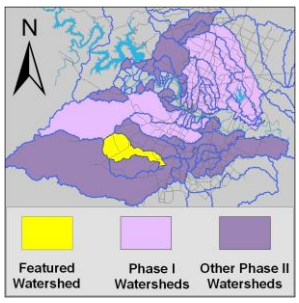
Bear Creek Watershed

Summary Sheet

Catchment	Total area	26.93 sq. miles				
	Area in recharge	6.47 sq. miles				
	Creek length	17 miles				
	Receiving water	Onion Creek				
Demographics	2000 population	5,419				
	2030 projected population	31,009				
	30 year projected % increase	472 %				
Land Use	Impervious cover (2003 estimate)	3.6 %				
	Impervious cover (2013 estimate)	8.2%				
Overall EII Scores	2001	2004	2007	2010	2012	2014
	79	67	79	72	69	81



Flow Regime* for Sample Sites on Bear Creek

Site	Site Name	1999		2001					2004							2007					2010				2011	2012				2014				
		Jan	Jan	Mar	Mar	Jun	Sep	Dec	Mar	May	May	Jun	Jun	Oct	Dec	Feb	May	Jun	Sep	Dec	Mar	May	May	Oct	Dec	Mar	Apr	Jul	Sep	Jan	Apr	May	Jul	Sep
		WQ	Bio	WQ	Bio	WQ	WQ	WQ	WQ	WQ	Bio	WQ	Bio	WQ	WQ	WQ	WQ	Bio	WQ	WQ	WQ	WQ	Bio	WQ	WQ	WQ	Bio	WQ	WQ	WQ	WQ	Bio	WQ	WQ
600	FM 1826 [S. Fork]	B	B	B	S	B	B	B																										
1089	ds FM1826 [N Fork]	B	B	B	S	B	B	B	n	n		B		n	B																			
1090	Spanish Oaks	B	B	B	S	B	B	B																										
1534	ds Bear Creek Pass								B			B	B	B	B																			
4112	Bear Creek Pass															B	B	S	B	B	B	B	B	B	B	B	B	B	n	B	B	B	B	B
1088	Bears Den Court	n	n	B	B	n	n	B																										
3935	Escondido															n	B	B	B	n	B	n	n	n	n	n	n	n	n					
1087	Twin Creeks	B	B	B	B	B	B	B	B	B	B	B		n	B	B	B	S	B	B	B	B	B	B	n	B	B	B	n	B	B	B	B	n

* B = baseflow n = no flow storm = storm flow blue = Samples were taken light blue = Samples were not taken blank = not visited

Index scores* for Bear Creek Sites by Year

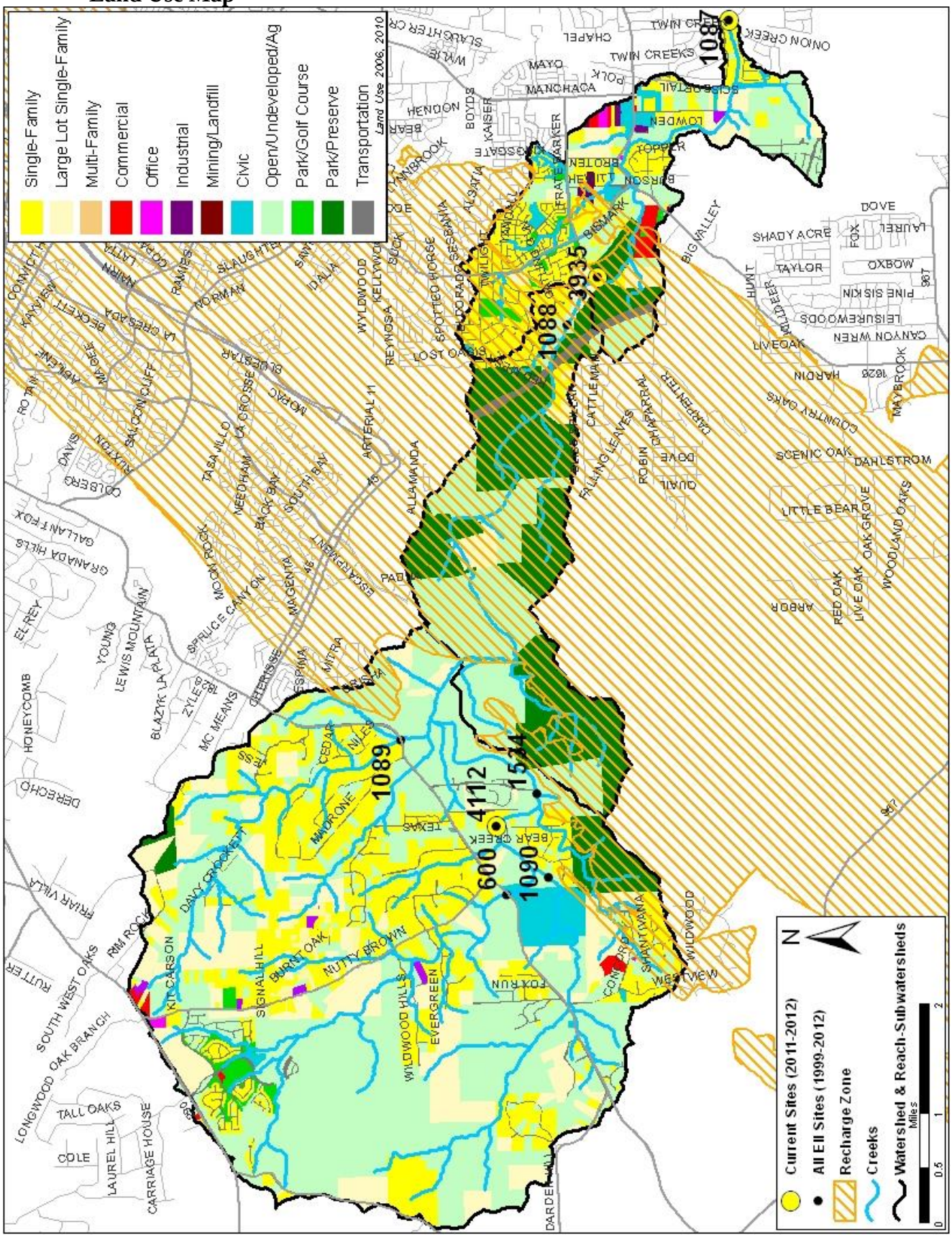
Reach	Site	Site Name	Year	Water Quality	Sediment**	Contact Rec.	Non-Contact Rec.	Physical Integrity	Aquatic Life	Benthic subindex	Diatom subindex	Total EII Score
BER1	1087	Bear Creek @ Twin Creeks Road	1998	72	81	99	78	69	75	54	95	79
BER2	1088	Bear Creek @ Bears Den Court	1998	74	81	95	68	80				66
BER3	600	Bear Creek @ FM 1826 (S. Fork)	1998	76	81	95	96	88	85	84	85	87
BER3	1089	Bear Creek DS of FM 1826 (N. Fork)	1998	72	81	96	93	74	69	66	71	81
BER3	1090	Bear Creek @ Spanish Oaks Circle	1998	80	81	94	93	84	84	83	85	86
BER1	1087	Bear Creek @ Twin Creeks Road	2001	54	82	90	68	91	62	58	66	71
BER2	1088	Bear Creek @ Bears Den Court	2001	61	82	90	91	80	75	61	88	76
BER3	600	Bear Creek @ FM 1826 (S. Fork)	2001	65	82	90	98	84	74	72	76	78
BER3	1089	Bear Creek DS of FM 1826 (N. Fork)	2001	55	82	83	97	83	49	66	31	71
BER3	1090	Bear Creek @ Spanish Oaks Circle	2001	66	82	89	99	81	81	100	62	80
BER1	1087	Bear Creek @ Twin Creeks Road	2004	59	74	71	59	72	64	62	66	67
BER3	1089	Bear Creek DS of FM 1826 (N. Fork)	2004	64	74	59	63	70				55
BER3	1534	Bear Creek DS of Bear Creek Pass	2004	75	74	89	90	73	74	66	82	79
BER1	1087	Bear Creek @ Twin Creeks Road	2007	65	82	64	85	71	95	91	98	77
BER2	3935	Bear Creek @ Escondido	2007	76	82	69	92	73	77	100	54	78
BER3	4112	Bear Creek @ Bear Creek Pass	2007	67	82	74	92	82	98	99	97	83
BER1	1087	Bear Creek @ Twin Creeks Road	2010	62	74	57	54	69	87	89	85	67
BER2	3935	Bear Creek @ Escondido	2010	72	74	94	67	70				63
BER3	4112	Bear Creek @ Bear Creek Pass	2010	67	74	86	98	89	98	96	100	85
BER1	1087	Bear Creek @ Twin Creeks Road	2012	55	79	64	74	76	76	85	67	71
BER2	3935	Bear Creek @ Escondido	2012		79		62	82				56
BER3	4112	Bear Creek @ Bear Creek Pass	2012	65	79	61	78	90	97	100	94	78
BER1	1087	Bear Creek @ Twin Creeks Road	2014	66	77	94	61	78	85	90	79	77
BER3	4112	Bear Creek @ Bear Creek Pass	2014	77	77	92	88	76	98	100	96	85

