A Comparison of Water Chemistry and Biological Integrity in Creel Ditch Before and After Two-Stage Ditch Construction

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I. Introduction

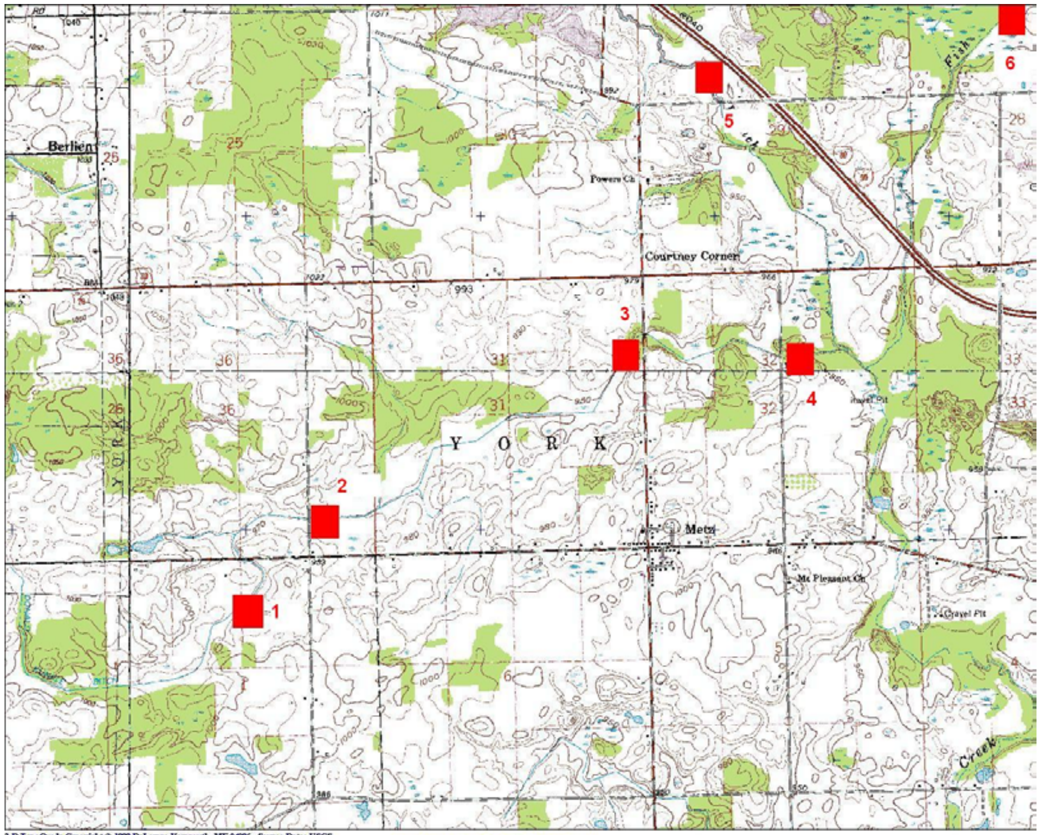
Many streams in Indiana have been artificially channelized to allow drainage for agriculture. Often this practice is detrimental to water quality and aquatic communities. The Nature Conservancy was awarded a grant by the Joyce Foundation to assess whether a new channelization technique (a two-stage ditch) will protect water quality and aquatic life in Creel Ditch, a direct tributary of the Fish Creek. Fish Creek is in the Lake Erie drainage and the only known location where the federally endangered white cat's paw pearly mussel (*Epioblasma obliquata perobliqua*) still exists.

The purpose of the two-stage construction is to establish a kind of flood plain for a channelized ditch. When storm events occur, the water spreads out over the new "flood plain," slows down velocity, and allows microbial action to occur as it does in natural streams. Photographs of Creel Ditch before and after two-stage construction are shown below:

Prior to Construction

After Construction

Chemical and biological monitoring was done to determine the effectiveness of two-stage construction for improving environmental conditions. Six sites were chosen for monitoring: Sites 1-4 were on Creel Ditch. Site 5 on the West Branch of Fish Creek and Site 6 on upper Fish Creek (also known as Dick Ditch) were monitored as "controls" where no construction will occur.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 750 ft Scale: 1 : 25,000 Detail: 13-0 Datum: WGS84

Water chemistry sampling began in May 2007. Grab samples were taken every two weeks, and automatic water samplers collected grab and 24-hr composite samples during storm events. Hydrolab data loggers were placed at each site and monitored water quality and flow continuously. Aquatic macroinvertebrate (benthos) samples were collected in September 2007, March 2009 and June 2009. Fish were sampled in October of 2007, 2008 and 2009. This summary compares pre- and post-construction conditions at the upstream and downstream sites of Creel Ditch. For the purposes of comparison, August 1, 2008 is considered to be the date construction began.

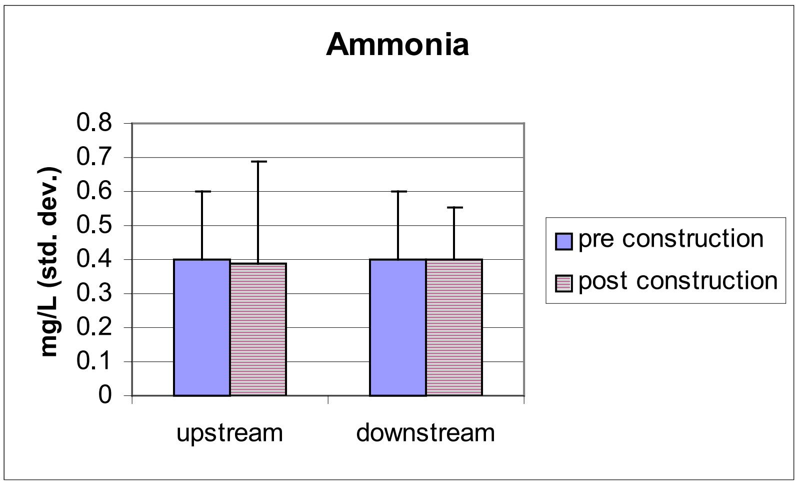
II. Water Chemistry

Parameters analyzed were ammonia nitrogen (NH_3) nitrate-nitrogen (NO_3), total and ortho phosphorus (PO_4), and total suspended solids (TSS). Table 1, shows the number of samples analyzed. Data are presented in the graphs as mean values with the error bars representing one standard deviation.

Table 1. Number of samples (grab and storm) analyzed

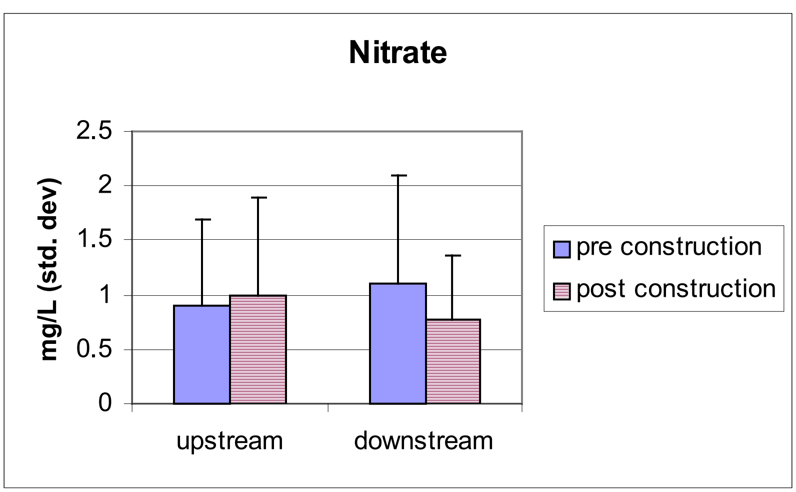
	Upstream	Downstream
Pre construction	44	53
Post construction	59	47

Ammonia and nitrate nitrogen

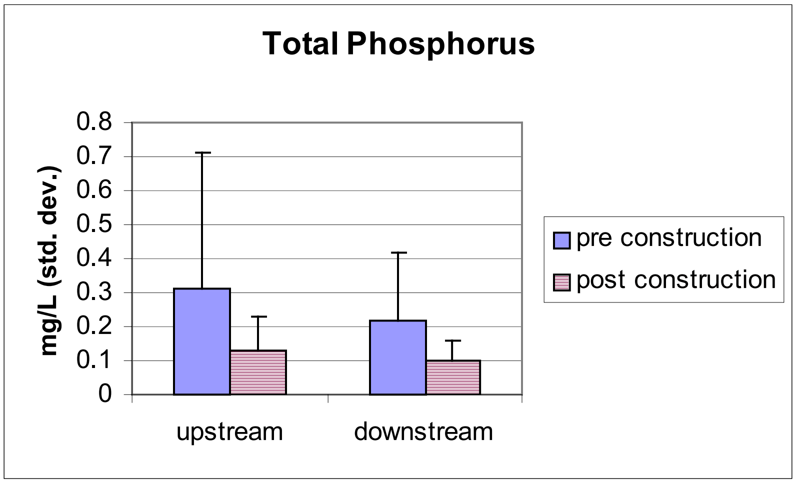


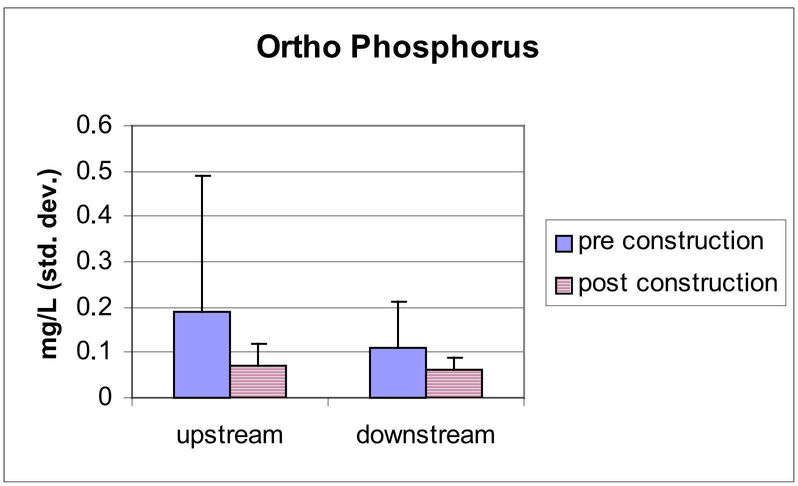
Ammonia levels were similar at upstream and downstream sites both pre- and post-construction. The highest ammonia values recorded were 2.2 mg/L at the upstream site and 0.8 mg/L at the downstream site on August 19, 2008.

Nitrates were generally quite low. The downstream site showed a decrease in its average nitrate concentration from pre to post construction time period, while the upstream site had a slight increase. The highest nitrate values were 5.6 mg/L at the upstream site from a July 2, 2009 storm sample and 2.9 mg/L at the downstream site from a December 17, 2008 grab sample.



