Macroinvertebrate Communities of the Great Swamp Watershed

2011

Lee Pollock

Professor Emeritus
Drew University

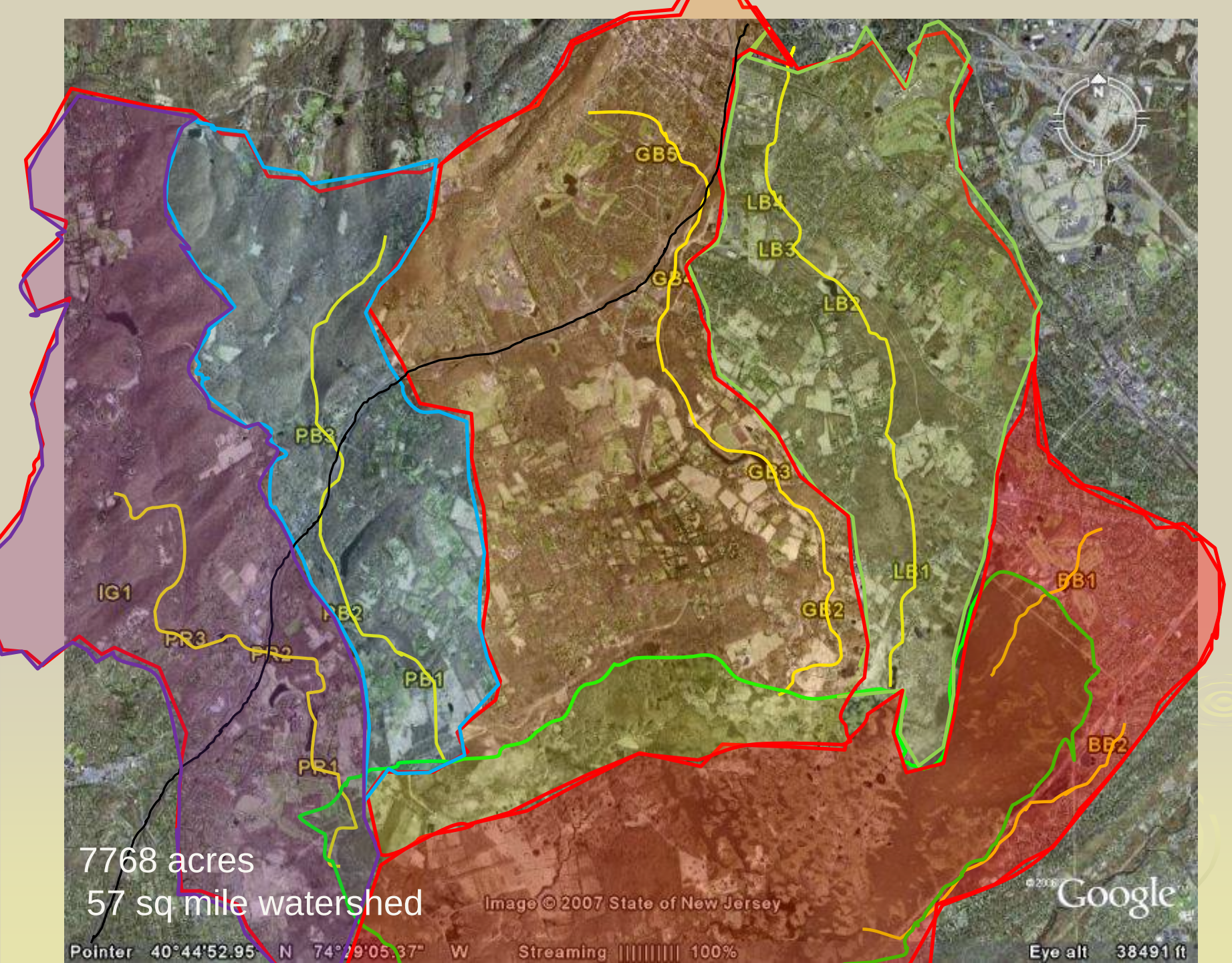
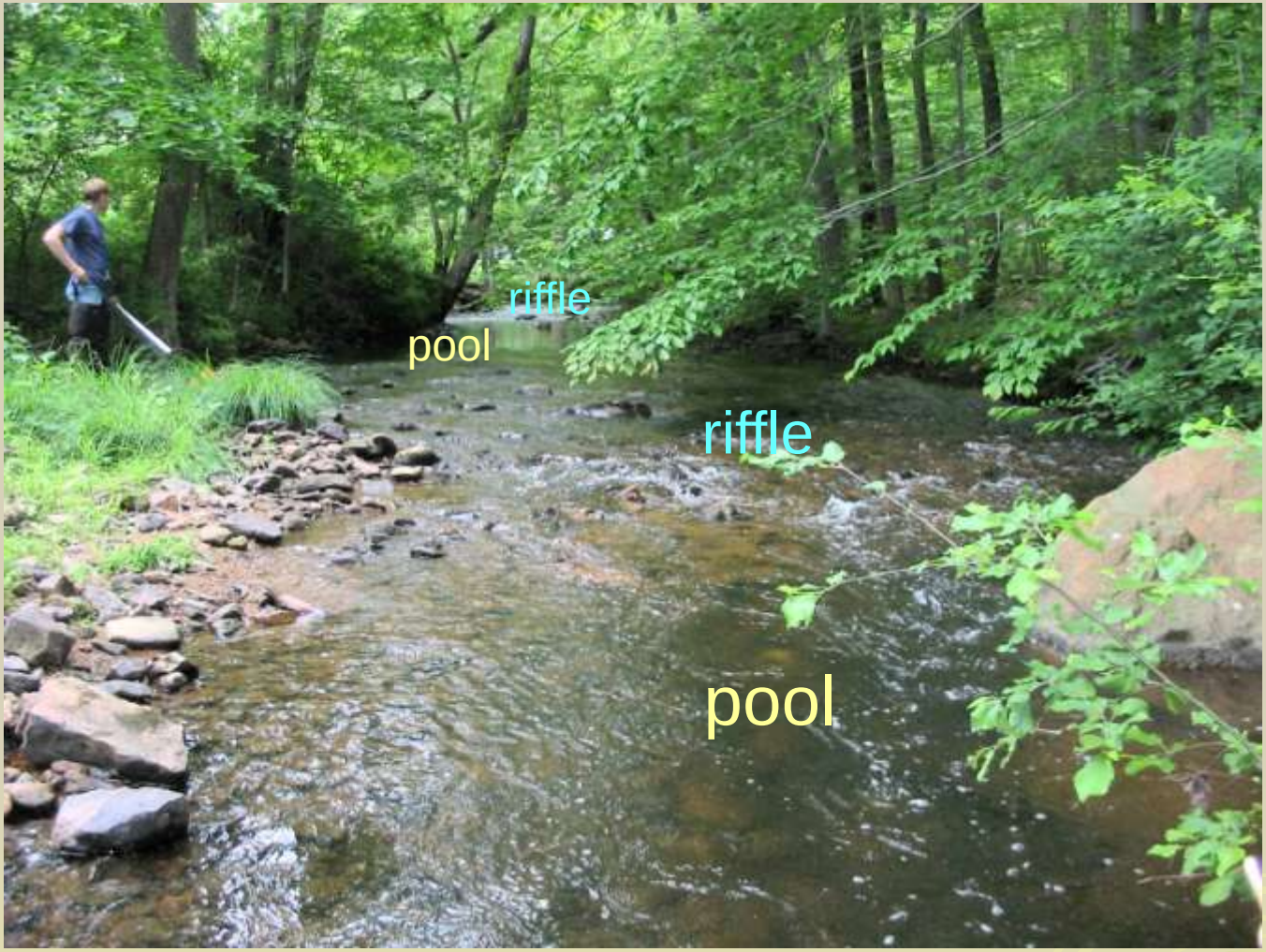

GB5
LB4
LB3
LB2
LB1
GB3
GB2
PB3
PB2
PB1
IG1
PR3
PR2
PR1
BB1
BB2
7768 acres
57 sq mile watershed
Image © 2007 State of New Jersey
Google
Pointer 40°44'52.95" N 74°29'05.37" W
Streaming 100%
Eye alt 38491 ft

Table 11-1. Great Swamp Watershed, May 27,2011. Habitat Assessment

	B-IBI	temp	TDS	DO	pH	Turbidity	total	HabValue2
BB1	16	21.2	381.7	5.43	7.04	9.99	61	27.00
BB2	16	16.8	592	8.8	6.87	4.42	71	22.00
LB1	18	19.2	517	7.73	7.22	4.87	66	19.00
LB2	16	20.0	680	7.67	7.31	3.21	78	24.00
LB3	20	17.5	756	7.4	7.30	1.19	49	7.00
LB4	20	18.0	906	8.13	7.44	5.01	40	15.00
GB2	22	18.4	246.1	8.43	7.32	5.79	74	34.00
GB3	20	19.0	254.8	8.6	7.40	8.13	119	58.00
GB4	22	19.7	304	6.94	7.57	4.24	55	20.00
GB5	16	21.0	498	7.96	7.58	4.64	91	38.00
PB1	34	18.0	148.7	9.31	7.35	1.76	129	68.00
PB2	30	18.0	145.5	9.35	7.42	1.92	137	63.00
PB3	36	17.0	90	9.88	7.84	2.09	159	75.00
PR1	24	21.0	170.6	9.6	7.58	3.79	105	46.00
PR2	32	20.5	157	8.98	7.38	8.14	108	40.00
PR3	36	18.9	144.4	9.15	7.50	1.85	150	77.00
IG1	36	18.3	157.9	9.23	7.51	1.68	154	79.00
Mean	24.35	18.97	361.75	8.39	7.39	4.28	96.82	41.88

- Macroinvertebrates (MIVs)
  - Direct, integrative measure of water quality
  - Provide historical information
  - Can be used to identify impairment sources
  - Both broad dispersal as adults and limited mobility as nymphs/larvae
  - Normally abundant
  - Easy & inexpensive to sample and identify


riffle
pool
riffle
pool

Appendix 11-1. Great Swamp, 2011	BB1	BB2	LB1	LB2	LB3	LB4	GB2	GB3	GB4	GB5	PB1	PB2	PB3	PR1	PR2	PR3	IG1	total
Ann:Hirudinea:Glossiphoniidae: Helobdella stagnalis	1			3														4
Ann:Hirudinea:Glossiphoniidae: Helobdella triserialis				2														2
Ann:Hirudinea:Erpobdellidae: Erpobdella punctata	1							2										3
Ann:Hirudinea:Erpobdellidae: Mooreobdella fervida								4										4
Ann:Hirudinea:Erpobdellidae: Mooreobdella sp.	4			3					1	17								25
Ann:Oligochaeta:Enchytraidae	18	36	2	15	101	21	4	2	2	18	7	19		4	6	2		257
Ann:Oligochaeta: Naiadae									1									1
Ann:Oligochaeta:Lumbricidae	2	26	2	6	26	9	1		3	2	2	1	1			3		84
Art:Chelicerata:Arachnida:Halacharidae		2											1					3
Col:Elmidae: Neoelmis			10				2		2								1	15
Col:Elmidae, Optioservus							12				8	6	2	3				31
Col:Elmidae: Stenelmis - adult			13	6			9		3		6	4	2	12	12	1	5	73
Col:Elmidae: Stenelmis A - larva			36	38	7	4	41	8	7	4	12	4	6	45	6	1	7	226
Col:Elmidae: Oulimnius														4				4
Col:Elmidae: Promoresia			1										2				8	11
Col:Elmidae: Stenelmis			5													1		6
Col:Elmidae: Neoelmis			1		3		10							7	1		7	29
Col:Elmidae: Stenelmis B - larva			5				6										2	13
Col:Hydrophilidae: Anacaena																1		1
Col:Elmidae:Macronyches																1		1
Col:Elmidae: adult unknown		2							1									3
Col:Dytiscidae: Dytiscid larva											1							1
Col:Psephenidae: Ectopria nervosa - larva																	2	2
Col:Psephenidae: Psephenus (herricki?)							13		1		21	48	1	1	9	16	29	139
Cru:Ostracoda										1								1
Cru:Amphipoda:Gammaridae: Gammarus faciatus		27	104	45	7	42	24	42	31	4	6	4	3	39	15	2	1	396
Cru:Cladocera - water flea		22			.													22
Cru:Isopoda: Caecidotea racovitzai			8					20						3	1		1	33
Dip:Athericidae: Atherix													1					1
Dip:Chironomidae:Orthocladini: Eukiefferiella discoloripes															1			1
Dip:Chironomidae:Orthocladini: Parametriocnemus					3													3
Dip:Chironomidae:Orthocladini: Cricotopus trifasciata															3			3
Dip:Chironomidae:Orthocladini: Synorthocladius				1														1
Dip:Chironomidae:Orthocladini: Eukiefferiella claripennis						17												17
Dip:Chironomidae:Orthocladini: Eukiefferiella bavarica group												3				1		4
Dip:Chironomidae:Orthocladini: Cricotopus tremulus	2					13			5	9						1		30
Dip:Chironomidae:Orthocladini: Orthocladius type III			2															2
Dip:Chironomidae:Orthocladini: Cardiocladius obscurus?			3		3		3	22	18	5	3	4		7	18	7	4	97
Dip:Chironomidae:Orthocladini: Cricotopus bicinctus									1		2							3
Dip:Chironomidae:Chironomini: Polypedilum convictum			1	54	3	46	5	30	31	92	8	2	3	3	7	3	4	292
Dip:Chironomidae:Chironomini: Endochironomus nigricans			1															1
Dip:Chironomidae:Chironomini: Cryptochironomus		48			.					2								50
Dip:Chironomidae:Orthocladini: Cricotopus intersectus		11			.	21		4					1					37
Dip:Chironomidae:Chironomini: Chironomus decorus group			7		14													21
Dip:Chironomidae:Chironomini: Chironomus riparius					5													5
Dip:Chironomidae:Tanypodini:Thienemannimyia group	56			12			4			4	1		2					79
Dip:Chironomidae:Orthocladini: Rheocricotopus robacki						4												4
Dip:Chironomidae:Tanypodini: Tanytarsus guerlus group	26												2					28
Dip:Chironomidae:Tanypodini: Tanytarsus coffmani	1		4	13						2								20
Dip:Chironomidae:Tanypodini: Pentaneura	4				3	13												20
Dip:Chironomidae,Tanypodini: Rheotanytarsus									16		6							22
Dip:Chironomidae: pupa	8	2		8	7		3		3	1	4				8	4	6	54
Dip:Simuliidae: Simulium venustum	3		40	38	19		53	6	50	2	6		17	9	13	6	6	268