* blank cells indicate parameter was not collected, blank row indicate site was dropped **sediment samples only collected at the downstream site

100-87.5 Excellent 87.5-75 V. Good 75-62.5 Good 62.5-50 Fair 50-37.5 Marginal 37.5-25 Poor 25-12.5 Bad 12.5-0 V. Bad

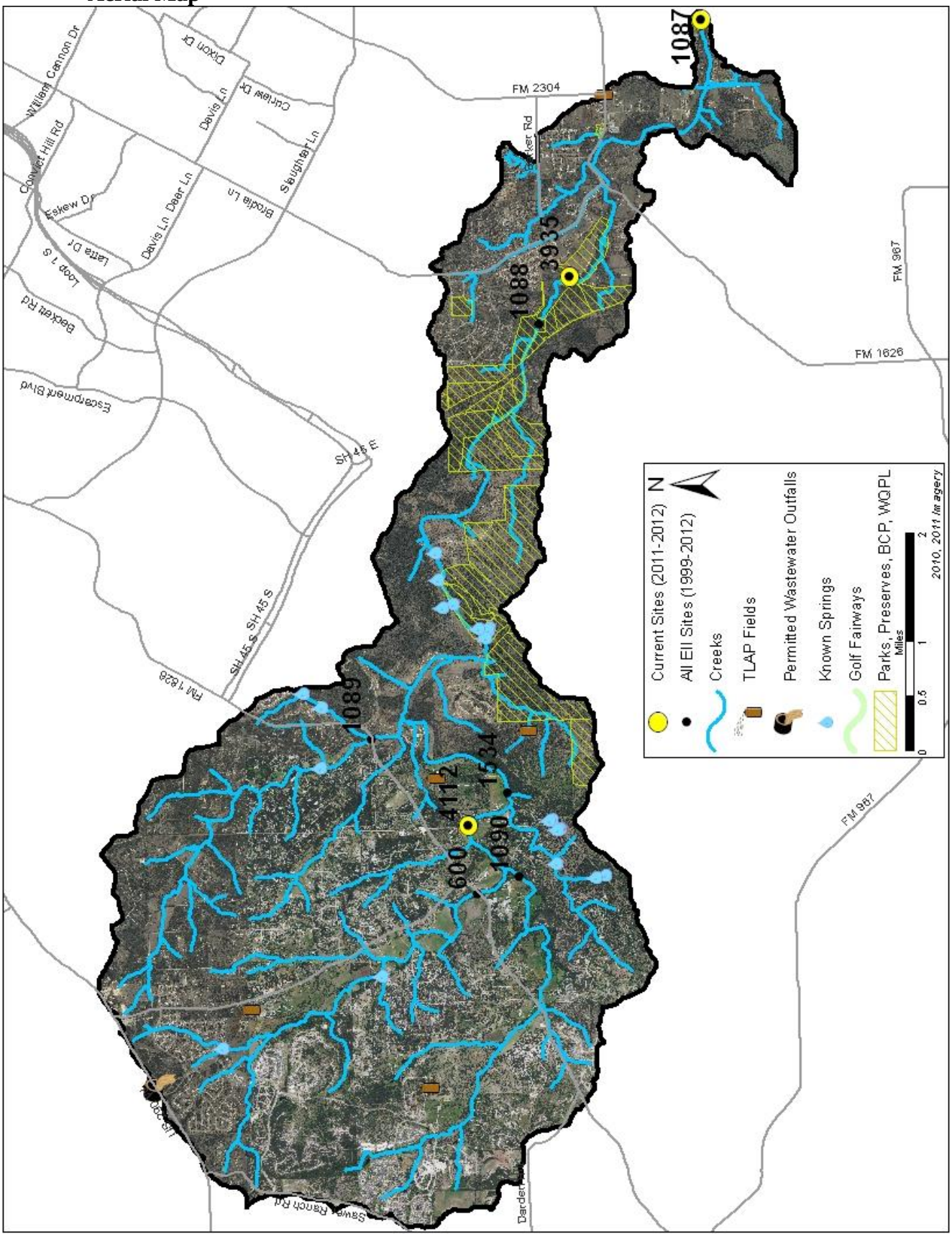
Bear Creek Watershed

Land Use Map



Bear Creek Watershed

Aerial Map



Bear Creek Watershed

Water Quality Data – Temperature, Conductivity, pH, Dissolved Oxygen & *E. coli* for 2014 Sample Sites (Downstream to Upstream)

Qualifiers to the left of value:			Qualifiers to the right of value:	
>	greater than		(*blank*)	Useable
<	less than		S	Exceeds standard range
< J	less than detection limit		R	Rejected, failed QC
J	Estimated			

Site Name	Site #	Reach	Date	Temp. <> Value	flag	Cond. <> Value	flag	pH <> Value	flag	D.O. <> Value	flag	*E.coli* <> Value	flag
Bear @ Twin Creeks Rd	1087	BER1	01/15/2014	14.0		676		7.95		12.5		3.0	
Bear @ Twin Creeks Rd	1087	BER1	04/17/2014	18.9		654		7.43		9.6		2.0	
Bear @ Twin Creeks Rd	1087	BER1	05/12/2014	25.4		763		8.08		4.2			
Bear @ Twin Creeks Rd	1087	BER1	07/02/2014	33.2		600		7.52		13.2		25.9	
Site 1087 Mean				22.9		673		7.75		9.9		10.3	
Bear @ Bear Creek Pass	4112	BER3	01/15/2014	11.0		695		8.00		10.0		12.2	
Bear @ Bear Creek Pass	4112	BER3	04/17/2014	17.7		746		7.75		9.5		28.1	
Bear @ Bear Creek Pass	4112	BER3	05/05/2014	21.9		761		7.92		8.1			
Bear @ Bear Creek Pass	4112	BER3	07/02/2014	27.9		733		7.78		7.9		5.0	
Bear @ Bear Creek Pass	4112	BER3	09/10/2014									8.5	
Site 4112 Mean				19.6		734		7.86		8.9		13.5	
Watershed Mean				21.2		703		7.80		9.4		12.1	

Orange highlighting indicates that the value exceeds one standard deviation from the mean of all E.I.I. sites combined.