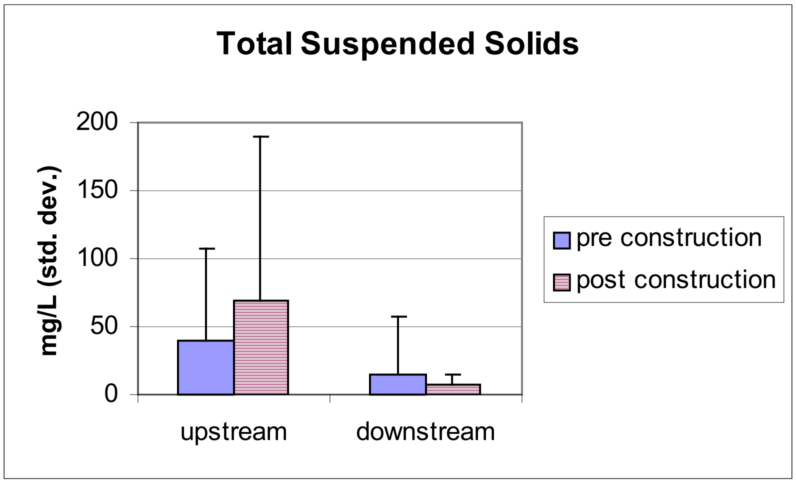
Phosphorus





Mean phosphorus levels decreased at both upstream and downstream sites in the post-construction time period, although there was a great deal of variability. Before construction, the highest phosphorus values were associated with a storm event on July 8, 2008 (total 2.2 mg/L and ortho 1.4 mg/L upstream and total 0.50 and ortho 0.38 mg/L downstream). Highest values in the post construction time period were not associated with a particular storm event. At the upstream site, the highest total phosphorus was 0.52 mg/L on September 10, 2009 and highest ortho phosphorus was 0.26 mg/L on August 19, 2009. These were both from storm samples. At the downstream site, the highest total phosphorus was 0.28 mg/L on August 19, 2008 and the highest ortho phosphorus was 0.16 mg/L on October 20, 2009, neither of which were storm samples.

Total Suspended Solids



Data presented in the graph include both storm and grab samples. TSS values of 260 mg/L (upstream) and 302 mg/L (downstream) were the results of a storm event on July 8, 2008. TSS values were strongly affected by storm events, but showed a mean increase at the upstream site, and a mean decrease at the downstream site in the post-construction time period.

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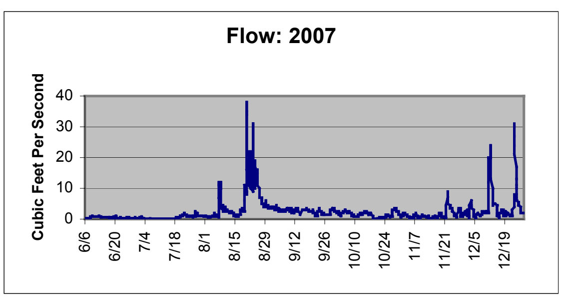
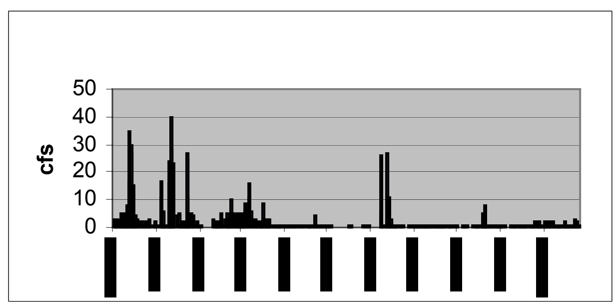
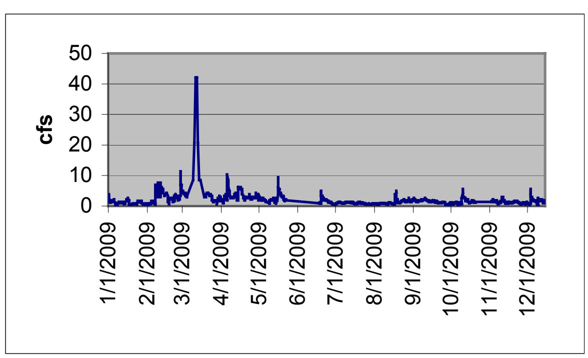
Hydrolab Data Summary

Stream Flow Data

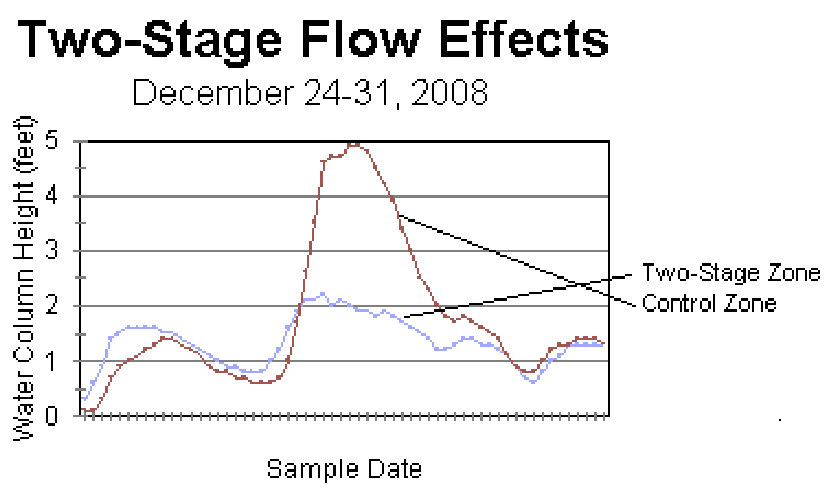
Average flow in Creel Ditch during the 30 months of monitoring was 4 cfs. There were 2 storm events in which flow exceeded 40 cfs and eight storm events in which flow exceeded 25 cfs. During the summer months, flow was usually less than 2 cfs.

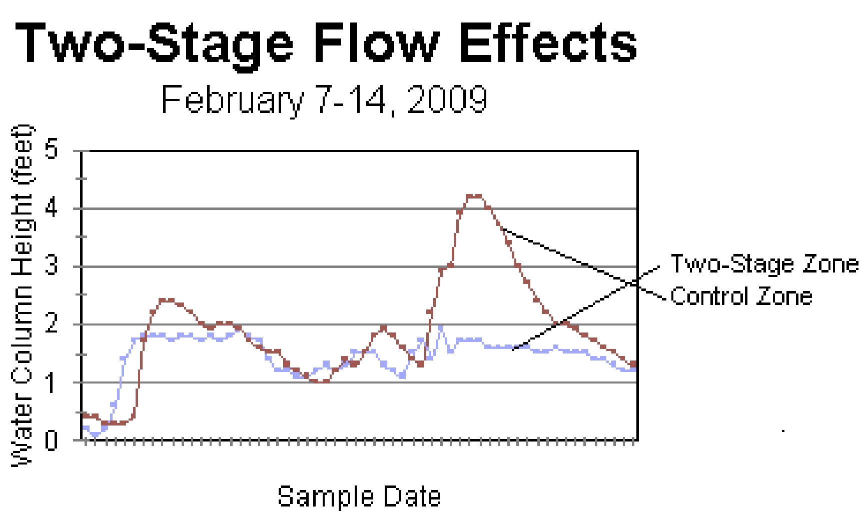






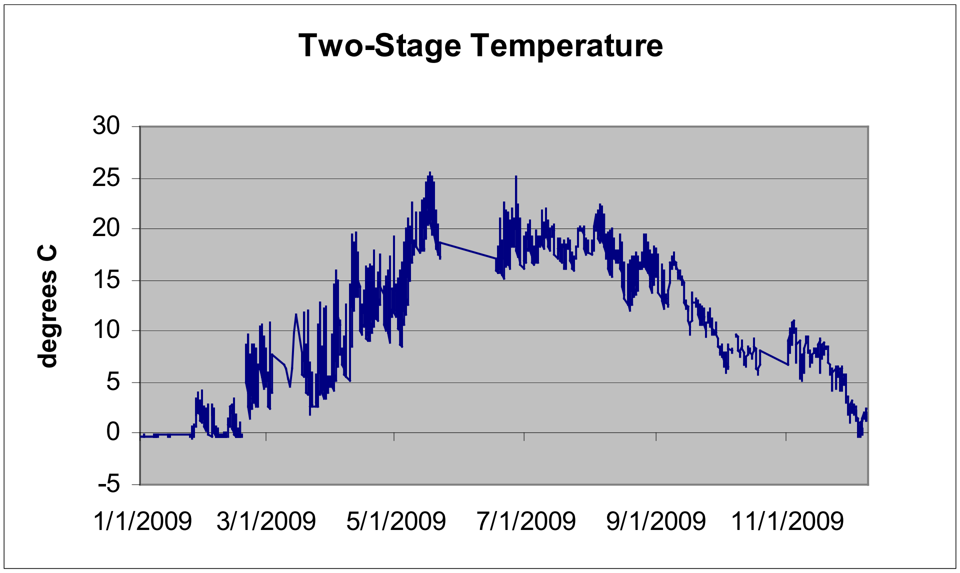
Another interesting aspect of flow monitoring was the difference in water column height after construction of the two-stage ditch. A monitor at site 2 (within the two-stage construction zone) and a monitor at site 4 (outside the two-stage construction zone) showed marked differences in water depth during certain high-flow events. In the summer, the height of the water column didn't vary much from inside and outside the construction zone. This is probably because the drier soils soak up a lot of the runoff and flows are generally lower at this time. But in the winter when the ground is frozen, there was a large difference in water column height (see the two graphs below showing two large storm events where flow volume increased twenty to thirty-fold over a 24-hour period). The two-stage construction allows water to flow out over the benches, greatly reducing the height of the water column and thereby reducing velocity during these large winter precipitation events. When velocity is reduced, current speed and the concurrent scouring forces are also reduced. This should have great benefits for reducing physical damage to the stream and reducing stress to aquatic life during flood conditions.





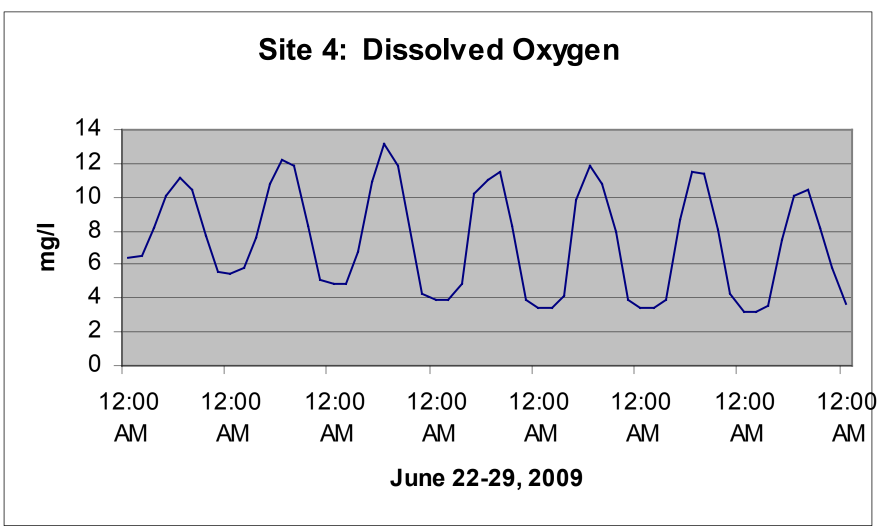
Temperature

Average daily temperature at all sites rarely exceeded 21 degrees C. This maximum temperature is lower than most agricultural streams in Indiana and allows "cool-water" fish such as mottled sculpin and hornyhead chub to thrive. There is no indication that the 2-stage ditch construction altered stream temperatures significantly.



