Huntington River Water Quality Study – 2016

Summary of Findings

The summer of 2016 marked the 10th year of Huntington River Conservation Partnership (HRCP) water quality monitoring, and the 12th year on the Huntington portion of the river. With laboratory support from a Vermont Dept. of Environmental Conservation Larosa Grant, a large number of volunteers from Huntington and Richmond sampled specified locations along the length of the Huntington River on a weekly basis for bacterial contamination by *E. coli*.

- The number of samples above Federal Standard (pink) and the old State Standard (pink plus yellow) and their clustering were within the observed historic range and pattern. Results remained consistent with runoff being a major contributor to contamination.

- Contamination for a given date was variable with no consistent pattern as one moved down stream. Occasional, inconsistent spikes leaves room for possible sporadic point sources of contamination, as found before.

- The daily pattern of peaks and valleys generally was similar to that in past years, again suggesting runoff as a key contributor.

- There was no obvious relationship between 12 and 24 hour rainfall prior to sampling and overall Geomean. A strong relationship was found using rainfall over the 48 hr. before sampling due to significant rainfall occurred in the 24-48 hr. window. This result is different from that which generally has been observed in prior years, where the 0-24 hr. relationship has been stronger.

- Any relationship between rate of change in water level compared with overall river Geoman was all but entirely due to a single pair of high values. No noteworthy relationship existed when the comparison was with E. coli contamination at Horseshoe where water level was measured.

- Results for 8/17 were noteworthy, with an 8-fold change in river level over the 12 hr. prior to sampling. The River was running very high and with high turbidity due to significant upstream rainfall. However, though there was significant rainfall as well in the Huntington – Richmond area, most feeder streams were clear and not over-flowing. A possible explanation is the recharging of severely depleted groundwater from summer drought conditions.

- Tributary Hollow Brook was sampled weekly based high values in previous years. High values were recorded on all but one date with the overall season Geomean exceeding Standard. Parallel samples taken on two occasions upstream recorded lower values, suggesting a point source for contamination. More study is required.

The recommendation from past results remains in place, to avoid river use after major rainfall.

Overall Results

What follows is a summary of the results from the 2016 Huntington River Water Quality study. The reader is encouraged to review the 2006 and 2007 Reports for discussion of definitions, methods, Standards and other background material. Past Reports can be found at: www.huntingtonriver.org

E. coli is considered a sentinel for fecal contamination, indicating the possible presence of human pathogens. The presence of pathogenic *E. coli* itself or other human pathogens has not been observed to date.

Funding constraints meant that the weekly sampling sites along the River were reduced to twelve. Monthly samples continued to be taken from feeder streams on a rotating basis, excepting Hollow Brook, a River feeder, which was sampled weekly. As for 2015, samples were taken over ten weeks as compared to 13 weeks in prior years for studies of the Huntington plus Richmond segments of the River.

Figure-1 shows the sampling locations for the main study sites. One site, Hollow Brook, was added based on assessment in 2015 indicating very high values and suggesting a possible point source(s).

Table 1 presents the complete 2016 data set. Data entries are color-coded indicating values exceeding the Federal Standard (pink: 235, measured as *E. coli* / 100 ml). Beginning in 2012, the State standard was adjusted upwards from 77, to the Federal Standard of 235. Values between 77 and 235 are colored in yellow to allow comparisons with years past when that was the State Standard. **Tables 2 and 3** provide yearly comparisons with results from previous years.

Similar to past years, samples above Standard mostly were clustered (7/19, 8/17) with some clustering on a third (8/2). A potential cause based on results from past years was significant rainfall the 48 hr. period before samples were taken (see below). The total number of samples above the Federal Standard (pink) and the old State Standard (pink plus yellow) was close to the average since the study began, bearing in mind there were fewer sampling sites (**Table 3**). The Geomean for a given date was above the Federal / current State Standard on two occasions (7/19, 8/17, **Table-1**). The overall Geomean for each weekly site exceeded the Federal / new State Standard for one site (Hollow Brook) (**Table 1**).