Summary Statistics for all 2013 – 2014 E.I.I. Sites Combined.					
Parameter	2013-2014 Average	2013-2014 Minimum	2013-2014 Maximum	1 Standard Deviation Above	1 Standard Deviation Below
Temperature (C°)	19.6	8.6	34.0	25.8	
Conductivity (uS/cm)	711	107	1783	942	
pH (Standard units)	7.86	6.96	8.97	8.19	7.52
D.O. (mg/l)	8.1	1.2	30.5	11.4	4.8
E.coli. (col/100ml)	435	1	4840	1127	

Bear Creek Watershed

Water Quality Data – <u>Ammonia, Nitrate / Nitrite, Ortho-Phosphorus, Total Suspended Solids & Turbidity for 2014 Sample Sites</u> (Downstream to Upstream)

Qualifiers to the left of value:			Qualifiers to the right of value:		
	>	greater than		(*blank*)	Useable
	<	less than		S	Exceeds standard range
	< J	less than detection limit		R	Rejected, failed QC
	J	Estimated			

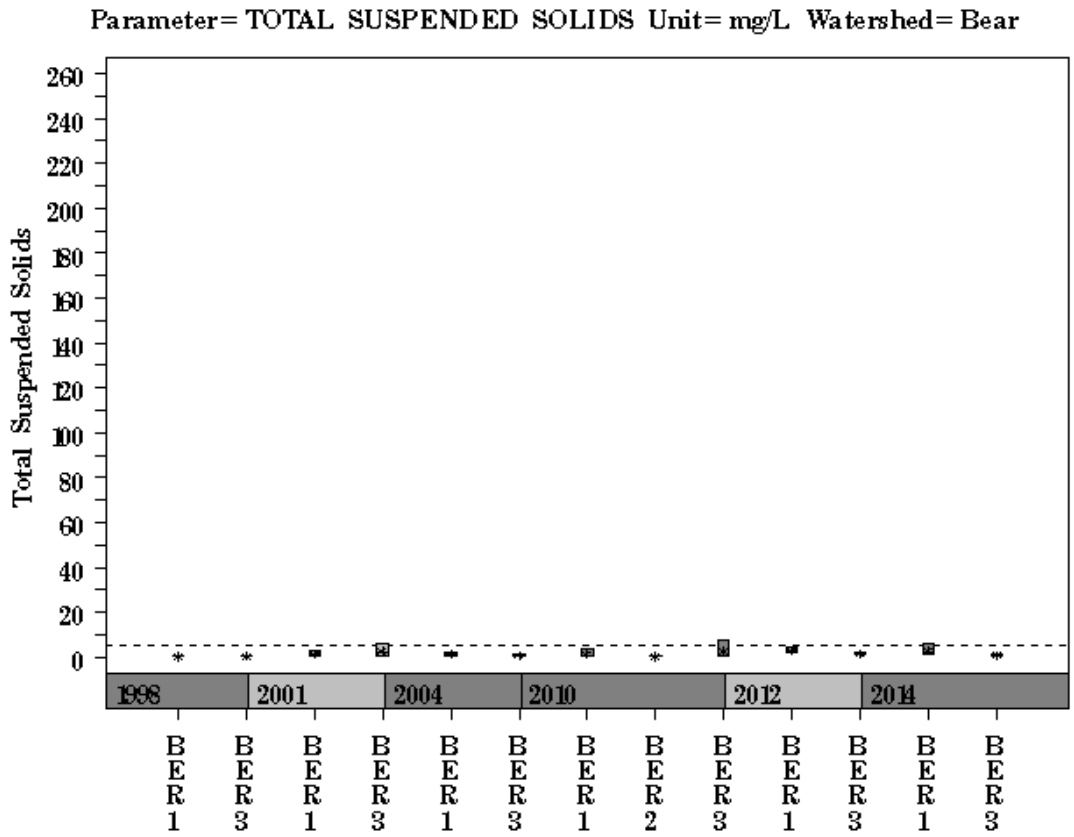
				NH3-N			NO3/NO2			Ortho-P			T.S.S.			Turb.		
Site Name	Site #	Reach	Date	< >	Value	flag	< >	Value	flag	< >	Value	flag	< >	Value	flag	< >	Value	flag
Bear @ Twin Creeks Rd	1087	BER1	01/15/2014	<J	0.008			3.67		<J	0.004			2.2			0.5	R
Bear @ Twin Creeks Rd	1087	BER1	04/17/2014		0.068			0.30		<J	0.004			1.4			0.7	R
Bear @ Twin Creeks Rd	1087	BER1	05/12/2014															
Bear @ Twin Creeks Rd	1087	BER1	07/02/2014	<J	0.008			0.19		<J	0.004			5.8			2.6	
Site 1087 Mean					0.028			1.39			0.004			3.1			1.3	
Bear @ Bear Creek Pass	4112	BER3	01/15/2014	<J	0.008			0.94		<J	0.004		<J	1.0			4.2	R
Bear @ Bear Creek Pass	4112	BER3	04/17/2014		0.059			0.06		<J	0.004			1.5			2.3	R
Bear @ Bear Creek Pass	4112	BER3	05/05/2014															
Bear @ Bear Creek Pass	4112	BER3	07/02/2014	<J	0.008			0.07		<J	0.004			1.3			0.8	
Bear @ Bear Creek Pass	4112	BER3	09/10/2014	<J	0.008		<J	0.01		<J	0.004		<J	1.0			1.0	R
Site 4112 Mean					0.021			0.27			0.004			1.2			2.1	
Watershed Mean					0.024			0.75			0.004			2.0			1.7	

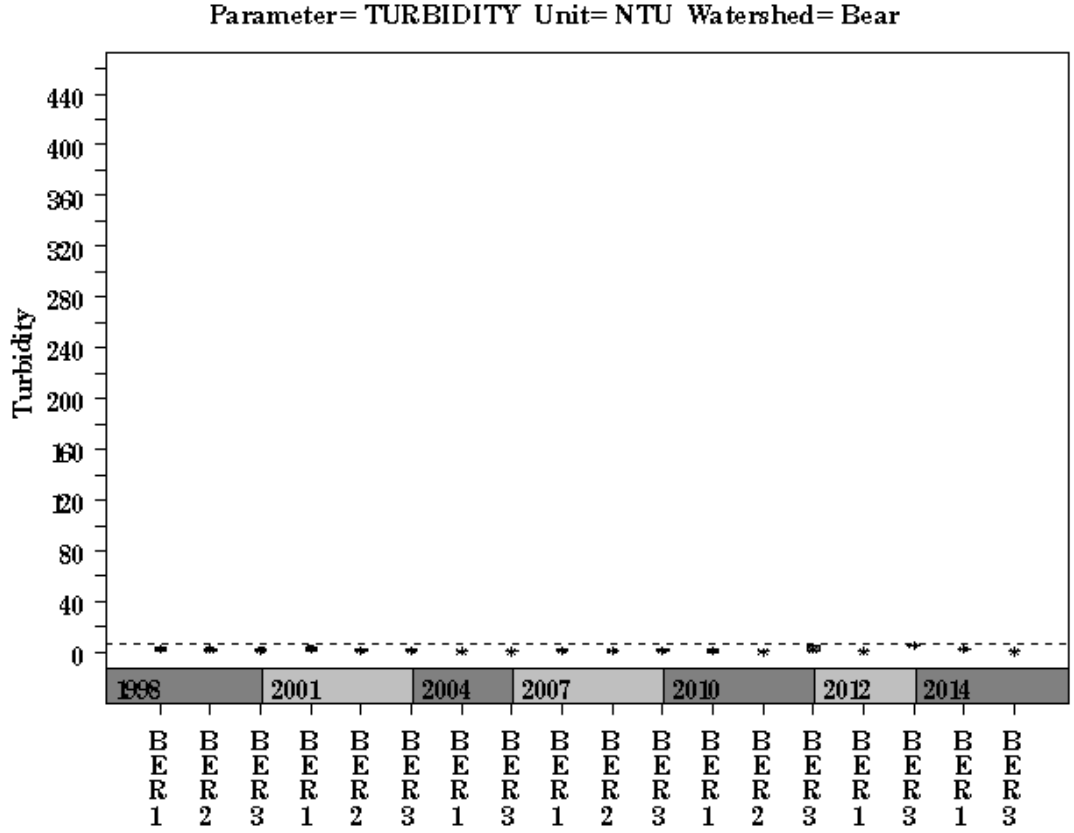
Orange highlighting indicates that the value exceeds one standard deviation from the mean of all E.I.I. sites combined.