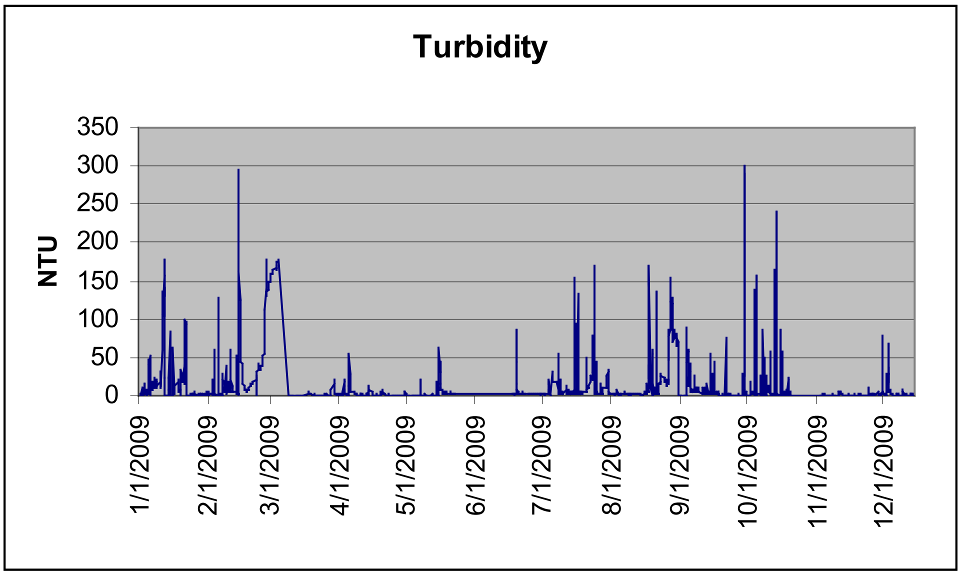
Dissolved Oxygen

Dissolved oxygen concentrations were almost always higher than 5 mg/l (the minimum amount considered necessary for healthy aquatic communities. There was a strong diurnal variation in D.O. concentrations during the summer months, especially in the 2-stage section. This indicates that primary production (algae growth) plays an important role in the metabolism of the 2-stage section of Creel Ditch.



Turbidity

Turbidity was strongly related to storm events. During base flow, all sites were generally clear, with NTU values less than 10. During storm events, NTU values rose to 300 for a day or two, then rapidly declined. Turbidity at control site 6 (Dick Ditch) usually did not decline as quickly after a storm event. Turbidity at site 1 (Creel Ditch upstream from the 2-stage construction) was generally similar to that at sites 2-4 in the construction zone. This indicates that, at least during the first year, the 2-stage did not help make Creel Ditch significantly clearer.



Quality Control
A total of 325 pairs of duplicates were done. Of these, 90% were within 15% of each other, indicating that the quality control goals of the project were achieved.

III. Macroinvertebrates

Because they are considered to be sensitive to local conditions and respond relatively rapidly to change, benthic (bottom-dwelling) organisms are considered to be an important tool to document the biological condition of the streams. The U.S. Environmental Protection Agency (EPA) has developed a "rapid bioassessment" protocol [3], which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used a modification of this protocol developed by Ohio EPA [4].

Four sites on Creel Ditch were chosen, with Site 1 being upstream from the construction area. Sites 5 (West Branch of Fish Creek, also known as Powers Ditch) and Site 6 (upper Fish Creek, also known as Dick Ditch) were control sites. Macroinvertebrate samples in this study were collected with a dipnet in riffle areas. All samples were preserved in the field with 70% isopropanol.

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the animals collected in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample. Each animal was identified to the lowest practical taxon (usually genus or species) using standard taxonomic references [5,6]. Voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection.

Following identification of the animals in the sample, ten metrics are calculated for each site. The sum of all ten metrics provides an individual "benthic index of biotic integrity" (Benthic IBI) score for each site. The maximum possible score with this method is 60. Because habitat evaluations have a maximum possible score of 100, benthic index of biotic integrity scores were standardized to a maximum possible score of 100 to facilitate comparisons. Sites with scores of 60 or greater are considered to have "excellent" biotic integrity; score of 50 to 59 are "good"; 40 to 49 are "fair"; less than 40 is "poor". Data for macroinvertebrate identifications, metrics values and metrics scoring are found in the annual bioassessment reports {7-9}.

Table 2. Benthic Index of Biotic Integrity Scores by Site Number

	1	2	3	4	5	6
Sept. 14, 2007	*	50	43	63	*	67
March 4, 2009	23	20	23	30	*	*
June 17, 2009	33	37	53	43	47	40

- not available

Biotic quality in 2007 in Creel Ditch was "fair" to "excellent", with dominant organisms being net-spinning caddsiflies (*Cheumatopsyche* spp.) and riffle beetles (*Stenelmis* and *Optioservus*). Biotic scores were lower from the March 2009 samples, with blackflies (*Prosimulium* spp) dominating the benthic community. The sampling event of June 2009 showed improving conditions, with *Cheumatopsyche* and *Stenelmis* again being the dominant organisms. Stoneflies (*Perlesta* spp.) were present at Sites 3 and 4, but had not been collected in 2007.

Biotic scores (Table 2) at Sites 2 and 4 were lower in June 2009 than in September 2007, while Site 3 had a higher biotic score. Site 6 (Dick Ditch, one of the control sites) also showed a decrease in its biotic score during the same time period. Biotic scores can be influenced by regional weather patterns, such as amount and timing of precipitation.

After a disturbance, blackflies may become the dominant organism. In this case, the proportional abundance of blackflies decreased the biotic index scores for the March 2009 collections. Stoneflies (*Allocapnia* spp) were present at each site, although not in high numbers. Stoneflies are considered to be indicators of good water quality.

The number of benthic taxa present at Sites 2, 3 and 4 was 27 before two-stage ditch construction, 17 in March 2009 and 30 in June 2009. The construction was a temporary disturbance to the benthic community. The most recent data suggest that recovery has occurred and that the benthic community after construction is healthier than before.

IV. Fish

Fish were sampled on October 8, 2007, October 23, 2008, and October 9 and 10, 2009 by use of DC electrofishing (Coffelt Backpack Shocker). Fish were identified on-site and released, except for representative voucher specimens and small cyprinids (minnows). The 2007 collection was pre-construction, and the 2008 and 2009 collections were after initiation of the two-stage ditch construction.

Fish Index of Biotic Integrity (IBI) scores were calculated based on twelve metrics according to the method of Karr {1} and Simon and Dufour {2}. Each metric receives a score of one, three, or five (five is best) which are then summed to give a fish IBI score, with a maximum possible score of 60. The scores were standardized to a scale of zero to 100 to better facilitate comparison with other indices. Fish raw data, metrics data, and metric scores have been included in annual bioassessment reports {7-9}.

Table 3. Standarized Fish Index of Biotic Integrity (IBI) scores

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2007	37	*	*	47	50	53
2008	33	50	53	47	*	*
2009	42	50	57	57	73	60

- not available

The standardized IBI (Table 3) score at site 4 improved from 2007 to 2009, from 47 to 57. The number of sunfish species increased from one to three, the number of fish collected was almost doubled, the percentage of insectivores (fish that utilize insects as a primary food source) increased from 16% to 40%, and the percentage of simple lithophils (fish that need clean gravel for spawning) increased from 2% to 24%.

Site 1 (upstream from the construction zone) also had an improved standardized IBI score from 2007 to 2009, from 37 to 42. The 2009 IBI score was affected by the collection of 21 smallmouth bass, resulting in a decrease in the percentage of tolerant species (from 72% in 2007 to 50% in 2009) and an increase in the percentage of carnivores (from 4% in 2007 to 44% in 2009).

The control sites (Site 5 and Site 6) also showed improvements in their IBI scores from 2007 to 2009. Site 5 had an increased number of species of darters, sunfishes, suckers, as well as sensitive species and percentages of simple lithophils. The Site 6 IBI score improved as a result of increases in the number of sensitive species and the percentages of simple lithophils.

Table 4. Number of Fish Species Collected at Each Site

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2007	8	*	*	12	11	9
2008	5	11	12	13	*	*
2009	5	9	10	12	14	14

Table 5. Dominant Fish Species Collected at Each Site

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2007	Bluntnose Minnow (38%)	*	*	Central Stoneroller (18%)	Mottled Sculpin (48%)	Bluntnose Minnow (30%)
2008	Bluntnose Minnow (36%)	Creek Chub (36%)	Creek Chub (29%)	Bluntnose Minnow (34%)		
2009	Smallmouth Bass (44%)	Creek Chub (32%)	Orangethroat Darter (30%)	Creek Chub (29%)	White Sucker Central Mudminnow (both 15%)	Mottled Sculpin (24%)

Table 4 shows the number of fish species collected, while Table 5 has the dominant species collected in each sample and its proportional abundance. The number of fish species remained relatively stable at each site during the project. The most upstream site on Creel Ditch (Site 1) had the least number of species during each sampling event. The number of species collected increased as sampling proceeded downstream. Streams with a larger watershed area are capable of supporting a greater diversity of fish species. The dominant species collected (bluntnose minnow, creek chub, central stoneroller, central mudminnow, and mottled sculpin) are all common and widespread small stream fish species. The occurrence of orangethroat darter as the dominant species at Site 3 in 2009 is an indication of relatively good conditions.

V. Stream Substrate Composition

The purpose of sampling Creel Ditch (also known as Metz Ditch) for sediment analysis was to determine whether two-stage ditch construction had an effect on the size composition of particles in the substrate. Samples were collected both before (2007) and after (2009) construction at sites 1-4 in Creel Ditch. Four replicate samples were collected from each site and placed into 1 liter containers for transport to the laboratory. A drying oven was used to dry the samples before sieve analysis.

For each replicate, the entire sample was mixed to ensure homogeneity and then a sub-sample of 100g was removed. The sub-sample was pulverized to break apart any aggregates of clay and then placed into a stacked series of sieves (mesh sizes of 4mm, 2mm, 250μm, 125μm, and 63μm) with a sold pan at the bottom to catch the finest particles. Fractions were described as gravel, very coarse sand, medium sand, fine sand, very fine sand, and silt. The sieves were shaken manually and each fraction was weighed to the nearest gram. Detritus that was retained on the largest mesh sieve was separated manually from the gravel and weighed. Results are presented as a percentage of the total weight recovered.

The average percentage data by site of each sediment fraction for sample years 2007 and 2009 are presented in Figures 1 and 2, and the net change between the two sampling events in Table 6. Raw data are in Figures 7 and 8.

Figure 1. Sieve analysis results for 2007 samples.

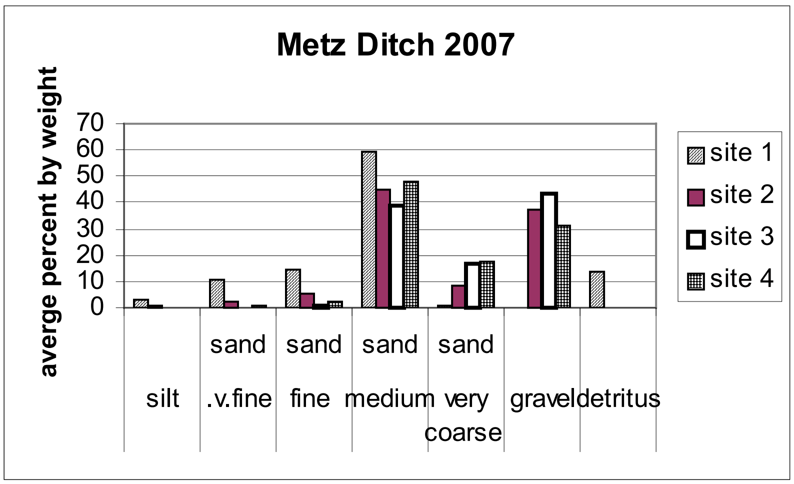


Figure 2. Sieve analysis results for 2009 samples.