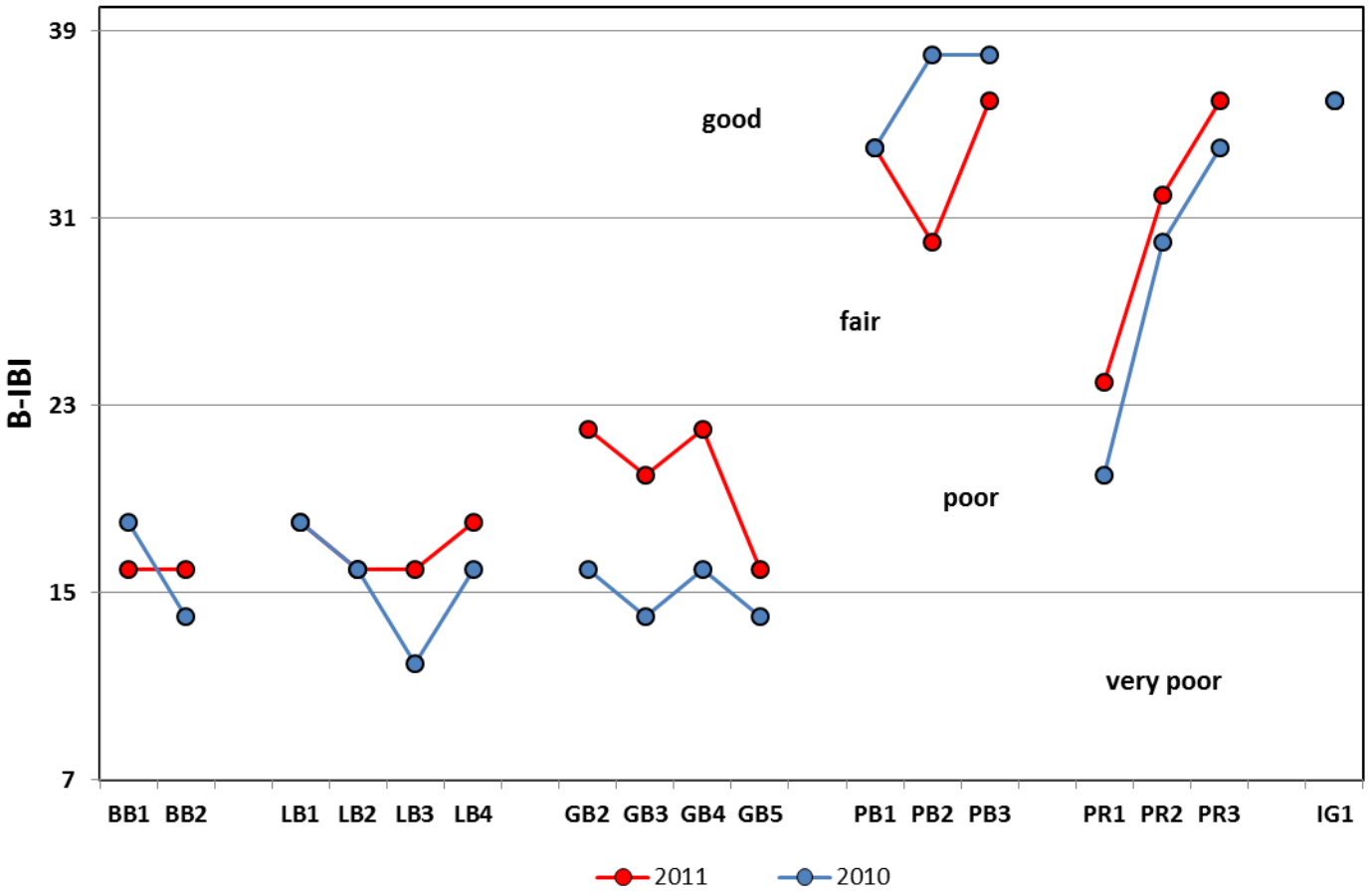
	BB1	BB2	LB1	LB2	LB3	LB4	GB2	GB3	GB4	GB5	PB1	PB2	PB3	PR1	PR2	PR3	IG1	
Eph:Caenidae, Caenis robusta							2											2
Eph:Ephemerellidae: Timpanoga B																1		1
Eph:Ephemerellidae: Timpanoga (Dannella) A																6		6
Eph:Ephemerellidae: Ephemerella simplex															1			1
Eph:Ephemerellidae: Ephemerella subvaria												3	12				3	18
Eph:Ephemerellidae: Timpanoga															1			1
Eph:Ephemerellidae: Serratella B											42	98	53			2	8	203
Eph:Ephemerellidae:Serratella A													2					2
Eph:Ephemerellidae: Attenella B															2			2
Eph:Heptageniidae:Heptagenia																	1	1
Eph:Heptageniidae: Stenonena A											3	14	9	4	2	7		39
Eph:Isonychiidae: Isonychia A																1		1
Eph:Leptophelbiidae: Paraleptophlebia													3					3
Collembola											1		1			1		3
Lepidoptera		2			2				1		3	1		1				10
Millipedes		3			.	4												7
Meg: Nigronia serricornis										21	2	6			1			30
Mol:Bivalvia:Sphaeriidae: Sphaerium striatinum?			5	1	3			4	14						1			28
Mol:Gastropoda:Pulmonata:Physidae: Physella gyrina	2	14		1	.				2	1								20
Mol:Gastropoda:Pulmonata:Pleuroceridae: Goniobasis livescens									2									2
Mol:Gastropoda:Prosobranchia:Ancylidae: Ferrissia rivularis																2		2
Mol:Gastropoda:Prosobranchia:Limacidae: Amnicola limosa									1									1
Mol:Gastropoda:Pulmonata:Planorbidae: Gyraulus parvus				1						1								2
Mol:Gastropoda:Pulmonata:Planorbidae: Planorbula armigera		2			.													2
Nematomorpha																	1	1
Odo:Anisoptera:Gomphidae: Lanthus																	1	1
Odo:Anisoptera:Cordulegastridae: Cordulegaster									1									1
Odo:Zygoptera:Coenagrionidae: Amphiagrion							1	2										3
Pla:Planariidae: Dugesia										46								46
Ple:Capniidae:Allocapnia													5				1	6
Ple:Taeniopterygidae: Taeniopteryx A												1	5			1		7
Ple:Leuctridae: Leuctra											1		24	1	1		5	32
Ple:Nemouridae: Amphinemura													1				2	3
Ple:Perlidae: Isoperla													2					2
Ple:Perlidae: Acroneuria arenosa											2	1				2	3	8
Ple:Perlidae: Agnetina												3	1			2		6
Ple:Perlidae: Paragnetina											2							2
Ple:Perlidae: Acroneuria A											5	1	2			2	4	14
Ple:Pteronarcyidae: Pteronarcys													1				1	2
Tri:Brachycentridae: Micrasema											1						7	8
Tri:Glossosomatidae: Glossosoma A												2			1	5	6	14
Tri:Glossosomatidae: Agapetus											1	1	2				6	10
Tri:Hydropsychidae: Chaeumatopsyche	72	3	1	9	.		24	53		6	14	2	2	56	10	2	5	259
Tri:Hydropsychidae: Hydropsyche A							2	2		4	6	9	5	9	18	15	10	80
Tri:Hydroptilidae: Hydroptila						13									1			14
Tri:Philopotamidae: Chimarra		2			.									10	14	38		64
Tri:Philopotamidae: Dolophilodes											5	1	21		13		46	86
Tri:Polycentropodidae: Polycentropus																7	1	8
Tri:Psychomyiidae: Psychomyia													2					2
Tri:Uenoidae: Neophylax												7	1		1	2	3	14
Tri:Rhyacophilidae: Rhyacophila B											2	7				8	1	18
Number of Individuals	200	202	258	256	206	207	225	203	204	243	213	266	200	219	229	221	237	3789
Number of Species	14	15	24	18	15	12	20	15	26	21	34	30	36	19	30	38	39	116
B-IBI	16	18	18	16	20	20	22	20	22	16	34	30	36	24	32	36	36	

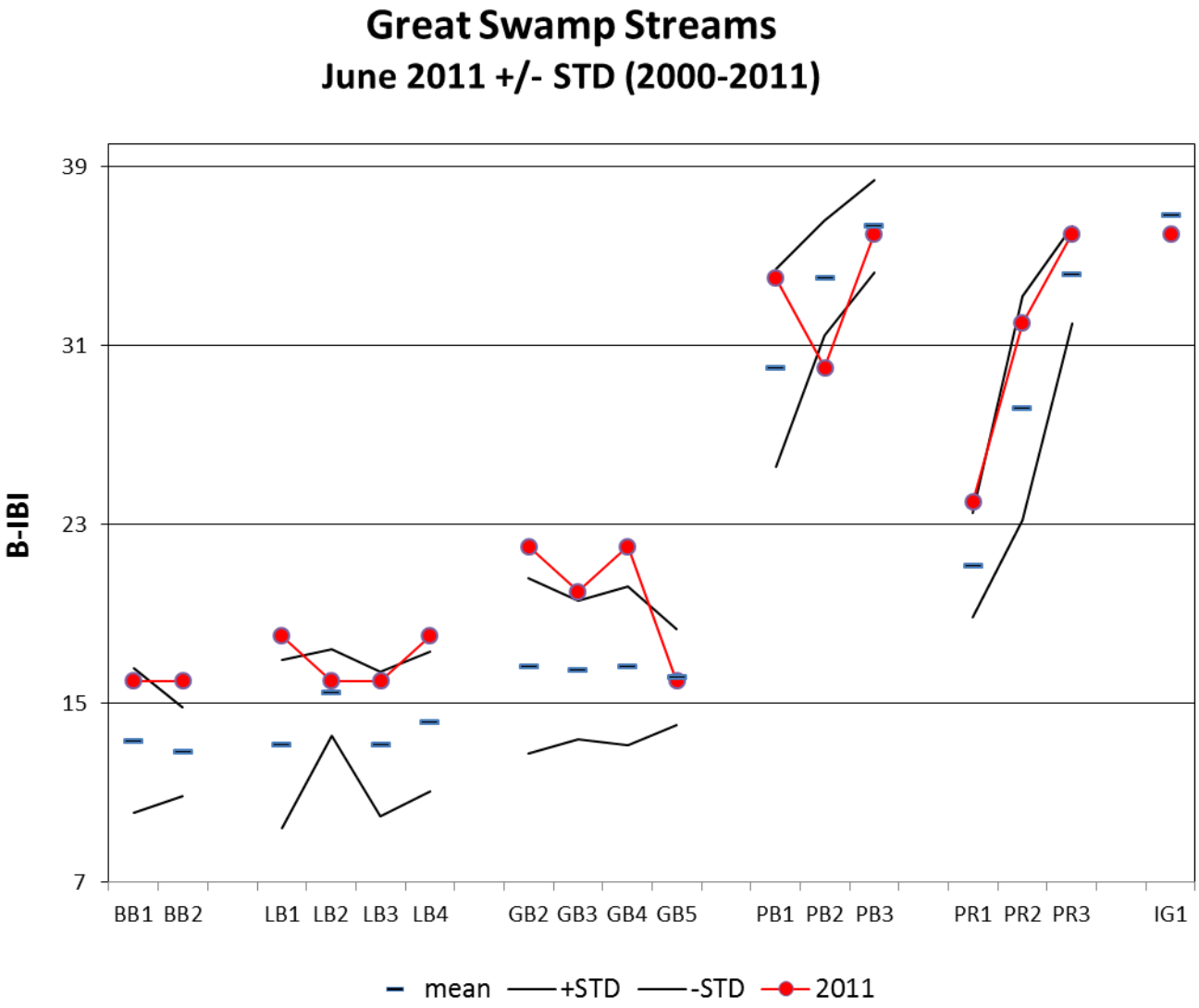
Calculating the Benthic Index of Biological Integrity B-IBI

	BB1		RB1		Scoring Table		
	2008	2007	2008	2007	1	3	5
Dominance	0.485	0.724	0.310	0.590	>.75	.75-.5	<.5
Taxa	33	21	31	26	<12	12-20	>20
%Predators	0.051	0.008	0.138	0.067	<.025	.025-.1	>.1
Ind Intolerant	3	3	3	6	<2	2-4	>4
#Ephem	4	3	4	6	<2	2-5	>5
#Trich	6	4	9	5	<2	2-5	>5
#Plec	1	0	2	3	<2	2-4	>4
Ind Tolerant	3	3	2	2	>4	4-2	<2
					High		Low
					Stress Level		
B-IBI Scores							
Dominance	***5***	3	**5**	3			
Taxa	5	5	5	5			
%Predators	***3***	1	***5***	3			
Ind Intolerant	3	3	3	5			
#Ephem	3	3	3	5			
#Trich	***5***	3	***5***	3			
#Plec	1	1	3	3			
Ind Tolerant	3	3	3	3			
B-IBI Total	**28**	**22**	**32**	**30**			
	BB1		**RB1**				

Great Swamp Streams

B-IBI Summer, 2011 vs Summer, 2010




Great Swamp Streams
June 2011 +/- STD (2000-2011)
B-IBI
39
31
23
15
7
BB1 BB2 LB1 LB2 LB3 LB4 GB2 GB3 GB4 GB5 PB1 PB2 PB3 PR1 PR2 PR3 IG1
mean
+STD
-STD
2011

Great Swamp Watershed Streams
Averaged Annual B-IBI Scores, 2000-2011

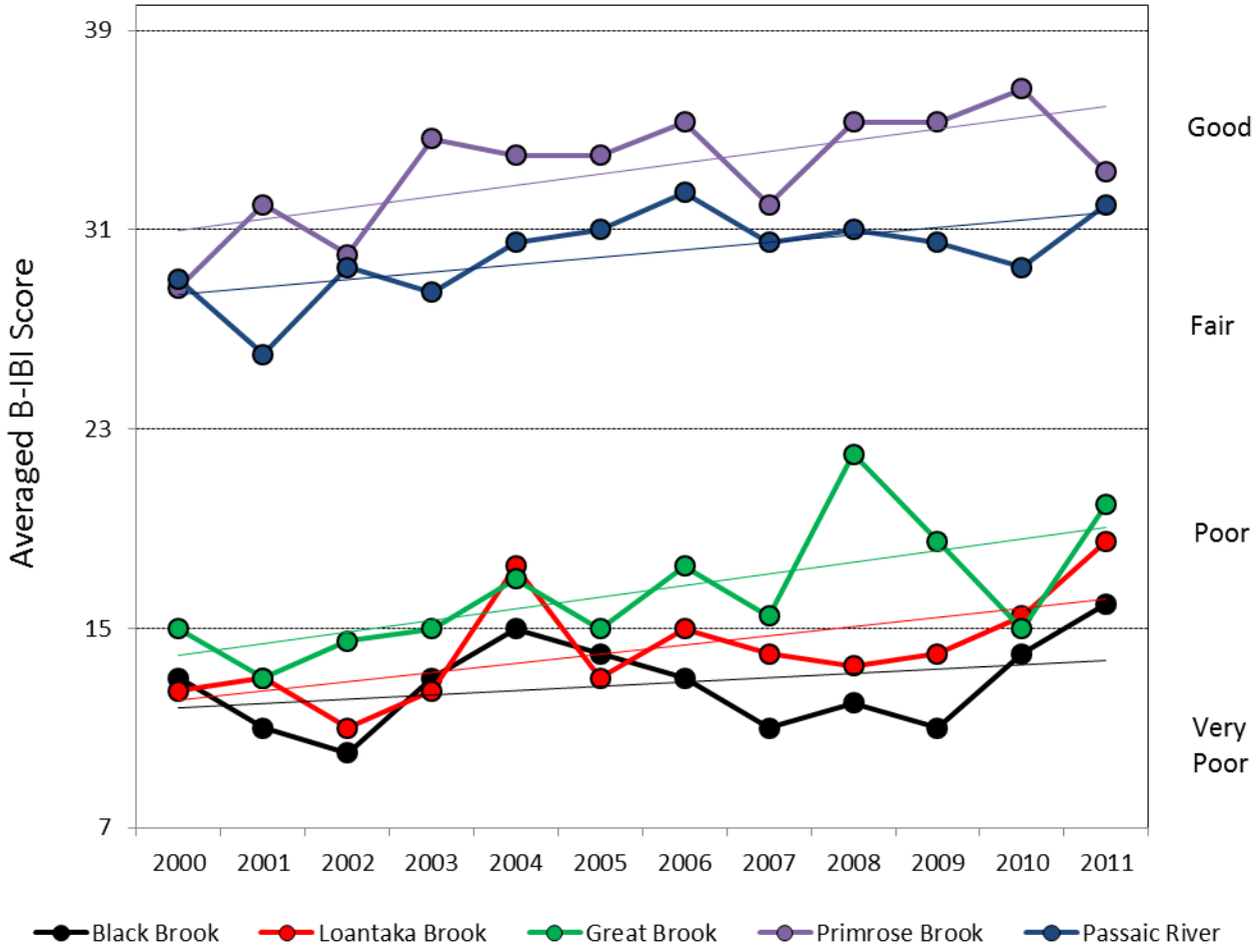
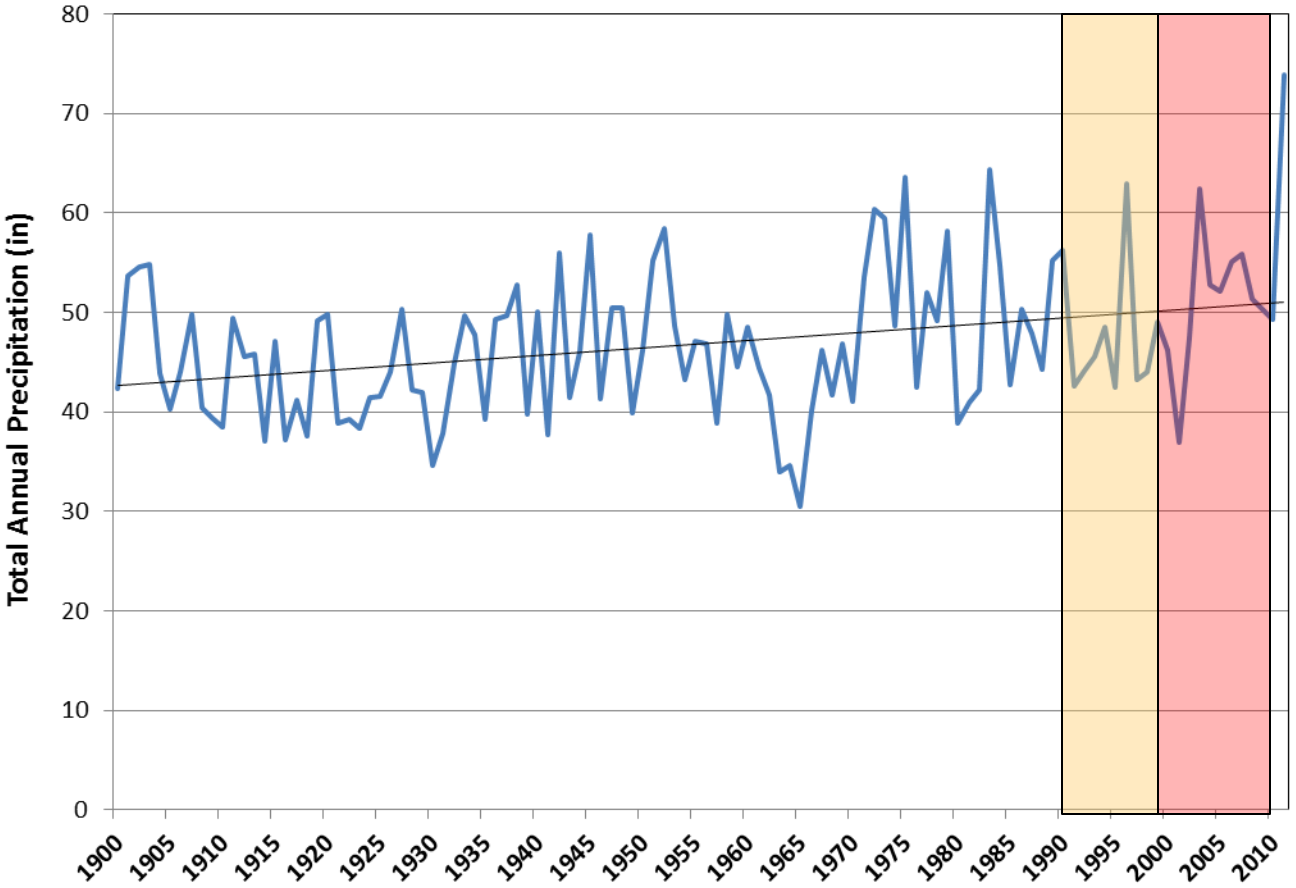
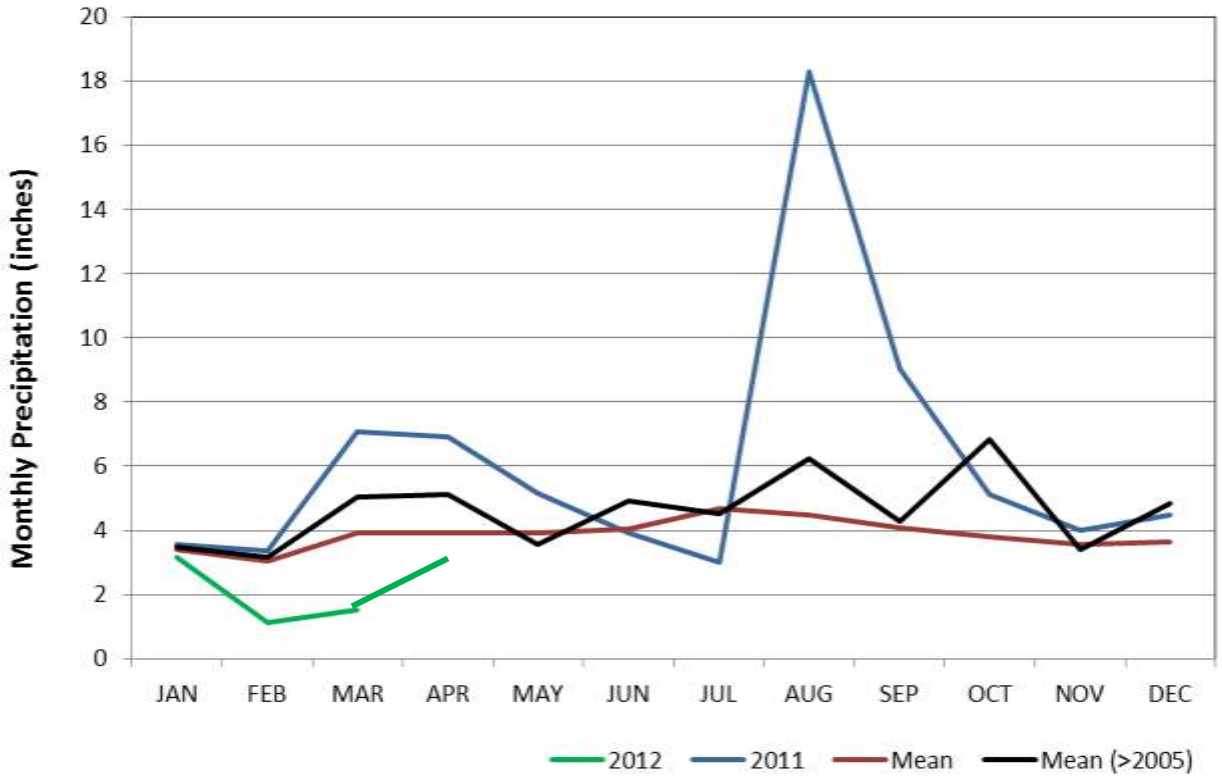