Summary Statistics for all 2013 – 2014 E.I.I. Sites Combined.				
Parameter	2013-2014 Mean	2013-2014 Minimum	2013-2014 Maximum	1 Standard Deviation Above
NH3-M (mg/l)	0.031	0.008	2.250	0.150
NO3-N (mg/l)	1.16	0.01	16.30	4.02
Ortho-P (mg/l)	0.041	0.004	1.360	0.164
TSS (mg/l)	5.6	1.0	70.0	15.3
Turbidity (NTU)	4.5	0.0	97.1	13.2

Bear Creek Watershed

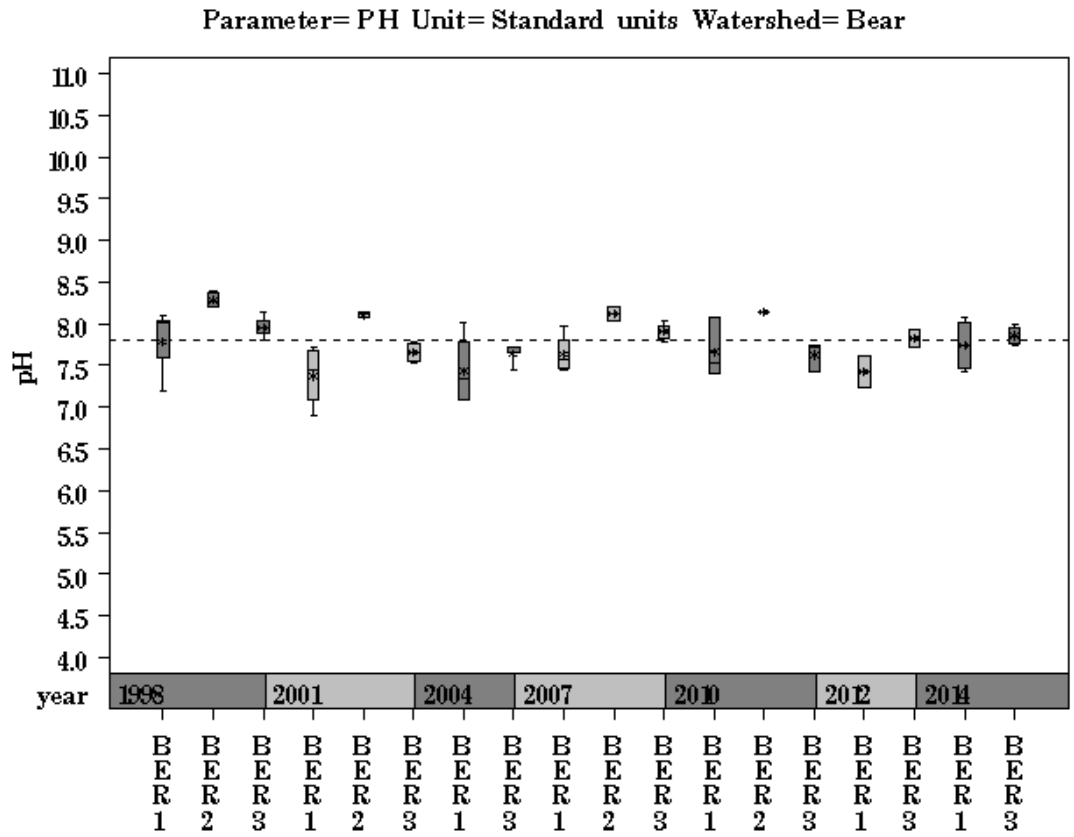
Data Summary Graphs – Total Suspended Solids and Turbidity (Downstream to Upstream by Year)

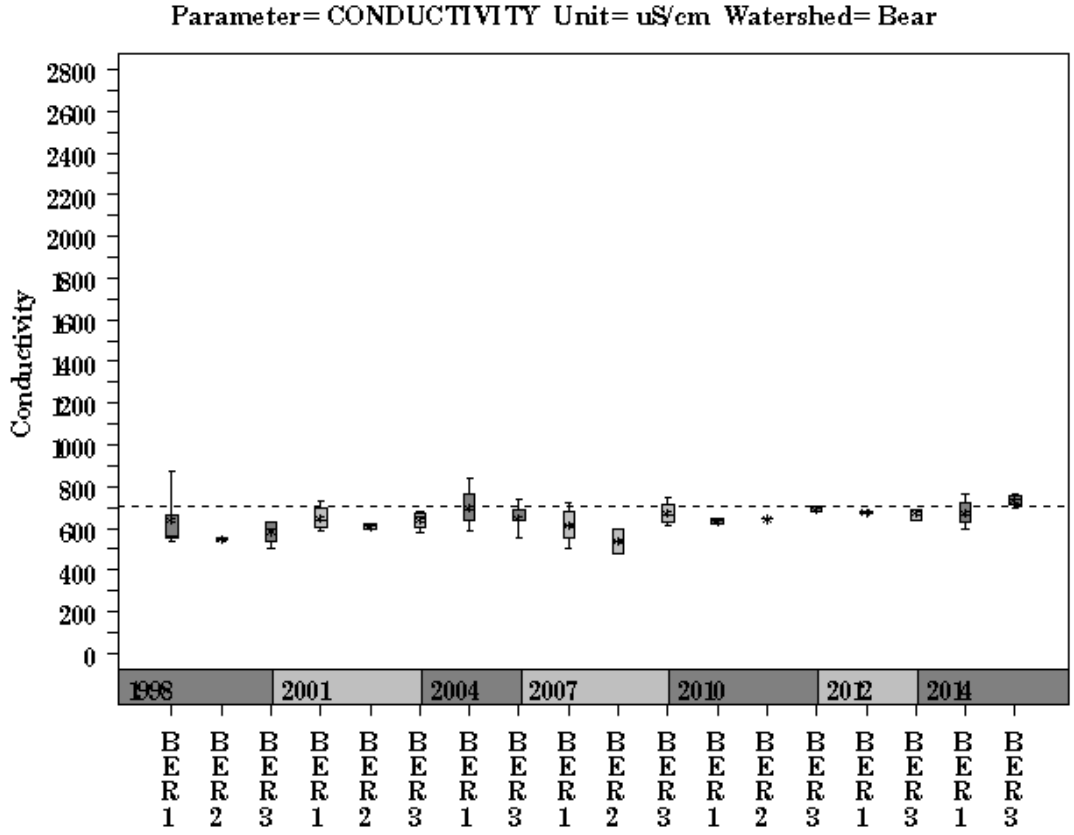




Bear Creek Watershed

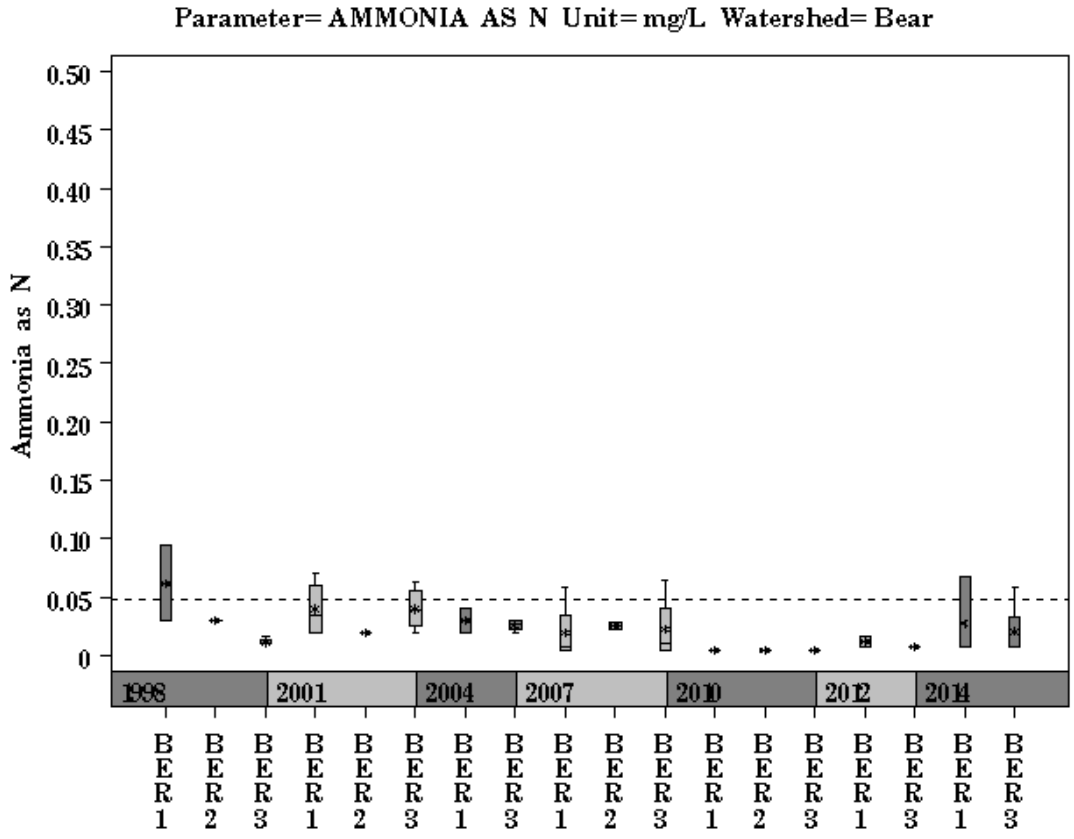
Data Summary Graphs – pH and Conductivity (Downstream to Upstream by Year)