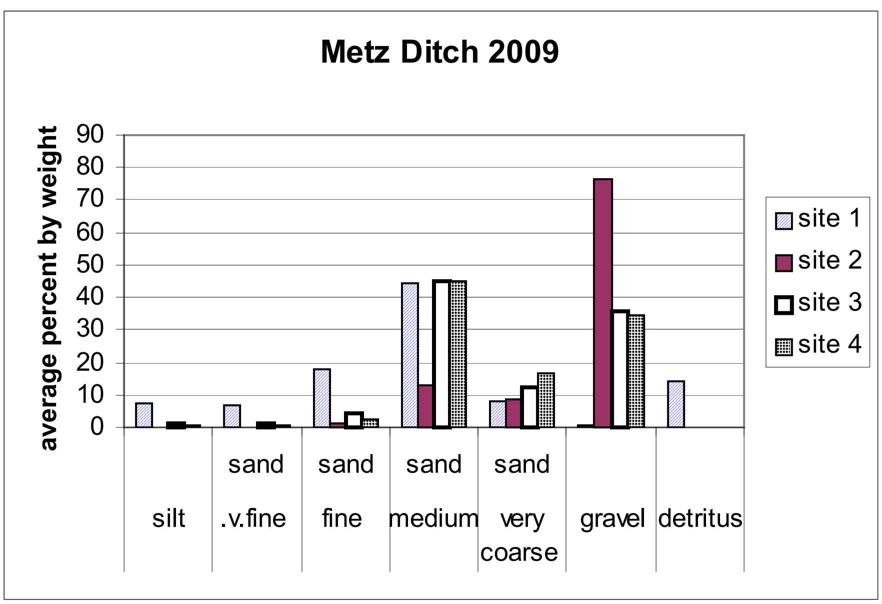


Table 6. Net change, in average percent by weight, from 2007 to 2009

	Silt	Very Fine Sand	Fine Sand	Medium Sand	Very Coarse Sand	Gravel	Detritus
Sample Site							
1	+ 4	-4	+ 4	- 14	+ 8	+ 1	+ 1
2	- 1	- 2	- 4	- 32	0	+ 39	0
3	+ 1	- 1	+ 4	+ 7	- 4	- 7	0
4	+ 1	0	0	-3	- 1	+ 3	0

Predominant substrate types throughout the reach were gravel and medium sand during both pre- and post-construction sampling events. Detritus accounted for less than 1% of all sample weights, except for Site 1. Site 1 also consistently contained the highest amount of silt and the least amount of gravel.

For all four sites, there was an overall increase of silt (from 1% to 2%) in 2009, although this increase was found to be not statistically significant by testing the data with a two-sample t-test assuming unequal variances. Site 1 had the largest increase in silt (4%). For all four sites, there was also an increase in the average percentage of gravel (from 28% to 37%), although the difference was shown to be not statistically significant by testing the data with a two-sample t-test assuming unequal variances. Site 2 had a 39% increase in gravel, while the other three sites had changes of less than plus or minus 10%.

Because there were non-significant increases in both the finest (silt) and coarsest (gravel) sediment fractions, further sampling may be needed to fully assess the long-term effects of the two-stage ditch construction on stream substrate composition.

Table 7.Sediment data for 2007

		Percent of Total Sample (By Weight)				samples collected 2007	
Sample site	silt	.v.fine	fine	medium	v. coarse	gravel	detritus
		sand	sand	sand	sand		
1	4	12	12	71	1	0	0
1	1	4	7	40	0	0	54
1	2	6	8	83	1	0	0
1	6	22	30	42	0	0	0
2	0	1	1	22	17	59	0
2	3	7	17	57	3	13	0
2	0	0	4	90	3	2	0
2	1	0	0	11	12	76	0
3	0	1	1	27	11	60	0
3	1	0	0	55	16	29	0
3	0	0	1	25	13	61	0
3	0	0	2	47	26	25	0
4	0	1	4	68	19	8	0
4	1	1	4	70	12	12	0
4	0	0	1	12	13	74	0
4	0	0	1	42	26	31	0

Table 8. Sediment data for 2009.

		Percent of Total Sample (By Weight)				sampled March 4, 2009		
Sample site	silt	.v.fine	fine	medium	v. coarse	gravel	detritus	
		sand	sand	sand	sand			
1	13	9	18	54	1	2	0	
1	2	4	16	30	0	0	48	
1	13	9	29	34	10	0	5	
1	2	4	9	59	22	1	3	
2	0	0	0	6	4	90	0	
2	0	0	1	9	8	82	0	
2	1	1	3	23	14	58	0	
2	0	0	2	13	9	76	0	
3	1	1	3	34	20	41	0	
3	1	2	8	88	1	0	0	
3	1	1	4	43	19	32	0	
3	1	1	2	15	10	71	0	
4	1	1	3	52	21	22	0	
4	1	1	3	87	7	1	0	
4	0	0	1	5	5	89	0	
4	1	1	2	36	34	26	0	

VI. Conclusions of the Study

Comparison of water chemistry data pre and post construction shows improvement in average nitrate nitrogen and total suspended solids at the downstream (within the construction zone) site. Phosphorus levels (both total and ortho) decreased at both upstream and downstream sites during the same time period, while ammonia levels showed no change.

Biotic communities are showing on-going improvement in the two-stage ditch construction area. Individual Index of Biotic Integrity metrics for both macroinvertebrates and fish (i.e. number of macroinvertebrate taxa, number of sunfish species) have shown a shift toward more healthy aquatic communities. The appearance of animals such as stoneflies and orangethroat darters in the 2-stage section also indicate improving water quality.

Substrate composition of Creel Ditch within the 2-stage zone has not changed substantially during the first year after construction.

VI. References

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9. Fish Creek Watershed Two-Stage Ditch Demonstration Project Bioassessment 2009. Prepared for The Nature Conservancy, by Commonwealth Biomonitoring Inc., Indianapolis, IN.

Raw Data for all Water Chemistry Samples

sample date	location	grab?	storm?	NH3-N mg/l	N03-N mg/l	Total P mg/l	ortho P mg/l	TSS mg/l
5/9/2007	Metz u/s	y	n	0.56	0.4	0.32	0.2	4.5
5/9/2007	Metz d/s	y	n	0.52	0.4	0.2	0.11	4.5
5/9/2007	Powers	y	n	0.52	0.4	0.05	0.02	5
5/9/2007	Dick	y	n	0.5	2.4	0.11	0.09	5.5
5/9/2007	Dick=dupl.	y	n	0.52	2.2	0.11	0.09	6
5/23/2007	Metz u/s	y	n	0.4	0.7	0.22	0.15	5.5
5/23/2007	Powers	y	n	0.35	0.35	0.14	0.07	4
5/23/2007	Dick	y	n	0.25	1.1	0.15	0.14	6
5/23/2007	Metz d/s	y	n	0.25	0.45	0.18	0.12	5
5/23/2007	Metz d/s dupl	y	n	0.3	0.45	0.18	0.12	5
6/6/2007	Metz u/s	y	n	0.15	1.2	0.3	0.16	48
6/6/2007	Metz u/s	n	y	0.14	1.1	0.26	0.12	57.5
6/6/2007	Powers d/s	y	n	0.26	0.3	0.18	0.12	10
6/6/2007	Metz d/s	y	n	0.5	5	0.6	0.37	109
6/6/2007	Dick	y	n	0.2	1	0.56	0.33	6
6/6/2007	Dick dupl	y	n	0.2	1	0.6	0.37	4.5
6/20/2007	Metz u/s	y	n	1	0.6	0.9	0.56	20.5
6/20/2007	Metz d/s	y	n	0.4	0.6	0.7	0.56	5.5
6/20/2007	Powers	y	n	0.2	0.65	0.46	0.35	6
6/20/2007	Dick	y	n	0.1	1.1	0.6	0.56	2.5
6/20/2007	Dick dupl.	y	n	0.2	1	0.6	0.54	2.5
7/5/2007	Metz us	y	n	0.16	1.4	0.32	0.26	23.5
7/5/2007	Metx d/s	y	n	0.18	0.8	0.32	0.28	6
7/5/2007	Powers	y	n	0.16	0.8	0.13	0.11	3.5
7/5/2007	Dcik	y	n	0.2	0.6	0.2	0.16	4.5
7/5/2007	Dick dupl	y	n	0.2	0.8	0.2	0.16	4
7/18/2007	Metz u/s	y	n	0.8	0.8	0.12	0.09	27
7/18/2007	Metz d/s	y	n	0.5	0.7	0.07	0.05	5
7/18/2007	Powers	y	y	0.4	1.2	0.12	0.06	59
7/18/2007	Powers	n	y	0.9	0.7	0.08	0.07	79
7/18/2007	Powers	y	n	0.5	1.1	0.07	0.06	7.5
7/18/2007	Dick	y	n	0.8	1.5	0.07	0.04	3.5
7/18/2007	Dick dupl.	y	n	0.7	1.3	0.07	0.05	3
7/26/2007	Metxz u/s	y	n	0.1	4.8	0.11	0.08	7.5
7/26/2007	Metz d/s	y	n	0.1	1	0.16	0.12	2
7/26/2007	Metz d/s	n	y	0.4	0.5	0.16	0.13	11.5
7/26/2007	Powers	y	n	0.1	0.2	0.13	0.08	50.5
7/26/2007	Dick	y	n	0.1	0.7	0.11	0.08	2.5
7/26/2007	Dick duplicate	y	n	0.1	0.7	0.12	0.08	2
8/8/2007	Metz u/s	y	n	0.6	3.3	0.1	0.08	21
8/8/2007	Metz u/s	y	y	0.9	2.2	0.22	0.13	91
8/8/2007	Metz d/s	y	n	0.4	3.2	0.11	0.1	14
8/8/2007	Metz d/s	y	y	0.4	2.7	0.26	0.13	67.5
8/8/2007	Powers	y	n	0.9	1.7	0.14	0.11	36.5
8/8/2007	Dick	y	n	0.8	2.8	0.09	0.07	13.5
8/8/2007	Dick dupl	y	n	0.9	2.8	0.09	0.07	15