Figure 11-1. Northern New Jersey
Annual Precipitation (in)



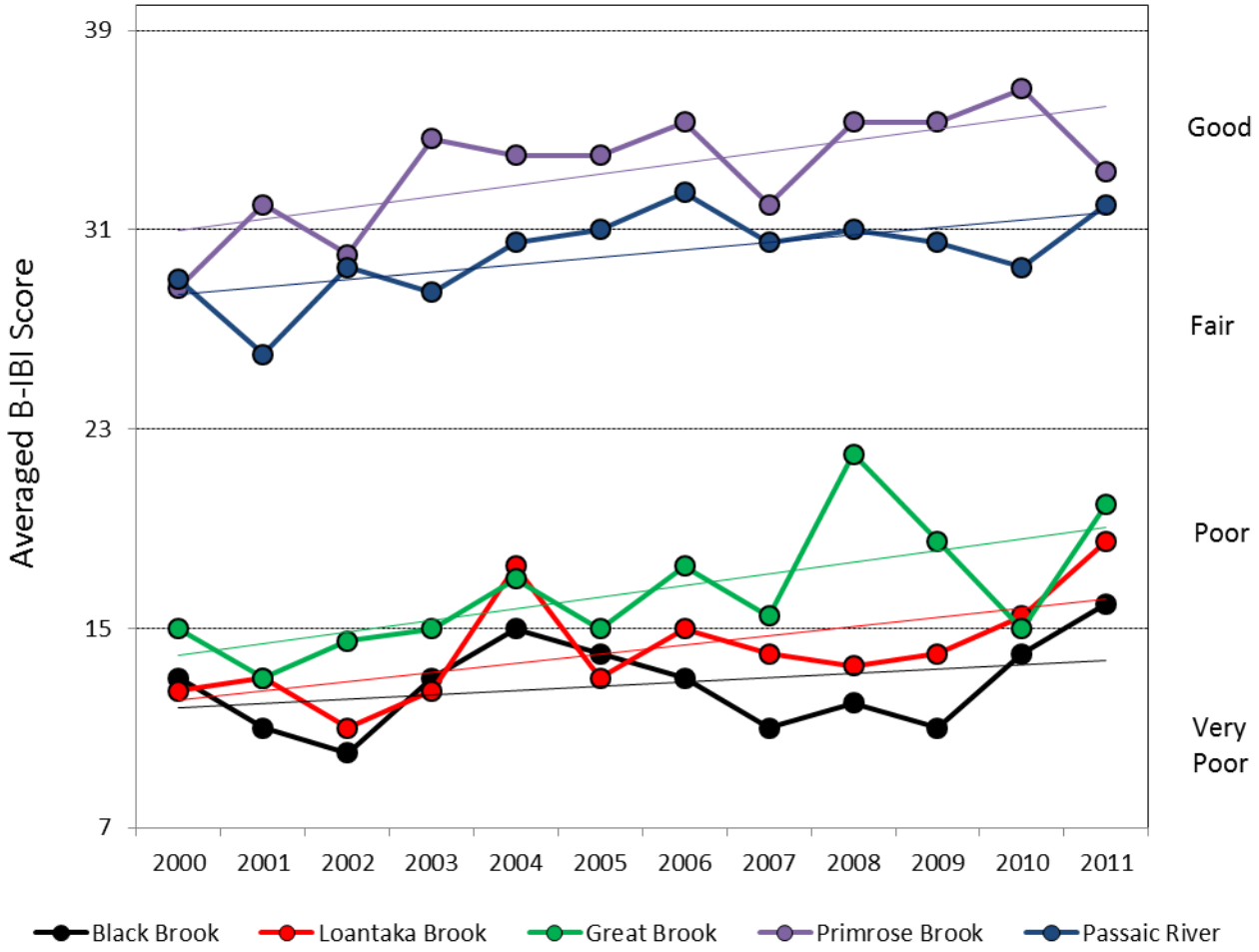
phttp://climate.rutgers.edu/stateclim_v1/data/north_njhistprecip.html

Northern New Jersey
Monthly Precipitation (inches)



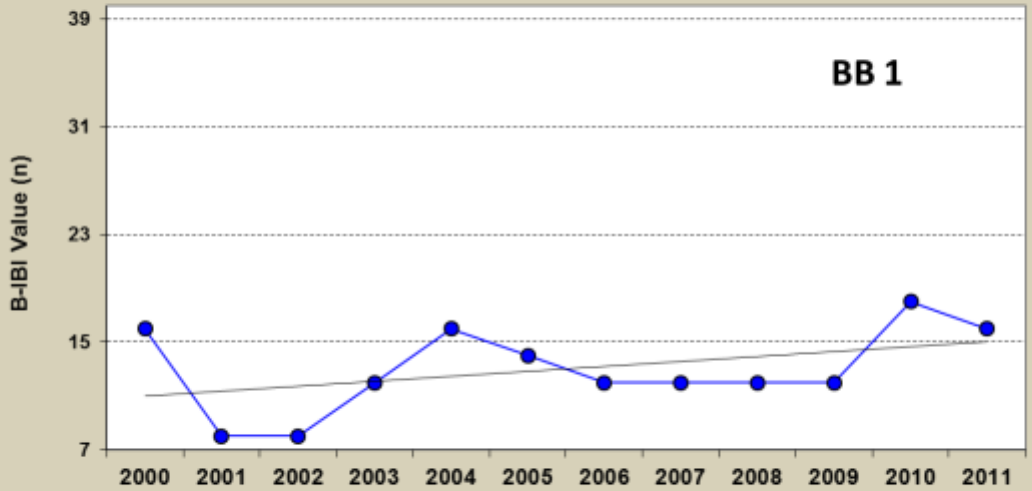
Source: http://climate.rutgers.edu/stateclim_v1/data/north_njhistprecip.html