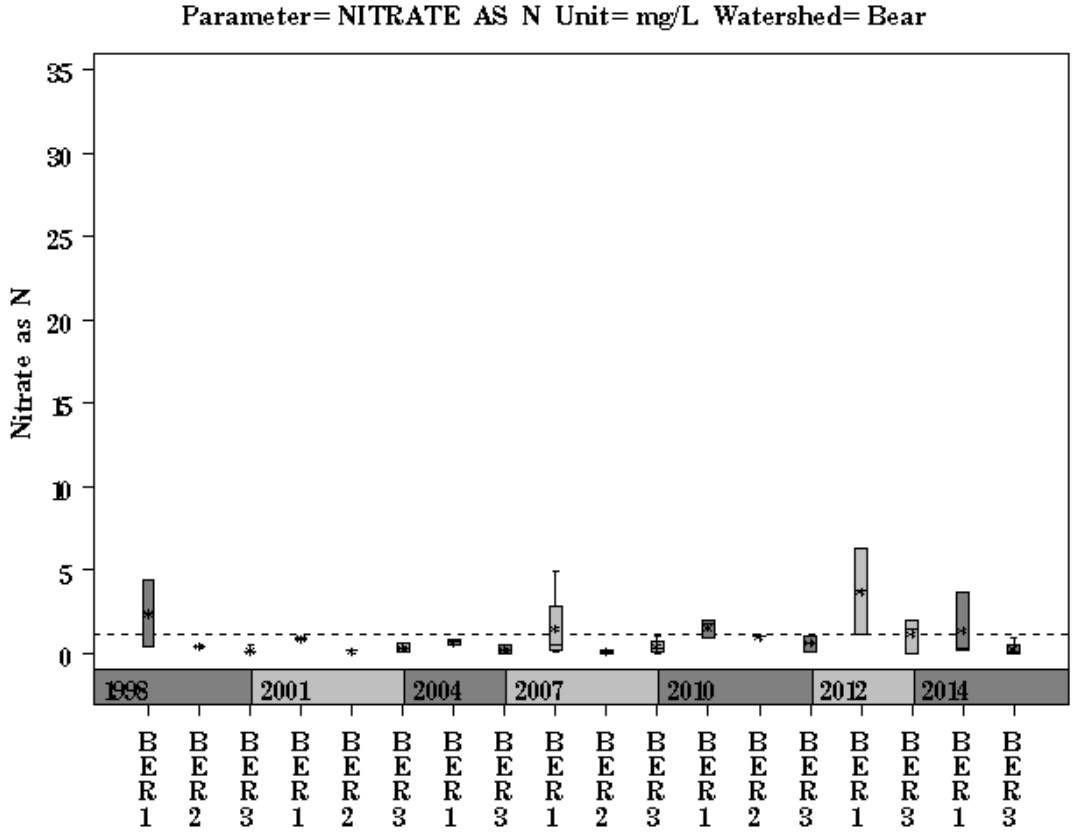




Bear Creek Watershed

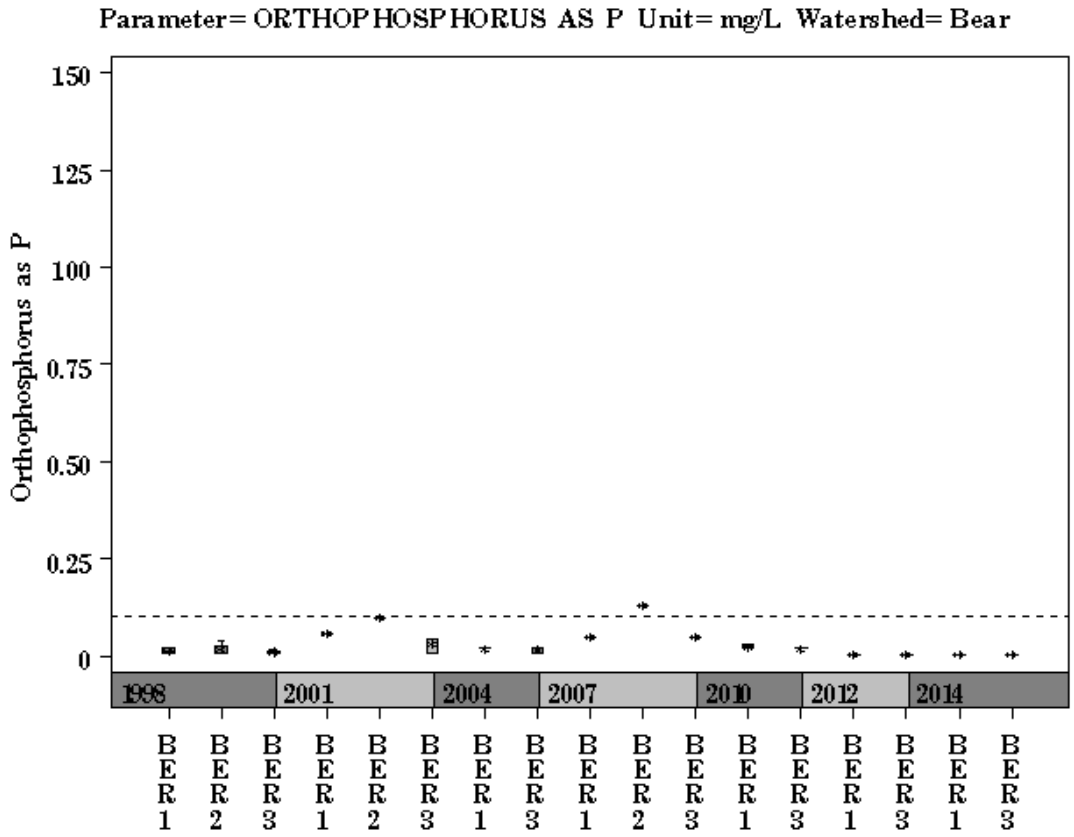
Data Summary Graphs – Ammonia and Nitrate/Nitrite (Downstream to Upstream by Year)

