future. Great to get some USGS data.

R_{fsp}. Need few more channel/floodplain cross-section morphologies.
Conduct analysis of FP area/depth and veg characteristics
Compare site characteristics to R_{fsp} data obtained.
Is R_{fsp} to Q:Qcc correct or should it be R_{fsp} to FPz?

SCE. Coordinate with BSTEM researchers. Develop simple method and compare results to higher resolution results from Trout and UTR reach.

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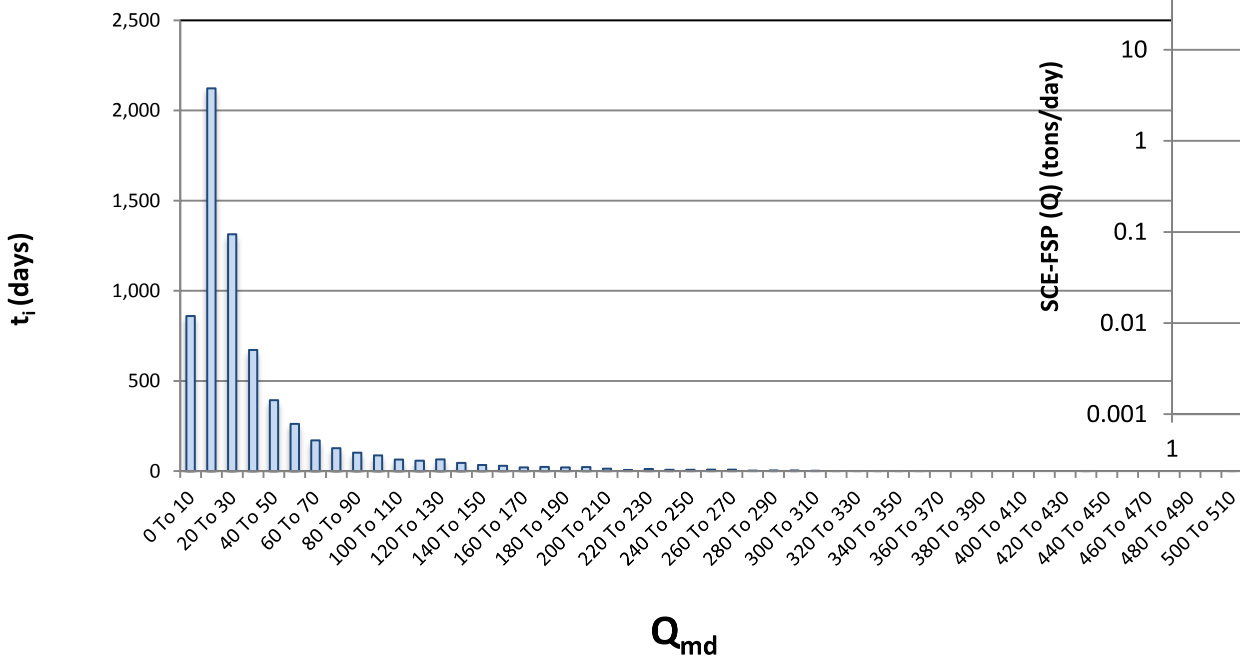
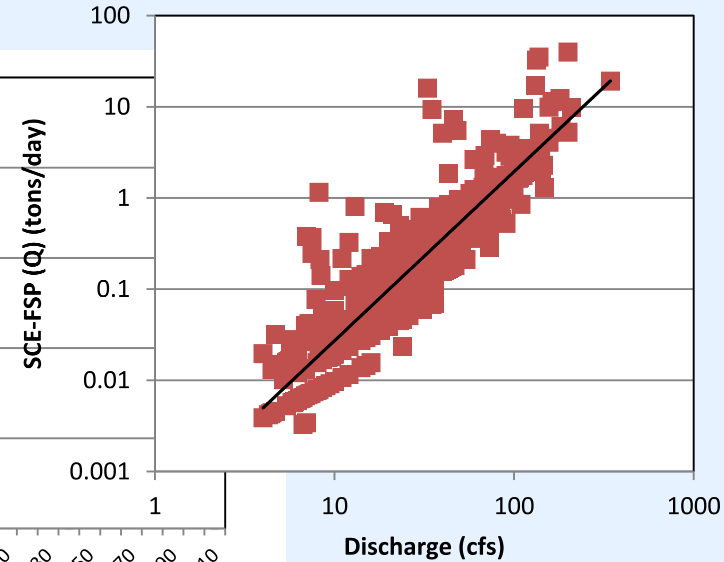
Critical data gap is the FSP mass per unit of channel sediment generated.