Great Swamp Watershed Streams
Averaged Annual B-IBI Scores, 2000-2011



Southern Boulevard, Chatham Township
Golf course; heavily traveled roadway

BB1

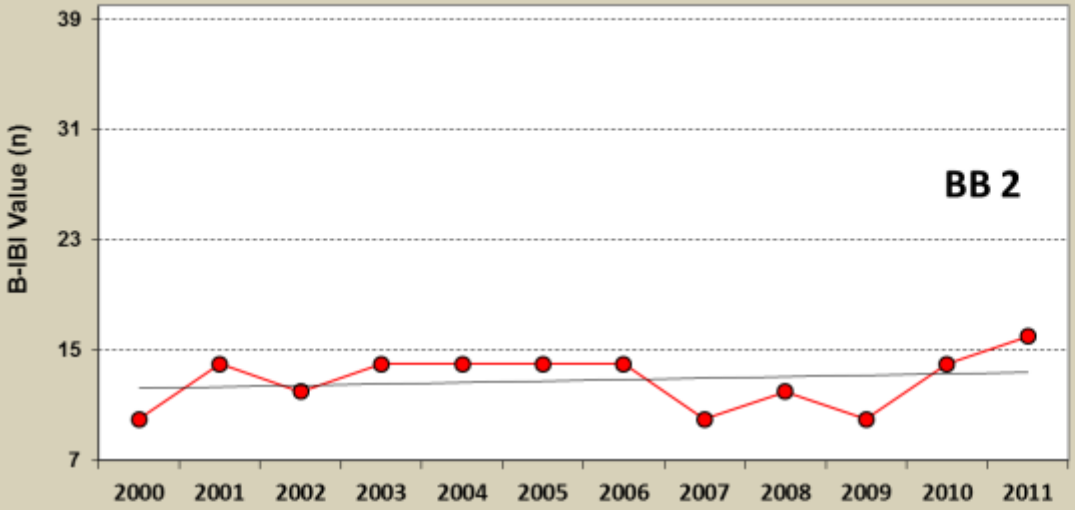


BB1

Small, slow flow
Trash, oil films

BB2

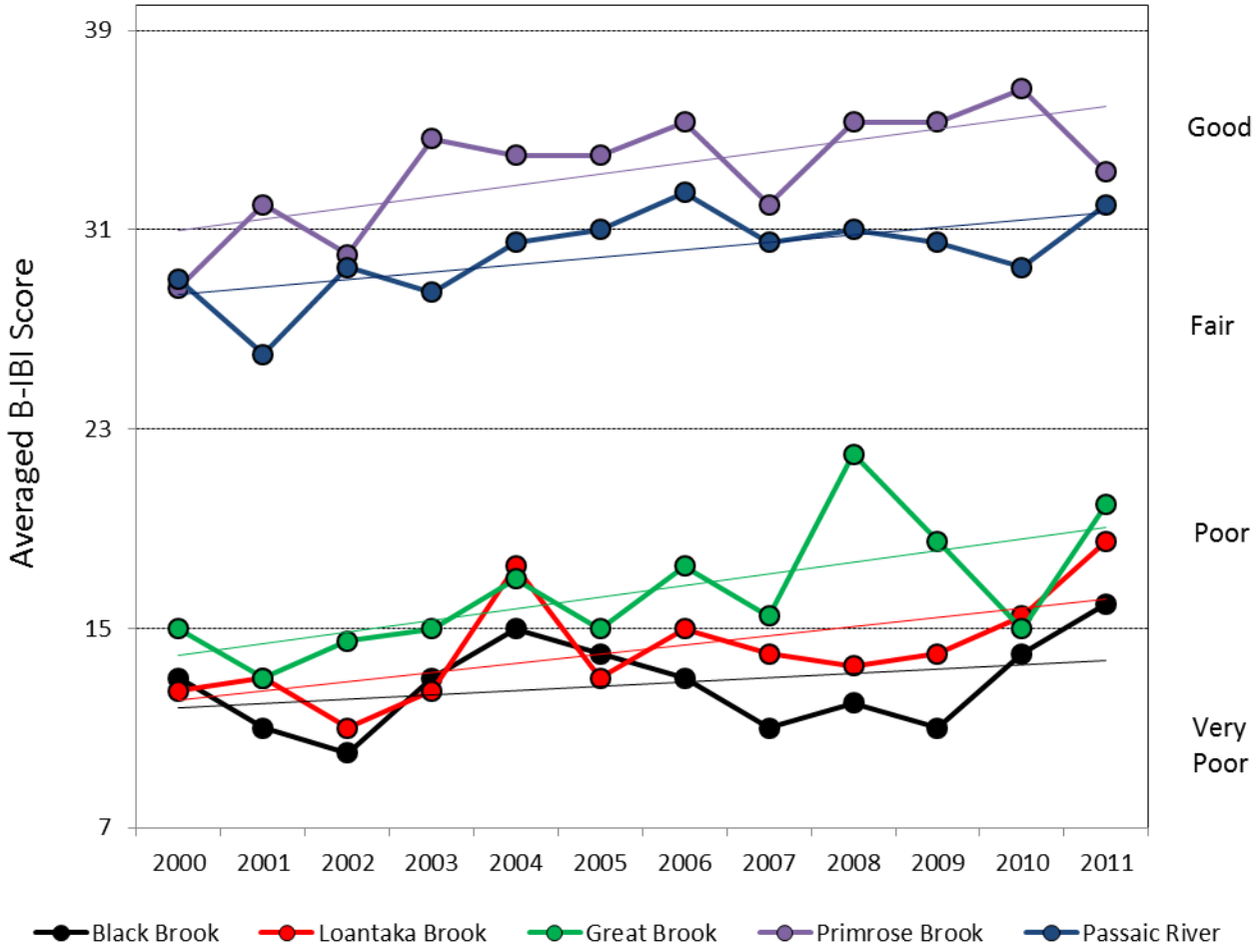
Drainage channel, STP



BB2

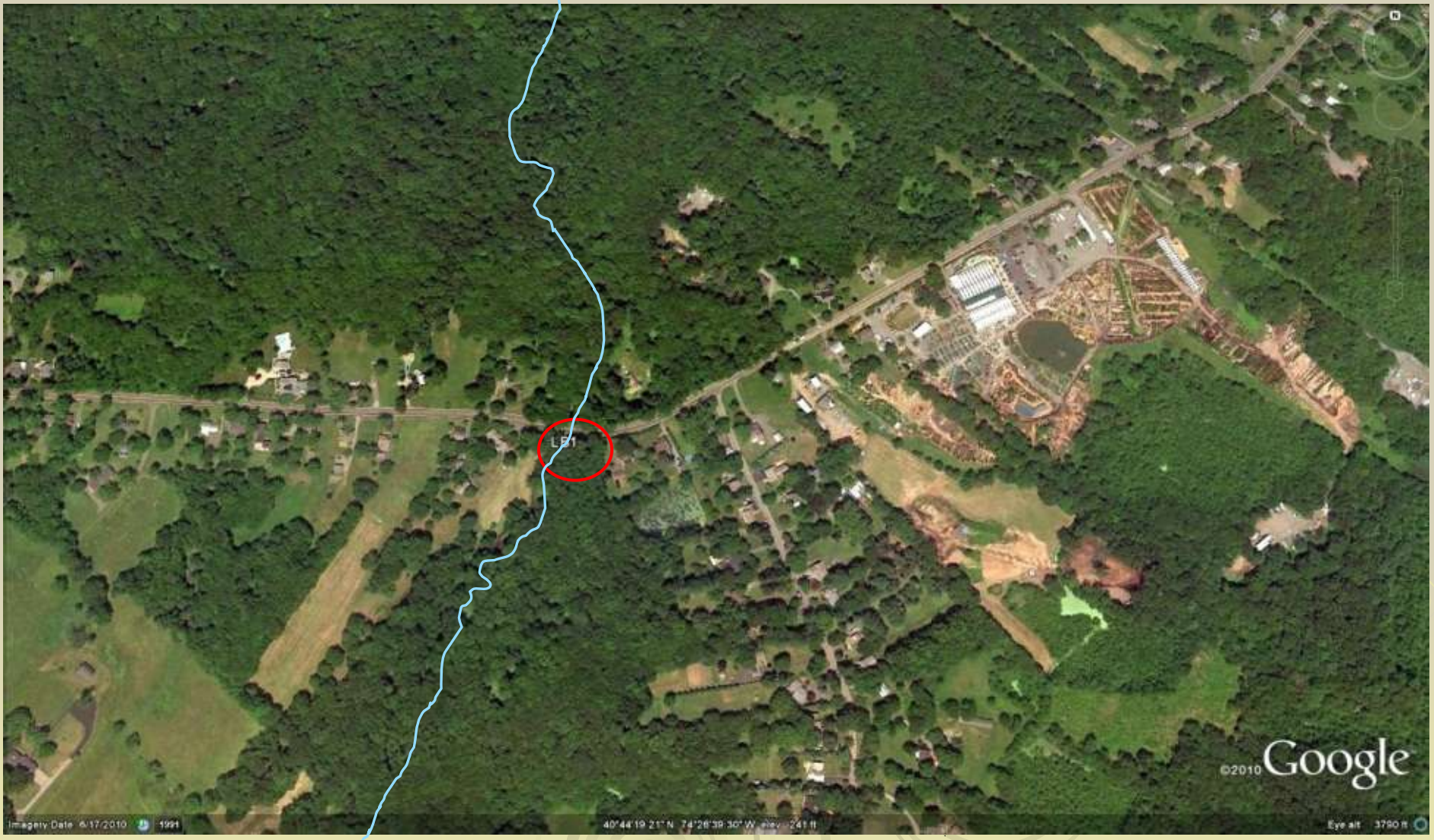
Sandy, poor substrate
Increasing TDS

Great Swamp Watershed Streams
Averaged Annual B-IBI Scores, 2000-2011

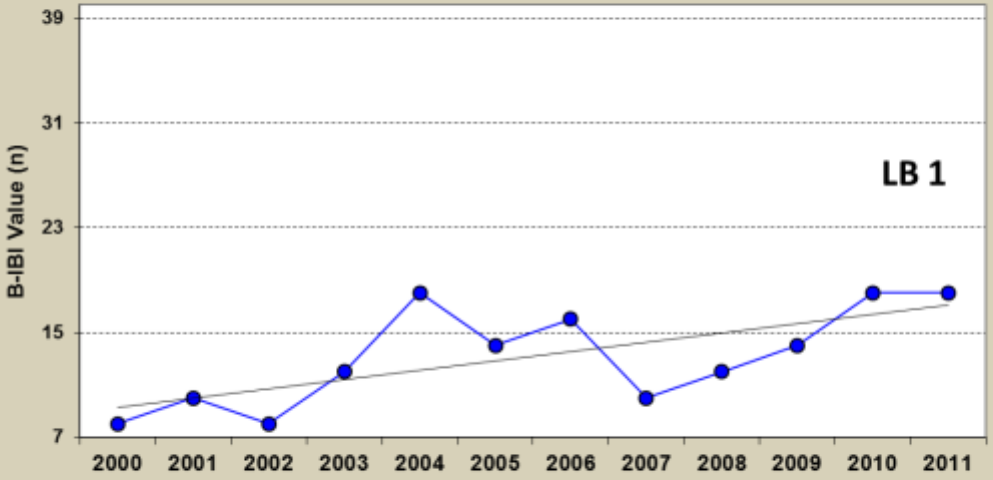


GSWA monitoring site
High turbidity, sediments
Diluted but high TDS

LB1




N
LB1
Image © 2007 State of New Jersey
©2006 Google
Pointer 40°44'22.13" N 74°26'46.20" W elev 239 ft Streaming 100%
Eye alt 3786 ft



LB1

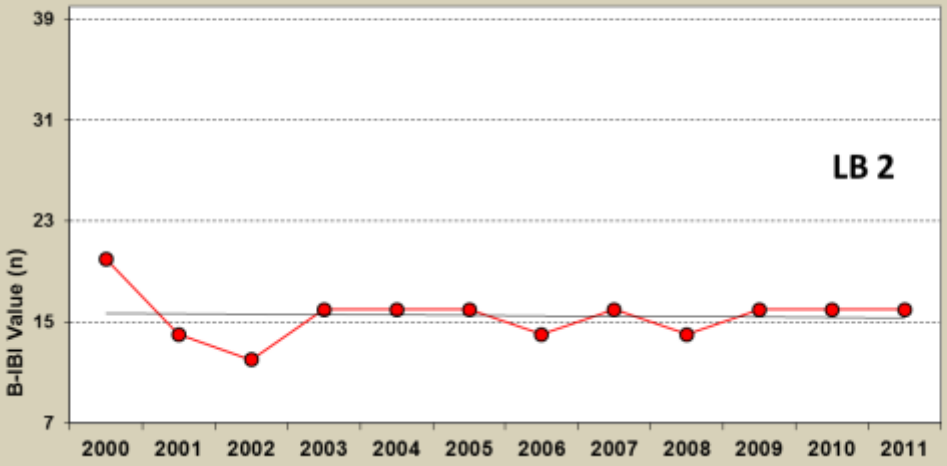
Limited substrate

Bank erosion

LB2

LB2


Eutrophic Kitchell Pond
N
LB2
© 2008 Sanborn
© 2008 Tele Atlas
Google
Pointer 40°46'06.32" N 74°27'17.33" W
Streaming 100%
Eye alt 1627 ft



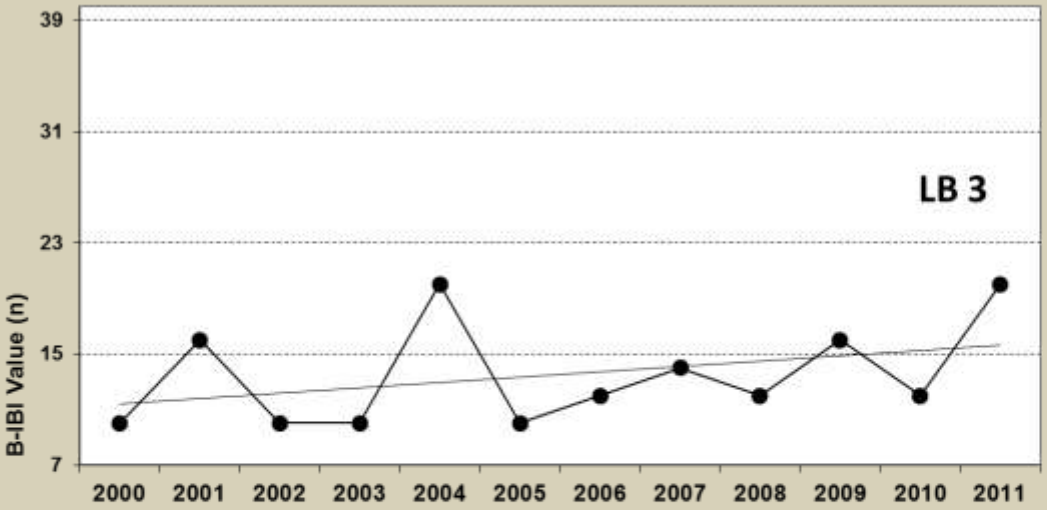
LB2

High temperature, low DO, detritus
High TDS, chemical smell

Morris Township STP
Strong chemical smell
High TDS

LB3


N
LB3
Image © 2007 State of New Jersey
© 2006 Google
Pointer 40°46'25.40" N 74°27'48.97" W elev 289 ft Streaming 100%
Eye alt 1860 ft



LB3

Very limited substrate
Shifting sands
2011: Jump in species richness
Drop in caddisfly dominance