No samples taken on a rotating monthly basis were above current Standard (**Table 1**).

Quality Assurance

For 2016, 113 regular *E.coli* samples were submitted. Twelve additional samples (10.6%) were taken as quality assurance field duplicates (**Table 4**). The VTDEC Laboratory quality assurance objectives for *E. coli* on Quanti-tray are the following: <25 colonies, 125% relative percent difference (%RPD); >25 colonies, 50% RPD. Overall, the mean %RPD was 26.8%. This is within VTDEC objectives for QA duplicates, though one individual duplicate comparisons exceeded the QA objectives (Hollow Brook).

Figure 2 examines contamination by date. (Hollow Brook was excluded as a feeder stream.) Geomean values by-in-large were below Standard for most days (enlarged red symbols for those

above Standard). The exceptions were 7/19 and 8/17, where above Standard were measured in most (7/19) or all (8/17) samples.

The patterns for a given date were highly variable. In some cases, there was a trend towards increasing values as one moved down stream (e.g. 7/19, 8/2, 8/17) though that pattern was not consistent through the sampling season. There were occasional high value peaks (e.g. 7/12, 8/9, 8/23, 8/30). Again, however, no seasonal consistency for a given site, leaving the possibility of sporadic point sources unresolved. Such spikes have been observed in the past and may illustrate how dilution, bactericidal activity and / or other, unknown factors cause significant reductions in contamination further down river. The short life-span of viable *E. coli* once it leaves the animal digestive tract is well-known.

Excepting the overall Geomean value for Carse Bridge, there was no indication of increasing values as one moved down river **Figure 3.1**. Indeed, it is difficult to recognize a specific pattern when previous results are compiled (**Figure 3.2**).

Figure 4.1 examines each dates at individual sites. **Figure 4.2** shows the same on a contracted scale to allow comparison of the pattern of low values. Again, larger, red triangles indicate values above Standard. Generally speaking, the pattern of peaks and valleys was similar in between-site comparisons. This suggests that some general contributor such as runoff was affecting each site.

Figure 4.3 presents the data for Hollow Brook, a tributary sampled weekly, high values having been observed in previous years with monthly sampling (**Figure 4.4**). High values were recorded on all but one occasion (8/30) with the result that the overall season Geomean for that site exceeded Standard. Noteworthy, parallel samples taken on two occasions upstream on Hollow Brook recorded low values, suggesting a point source for contamination (235.9 vs 488.4 for 7/12; 178.5 vs 261.3 for 8/23). More study is required to confirm this conclusion.

Past results have suggested that high levels of contamination follow heavy rains, interpreted to indicate contamination from runoff. This was based on significant rain in the hours before sampling and the co-occurrence of high levels of contamination at multiple sites along the river. As shown in **Figure 5**, there was no obvious relationship between 24 hour rainfall and overall Geomean for the day in 2016. At the same time, a strong relationship was calculated using rainfall over the 48 hr. before sampling. This was because of the several cases in which significant rainfall occurred in the 24-48 hr. window prior to sampling (see below). This pattern was different from what has been observed in prior years, where the 0-24 hr. relationship was better. As before, interpretation is confounded by the number of observations where there was little or no rainfall.

As shown in **Figure 6.1**, an apparent strong relationship between river level and overall Geomean contamination was dependent on an extreme value for both water level and Geomean and hence untrustworthy. Indeed, the correlation was weak at best when it was made between water level and E. coli contamination both measured at Audubon Horseshoe, even when all values were included.

Half hourly measurement of water level were made for the fourth year running, made possible by a donation of continuous data-logging equipment by the US EPA. **Figure 6.2** shows the pattern of change in river level the 48 hours before sampling (RED triangles indicate 48, 24, 12 hr. prior to sampling, plus sampling time). The curves were flat on several dates, notable exceptions being 7/19, 8/23 and 8/17. Most or all samples were above Standard for 7/19 and 8/17.