8/23/2007	Metz u/s	n	y	0.6	0.2	1.2	0.09	283
8/23/2007	Metz u/s	y	y	0.4	0.2	0.48	0.3	222
8/23/2007	Metz u/s	y	n	0.5	0.7	0.3	0.07	33.5
8/23/2007	Metz d/s	n	y	0.7	1	0.09	0.05	11.5
8/23/2007	Metz d/s	y	y	0.5	1.4	0.3	0.22	26.5
8/23/2007	Metz d/s	y	n	0.5	1.3	0.26	0.12	48
8/23/2007	Powers	y	n	0.7	0.8	0.48	0.05	69.5
8/23/2007	Dick	y	n	0.7	3.2	0.37	0.22	133.5
8/23/2007	Dick dupl.	y	n	0.7	3.5	0.37	0.18	151.5
9/3/2007	Metz u/s	y	n	0.4	1.2	0.4	0.29	7.5
9/3/2007	Metz d/s	n	y	0.4	1	0.4	0.29	2.5
9/3/2007	Metz d/s	y	y	0.4	0.5	0.28	0.24	8
9/3/2007	Metz d/s	y	n	0.7	0.5	0.52	0.32	2.5
9/3/2007	Powers	y	n	0.7	0.5	0.75	0.52	7
9/3/2007	Dick	y	n	0.6	1.1	0.4	0.32	5.5
9/3/2007	Dick dupl	y	n	0.5	1.1	0.4	0.29	5.5
9/14/2007	Metz u/s	y	n	0.9	0.2	0.35	0.33	1
9/14/2007	Metz d/s	y	n	0.9	0.2	0.21	0.18	6
9/14/2007	Powers	y	n	0.6	0.2	0.24	0.18	3.5
9/14/2007	Dick	y	n	0.7	0.9	0.24	0.18	2.5
9/14/2007	Dick dupl	y	n	0.7	0.9	0.24	0.19	2.5
10/8/2007	Metz u/s	y	n	0.6	0.3	0.07	0.06	1
10/8/2007	Metz d/s	y	n	0.6	0.7	0.08	0.07	3.5
10/8/2007	Powers	y	n	0.5	0.6	0.1	0.09	5
10/8/2007	Dick	y	n	0.5	1.1	0.15	0.11	4
10/8/2007	Dick dupl	y	n	0.5	1.1	0.13	0.1	4
10/18/2007	Metz u/s	y	n	0.6	0.3	0.15	0.08	6
10/18/2007	Metz d/s	y	n	0.9	0.2	0.12	0.08	5.5
10/18/2007	Powers	y	n	0.8	0.2	0.11	0.09	12
10/18/2007	Dick	y	n	0.9	0.7	0.17	0.03	8.5
10/18/2007	Dick dupl	y	n	1	0.8	0.16	0.03	8.5
11/1/2007	Metz u/s	y	n	0.4	0.4	0.13	0.07	1.5
11/1/2007	Metz d/s	n	y	0.4	0.4	0.14	0.05	2
11/1/2007	Metz d/s	y	y	0.3	0.4	0.05	0.04	5
11/1/2007	Metz d/s	y	n	0.1	0.4	0.07	0.06	1.5
11/1/2007	Powers	y	n	0.5	1	0.1	0.08	3.5
11/1/2007	Dick	y	n	0.1	1.5	0.08	0.05	2
11/1/2007	Dick dupl	y	n	0.1	1.4	0.08	0.06	2
11/19/2007	Metz u/s	y	n	0.3	0.7	0.04	0.03	1.5
11/19/2007	Metz d/s	y	n	0.2	0.8	0.04	0.03	1.5
11/19/2007	Powers	n	y	0.7	1.4	0.2	0.12	97.5
11/19/2007	Powers	y	y	0.3	1	0.04	0.03	45
11/19/2007	Powers	y	n	0.3	0.6	0.08	0.04	3.5
11/19/2007	Dick	y	n	0.3	1	0.08	0.05	0.5
11/19/2007	Dick dupl	y	n	0.3	1	0.07	0.04	0.5
12/12/2007	Metz u/s	y	n	0.4	1.1	0.5	0.1	77
12/12/2007	Metz d/s	y	n	0.1	1.2	0.24	0.13	40
12/12/2007	Powers	y	n	0.4	1.4	0.2	0.11	139.5
12/12/2007	Dick	y	n	0.4	2.5	0.09	0.05	44
12/12/2007	Dick dupl	y	n	0.5	2.5	0.09	0.06	42

12/27/2007	Metz u/s	y	n	0.4	0.8	0.09	0.08	3.5
12/27/2007	Metz u/s	n	y	0.5	1.2	0.32	0.19	65
12/27/2007	Metz u/s	y	y	0.4	1.1	0.4	0.28	93
12/27/2007	Metz d/s	y	n	0.3	1.3	0.09	0.07	6.5
12/27/2007	Powers	y	n	0.3	1	0.07	0.05	8
12/27/2007	Powers	n	y	0.2	0.9	0.09	0.03	125
12/27/2007	Powers	y	y	0.1	1.2	0.24	0.06	129
12/27/2007	Dick	y	n	0.2	2.4	0.18	0.13	13
12/27/2007	Dick dupl	y	n	0.2	2.3	0.18	0.15	13
1/14/2008	Metz u/s	y	n	0.4	0.4	0.05	0.04	2.5
1/14/2008	Metz u/s	n	y	0.6	0.2	0.05	0.04	11.5
1/14/2008	Metz u/s	y	y	0.5	0.4	0.12	0.08	25.5
1/14/2008	Metz d/s	y	n	0.7	1	0.07	0.06	7
1/14/2008	Powers	y	n	0.9	1.2	0.13	0.06	9.5
1/14/2008	Dick	y	n	0.9	2.6	0.1	0.07	10
1/14/2008	Dick duplicate	y	n	0.8	2.8	0.1	0.09	10
1/29/2008	Metz u/s	y	n	0.2	1	0.16	0.13	11
1/29/2008	Metz d/s	y	n	0.2	1.2	0.13	0.1	9.5
1/29/2008	Powers	y	n	0.6	0.7	0.1	0.07	19
1/29/2008	Dick	y	n	0.6	2.2	0.09	0.07	11
1/29/2008	Dick duplicate	y	n	0.5	2.2	0.09	0.07	11
2/15/2008	Metz u/s	y	n	0.1	0.5	0.07	0.06	3.5
2/15/2008	Metz u/s	y	y	0.3	0.6	0.14	0.12	17.5
2/15/2008	Metz d/s	y	n	0.3	0.6	0.09	0.06	6.5
2/15/2008	Metz d/s	y	y	0.4	1.2	0.11	0.06	32.5
2/15/2008	Powers	y	n	0.5	0.5	0.11	0.08	6
2/15/2008	Dick	y	n	0.7	3	0.11	0.09	7
2/15/2008	Dick duplicate	y	n	0.7	3.5	0.12	0.09	7
2/28/2008	Metz u/s	y	n	0.3	0.8	0.08	0.07	4.5
2/28/2008	Metz d/s	y	n	0.5	0.8	0.06	0.04	0.5
2/28/2008	Powers	y	n	0.8	0.8	0.12	0.08	1.5
2/28/2008	Dick	y	n	0.8	2.5	0.12	0.09	3
2/28/2008	Dick duplicate	y	n	0.8	2.5	0.12	0.09	2.5
3/6/2008	Metz u/s	y	n	0.3	0.4	0.09	0.07	3.5
3/6/2008	Metz d/s	y	n	0.4	0.7	0.09	0.07	3.5
3/6/2008	Powers	y	n	0.6	0.6	0.08	0.06	5.5
3/6/2008	Dick	y	n	0.6	1.2	0.09	0.06	8.5
3/6/2008	Dick duplicate	y	n	0.6	1.2	0.09	0.06	9.5
3/10/2008	Metz u/s	y	n	0.7	0.7	0.09	0.08	5
3/10/2008	Metz d/s	y	n	0.7	0.9	0.09	0.06	4
3/10/2008	Powers	y	n	0.7	0.5	0.07	0.06	5.5
3/10/2008	Dick	y	n	0.6	1.2	0.12	0.09	5
3/10/2008	Dick duplicate	y	n	0.6	1.2	0.11	0.09	5
3/26/2008	Metz u/s	y	y	0.5	0.9	0.07	0.06	1
3/26/2008	Metz u/s	y	n	0.2	0.8	0.06	0.03	2
3/26/2008	Metz d/s	y	n	0.1	1.9	0.06	0.03	4
3/26/2008	Powers	y	n	0.1	1.5	0.07	0.05	8.5
3/26/2008	Dick	y	n	0.1	2.3	0.08	0.06	11.5
3/26/2008	Dick duplicate	y	n	0.1	2.3	0.08	0.06	12
4/8/2008	Metz u/s	y	n	0.4	0.3	0.12	0.09	3.5

4/8/2008	Metz d/s	y	n	0.4	0.4	0.11	0.08	3
4/8/2008	Powers	y	n	0.4	0.3	0.12	0.07	6
4/8/2008	Dick	y	n	0.1	1	0.07	0.06	5
4/8/2008	Dick duplicate	y	n	0.1	1	0.07	0.06	5
4/17/2008	Metz u/s	y	n	0.3	0.4	0.13	0.1	6.5
4/17/2008	Metz d/s	y	n	0.2	1.2	0.1	0.05	2.5
4/17/2008	Metz d/s	y	y	0.9	1.4	0.2	0.17	9
4/17/2008	Metz d/s	n	y	0.2	1.5	0.11	0.1	11.5
4/17/2008	Powers	y	n	0.1	0.5	0.08	0.07	4
4/17/2008	Dick	y	n	0.2	2.6	0.17	0.12	4
4/17/2008	Dick duplicate	y	n	0.2	2.6	0.17	0.11	4
4/30/2008	Metz u/s	y	n	0.5	0.7	0.05	0.04	3
4/30/2008	Metz d/s	y	n	0.6	0.7	0.05	0.04	3
4/30/2008	Powers	y	n	0.6	0.9	0.07	0.06	3
4/30/2008	Dick	y	n	0.3	2.4	0.09	0.05	3
4/30/2008	Dick duplicate	y	n	0.3	2.5	0.09	0.05	3
5/15/2008	Metz u/s	y	n	0.1	0.8	0.18	0.14	2.5
5/15/2008	Metz d/s	y	n	0.1	0.8	0.14	0.12	1
5/15/2008	Powers	y	n	0.2	0.9	0.11	0.07	5
5/15/2008	Dick	y	n	0.2	1.5	0.12	0.08	2.5
5/15/2008	Dick duplicate	y	n	0.2	1.5	0.12	0.07	2.5
5/18/2008	Metz d/s	y	y	0.2	3	0.3	0.13	9
5/18/2008	Metz d/s	n	y	0.3	2.3	0.24	0.11	3.5
5/18/2008	Powers	y	y	0.2	1.8	0.19	0.12	6.5
5/18/2008	Powers	n	y	0.2	1.5	0.19	0.08	10.5
5/18/2008	Dick	y	y	0.4	2.3	0.48	0.32	10
5/18/2008	Dick	n	y	0.3	2.8	0.6	0.2	212.5
5/27/2008	Metz u/s	y	n	0.3	0.6	0.14	0.06	2
5/27/2008	Metz d/s	y	n	0.2	0.8	0.19	0.07	2
5/27/2008	Powers	y	n	0.3	0.8	0.11	0.07	5
5/27/2008	Dick	y	n	0.3	2.3	0.16	0.11	1.5
5/27/2008	Dick duplicate	y	n	0.3	2.2	0.14	0.11	2
6/6/2008	Metz u/s	y	n	0.25	0.6	0.22	0.1	14
6/6/2008	Metz d/s	y	n	0.3	0.6	0.19	0.07	1
6/6/2008	Powers	y	n	0.3	0.6	0.07	0.05	4
6/6/2008	Powers	y	y	0.25	0.6	0.08	0.05	1
6/6/2008	Powers	n	y	0.1	0.5	0.1	0.05	0.5
6/6/2008	Dick	y	n	0.2	1.5	0.07	0.06	7.5
6/6/2008	Dick	y	y	0.2	2	0.07	0.03	0.5
6/6/2008	Dick	n	y	0.2	1.3	0.15	0.07	161.5
6/6/2008	Dick duplicate	y	n	0.2	1.5	0.07	0.06	7
6/23/2008	Metz u/s	y	n	0.1	1	0.22	0.1	44
6/23/2008	Metz d/s	y	n	0.1	2.1	0.17	0.12	7.5
6/23/2008	Powers	y	n	0.2	1.2	0.24	0.12	5
6/23/2008	Dick	y	n	0.1	2.1	0.1	0.04	1
6/23/2008	Dick duplicate	y	n	0.2	1.9	0.1	0.04	1
6/23/2008	Metz d/s	y	y	0.2	0.5	0.27	0.17	1
6/23/2008	Dick	y	y	0.3	1.7	0.12	0.07	0.5
6/23/2008	Metz d/s	n	y	0.2	0.5	0.15	0.07	7
6/23/2008	Dick	n	y	0.2	1.8	0.1	0.04	4