Fanok Road municipal pool
Channelized ditch

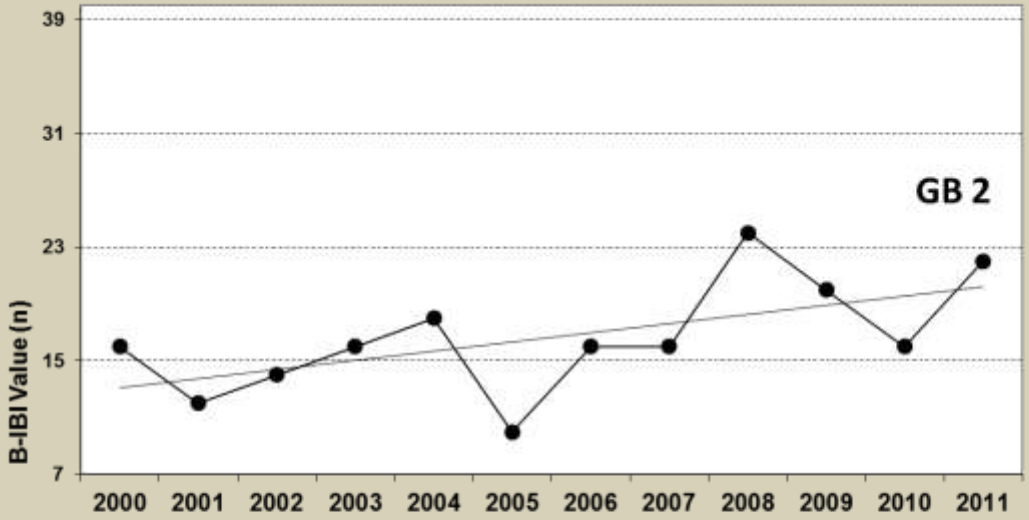
LB4

LB4

Little MIV substrate
Very high TDS

GSWA monitoring site
Sedimentation – but mussels

GB2

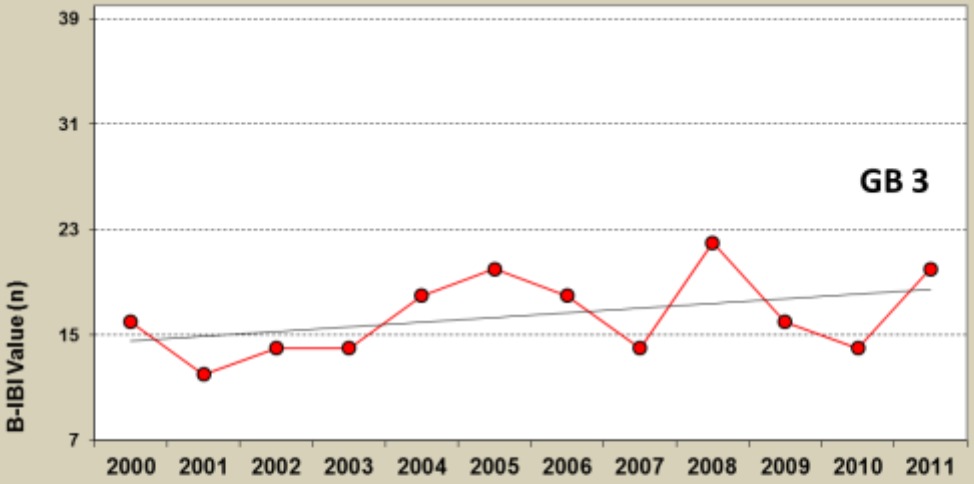


GB2

Poor substrate diversity

Below Silver Lake

GB3

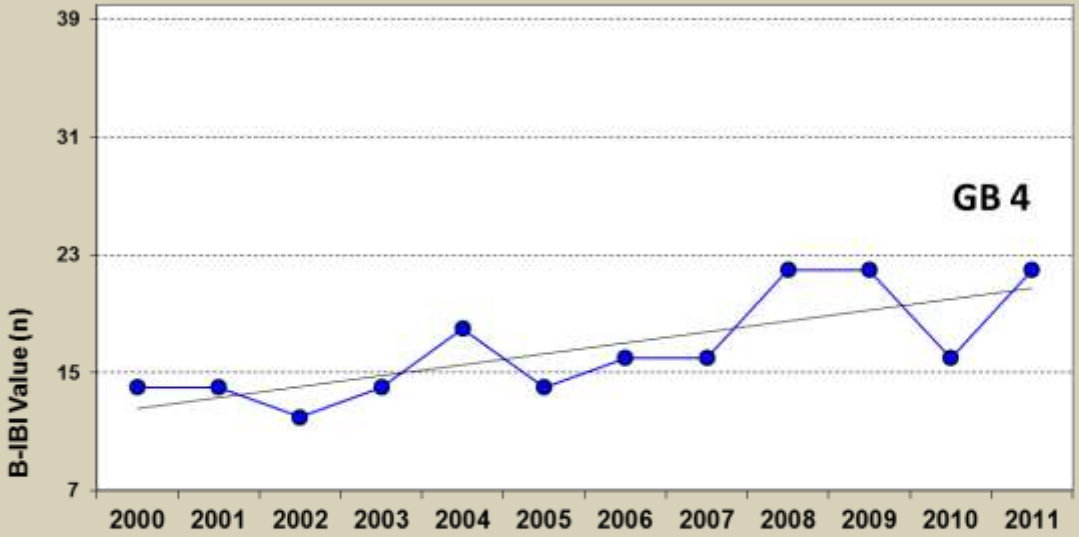


GB3

Good substrate
High temperature, silt & debris
2011- high ppt ➡ turbidity

GB4

Office complex
Parking lots, retention ponds, I-287

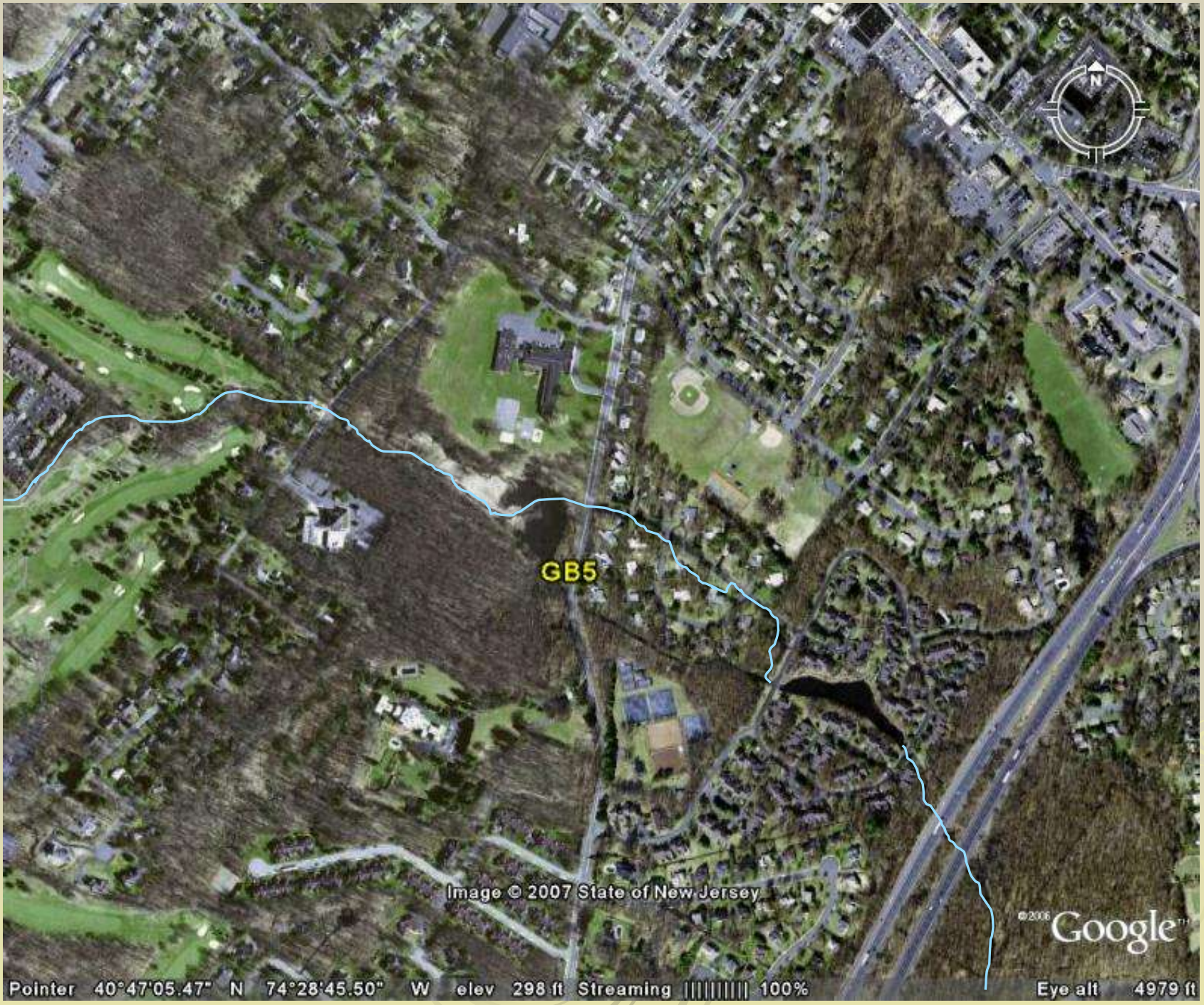


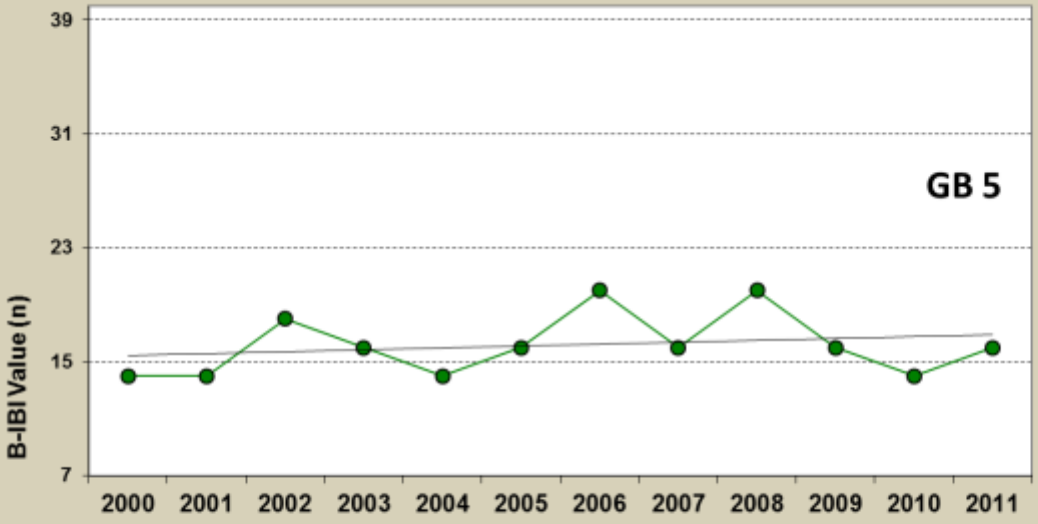
GB4

Poor substrate
High TDS & silt

James Street, Footes Pond
Eutrophic, silty
Golf course upstream

GB5


GB5
Image © 2007 State of New Jersey
©2006 Google
Pointer 40°47'05.47" N 74°28'45.50" W elev 298 ft Streaming 100%
Eye alt 4979 ft



GB5

Temperature high, 2011
High and rising TDS
Thick silt & algae
cover substrate

Foote's Pond

Great Swamp Watershed Streams
Averaged Annual B-IBI Scores, 2000-2011

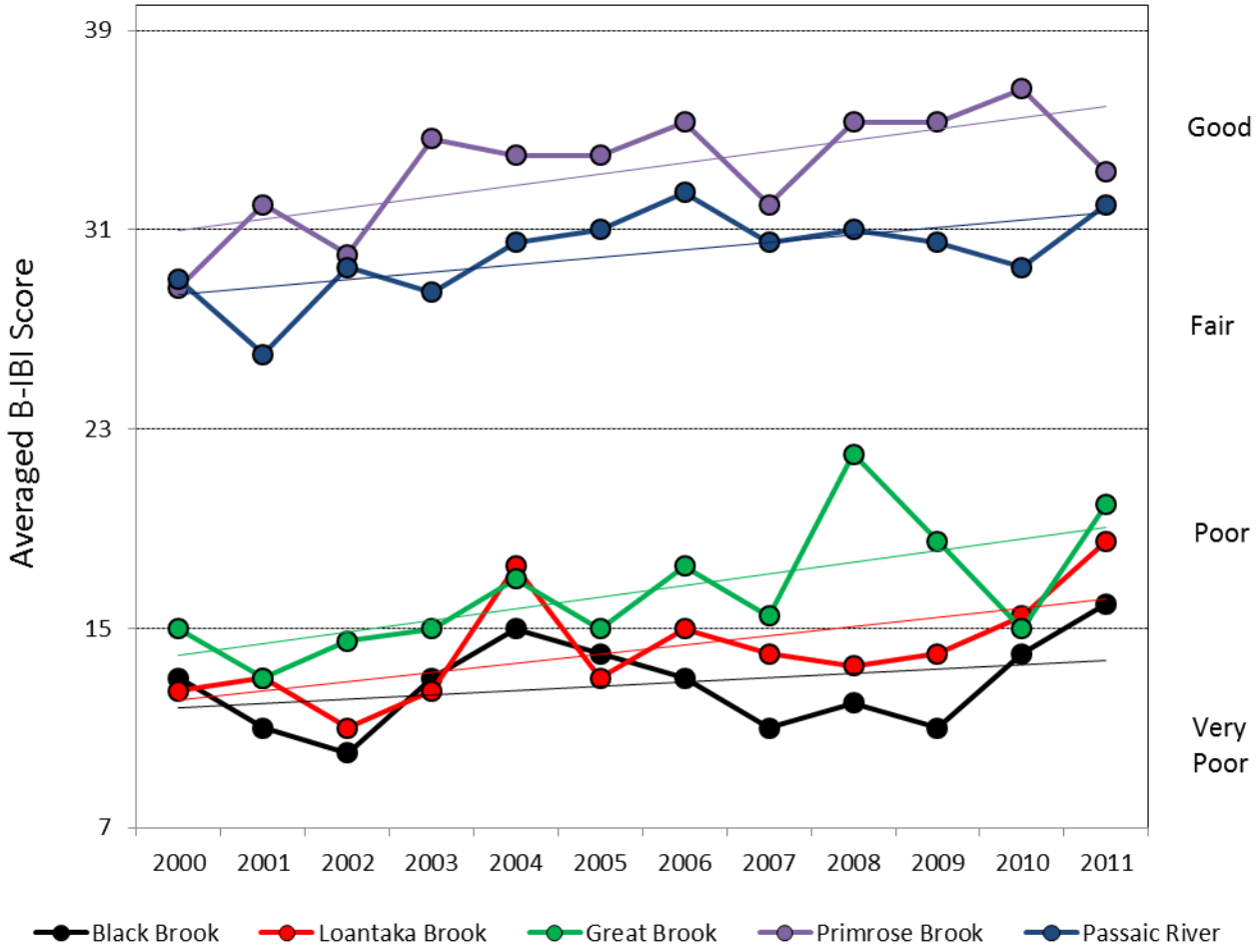


Table 11-4. Comparison between B-IBI components, 2010 and 2011

declined

improved

Data	GB2		GB3		GB4		GB5	
	2011	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**
DOM	0.417778	0.531401	0.46798	0.671429	0.397059	0.741445	0.579832	0.884444
TAXA	20	18	15	18	26	21	20	13
PPred	0.035714	0.029126	0.167488	0.05314	0.108911	0.007722	0.100478	0.048689
IndIntol	1	1	0	1	2	2	0	0
#Eph	2	1	1	0	0	0	1	1
#Trich	2	2	2	1	0	1	1	1
#Plec	0	1	0	0	0	0	0	0
IndTol	3	5	6	8	5	7	6	2
B-IBI Scores	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**
DOM	***5***	3	***5***	3	***5***	3	***3***	1
TAXA	3	3	3	3	5	5	3	3
PPred	3	3	***5***	3	***5***	1	***5***	3
IndIntol	1	1	1	1	3	3	1	1
#Eph	***3***	1	1	1	1	1	1	1
#Trich	3	3	***3***	1	1	1	1	1
#Plec	1	1	1	1	1	1	1	1
IndTol	***3***	1	1	1	1	1	1	3
B-IBI Total	**22**	**16**	**20**	**14**	**22**	**16**	**16**	**14**

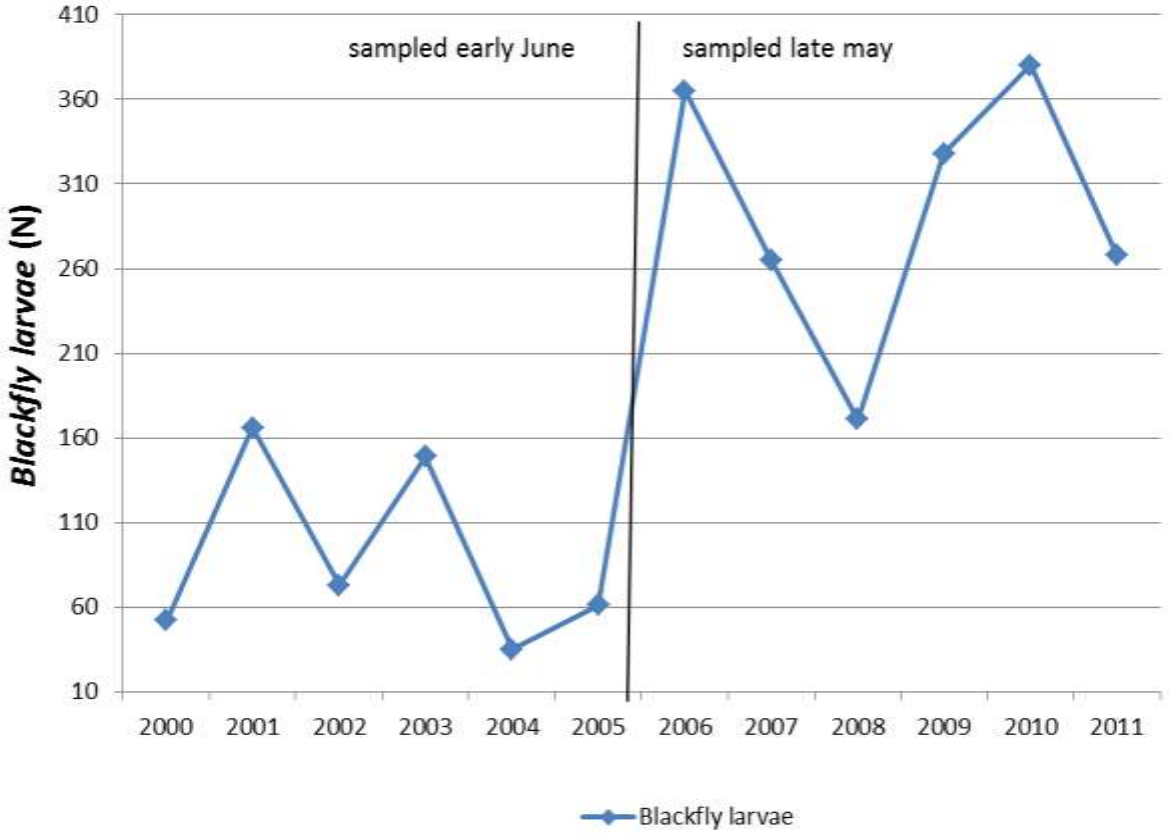

Great Brook
Blackfly larvae
Blackfly larvae (N)
410
360
310
260
210
160
110
60
10
sampled early June
sampled late may
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Blackfly larvae

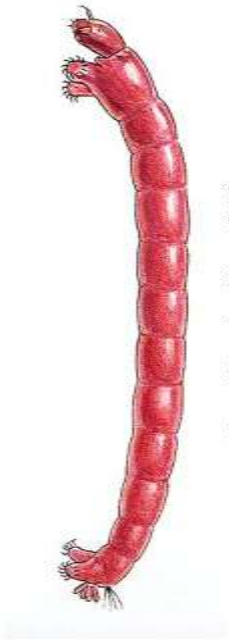
Table 11-4. Comparison between B-IBI components, 2010 and 2011

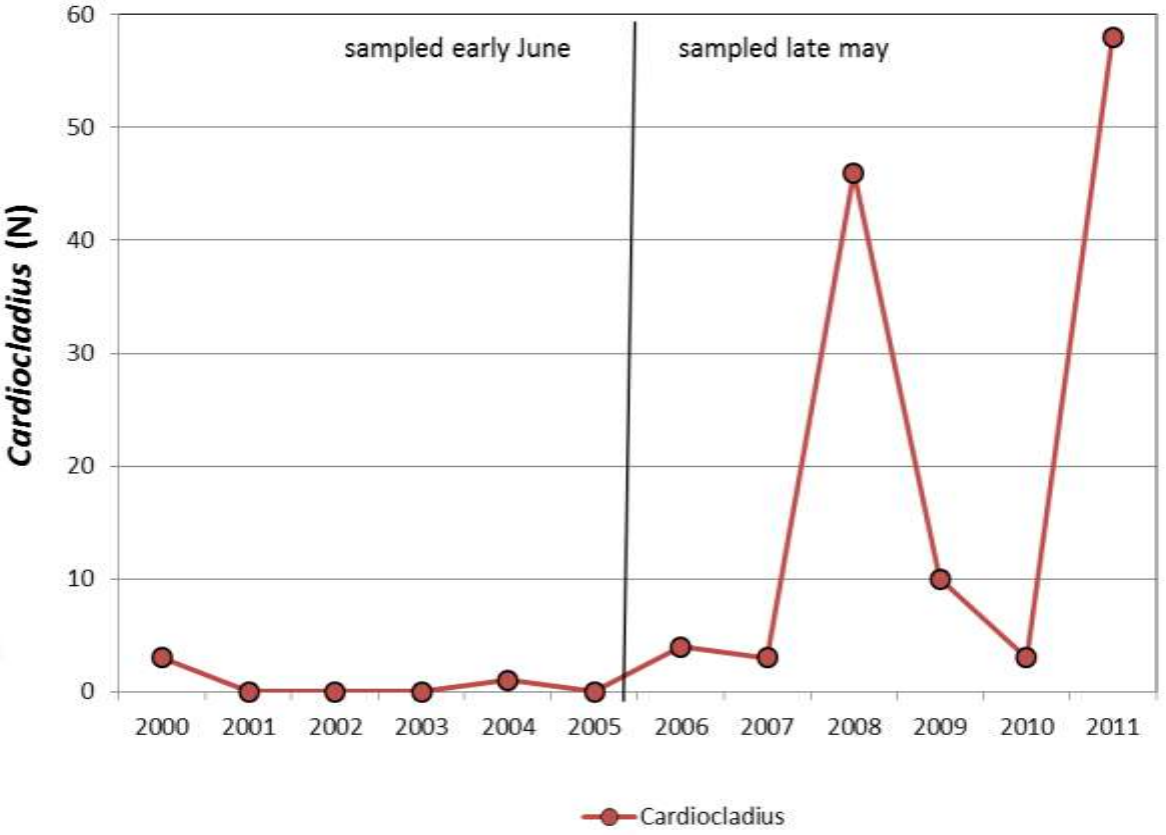
declined

improved

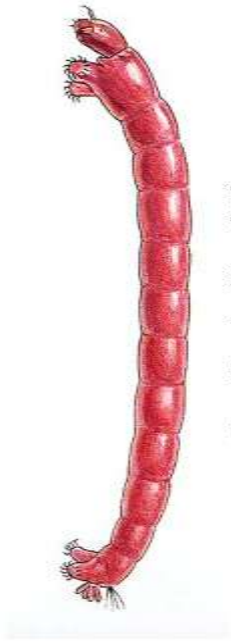
	GB2		GB3		GB4		GB5	
Data	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**
DOM	0.417778	0.531401	0.46798	0.671429	0.397059	0.741445	0.579832	0.884444
TAXA	20	18	15	18	26	21	20	13
PPred	0.035714	0.029126	0.167488	0.05314	0.108911	0.007722	0.100478	0.048689
IndIntol	1	1	0	1	2	2	0	0
#Eph	2	1	1	0	0	0	1	1
#Trich	2	2	2	1	0	1	1	1
#Plec	0	1	0	0	0	0	0	0
IndTol	3	5	6	8	5	7	6	2
B-IBI Scores	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**
DOM	***5***	3	***5***	3	***5***	3	***3***	1
TAXA	3	3	3	3	5	5	3	3
PPred	3	3	***5***	3	***5***	1	***5***	3
IndIntol	1	1	1	1	3	3	1	1
#Eph	***3***	1	1	1	1	1	1	1
#Trich	3	3	***3***	1	1	1	1	1
#Plec	1	1	1	1	1	1	1	1
IndTol	***3***	1	1	1	1	1	1	3
B-IBI Total	**22**	**16**	**20**	**14**	**22**	**16**	**16**	**14**