The 8/17 contour was most unusual. Note the change in the vertical scale in **Figure 6.2**. River level changed 8-fold over the 12 hr. prior to sampling. The Huntington River was running very high and with high turbidity. Road washouts had occurred in Hanksville and to the east in Duxbury. Though there was significant rainfall as well in the Huntington – Richmond area the day before samples were taken, most feeder streams were clear and not over-flowing. Related, no meaningful change occurred in the Gillett Pond water level. Unfortunately, no samples were taken in feeder streams on that date. A possible explanation is that severely depleted groundwater from summer drought conditions meant insignificant local runoff.

The apparent relationship between rate of change in water level when water level was compared with overall river Geoman, once again, was due to a single pair of high values (**Figure 6.3.1** - Red symbols indicate when water level was falling – see **Figure 6.2**). The relationship was poor when E. coli contamination at Horseshoe, where water level was measured, was the metric rather than overall River Geomean.

A factor to bear in mind when interpreting results based on water level change is that the amount of level change often was been small (**Figure 6.2**) as also has been the case in past years. More data are required to strengthen the view that a true relationship exists when level change is substantial.

As shown in **Figure 6.3.2**, the relationship for 12 hr. and 24 hr. compiled over all of the years measurements have been made (2014-2016) for Overall Geomean vs Water Level is dependent on a single high pair of values. The correlation for 48 hr. is more robust, being determined by a more complete range of values.

Shown in **Figure 6.3.3**, the relationship between E. coli contamination and Water Level change, both measured at Audubon Horseshoe, was dependent on a limited number of high values, as for the Geomean comparison, with no meaningful realtionship at 24 hr. and nonexistent at 48 hr.

Though it is true that levels were falling a number of the times, there was no obvious difference between the impact of rising vs falling levels (not shown). Presumably, a recent runoff event is signified in both cases.

Box Plots - Variability

Geomeans again were computed for data analysis, because of the wide range of values and the fact the data are not normally distributed (see 2006 and 2007 Reports for further explanation). The spread of values is illustrated by the use of "box plots" (**Figure 7)**. Box plots are often used to assess the variability in the data. The intent is to compare values for a specific site and not to make comparisons between sites. Hence the vertical axis scale is not the same for each site: using the same scale makes it difficult to observe the data distribution in certain cases.

All but two River sites (Audubon Horseshoe, Cochran Bridge) had one outlier. Past results, as well, have been characterized in general by a preponderance of sites with outliers. Caution must be exercised in interpreting results from a statistical point of view.

Hollow Brook had no outliers, though the high E coli counts and range of values should be noted.

Thanks to all the volunteers

Many thanks to all the volunteers whose efforts made the study possible. It was their effort over the years that caused the Huntington River to have continued to be chosen to be surveyed by the State and to be supported through State and Federal funding. All should be proud of the effort and result.

Those interested in learning more about the Huntington River project should go to: http://www.huntingtonriver.org