7/4/2008	Metz d/s	y	y	0.1	0.9	0.24	0.17	1
7/4/2008	Metz d/s	n	y	0.1	0.7	0.24	0.17	8
7/8/2008	Metz u/s	y	y	0.2	0.8	1.8	1.4	260
7/8/2008	Metz d/s	y	y	0.3	0.6	0.5	0.35	302
7/8/2008	Powers	y	y	0.7	0.7	1.7	1.1	570
7/8/2008	Dick	y	y	0.2	1	0.75	0.52	362
7/8/2008	Metz u/s	n	y	0.2	0.8	2	1.3	168
7/8/2008	Metz d/s	n	y	0.2	1.7	0.54	0.38	1114
7/8/2008	Powers	n	y	0.3	0.6	0.38	0.35	240
7/8/2008	Dick	n	y	0.3	1.7	0.65	0.32	374
7/8/2008	Dick duplicate	n	y	0.3	1.7	0.62	0.32	400
7/23/2008	Metz u/s	y	n	0.4	0.8	0.7	0.38	24.5
7/23/2008	Metz d/s	y	n	0.5	0.7	1.3	0.2	6.5
7/23/2008	Dick	y	n	0.4	1.4	0.26	0.24	4.5
7/23/2008	Powers	y	n	0.4	0.5	0.13	0.1	5.5
7/23/2008	Powers	y	y	0.4	0.4	0.13	0.08	35.5
7/23/2008	Powers	n	y	0.4	0.4	0.35	0.33	12.5
8/5/2009	Metz u/s	y	n	0.6	0.4	0.22	0.12	13.5
8/5/2009	Metz d/s	y	n	0.7	0.5	0.19	0.1	6
8/5/2009	Powers	y	n	0.4	0.4	0.14	0.08	24
8/5/2009	Dick	y	n	0.2	1.2	0.15	0.1	4
8/5/2009	Dick duplicate	y	n	0.3	1.2	0.15	0.1	4
8/5/2009	Metz d/s	y	y	0.2	0.8	0.22	0.1	13.5
8/5/2009	Metz d/s	n	y	0.2	2.4	0.19	0.09	15
8/5/2009	Powers	y	y	0.2	0.9	0.17	0.08	10
8/5/2009	Powers	n	y	0.2	1	0.15	0.08	21
8/19/2008	Metz u/s	y	n	2.2	0.3	0.28	0.1	36
8/19/2008	Metz d/s	y	n	0.8	0.2	0.28	0.1	6.5
8/19/2008	Powers	y	n	0.3	0.2	0.13	0.02	3.5
8/19/2008	Dick	y	n	0.2	2	0.11	0.07	2
8/19/2008	Dick duplicate	y	n	0.2	1.7	0.11	0.07	2
8/19/2008	Powers	y	y	0.2	0.2	0.11	0.07	3.5
8/19/2008	Powers	n	y	0.1	0.3	0.09	0.07	29.5
8/19/2008	Dick	y	y	0.1	1	0.1	0.07	3
8/19/2008	Dick	n	y	0.1	0.6	0.07	0.06	8.5
8/27/2008	Metz u/s	y	n	0.2	0.4	0.19	0.11	12.5
8/27/2008	Metz d/s	y	n	0.2	0.2	0.19	0.11	10
8/27/2008	Powers	y	n	0.3	0.2	0.22	0.11	5
8/27/2008	Dick	y	n	0.3	0.8	0.08	0.03	3
8/27/2008	Dick duplicate	y	n	0.3	0.8	0.08	0.03	3
9/12/2008	Metz u/s	y	n	0.6	0.4	0.09	0.06	11.5
9/12/2008	Metz d/s	y	n	0.5	0.5	0.13	0.06	1.5
9/12/2008	Powers	y	n	0.5	0.6	0.12	0.07	2
9/12/2008	Dick	y	n	0.5	1	0.07	0.04	3
9/12/2008	Dick duplicate	y	n	0.5	1	0.07	0.04	3
9/12/2008	Metz d/s	y	y	0.6	0.6	0.09	0.05	30
9/12/2008	Metz d/s	n	y	0.6	0.4	0.15	0.08	20.5
9/23/2008	Metz u/s	y	n	0.2	0.4	0.11	0.08	4.5
9/23/2008	Metz d/s	y	n	0.1	0.3	0.11	0.05	5
9/23/2008	Powers	y	n	0.1	0.3	0.07	0.05	5.5

9/23/2008	Powers	y	y	0.1	1.2	0.44	0.13	75
9/23/2008	Powers	n	y	0.1	0.8	0.5	0.11	489
9/23/2008	Dick	y	n	0.1	1.3	0.07	0.05	14.5
9/23/2008	Dick	y	y	0.1	1	0.18	0.11	15
9/23/2008	Dick	n	y	0.1	1.6	0.1	0.05	183
10/7/2008	Metz u/s	y	n	0.5	0.5	0.08	0.04	3
10/7/2008	Metz d/s	y	n	0.3	0.5	0.1	0.07	4
10/7/2008	Powers	y	n	0.2	1	0.05	0.03	4
10/7/2008	Dick	y	n	0.2	1.8	0.11	0.05	2
10/7/2008	Dick duplicate	y	n	0.2	1.8	0.11	0.04	2
10/23/2008	Metz u/s	y	n	0.7	0.7	0.14	0.09	1
10/23/2008	Metz d/s	y	n	0.7	0.4	0.14	0.06	8
10/23/2008	Powers	y	n	0.5	1	0.07	0.03	2.5
10/23/2008	Powers	y	y	0.3	0.4	0.14	0.06	7
10/23/2008	Powers	n	y	0.4	0.4	0.14	0.06	15
10/23/2008	Dick	y	n	0.7	1	0.07	0.04	4
10/23/2008	Dick	y	y	0.4	0.8	0.06	0.03	15
10/23/2008	Dick	n	y	0.3	0.9	0.12	0.09	100
11/10/2008	Metz u/s	y	n	0.3	0.3	0.09	0.07	0.5
11/10/2008	Metz d/s	y	n	0.3	0.3	0.07	0.06	2.5
11/10/2008	Powers	y	n	0.3	0.7	0.07	0.04	1
11/10/2008	Powers	y	y	0.2	0.2	0.06	0.05	3
11/10/2008	Powers	n	y	0.2	0.3	0.07	0.04	20
11/10/2008	Dick	y	n	0.1	0.5	0.06	0.04	3.5
11/10/2008	Dick	y	y	0.3	0.7	0.09	0.07	1
11/10/2008	Dick	n	y	0.4	0.4	0.07	0.06	6.5
11/10/2008	Dick duplicate	n	y	0.4	0.4	0.07	0.06	6.5
11/29/2008	Metz u/s	y	n	0.3	1	0.08	0.05	4.5
11/29/2008	Metz d/s	y	n	0.5	0.9	0.05	0.03	2.5
11/29/2008	Powers	y	n	0.5	0.4	0.08	0.04	1.5
11/29/2008	Dick	y	n	0.4	1.9	0.11	0.04	2.5
11/29/2008	Dick duplicate	y	n	0.4	1.9	0.11	0.05	2.5
12/17/2008	Metz u/s	y	n	0.4	1.9	0.24	0.15	7
12/17/2008	Metz d/s	y	n	0.3	2.9	0.15	0.12	3.5
12/17/2008	Powers	y	n	0.3	1.1	0.22	0.15	2.5
12/17/2008	Dick	y	n	0.4	2.3	0.18	0.1	3
12/17/2008	Dick duplicate	y	n	0.4	2.2	0.17	0.1	3
12/30/2008	Metz u/s	y	n	0.1	0.9	0.09	0.05	3.5
12/30/2008	Metz u/s	y	y	0.1	0.4	0.13	0.03	136.5
12/30/2008	Metz d/s	y	n	0.2	1.6	0.11	0.08	7.5
12/30/2008	Powers	y	n	0.2	0.9	0.13	0.11	16.5
12/30/2008	Dick	y	n	0.2	3.5	0.19	0.14	10
12/30/2008	Dick	y	y	1.1	1.6	0.17	0.1	58
12/30/2008	Dick	n	y	0.7	0.6	0.19	0.12	233
1/12/2009	Metz u/s	yes	no	0.3	0.8	0.03	0.02	0.5
1/12/2009	Metz d/s	yes	no	0.3	1	0.02	0.01	0.5
1/12/2009	Powers	yes	no	0.3	0.7	0.02	0.01	1
1/12/2009	Dick	yes	no	0.5	3.5	0.05	0.03	0.5
1/12/2009	Dick duplicate	yes	no	0.4	3.6	0.05	0.03	0.5
1/28/2009	Metz u/s	yes	no	0.4	0.3	0.05	0.02	0.5