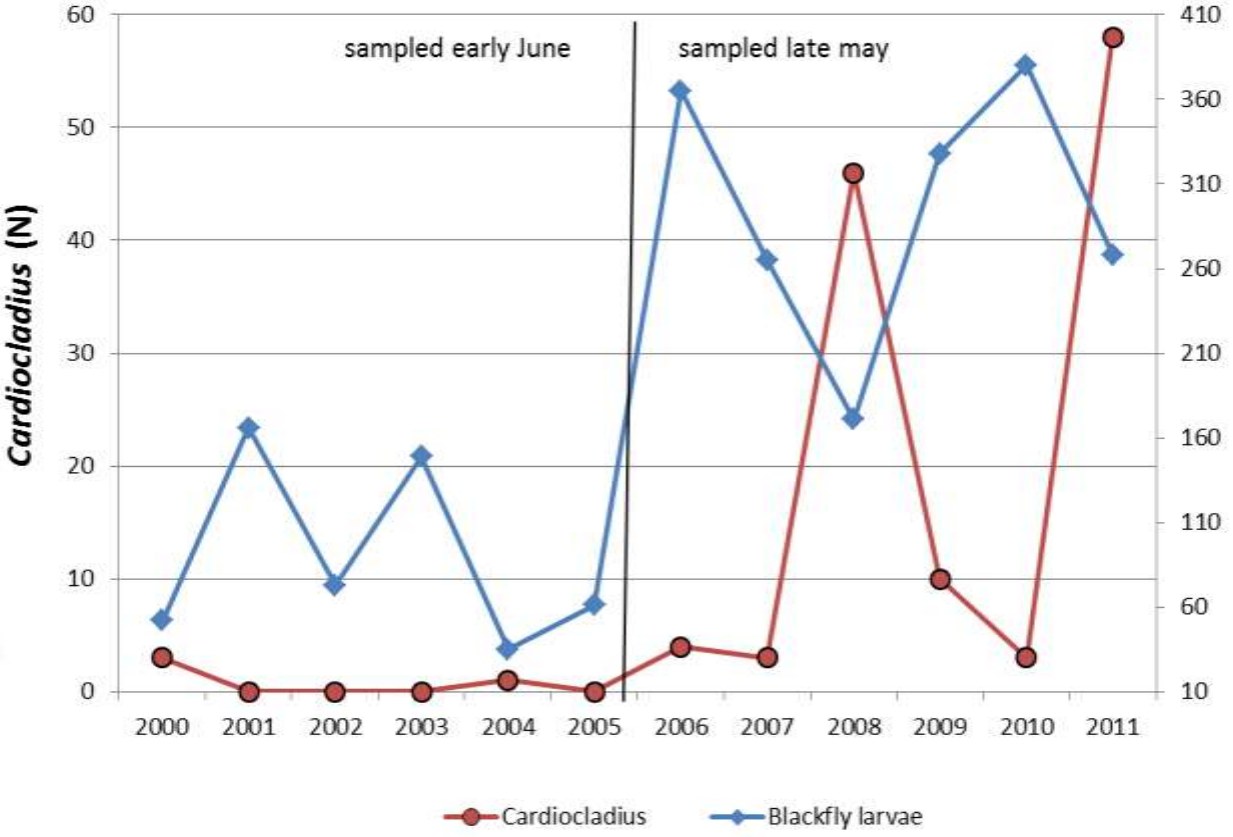
Great Brook
Cardiocladius obscurus

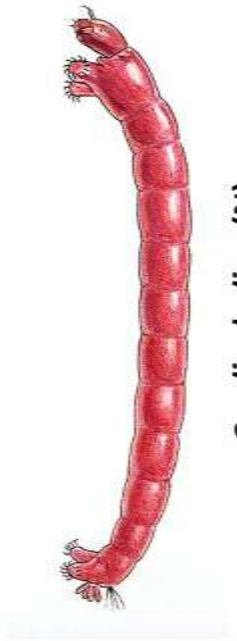




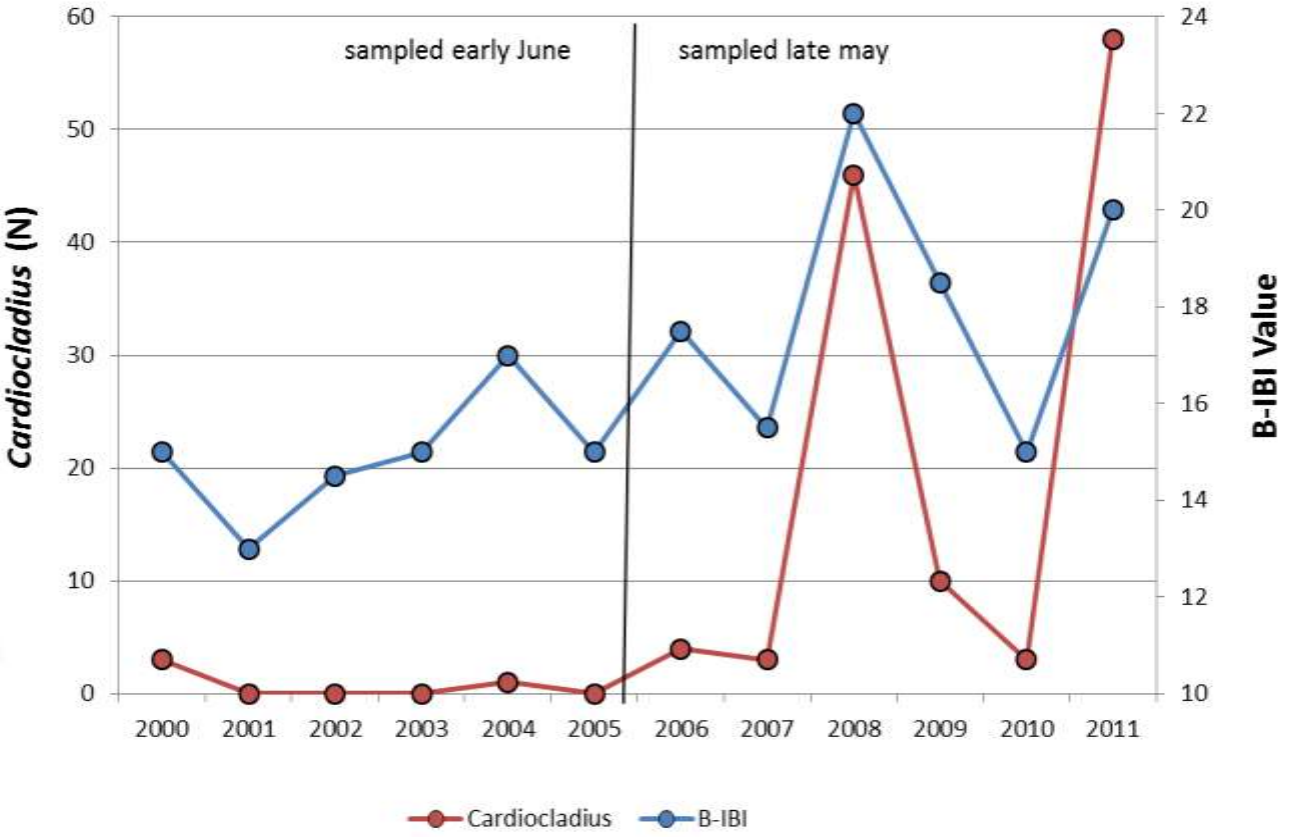
Great Brook
Cardiocladius obscurus and Blackfly larvae



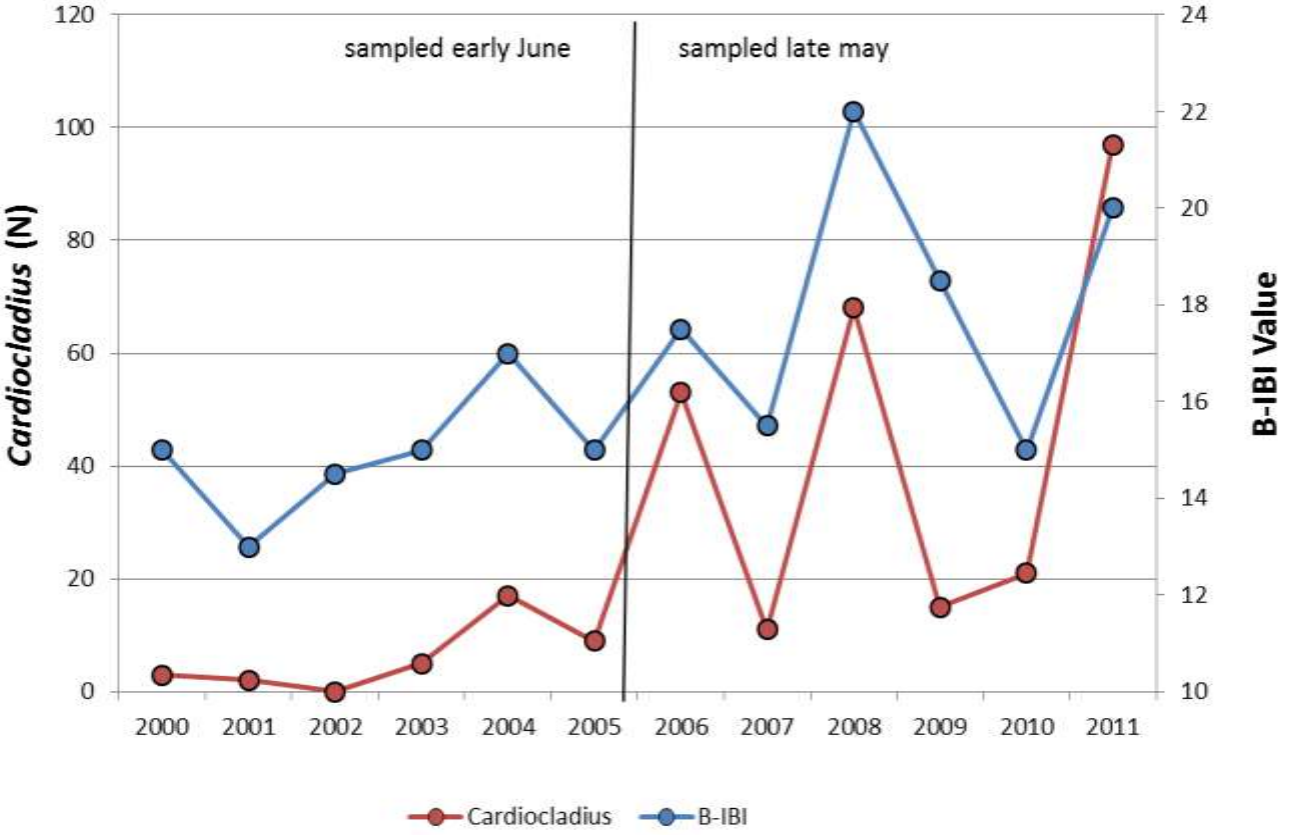




Great Swamp Streams
Great Brook B-IBI vs *Cardiocladius obscurus*



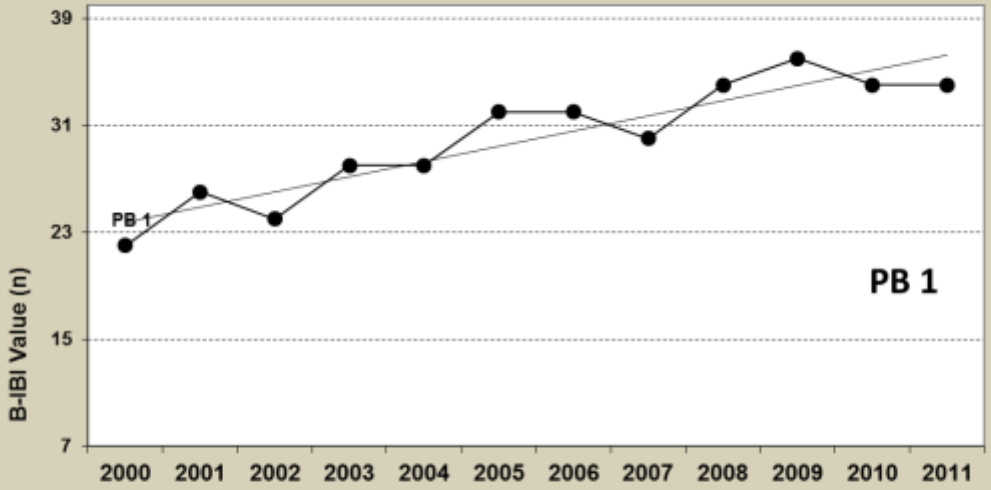
Great Swamp Streams
Great Brook B-IBI vs *Cardiocladius obscurus*



Lee's Mill Road

PB1


N
PB1
Image © 2007 State of New Jersey
Google
Pointer 40°43'47.15" N 74°30'56.77" W elev 243 ft Streaming 100%
Eye alt 4292 ft

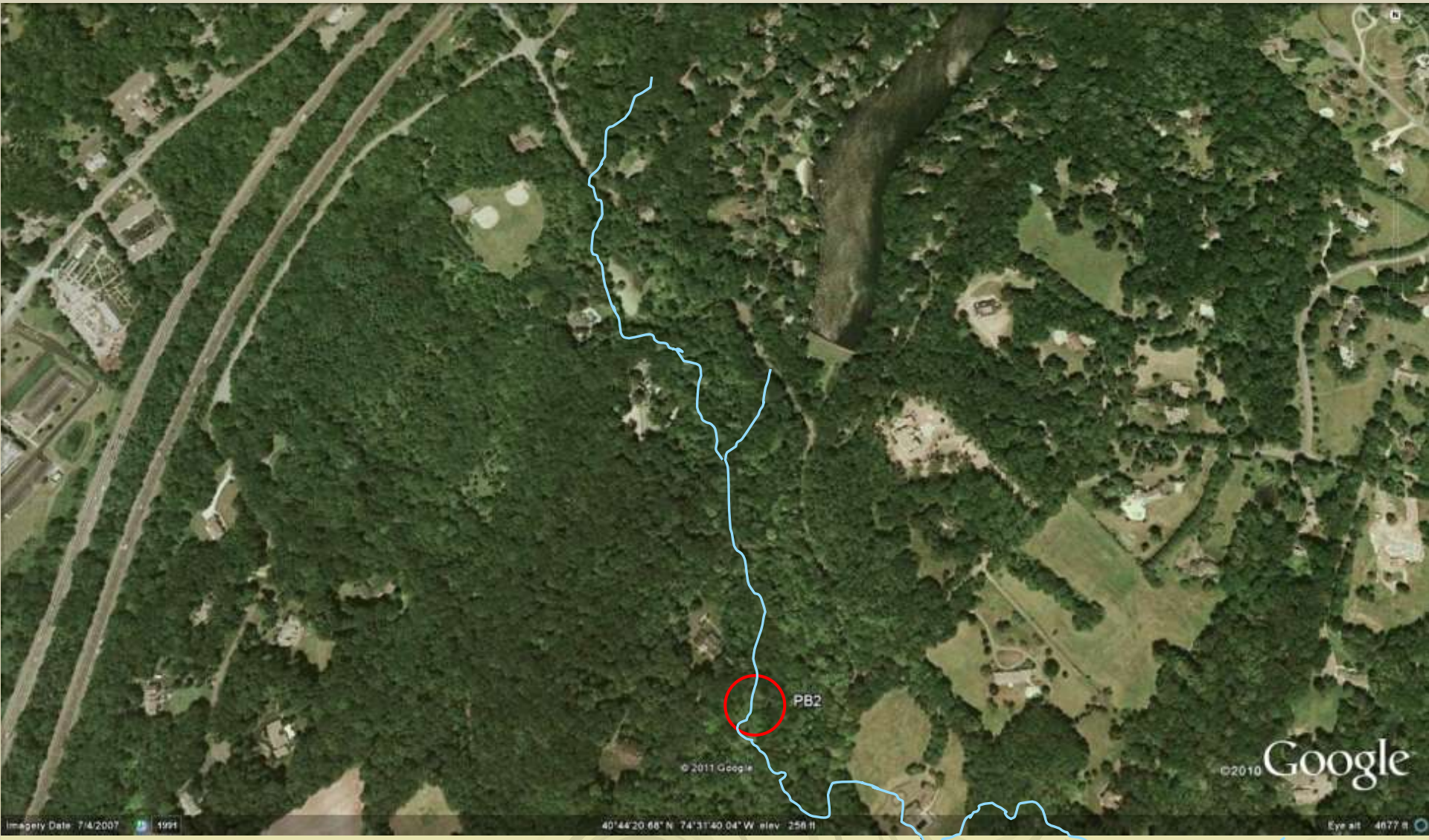


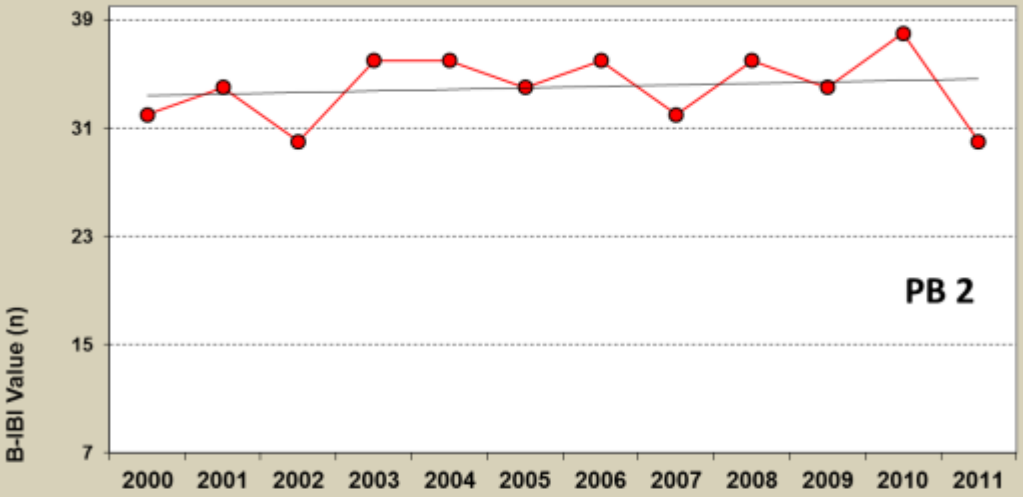
PB1

Good substrate
Some sedimentation

Opposite Youngs Road
Good canopy cover
Mt Kemble influences?