$$AA\ OUT_{fsp} = (IN_{fsp} - SFP_{fsp} + \mathbf{SCE_{fsp}})/18$$

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SLRT calibration using existing datasets

Variable	Site	Duration	Calibration approach
IN_{fsp}	Trout at Pioneer Trail	WY10/ WY11	Continuous sediment loading data compared to predicted load for spring snow melt events.
IN_{fsp}	Pasadena and Incline urban catchments	WY12	Continuous sediment loading data compared to predicted load for events where reliable data is available.
SCE_{fsp}	Trout from Pioneer Trail to Cold Creek	2002-2006	Compare SLRT simple approach using BSTEM for reduced time series to detailed BSTEM model created for Trout by Simon and Mahacek in late 2009 (SNPLMA). In addition, compare to repeated cross-section dataset to quantify mass of sediment eroded from reach from monitoring points.
SCE_{fsp}	Bristlecone	1998-2006	Compare SLRT simple approach using BSTEM to results using more rigorous input parameters to evaluate annual deviations and signal in overall OUT_{fsp} load.
OUT_{fsp}	Trout	WY11/WY12 (?)	Compare SLRT estimate using event hydrology to measured continuous sediment loading data at Reach 3 boundary.

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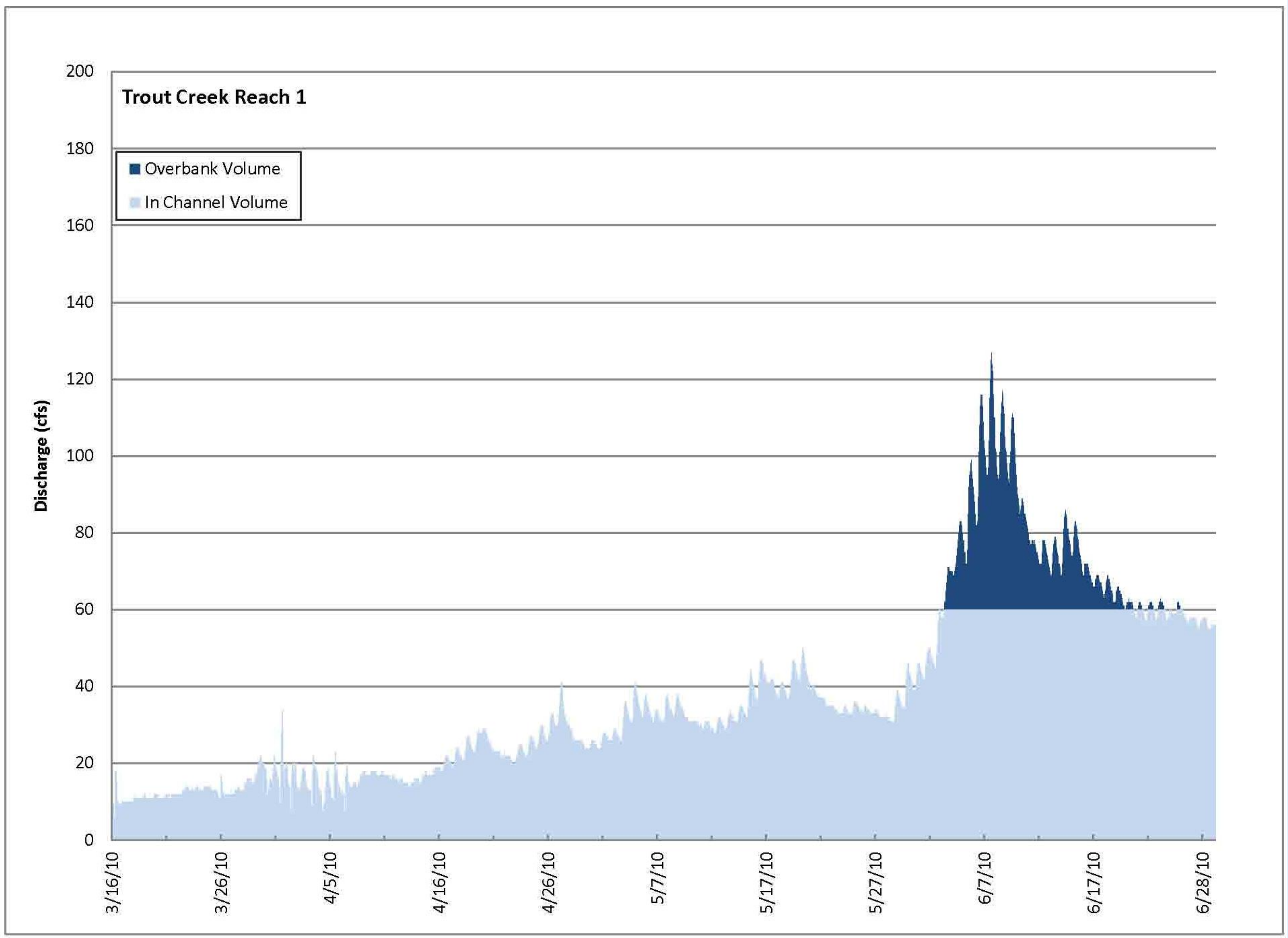
FSP Data Calculations