1/28/2009	Metz d/s	yes	no	0.4	0.4	0.09	0.05	0.5
1/28/2009	Powers	yes	no	0.5	0.2	0.04	0.03	1.5
1/28/2009	Dick	yes	no	0.2	1.3	0.04	0.03	0.5
1/28/2009	Dick duplicate	yes	no	0.2	1.4	0.04	0.03	0.5
2/15/2009	Metz u/s	yes	no	0.2	0.3	0.45	0.12	3
2/15/2009	Metz d/s	yes	no	0.3	0.5	0.12	0.08	3
2/15/2009	Powers	yes	no	0.3	0.4	0.09	0.06	14
2/15/2009	Dick	yes	no	0.3	1.9	0.15	0.06	12.5
2/15/2009	Dick duplicate	yes	no	0.3	1.9	0.12	0.06	14
3/4/2009	Metz u/s	yes	no	0.5	0.8	0.08	0.06	9
3/4/2009	Metz d/s	yes	no	0.8	2	0.04	0.03	4.5
3/4/2009	Powers	yes	no	0.5	1.4	0.04	0.03	11
3/4/2009	Dick	yes	no	0.6	3.7	0.06	0.05	38.5
3/4/2009	Dick duplicate	yes	no	0.6	3.7	0.06	0.05	43.5
3/4/2009	Powers	no	yes	0.7	4.1	0.08	0.04	250.5
3/4/2009	Dick	yes	yes	0.6	7	0.06	0.03	117.5
3/4/2009	Dick	no	yes	0.7	7.5	0.12	0.09	110.5
3/4/2009	Powers	yes	yes	0.5	1.7	0.05	0.02	239.5
3/18/2009	Metz u/s	yes	no	0.2	0.6	0.03	0.01	8
3/18/2009	Metz d/s	yes	no	0.2	0.6	0.02	0.01	9
3/18/2009	Powers	yes	no	0.2	0.6	0.02	0.01	13.5
3/18/2009	Dick	yes	no	0.1	1.4	0.04	0.03	19.5
3/18/2009	Dick duplicate	yes	no	0.1	1.4	0.04	0.03	20.5
3/18/2009	Dick	yes	yes	0.1	1.6	0.02	0.01	23
3/18/2009	Dick	no	yes	0.1	2	0.02	0.01	42.5
4/1/2009	Metz u/s	yes	no	0.5	1.3	0.02	0.01	2
4/1/2009	Metz d/s	yes	no	0.6	1.2	0.03	0.02	4
4/1/2009	Powers	yes	no	0.5	0.6	0.04	0.02	5
4/1/2009	Dick	yes	no	0.6	2	0.02	0.01	9
4/1/2009	Dick duplicate	yes	no	0.5	2	0.02	0.01	10
4/15/2009	Metz u/s	yes	no	0.4	1.7	0.11	0.07	20.5
4/15/2009	Metz d/s	yes	no	0.4	2.8	0.07	0.05	21.5
4/15/2009	Powers	yes	no	0.4	0.8	0.04	0.03	1
4/15/2009	Dick	yes	no	0.3	1.9	0.07	0.05	16
4/15/2009	Dick duplicate	yes	no	0.3	2	0.08	0.06	18
4/15/2009	Dick	yes	yes	0.5	2.2	0.03	0.02	8
4/15/2009	Dick	no	yes	0.5	1.7	0.03	0.02	6
5/1/2009	Metz u/s	yes	no	0.8	1	0.06	0.03	2
5/1/2009	Metz d/s	yes	no	0.5	1.2	0.06	0.03	4
5/1/2009	Powers	yes	no	0.3	1	0.04	0.02	3.5
5/1/2009	Dick	yes	no	0.3	1.8	0.03	0.01	6.5
5/1/2009	Dick duplicate	yes	no	0.3	1.7	0.03	0.01	5.5
5/1/2009	Dick	yes	yes	0.3	3.2	0.04	0.01	16
5/1/2009	Dick	no	yes	0.1	3	0.03	0.02	8.5
5/11/2009	Dick	no	yes	0.2	1.6	0.02	0.01	41
5/11/2009	Dick	yes	no	0.3	0.9	0.05	0.02	2.5
5/11/2009	Dick	yes	yes	0.3	1.5	0.02	0.01	5
5/11/2009	Dick duplicate	yes	no	0.3	0.9	0.05	0.02	2.5
5/11/2009	Metz d/s	yes	no	0.4	0.5	0.05	0.02	3
5/11/2009	Metz u/s	yes	no	0.5	0.5	0.03	0.02	3

5/11/2009	Powers	yes	no	0.3	0.3	0.03	0.02	2
5/27/2009	Dick	no	yes	0.2	0.9	0.13	0.07	59
5/27/2009	Dick	yes	no	0.3	1.4	0.11	0.07	21.5
5/27/2009	Dick	yes	yes	0.3	1	0.08	0.06	48
5/27/2009	Dick duplicate	yes	no	0.3	1.6	0.1	0.07	22.5
5/27/2009	Metz d/s	yes	no	0.4	1	0.09	0.04	4.5
5/27/2009	Metz u/s	yes	no	1.1	4.4	0.38	0.24	21.5
5/27/2009	Powers	no	yes	0.3	0.3	0.04	0.02	1.5
5/27/2009	Powers	yes	no	0.3	0.6	0.15	0.04	37
5/27/2009	Powers	yes	yes	0.3	0.3	0.04	0.02	1
6/9/2009	Dick	no	yes	0.4	5.6	0.12	0.07	128.5
6/9/2009	Dick	yes	no	0.4	1.8	0.07	0.04	2.5
6/9/2009	Dick	yes	yes	0.4	5.6	0.35	0.14	172
6/9/2009	Dick duplicate	yes	no	0.4	1.8	0.07	0.04	2.5
6/9/2009	Metz d/s	yes	no	0.4	1.1	0.08	0.03	2
6/9/2009	Metz u/s	yes	no	0.4	1.5	0.04	0.02	5.5
6/9/2009	Powers	yes	no	0.4	0.6	0.11	0.08	5
6/17/2009	Dick	no	yes	0.3	1.4	0.07	0.04	38.5
6/17/2009	Dick	yes	no	0.4	2	0.07	0.05	1
6/17/2009	Dick	yes	yes	0.3	2	0.07	0.03	117.5
6/17/2009	Dick duplicate	yes	no	0.3	2	0.07	0.04	1
6/17/2009	Metz d/s	yes	no	0.3	1.1	0.18	0.1	10.5
6/17/2009	Metz u/s	no	yes	0.3	1.4	0.07	0.03	19
6/17/2009	Metz u/s	yes	no	0.4	1.4	0.08	0.06	38.5
6/17/2009	Metz u/s	yes	yes	0.3	1.4	0.05	0.04	26.5
6/17/2009	Powers	no	yes	0.2	0.7	0.08	0.04	10
6/17/2009	Powers	yes	no	0.3	0.5	0.13	0.06	9
6/17/2009	Powers	yes	yes	0.3	0.7	0.11	0.05	8
7/2/2009	Metz u/s	yes	no	0.4	1.8	0.19	0.12	8
7/2/2009	Metz d/s	yes	no	0.5	1.5	0.09	0.03	9
7/2/2009	Powers	yes	no	0.5	0.6	0.11	0.09	3.5
7/2/2009	Dick	yes	no	0.5	1.8	0.11	0.08	1.5
7/2/2009	Dick duplicate	yes	no	0.5	2	0.11	0.08.1.5	
7/2/2009	Metz u/s	yes	yes	0.3	1.8	0.16	0.08	16.5
7/2/2009	Metz u/s	no	yes	0.3	5.6	0.19	0.14	105
7/2/2009	Powers	yes	yes	0.2	2.2	0.11	0.05	18
7/2/2009	Powers	no	yes	0.3	2.4	0.22	0.04	171.5
7/2/2009	Dick	yes	yes	0.2	2	0.08	0.04	37
7/2/2009	Dick	no	yes	0.2	2	0.04	0.02	11
7/15/2009	Metz u/s	yes	no	0.2	1.3	0.04	0.03	13.5
7/15/2009	Metz d/s	yes	no	0.3	0.8	0.02	0.01	5.5
7/15/2009	Powers	yes	no	0.4	0.8	0.04	0.02	13
7/15/2009	Dick	yes	no	0.4	1.6	0.15	0.1	3.5
7/15/2009	Dick duplicate	yes	no	0.4	1.6	0.15	0.1	3.5
7/15/2009	Metz u/s	yes	yes	0.5	1.6	0.08	0.06	8.5
7/15/2009	Metz u/s	no	yes	0.3	2	0.1	0.02	27.5
7/15/2009	Metz d/s	yes	yes	0.4	0.7	0.03	0.02	7.5
7/15/2009	Metz d/s	no	yes	0.4	0.7	0.03	0.02	7
7/15/2009	Powers	yes	yes	0.2	0.5	0.14	0.03	11.5
7/15/2009	Powers	no	yes	0.3	0.7	0.05	0.02	5

7/15/2009	Dick	yes	yes	0.3	2.2	0.03	0.02	117.5
7/15/2009	Dick	no	yes	0.2	2.4	0.05	0.02	16.5
7/28/2009	Metz u/s	yes	no	0.2	0.5	0.16	0.1	8
7/28/2009	Metz d/s	yes	no	0.3	0.3	0.16	0.1	1.5
7/28/2009	Powers	yes	no	0.2	0.3	0.2	0.11	2.5
7/28/2009	Dick	yes	no	0.2	0.9	0.14	0.1	0.5
7/28/2009	Dick duplicate	yes	no	0.2	0.9	0.14	0.1	0.5
7/28/2009	Metz u/s	yes	yes	0.2	0.5	0.15	0.05	22
7/28/2009	Metz u/s	no	yes	0.2	0.7	0.17	0.15	24
7/28/2009	Powers	yes	yes	0.2	0.5	0.38	0.26	12
7/28/2009	Powers	no	yes	0.2	0.5	0.24	0.11	7
7/28/2009	Dick	yes	yes	0.2	1.5	0.3	0.19	147.5
7/28/2009	Dick	no	yes	0.1	1.5	0.11	0.09	16
8/12/2009	Metz u/s	yes	no	0.5	0.7	0.07	0.05	1.5
8/12/2009	Metz d/s	yes	no	0.4	0.3	0.13	0.11	0.5
8/12/2009	Powers	yes	no	0.4	0.3	0.09	0.05	2.5
8/12/2009	Dick	yes	no	0.3	1.9	0.07	0.03	3
8/12/2009	Dick duplicate	yes	no	0.3	1.8	0.06	0.03	3
8/12/2009	Metz u/s	yes	yes	0.3	1.4	0.24	0.13	57
8/12/2009	Metz u/s	no	yes	0.3	0.9	0.13	0.03	34
8/12/2009	Powers	yes	yes	0.2	0.3	0.02	0.01	20.5
8/12/2009	Powers	no	yes	0.2	0.3	0.07	0.03	10
8/12/2009	Dick	yes	yes	0.2	2.2	0.1	0.05	8.5
8/12/2009	Dick	no	yes	0.2	1.8	0.07	0.03	3
8/19/2009	Metz u/s	yes	no	0.2	1	0.12	0.05	20
8/19/2009	Metz d/s	yes	no	0.2	1.4	0.12	0.08	15
8/19/2009	Powers	yes	no	0.3	0.9	0.06	0.03	4.5
8/19/2009	Dick	yes	no	0.3	1.1	0.06	0.05	33
8/19/2009	Dick duplicate	yes	no	0.3	1.1	0.06	0.05	37
8/19/2009	Metz u/s	yes	yes	0.2	1.4	0.34	0.26	101
8/19/2009	Metz u/s	no	yes	0.2	0.5	0.32	0.24	9
8/19/2009	Powers	yes	yes	0.2	0.3	0.04	0.03	2.5
8/19/2009	Powers	no	yes	0.2	0.2	0.06	0.03	0.5
8/19/2009	Dick	yes	yes	0.2	1.1	0.14	0.09	1.5
8/19/2009	Dick	no	yes	0.2	1	0.1	0.06	0.5
8/26/2009	Metz u/s	yes	no	0.3	0.7	0.1	0.08	3
8/26/2009	Metz d/s	yes	no	0.3	0.4	0.15	0.09	4
8/26/2009	Powers	yes	no	0.2	0.4	0.19	0.13	4
8/26/2009	Dick	yes	no	0.2	1.5	0.09	0.07	2
8/26/2009	Dick duplicate	yes	no	0.2	1.6	0.09	0.06	2
8/26/2009	Metz u/s	yes	yes	0.2	0.7	0.19	0.08	97
8/26/2009	Metz u/s	no	yes	0.2	0.8	0.28	0.15	292.5
8/26/2009	Dick	yes	yes	0.2	1.6	0.15	0.05	2
8/26/2009	Dick	no	yes	0.2	1.6	0.19	0.04	4.5
9/10/2009	Metz u/s	yes	no	0.5	0.5	0.11	0.08	5
9/10/2009	Metz d/s	yes	no	0.5	0.7	0.07	0.06	11
9/10/2009	Powers	yes	no	0.5	0.6	0.11	0.09	5
9/10/2009	Dick	yes	no	0.4	1.1	0.15	0.08	3
9/10/2009	Dick duplicate	yes	no	0.4	1.1	0.15	0.08	3
9/10/2009	Metz u/s	yes	yes	0.4	0.8	0.52	0.11	256.5