PB2





PB2

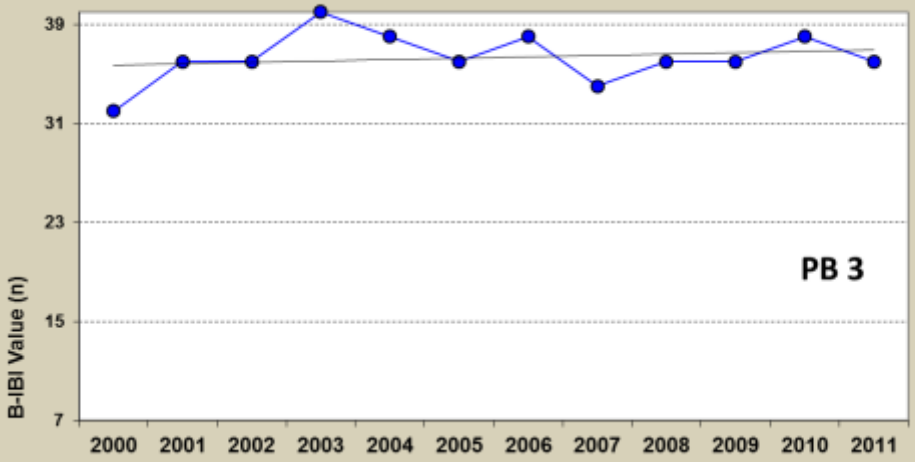
Big 2011 drop in B-IBI??

Table 11-4. Comparison between B-IBI components, 2010 and 2011

Data	3-5 Scoring Threshold Value	PB2 2011	PB2 2010
DOM	**0.50**	**0.548872**	**0.432099**
TAXA	20	30	34
PPred	**0.10**	**0.086466**	**0.102881**
IndIntol	>4	9	11
#Eph	**>5**	**5**	**6**
#Trich	>5	7	6
#Plec	**>4**	**4**	**6**
IndTol	<2	2	3
B-IBI Scores		**2011**	**2010**
DOM		**3**	**5**
TAXA		5	5
PPred		**3**	**5**
IndIntol		5	5
#Eph		**3**	**5**
#Trich		5	5
#Plec		**3**	**5**
IndTol		3	3
B-IBI Total		**30**	**38**

Tempe Wick Road
Small impoundment upstream

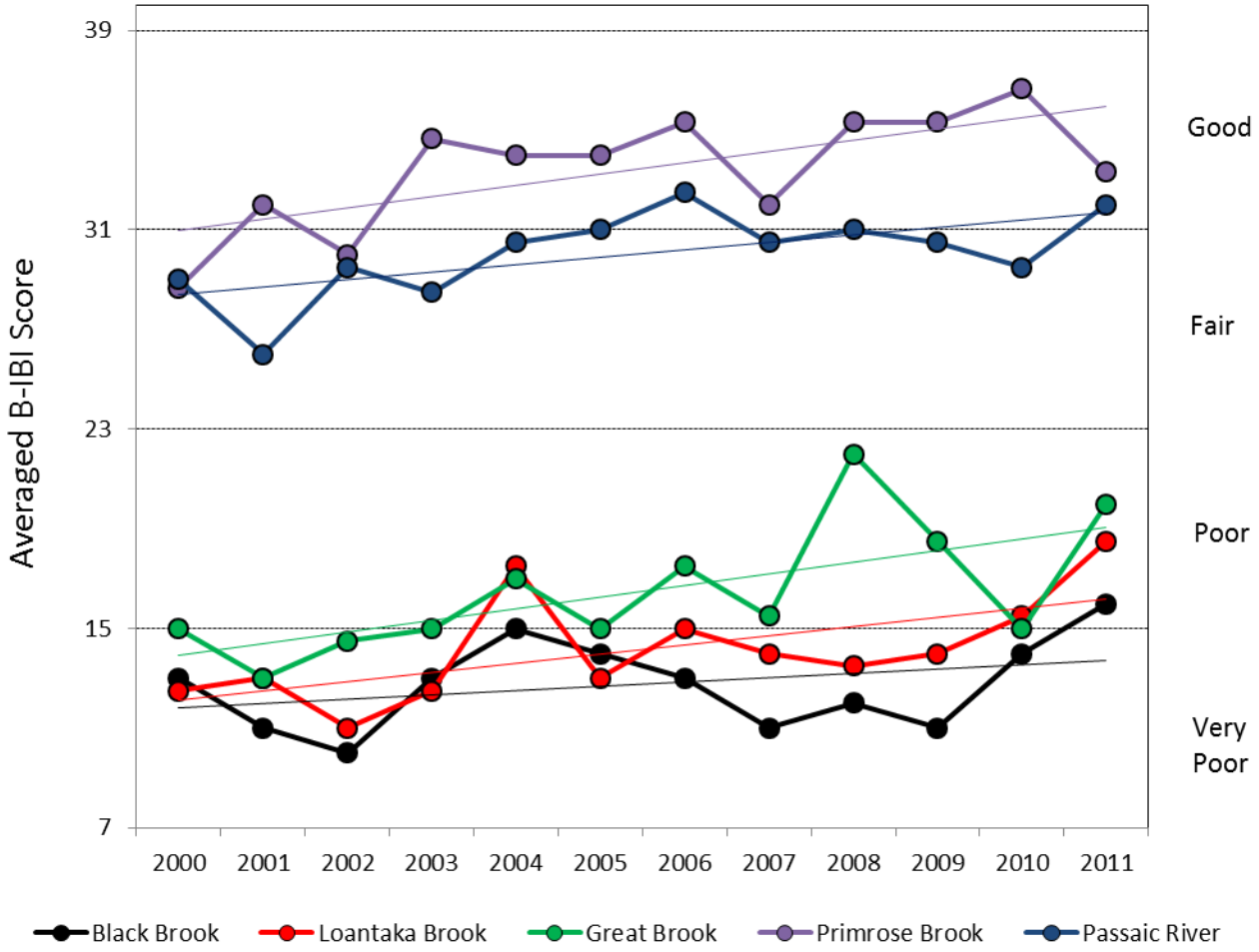
PB3



PB3

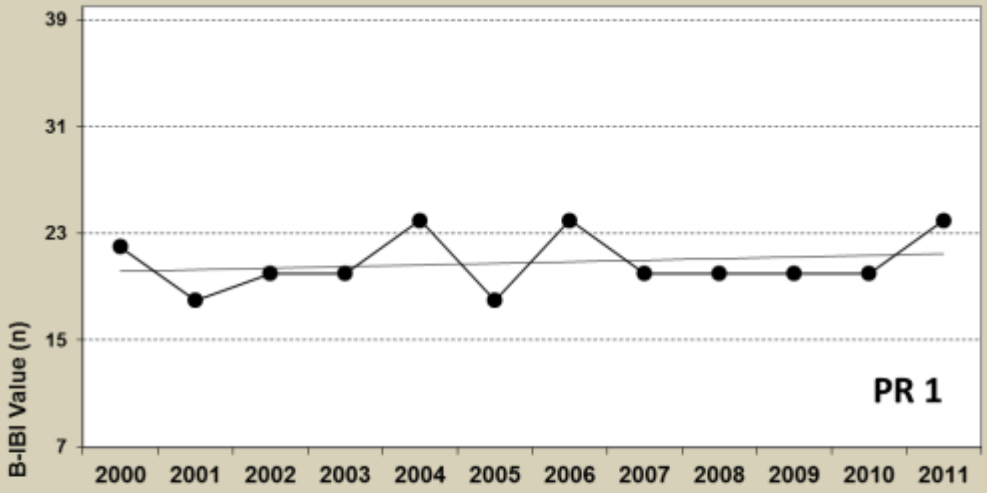
Ideal MIV habitat - Despite heavily traveled roadway

Great Swamp Watershed Streams
Averaged Annual B-IBI Scores, 2000-2011



Below Osborn Pond
High temperature, eutrophication products from pond

PR1

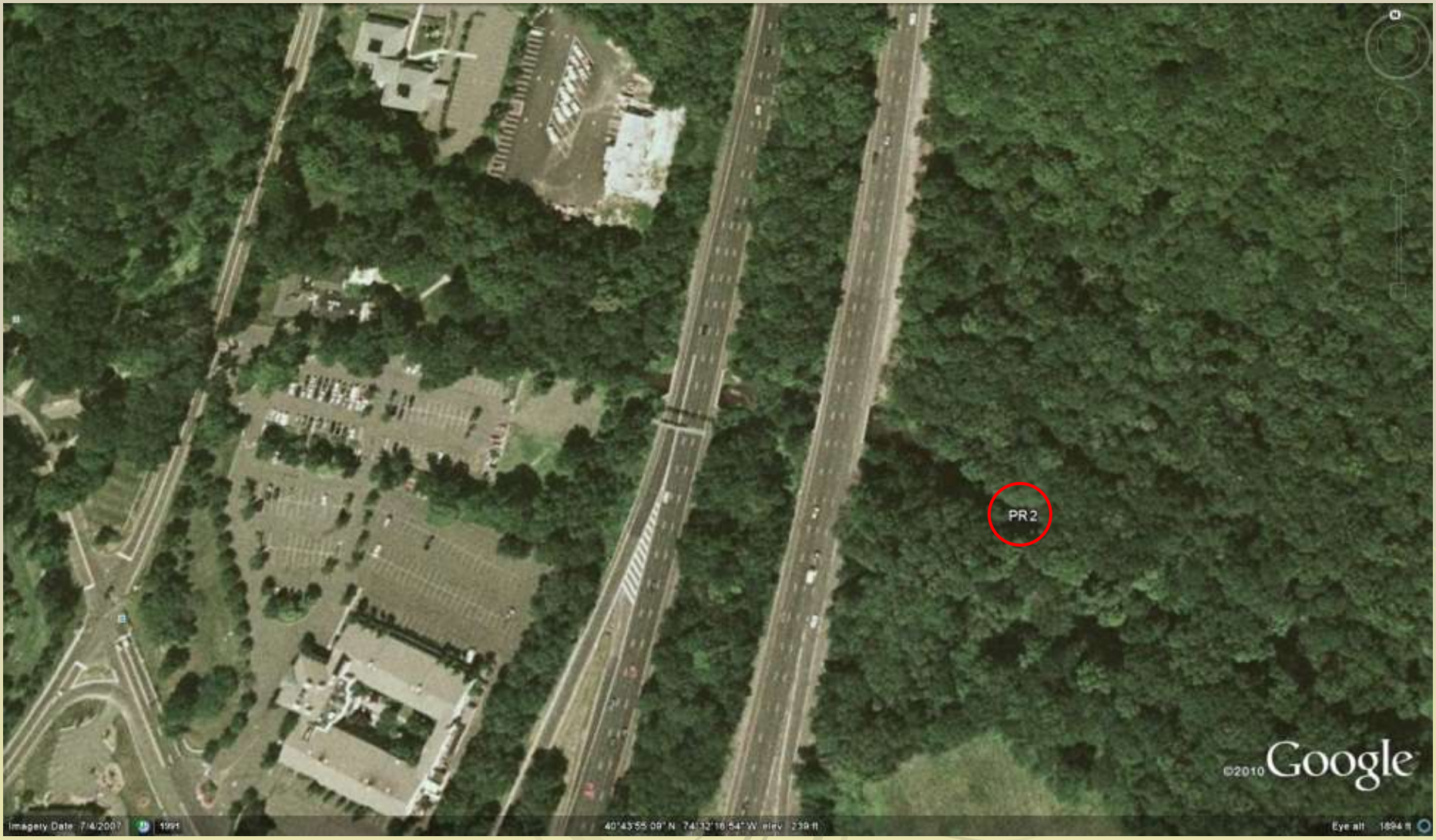


PR1

Limited substrate
Hydropsychids down
Cardiocladius up

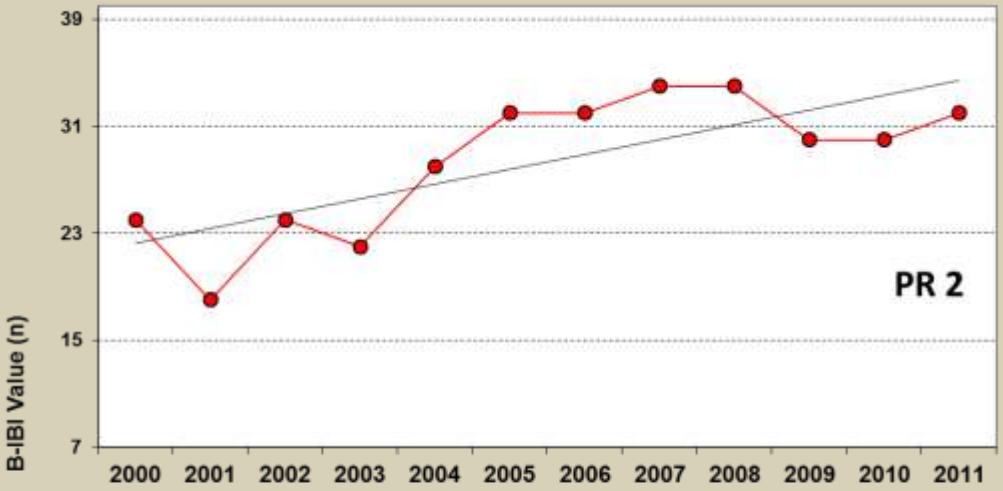
Below I-287
Flooding, sediments, highway debris

PR2



PR2


PR2
Image © 2007 State of New Jersey
Google
Pointer 40°43'57.68" N 74°32'20.14" W elev 259 ft Streaming 100%
Eye alt 2854 ft