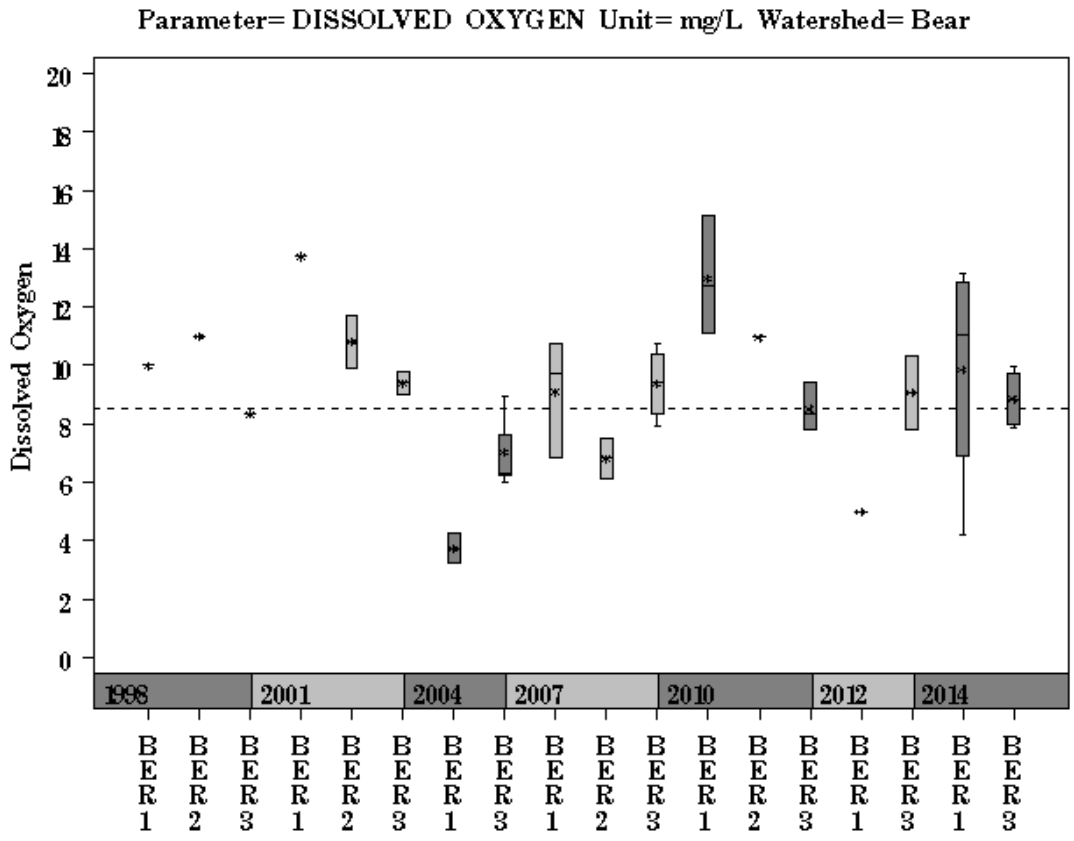




Bear Creek Watershed

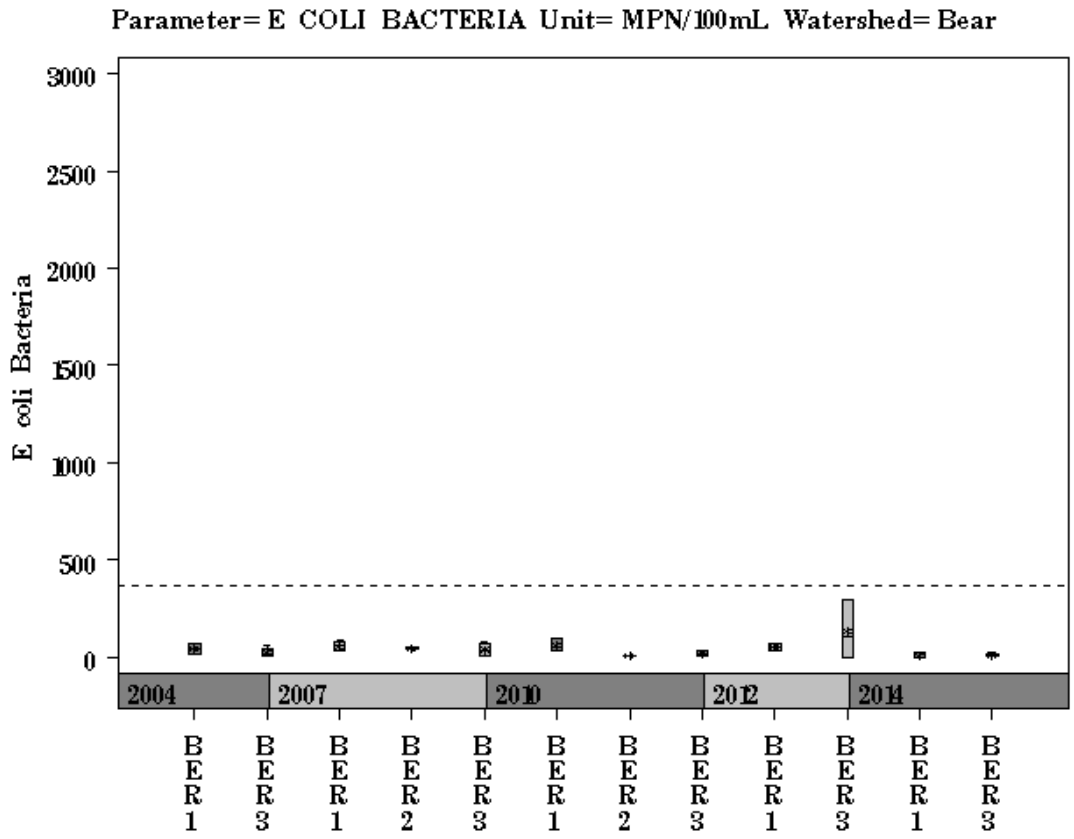
Data Summary Graphs – Orthophosphate and Dissolved Oxygen (Downstream to Upstream by Year)





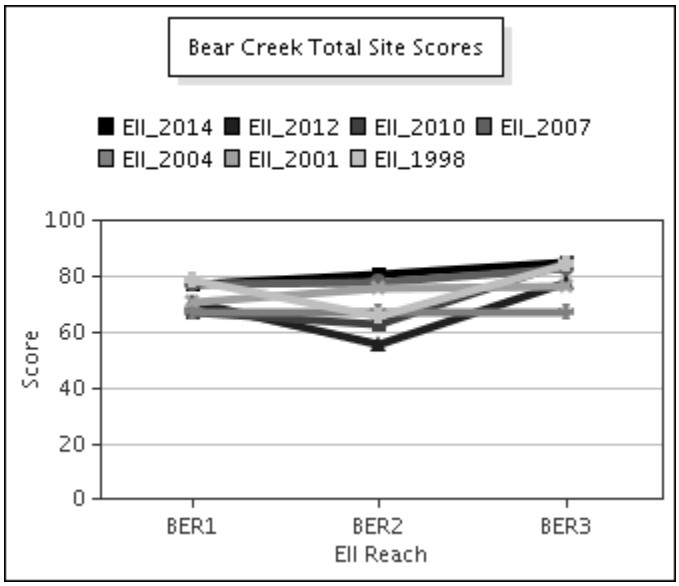
Bear Creek Watershed

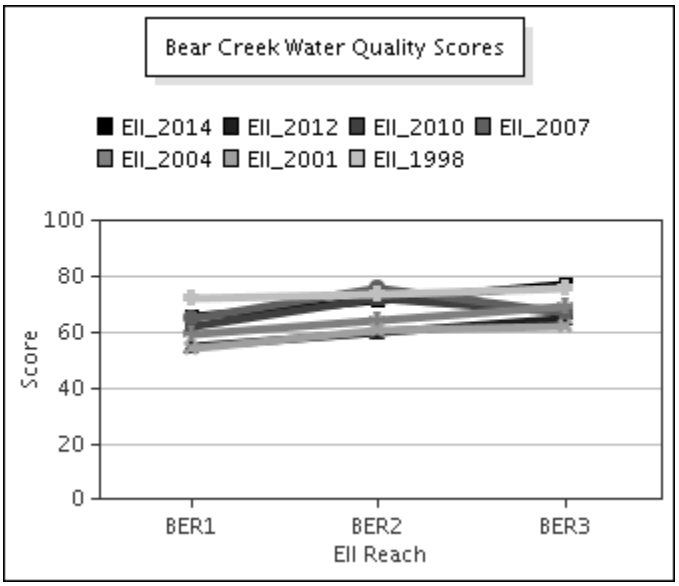
Data Summary Graphs – *E.coli* (Downstream to Upstream by Year)