9/10/2009	Metz u/s	no	yes	0.4	0.5	0.17	0.1	65
9/10/2009	Metz d/s	yes	yes	0.6	0.7	0.11	0.07	68.5
9/10/2009	Metz d/s	no	yes	0.5	0.7	0.08	0.04	5
9/10/2009	Powers	yes	yes	0.5	0.6	0.07	0.06	0.5
9/10/2009	Powers	no	yes	0.4	0.5	0.05	0.03	0.5
9/10/2009	Dick	yes	yes	0.4	1.1	0.15	0.12	2.5
9/10/2009	Dick	no	yes	0.4	1.2	0.06	0.04	6
9/25/2009	Metz u/s	yes	no	0.4	<0.2	0.18	0.13	1.5
9/25/2009	Metz d/s	yes	no	0.3	0.2	0.14	0.08	1
9/25/2009	Powers	yes	no	0.3	<0.2	0.05	0.04	2
9/25/2009	Dick	yes	no	0.2	0.7	0.03	0.02	0.5
9/25/2009	Dick duplicate	yes	no	0.2	0.7	0.04	0.02	0.5
9/25/2009	Metz u/s	yes	yes	0.1	1.2	0.2	0.1	508.5
9/25/2009	Metz u/s	no	yes	0.2	0.8	0.1	0.02	53
9/25/2009	Powers	yes	yes	0.2	0.4	0.08	0.02	16
9/25/2009	Powers	no	yes	0.1	0.5	0.04	0.03	9
9/25/2009	Dick	yes	yes	0.1	0.7	0.1	0.08	2.2
9/25/2009	Dick	no	yes	0.1	1.2	0.13	0.02	66
10/2/2009	Metz u/s	yes	no	0.5	2.1	0.2	0.11	50
10/2/2009	Metz d/s	yes	no	0.4	0.9	0.19	0.12	21
10/2/2009	Powers	yes	no	0.4	1.3	0.32	0.17	108
10/2/2009	Dick	yes	no	0.5	2.9	0.56	0.34	93.5
10/2/2009	Dick duplicate	yes	no	0.5	2.9	0.52	0.3	114
10/12/2009	Metz u/s	yes	no	0.6	0.7	0.04	0.03	70
10/12/2009	Metz d/s	yes	no	0.5	0.5	0.02	0.01	4
10/12/2009	Powers	yes	no	0.6	0.3	0.08	0.06	5.5
10/12/2009	Dick	yes	no	0.5	0.8	0.06	0.04	11
10/12/2009	Dick duplicate	yes	no	0.5	0.7	0.06	0.03	11
10/12/2009	Metz d/s	yes	yes	0.5	0.3	0.26	0.14	32.5
10/12/2009	Metz d/s	no	yes	0.5	0.3	0.17	0.05	16
10/12/2009	Powers	yes	yes	0.6	0.2	0.08	0.05	6
10/12/2009	Powers	no	yes	0.5	0.2	0.12	0.05	11.5
10/12/2009	Dick	yes	yes	0.4	0.2	0.07	0.05	16.5
10/12/2009	Dick	no	yes	0.4	0.2	0.05	0.03	45.5
10/20/2009	Metz u/s	yes	no	0.3	0.5	0.19	0.16	1
10/20/2009	Metz d/s	yes	no	0.3	0.5	0.22	0.16	4
10/20/2009	Powers	yes	no	0.2	0.5	0.07	0.04	2
10/20/2009	Dick	yes	no	0.2	1.9	0.11	0.07	1.5
10/20/2009	Dick duplicate	yes	no	0.2	1.9	0.11	0.07	1.5
10/20/2009	Metz u/s	yes	yes	0.1	0.8	0.28	0.15	438
10/20/2009	Metz u/s	no	yes	0.1	0.5	0.32	0.19	430
10/26/2009	Metz u/s	yes	no	0.6	0.6	0.13	0.12	4.5
10/26/2009	Metz d/s	yes	no	0.4	1.1	0.11	0.03	6
10/26/2009	Powers	yes	no	0.3	0.5	0.12	0.1	5
10/26/2009	Dick	yes	no	0.2	1.7	0.19	0.12	7.5
10/26/2009	Dick duplicate	yes	no	0.2	1.7	0.19	0.14	7.5
10/26/2009	Metz u/s	yes	yes	0.2	0.5	0.31	0.22	350
10/26/2009	Metz u/s	no	yes	0.3	0.5	0.32	0.12	263
10/26/2009	Metz d/s	yes	yes	0.3	0.4	0.16	0.11	12.5
10/26/2009	Metz d/s	no	yes	0.3	0.3	0.18	0.09	16.5

10/26/2009	Powers	yes	yes	0.2	0.3	0.19	0.14	4.5
10/26/2009	Powers	no	yes	0.2	0.3	0.29	0.21	6.5
10/26/2009	Dick	yes	yes	0.3	1.5	0.22	0.16	86
10/26/2009	Dick	no	yes	0.4	1.1	0.22	0.14	48.5
11/2/2009	Metz u/s	yes	no	0.5	0.5	0.14	0.08	5
11/2/2009	Metz d/s	yes	no	0.4	0.5	0.08	0.07	3
11/2/2009	Powers	yes	no	0.4	0.2	0.16	0.11	1
11/2/2009	Dick	yes	no	0.2	2.6	0.13	0.08	3.5
11/2/2009	Dick duplicate	yes	no	0.3	2.6	0.13	0.08	3.5
11/2/2009	Metz u/s	yes	yes	0.3	0.9	0.16	0.08	119
11/2/2009	Metz u/s	no	yes	0.4	0.4	0.38	0.22	295
11/2/2009	Metz d/s	yes	yes	0.4	0.4	0.24	0.12	12.5
11/2/2009	Metz d/s	no	yes	0.3	0.7	0.13	0.1	4.5
11/2/2009	Powers	yes	yes	0.4	0.5	0.16	0.06	0.5
11/2/2009	Powers	no	yes	0.4	0.8	0.24	0.07	10.5
11/2/2009	Dick	yes	yes	0.3	2	0.08	0.06	11.5
11/2/2009	Dick	no	yes	0.3	2.3	0.1	0.06	21
11/19/2009	Metz u/s	yes	no	0.6	0.8	0.2	0.09	7.5
11/19/2009	Metz d/s	yes	no	0.5	0.8	0.14	0.09	4
11/19/2009	Powers	yes	no	0.5	0.4	0.09	0.07	4
11/19/2009	Dick	yes	no	0.3	1.2	0.12	0.06	3
11/19/2009	Dick duplicate	yes	no	0.3	1.3	0.12	0.05	2.5
11/19/2009	Metz u/s	yes	yes	0.2	0.4	0.2	0.13	184.5
11/19/2009	Metz u/s	no	yes	0.3	0.5	0.46	0.09	460.5
11/19/2009	Powers	no	yes	0.2	0.4	0.15	0.12	7.5
11/19/2009	Dick	yes	yes	0.3	1.7	0.22	12	17
11/19/2009	Dick	no	yes	0.2	2.2	0.14	0.11	6

Summary of all Fish Data for 2009

Species	**Site 5**	**Site 6**	**Site 1**	**Site 2**	**Site 3**	**Site 4**
Bass-Sm Mouth	3	1	21	10	2	3
Bluegill	4			9	1	6
Pumpkinseed				1		
Chub-Creek	6	14	12	23	22	30
Dace-Blacksided		2			2	14
Darter-Blacksided	4	3				
Darter-Greensided		1				
Darter-Johnny	8	12	2		13	10
Darter-Orange Throat	5	6			25	14
Longear	1					
Minnow-Bluntnose		4				
Minnow-Central Mud	13	9	12	7	2	13
Golden Shiner				1		
Pirate Perch						4
Mottled Sculpin	12	23			9	19
Stoneroller	8	12	1	11	6	5
Sucker-Common White	13	7		4		1
Sucker-Golden Redhorse	6	2				
Northern Hogsucker	1					
Sunfish-Green	5	1		6	2	3
	89	97	48	72	84	122

21 species

- 5 Centrarchids
- 3 Catastomids
- 4 Percidae
- 6 Cyprinids
- 3 Other families

Dominant Species [>10%]

- Creek Chubs
- Sculpins
- Mudminnows

Macroinvertebrate Data for 2009

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Thienemannimyia spp.	29	17	22	16	5	3
Brillia spp.			1			
Cardiocladius obscurus		1				
Cricotopus bicinctus		3	1		2	
C. tremulus						6
C. trifascia		1				
Eukiefferiella claripennis	2		1	2	2	
Orthocladius obumbratus			1	1		
Thienemanniella xena				1		
Cryptochironomus fulvus	4					3
Microtendipes caelum		3	3			32
Phaenopsectra flavipes			2			15
Polypedilum convictum	17	2	7	3	9	
Parathanytarsus spp.		2	1			
Ceratopogonidae			1			
Tabanidae	1			2		
Simulium spp.	6	6	4		16	
Tipula spp.			1			
Pseudolimnophila spp.				1		
Baetis flavistriga	1		4		7	1
B. amplus			1			
Caenis spp.			1	2		9
Stenacron interpunctatum			1			
Tricorythodes spp.						10
Cheumatospyche spp.	2	8	33	30	19	4
Ceratopsyche bifida				2		
C. slossonae					7	
Hydropsyche betteni					1	2
Perlesta spp.			4	6		
Hydrophilidae	1		1			
Stenelmis spp.	8	47	8	33	21	
Dubiraphia spp.	6	2				6
Optioservus		5		1	7	
Hetaerina spp.	3					
Lirceus spp.						1
Amphipoda					3	
Decapoda		3				2
Oligochaeta	9		2			4
Physella spp.	7					1
Sphaeridae	4				1	1
Total	100	100	100	100	100	100

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
# genera	15	12	20	13	13	16
#mayfly taxa	1	0	4	1	1	3
# caddisfly taxa	1	1	1	2	3	2
#dipteran taxa	6	8	12	7	5	5
% tanytarsid	0	2	1	0	0	0
%mayfly	1	0	7	2	7	20
%caddisfly	2	8	33	32	27	6
% tolerant	16	3	3	0	2	5
%non-tanytarsid	79	36	46	26	38	68
% dominant	29	47	33	33	21	32

# genera	4	2	4	2	2	4
#mayfly taxa	0	0	2	0	0	2
# caddisfly taxa	2	2	2	2	2	2
#dipteran taxa	2	4	4	2	2	2
% tanytarsid	0	2	2	0	0	0
%mayfly	2	0	2	2	2	4
%caddisfly	2	2	6	6	6	2
% tolerant	4	6	6	6	6	6
%non-tanytarsid	0	4	2	4	4	0
% dominant	4	0	2	2	4	2
score	20	22	32	26	28	24
standardized score	33	37	53	43	47	40