							Post CC (cfs)	Pre CC (cfs)	ChV post (acft)	ChV pre (acft)		
							70	200	5400	500		
		ti			Post	Pre	Post	Pre	Post	Pre	Post	Pre
Discharge (cfs)	midpoint	count	FSP(Q) (MT/d)	IN fsp(MT)	DFPfsp (MT)	DFPfsp (MT)	Q/Qcc	Q/Qcc	Rfsp	Rfsp	SFPfsp	SFPfsp
0 To 10	5	2772	0.01	21.77								
10 To 20	15	1843	0.06	110.50				m3ps				
20 To 30	25	747	0.15	115.23				5.67				
30 To 40	35	372	0.29	106.94				2.83				
40 To 50	45	229	0.46	104.79								
50 To 60	55	125	0.66	82.92								
60 To 70	65	90	0.90	81.32								
70 To 80	75	69	1.18	81.24	18.90		1.07		0.88		16.7	
80 To 90	85	79	1.48	117.25	45.87		1.21		0.76		34.9	
90 To 100	95	67	1.82	122.16	61.62		1.36		0.67		41.0	
100 To 110	105	52	2.19	114.09	67.11		1.50		0.59		39.6	
110 To 120	115	42	2.60	109.04	71.09		1.64		0.53		37.6	
120 To 130	125	44	3.03	133.29	93.53		1.79		0.48		44.8	
130 To 140	135	33	3.49	115.26	85.45		1.93		0.44		37.3	
140 To 150	145	21	3.99	83.72	64.74		2.07		0.40		25.9	
150 To 160	155	13	4.51	58.63	46.88		2.21		0.37		17.3	
160 To 170	165	6	5.06	30.38	24.96		2.36		0.34		8.6	
170 To 180	175	5	5.65	28.23	23.71		2.50		0.32		7.6	
180 To 190	185	3	6.26	18.77	16.06		2.64		0.30		4.8	
190 To 200	195	2	6.90	13.79	11.99		2.79		0.28		3.4	
200 To 210	205	3	7.56	22.69	19.98	2.01	2.93	1.03	0.26	0.93	5.3	1.9
210 To 220	215	5	8.26	41.31	36.79	6.83	3.07	1.08	0.25	0.88	9.2	6.0