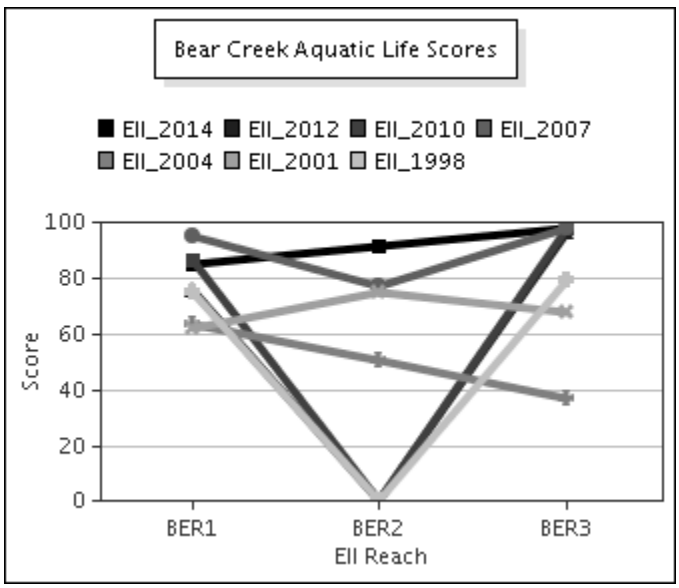


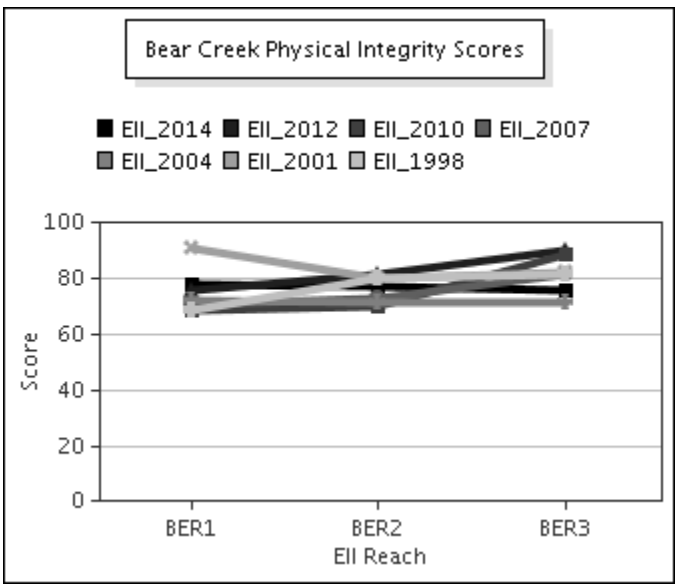
Bear Creek Watershed

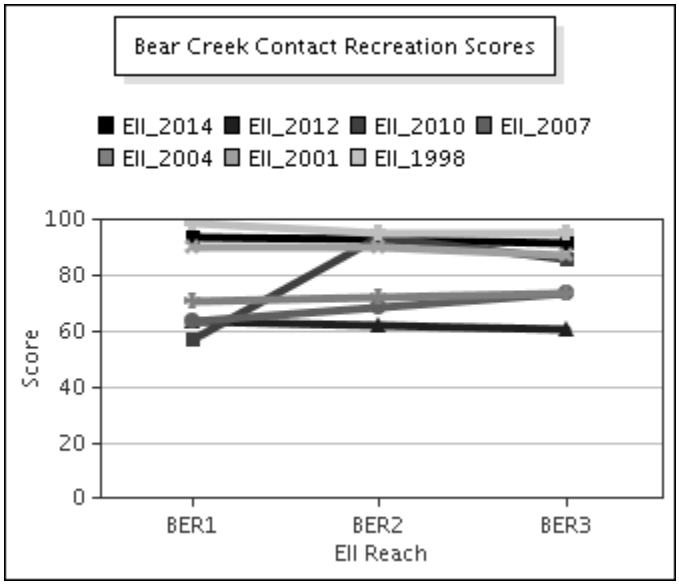
Score Summary – Reach scores for each sample year

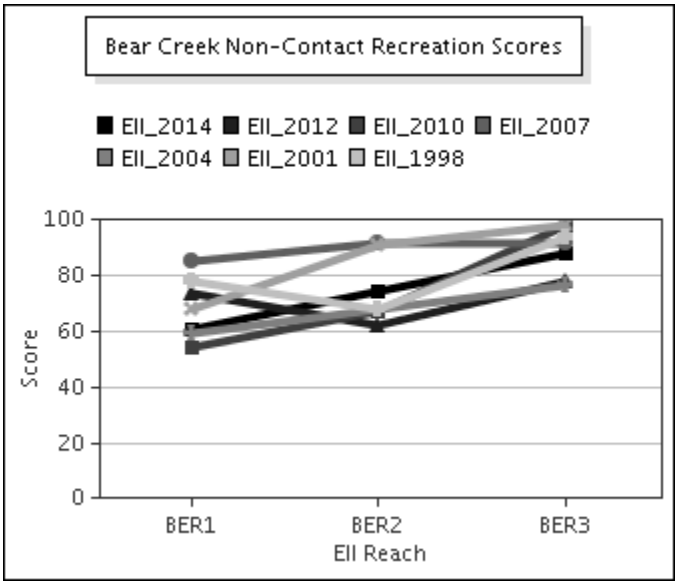












Bear Creek Watershed

Benthic Macroinvertebrates – Taxa List, Pollution Tolerance Index & Functional Feeding Group for 2014 Sample Sites (Downstream to Upstream)

Benthic Macroinvertebrate ID	PTI	FFG	Bear @ Twin Creeks Rd (Site 1087)	Bear @ Bear Creek Pass (Site 4112)
Perlesta sp.	0	P		3
Chimarra sp.	2	FC	4	58
Hydroptila sp.	2	SC,PI	3	1
Gammarus sp.	3	SH,CG	4	
Callibaetis sp.	4	CG	2	
Camelobaetidius sp.	4	CG		1
Copepoda	4	SC	1	
Dolichopodidae	4	P	1	
Fallceon quilleri	4	SC,CG	20	52
Ostracoda	4	FC,CG	14	1
Psephenus sp.	4	SC	1	
Simulium sp.	4	FC		37
Agabus sp.	5	P	1	
Ambrysus sp.	5	P	1	
Helochares sp.	5	CG	3	
Mesovelia sp.	5	P	1	
Argia sp.	6	P	1	
Cheumatopsyche sp.	6	FC	31	178
Chironomidae	6	P,FC	8	13
Fossaria sp.	6	SC	3	
Hydracarina	6			8
Limonia sp.	6	SH	1	
Microvelia sp.	6	P	9	
Rhagovelia sp.	6	P		4
Stenonema femoratum	6	SC,CG		2
Tanypodinae	6	P	5	1
Bezzia sp. / *Palpomyia* sp.	7	P,CG	5	
Caenis sp.	7	SC,CG	8	
Stenelmis sp.	7	SC,CG	7	
Caloparyphus sp. / *Euparyphus* sp.	8	SC,CG	4	
Cladocera	8	FC	4	
Cymbiodyta sp.	8	P	2	
Hirudinea	8	P	1	
Hyalella sp.	8	SH,CG	2	
Oligochaeta	8	CG	2	2
Physella sp.	9	SC	95	1
Dugesia sp.		P,CG		12
Micrathyria hagenii		P	1	

Bear Creek Watershed

Benthic Macroinvertebrates – Metric Summary for 2014 Sample Sites (Downstream to Upstream)

Scoring Metric	Bear @ Twin Creeks Rd (Site 1087)	Bear @ Bear Creek Pass (Site 4112)
Number of Taxa *	30	15
Hilsenhoff Biotic Index *	6.9	4.8
Number of Ephemeroptera Taxa *	3	3
Percent of Total as Chironomidae *	5	4
Number of EPT Taxa *	6	7
Percent of Total as EPT *	28	79
Percent of Total as Predator *	15	9
Number of Intolerant Taxa *	9	7
Percent Dominance (Top 3 Taxa) *	60	77
EPT / EPT + Chironomidae	1	1
Number of Diptera Taxa	5	2
Number of Non-Insect Taxa	9	5
Number of Organisms	245	374
Percent Dominance (Top 1 Taxa)	39	48
Percent of Total as Collector / Gatherer	29	19
Percent of Total as Dominant Guild (FFG)	58	77
Percent of Total as Elmidae	3	0
Percent of Total as Filterers	27	77
Percent of Total as Grazers (PI & SC)	58	15
Percent of Total as Tolerant Organisms	39	0
Percent of Trichoptera as Hydropsychidae	82	75
Ratio of Intolerant : Tolerant Organisms	0.29	0.73
TCEQ Qualitative Aquatic Life Use Score	30	29
TCEQ Quantitative Aquatic Life Use Score	29	29

*** EII scoring parameter: Nine metric parameters are used in the calculation of the EII Benthic Subindex score. Other metrics are shown to supplement evaluation.**