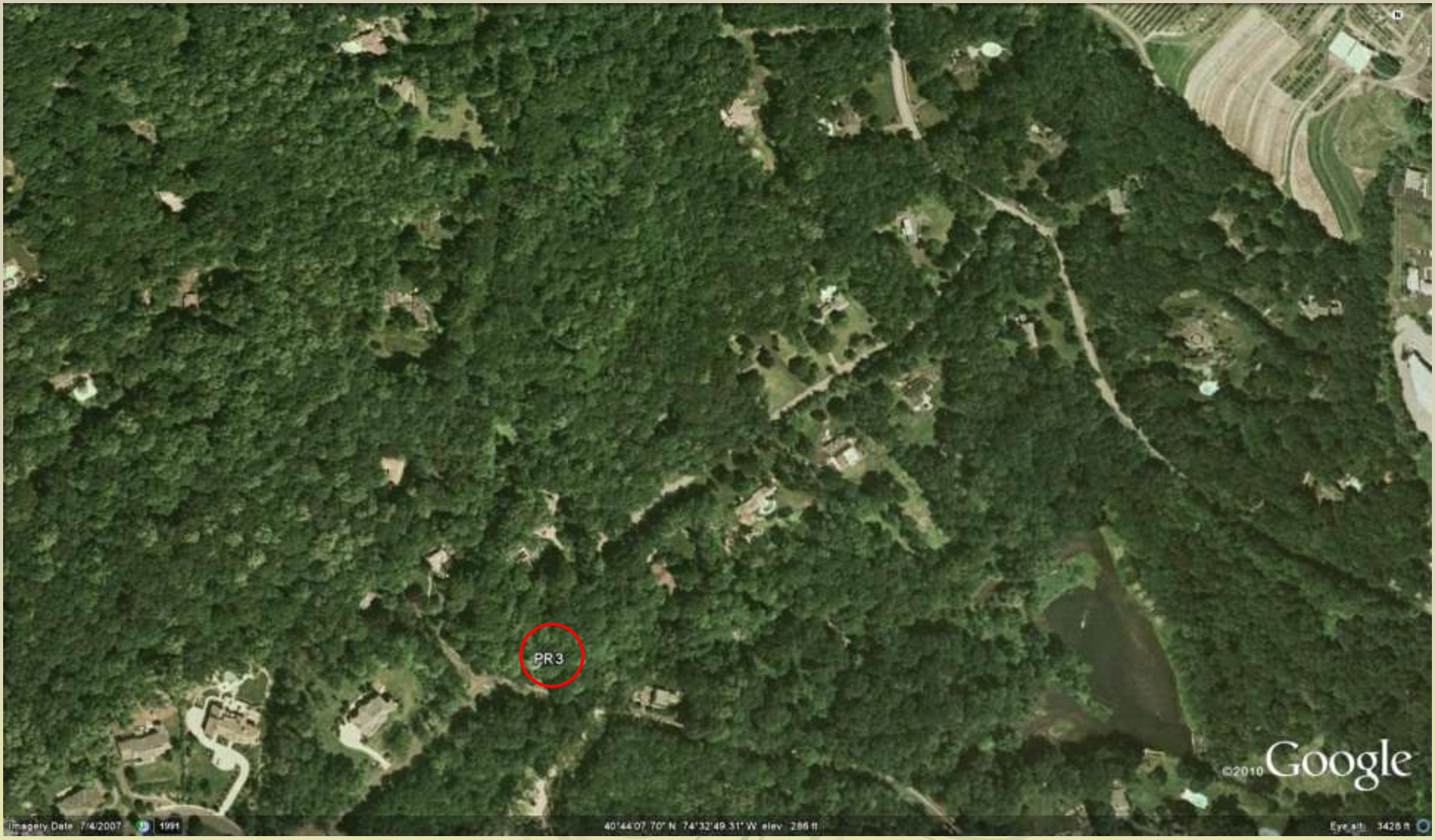


PR2

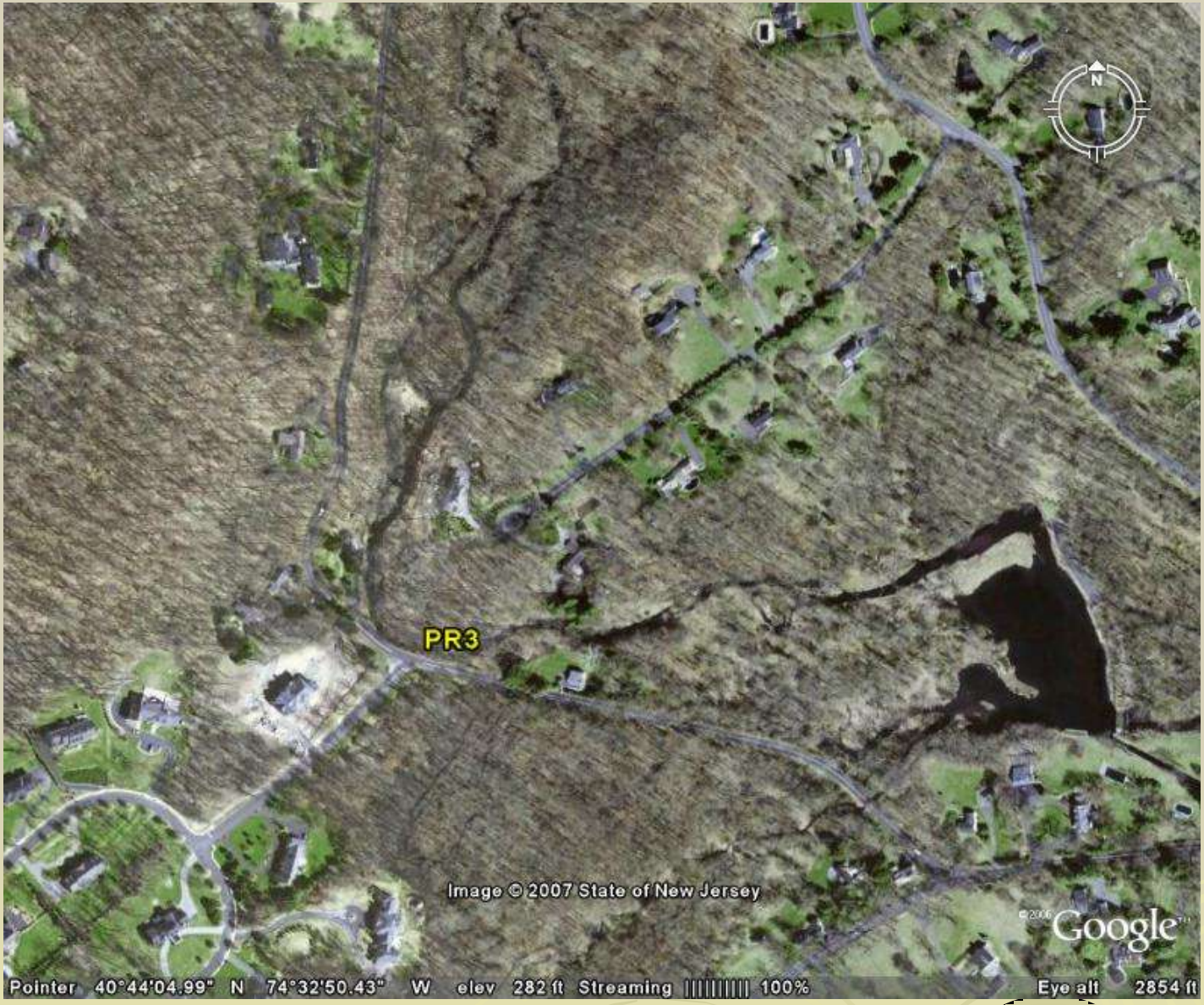
Little TDS impact from Highway

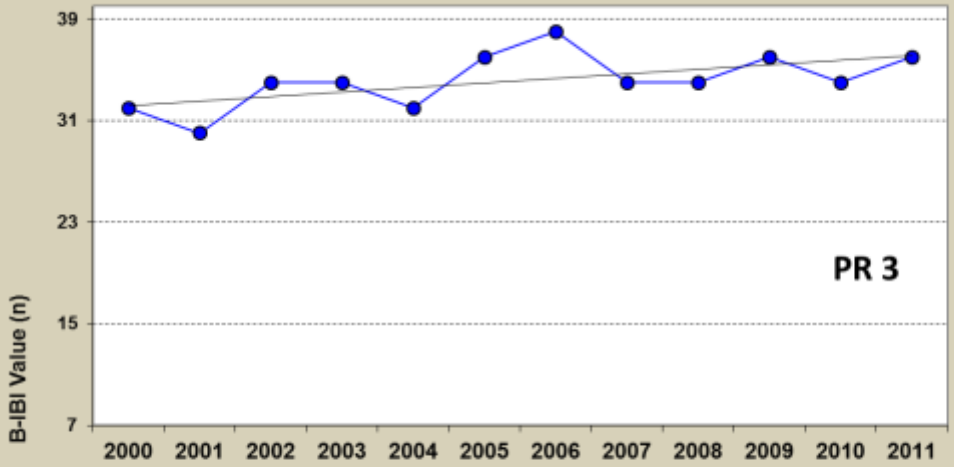
Hardscrabble Road
Ideal habitat – close to roadway

PR3



PR3


PR3
Image © 2007 State of New Jersey
Google
Pointer 40°44'04.99" N 74°32'50.43" W elev 282 ft Streaming 100%
Eye alt 2854 ft



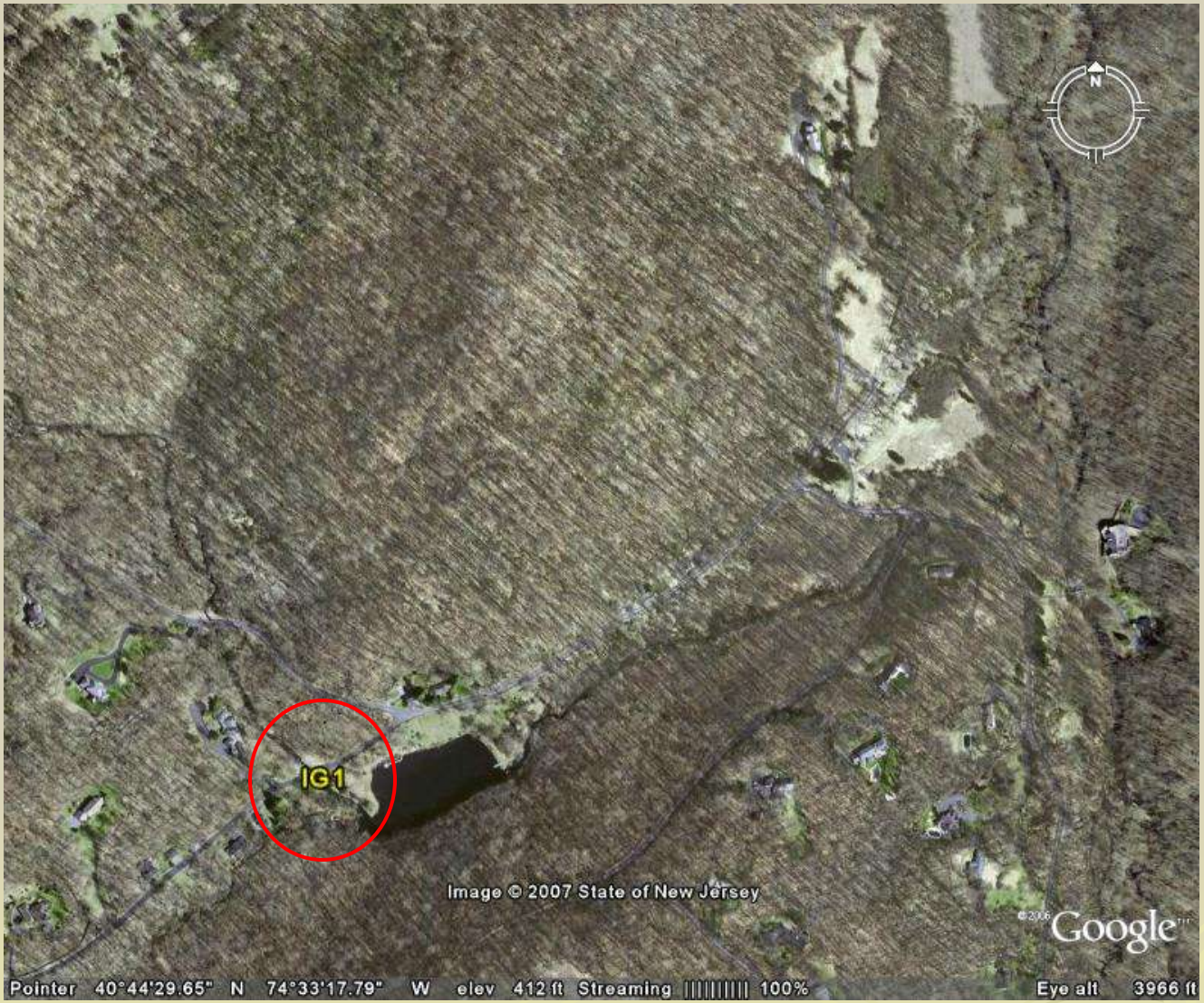
PR3

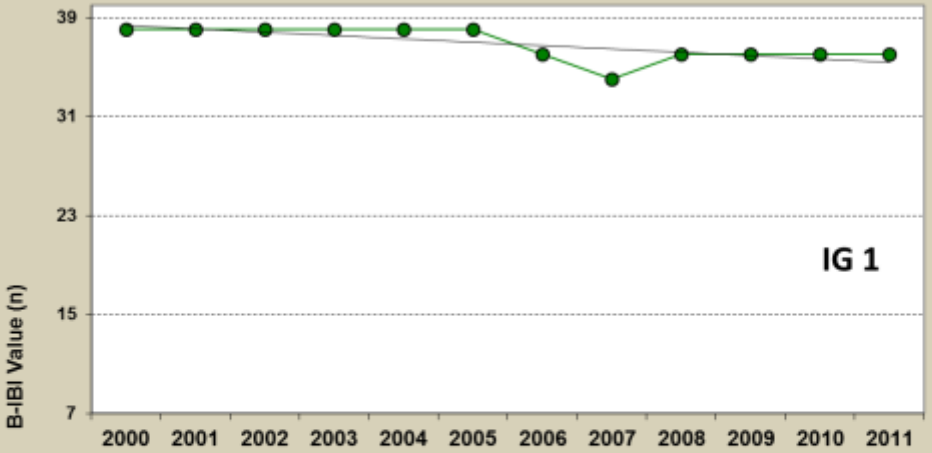
High MIV diversity; low density

Upper Passaic tributary
"Reference" site

IG1

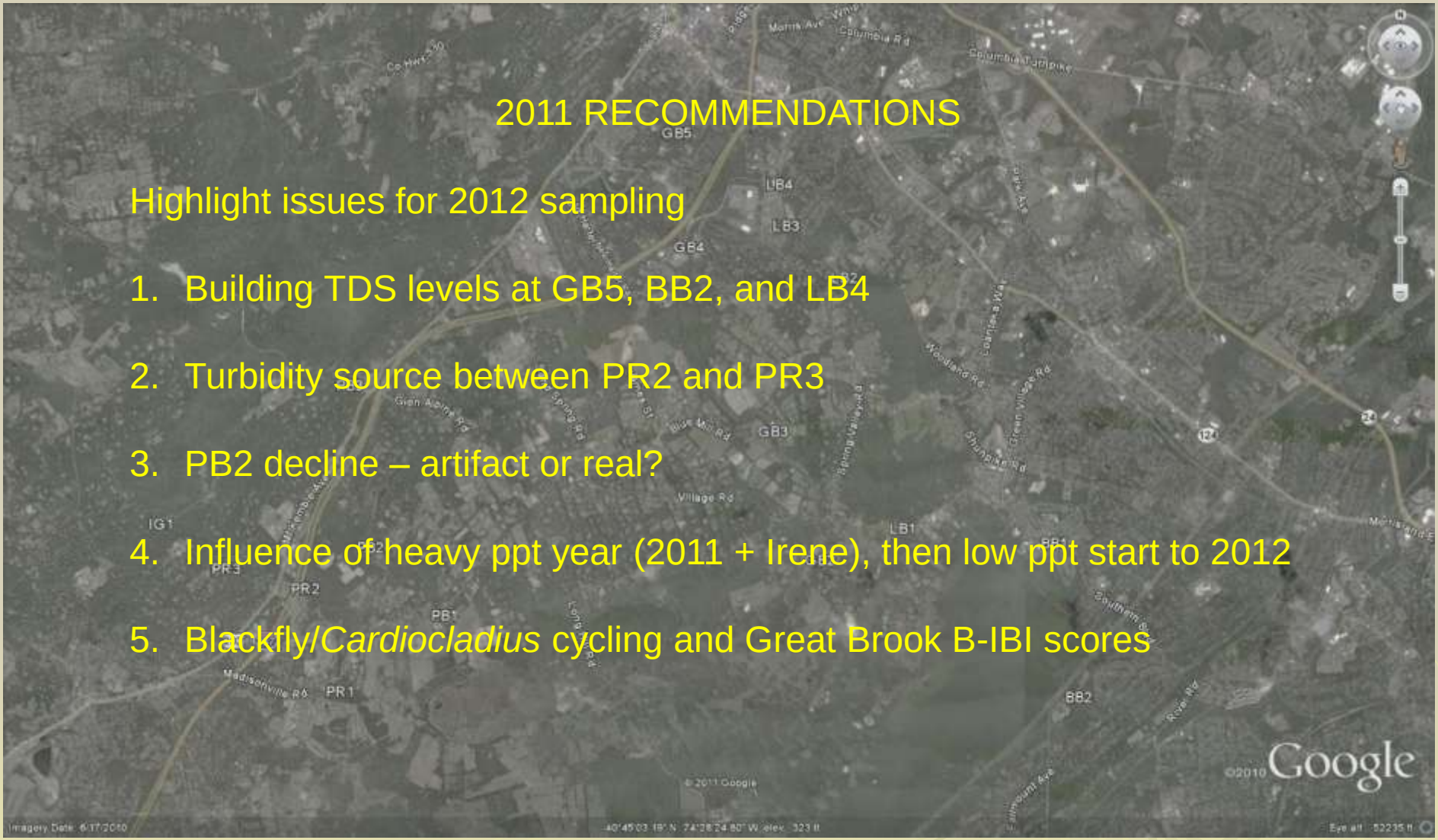
IG1


N
IG1
Image © 2007 State of New Jersey
©2006 Google
Pointer 40°44'29.65" N 74°33'17.79" W elev 412 ft Streaming 100%
Eye alt 3966 ft



IG1

Great habitat



2011 RECOMMENDATIONS

Highlight issues for 2012 sampling

1. Building TDS levels at GB5, BB2, and LB4
2. Turbidity source between PR2 and PR3
3. PB2 decline – artifact or real?
4. Influence of heavy ppt year (2011 + Irene), then low ppt start to 2012
5. Blackfly/*Cardiocladius* cycling and Great Brook B-IBI scores

Conclusions

- **Highest MIV quality correlations:**
  - **Higher habitat quality – varied flow regimes, larger and varied substrate elements**
  - **Lower sediment loading – stable banks, good vegetation cover, reduced sediment burial**
  - **Higher dissolved oxygen and lower TDS**
- **Best practice consequences**
  - **Support natural, unimpeded stream flow - minimal impoundments, channelization, habitat "simplification"**
  - **Maintain good canopy/vegetation cover and bank protection; prevent of stormwater or construction sedimentation**
  - **Protect against high organic loading & introduced chemical substances – road salt, nutrients (N & P) from STPs and yards, toxins**

Great Brook, 2006-2011
Dominance (DOM) & Proportion Predators (PPRED)