Stream FSP Data



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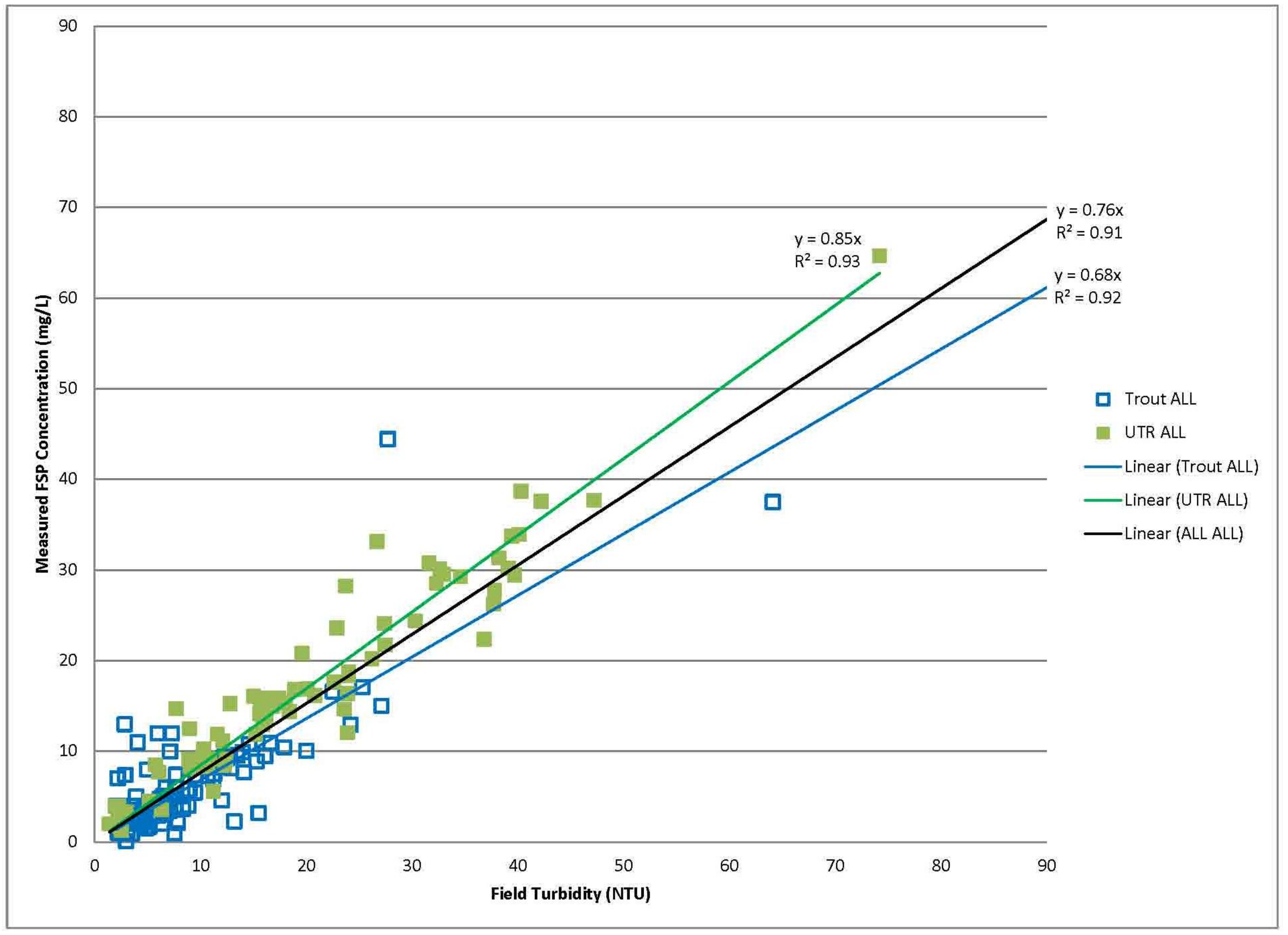
Stream FSP Data