1. # of Taxa: Higher diversity (number of taxa) correlates with greater biological integrity. The average number of taxa per site for 2013/2014 samples was 15; the lowest value was 5 and the highest value was 30.
2. Hilsenhoff Biotic Index (HBI): HBI values range from 0 to 10. Low HBI values reflect a higher abundance of taxa that are sensitive to organic (nutrient) pollution, thus a lower level of this type of pollution. The average HBI per site for 2013/2014 samples was 5.4; the lowest value was 3.7 and the highest value was 8.1.
3. # of Ephemeroptera taxa: A higher number of Ephemeroptera (mayfly) taxa correlates with greater biological integrity. The average number of taxa per site for 2013/2014 samples was 2; the lowest value was 0 and the highest value was 7.
4. % of total as Chironomidae: The percentage of the sample represented by the Dipteran family Chironomidae will increase with a decrease in biological integrity. The average percent Chironomidae per site for 2013/2014 samples was 16%; the lowest value was 0% and the highest value was 77%.
5. # of EPT Taxa: A higher number of Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) taxa correlates with greater biological integrity. The average number of EPT taxa per site for 2013/2014 samples was 4; the lowest value was 0 and the highest value was 12.
6. % of total as EPT: The percentage of the sample represented by the insect orders Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) will decrease with a decrease in biological integrity. The average percent EPT taxa per site for 2013/2014 samples was 46%; the lowest value was 0% and the highest value was 89%.
7. % of total as Predator: The percentage of the sample represented by predators is variable with regard to biological integrity. The average percent predator per site for 2013/2014 samples was 31%; the lowest value was 3% and the highest value was 82%.
8. # of Intolerant Taxa: A higher number of pollution intolerant taxa correlates with greater biological integrity. The average number of intolerant taxa per site for 2013/2014 samples was 5; the lowest value was 0 and the highest value was 15.
9. % Dominance (top 3 taxa): The percentage of the sample represented by the three most abundant taxa will increase with a decrease in biological integrity. The average percent of sample dominated by the top three taxa per site for 2013/2014 samples was 72%; the lowest value was 39% and the highest value was 96%.

Bear Creek Watershed

Diatoms – Taxa List & Pollution Tolerance Index for 2014 Sample Sites (Downstream to Upstream)

Diatom Species Name	PTI	Bear @ Twin Creeks Rd (Site 1087)	Bear @ Bear Creek Pass (Site 4112)
Brachysira neoexilis (*serians*)	4		2
Eucocconeis flexella	4		1
Eunotia arcus	4		7
Pinnularia interrupta	4		1
Achnanthidium affine	3		14
Achnanthidium alteragracillimum	3	66	28
Achnanthidium minutissimum	3	104	22
Cocconeis pediculus	3	2	2
Cymbella laevis	3		1
Denticula kuetzingii	3	255	234
Encyonema evergladianum	3	28	49
Encyonopsis microcephala	3	3	14
Fragilaria delicatissima	3		6
Gomphonema clavatum	3	2	
Gomphonema intricatum var. *vibrio*	3		2
Gomphonema minutum	3	14	
Navicula radiosa	3		6
Cyclotella meneghiniana	2	4	
Fragilaria vaucheriae	2		4
Gomphonema angustatum	2		1
Nitzschia amphibia	2		9
Amphora copulata		1	
Cocconeis placentula var. *euglypta*		1	
Cymbella cistula		4	1
Cymbella neoleptoceros			3
Delicata delicatula			85
Encyonema semilanceolatum			1
Gomphonema mclaughlinii		2	
Navicula lanceolata		1	
Sellaphora stroemii			4
Ulnaria acus		5	2
Ulnaria ulna		8	1

Bear Creek Watershed

Diatoms – Metric Summary for 2014 Sample Sites (Downstream to Upstream)

Scoring Metric	Bear @ Twin Creeks Rd (Site 1087)	Bear @ Bear Creek Pass (Site 4112)
Cymbella Richness	2	4
Number of organisms	500	500
Number of taxa	16	25
Percent motile taxa	0	3
Percent similarity to reference condition	39	46
Pollution tolerance index	2.99	2.99

* **EII scoring parameter: Four metric parameters are used in the calculation of the EII Diatom Subindex score: *Cymbella* richness, percent motile taxa, percent similarity to reference condition and pollution tolerance index. Number of taxa is non-scoring, but is shown to supplement evaluation. The number of organisms is typically a sample of 500, but occasionally differs due to sample conditions.**

1. *Cymbella* Richness: The Cymbelloid taxa include species in the genus *Cymbella*, in addition to some species belonging to the genera *Cymbellopsis*, *Cymbopleura*, *Encyonema*, *Encyonemopsis*, *Navicymbula* and *Reimeria*. Their presence highlights the presence of sensitive species, especially with regard to impervious cover, and this value increases with an increase in overall water quality. The average number of Cymbelloid taxa per site for 2013/2014 samples was 3; the lowest value was 0 and the highest value was 7.
2. % Motile Taxa: This is a siltation index showing the relative abundance of genera that are able to move towards the surface if covered by silt. A higher percentage is indicative of a degraded condition caused by increased silt pollution. The average percent motile taxa per site for 2013/2014 samples was 16%; the lowest value was 0% and the highest value was 77%.
3. % similarity to reference condition: This percentage compares a site to reference sites that are selected based on having low percent impervious cover. A higher percentage reflects greater biological integrity. The average percent similarity per site for 2013/2014 samples was 31%; the lowest value was 6% and the highest value was 57%.
4. Pollution Tolerance Index (PTI): This is a total value for a sample, which is a function of the abundance of each taxon (usually species) in a sample and the individual PTI's for each of those taxa. Individual PTI's for each taxon range from 1 (most pollution tolerant) to 4 (most pollution sensitive), thus higher total PTI's for a site reflect greater biological integrity. The average PTI per site for 2013/2014 samples was 2.76; the lowest value was 1.70 and the highest value was 3.45.

Bear Creek Watershed

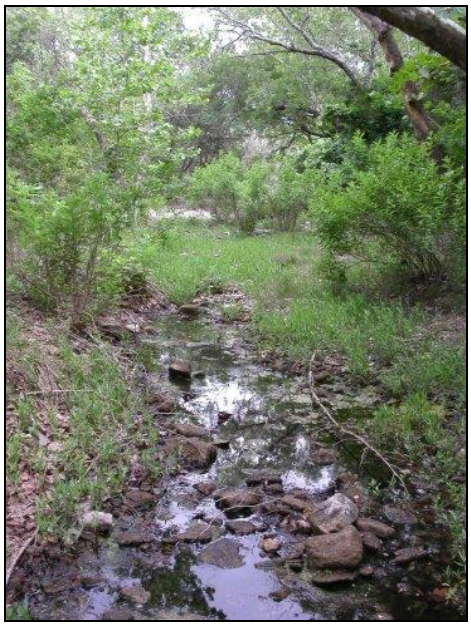
Site Photographs

4112_00-ds-05_19_2010

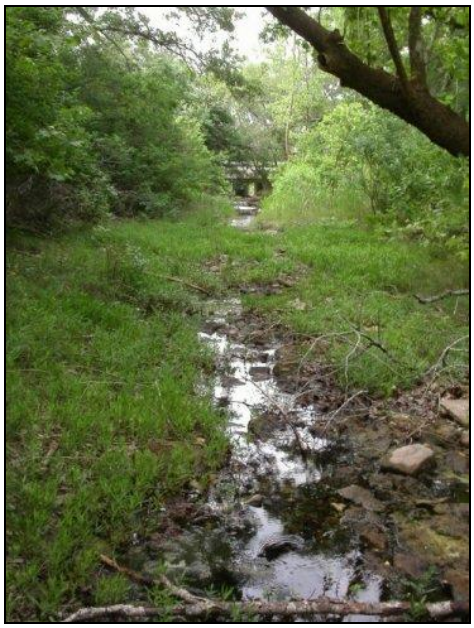
4112_00-ur-05_19_2010

1534_ur_06_20_2007

1534_ds_06_20_2007



1089_t00-ur-05_26_2004



1089_t00-ds-05_26_2004

3935_ur_06_27_2007

3935_ds_06_27_2007


1087_ur_06_20_2007


1087_t00-ds-05_20_2004

1087_00-us-05_27_2010

1087_00-ds-05_27_2010

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