FSP/Turbidity rating curve; cost effective turbidity to FSP by mass conversion

n = 192



$OUT_{fsp} = \mathbf{IN_{fsp}} - SFP_{fsp} + SCE_{fsp}$

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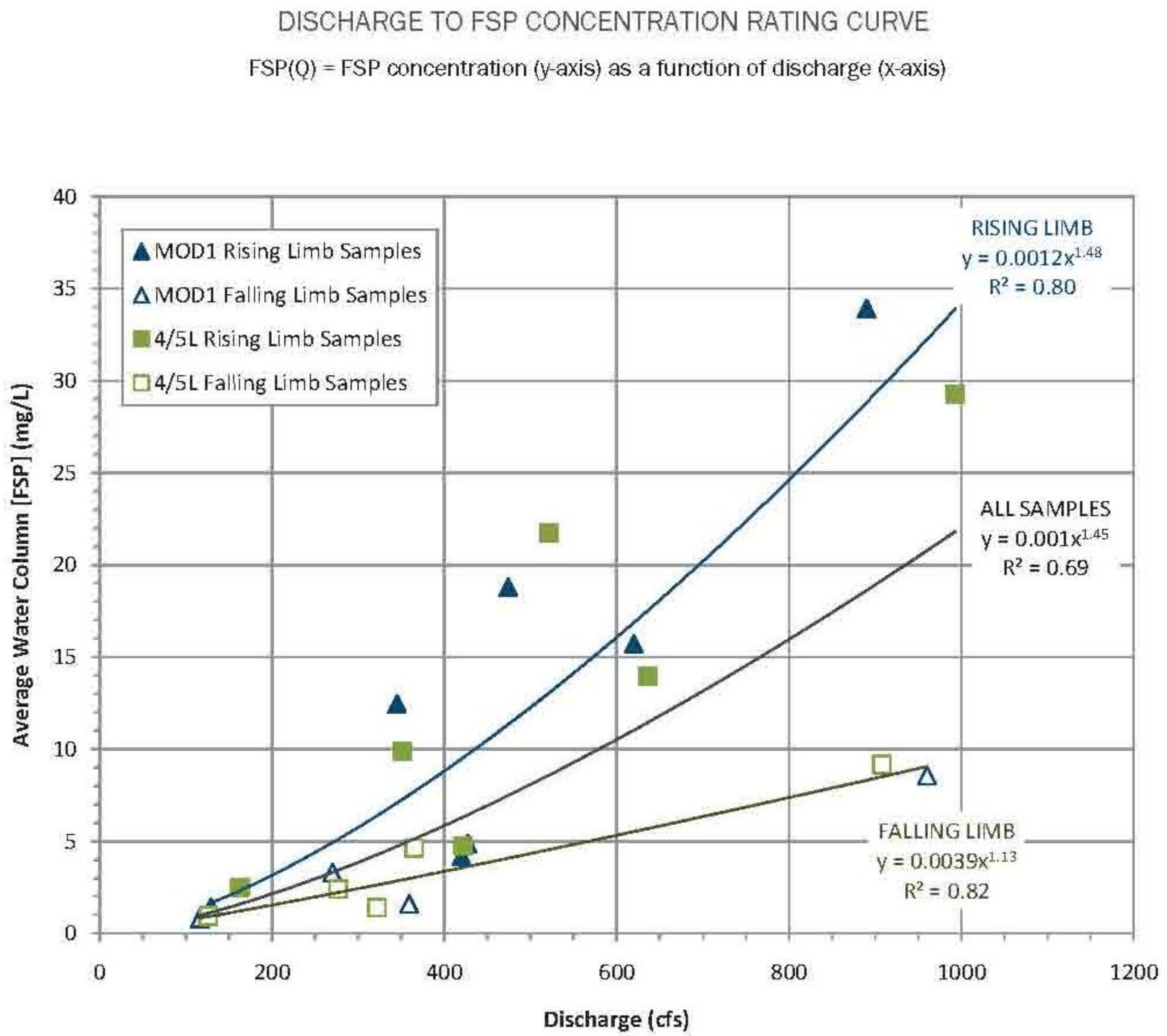
Stream FSP Data

FSP/Q Rating Curves:

- In-Stream samples
- *n* = 28



$OUT_{fsp} = \mathbf{IN_{fsp}} - SFP_{fsp} + SCE_{fsp}$

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