HUNTINGTON RIVER E. COLI STUDY RESULTS - 2016

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Table 1

	6/28/2016	7/5/2016	7/12/2016	7/19/2016	7/26/2016	8/2/2016	8/9/2016	8/17/2016	8/23/2016	8/30/2016	GEOMEAN	Mean	Median
Carse Bridge	21.33	9.79	49.59	108.6	41.65	53.92	7.45	344.11	25.9	11.99	**33.91**	67.4	33.78
Shaker Mtn	179.34	131.35	122.29	178.9	54.48	53.71	26.21	325.54	53.71	17.31	**80.87**	114.3	88.39
Spence Bridge	146.72		67.66	235.93	153.86	93.26		290.93	44.34	24.91	**100.97**	132.2	119.99
Bridge Street	166.95	61.98	260.25	248.9	129.63	238.22	101.93	648.82	39.31	18.69	**125.96**	191.5	148.29
Audubon Horseshoe	95.9	65.65	101.44	410.58	40.2	114.46	156.48		48.08	53.81	**92.35**	120.7	95.90
Audubon Hemlock	81.62	40.77	67.01	461.11	42.57	101.44	325.54	920.84	275.51	32.67	**128.19**	234.9	91.53
Hollow Brook	2419.57	866.44	488.44	461.11	517.21	1986.29		>2419.6	261.25	178.53	**622.76**	897.4	502.83
Moultrop Bridge	98.54	38.25	172.33	517.21	52.01	193.49	325.54		114.46	39.31	**119.45**	172.3	114.46
Yaggy	44.12	86	95.94	488.44	63.14	307.59	39.86	1299.65	40.2	48.74	**113.36**	251.4	74.57
Triple Buckets		131.35	73.28	313.01	44.55	248.9	34.51		32.25	78.8	**85.77**	119.6	76.04
Chalet Trail	63.14	98.67	83.61	461.11	79.76	186	15.79	1203.33	41.65	46.22	**102.68**	227.9	81.69
Cochran Bridge	60.86	65.65	82.61	235.93	75.41	201.42	10.78	2419.57	34.54	307.59	**112.60**	349.4	79.01
GEOMEAN	**110.4**	**76.4**	**109.5**	312.18	**75.7**	**176.0**	**48.8**	721.80	**59.0**	**44.8**	**113.53**		
Water level	0.819	0.837	1.039	1.122	0.856	0.864	0.754	3.381	1.102	0.693			
Values are mpn / 100 ml	Above Federal level (235)										**114**		
	Above State Level (77)									**Richmond**	**106**		

Monthly Samples	**28-Jun**		**12-Jul**				**9-Aug**			
Texas Hill Brook	108.00		49.59				17.31			
Fargo Brook	107.00						9.79			
Brushy Brook	105.00		44.79							
Carpenter Brook	104.00									
Cobb Brook	103.00		9.69							
7 Falls	1.00									

Duplicates	**6/28/2016**	**7/5/2016**	**7/12/2016**	**7/19/2016**	**7/26/2016**	**8/2/2016**	**8/9/2016**	**8/17/2016**	**8/23/2016**	**8/30/2016**
Carse Bridge	14.8									
Shaker Mtn		201.42								
Spence Bridge				344.8						
Bridge Street					152.86					
Audubon Horseshoe							230.98			
Audubon Hemlock								1119.87		
Moultrop Bridge			160.71							
Yaggy					76.65					
Gorge										
Triple Buckets										
Chalet Trail							11.99	1203.33		
Cochran Bridge										
Texas Hill Brook										
Fargo Brook										
Hollow Brook			235.93						178.53	
Brushy Brook										
Carpenter Brook										
Cobb Brook										
7 Falls										
Floating										
Hollow Brook Culvert 2		20.11		36.84						
Gorge	16	81.62								

Overall Results Composite - 2005-2016

Table 2

2004

Site	6/21/2004	6/28/2004	7/6/2004	7/12/2004	7/19/2004	7/26/2004	8/2/2004	8/9/2004	8/17/2004	8/23/2004	8/30/2004	9/7/2004	9/13/2004	9/20/2004	9/27/2004	2004 GeoMean
Sheldrake	73	13	261	30	93	64	24	12	50	18	126	26	21	19	4	33.0
Shaker Mtn	36	47	517	52	160	50	39	17	34	16	109	17	21	15	4	36.8
Brace Br	55	25	548	46	326	49	53	31	50	17	93	727	23	26	11	58.8
Spence Br	166	63	866	44		80		31	51	56	124	135	34	20	13	65.6
East St	50	17	816	50	240	72	104	39	93	60	326	37	28	24	23	67.1
Bridge St	72	18	579	45	308	47	141	23	61	93	194	40	45	13	13	60.6
Cemetery	71	25	461	50	299	42	111		56	33	248	23	365		13	76.1
dub Horse	113	43	649	39	488	26	192	30	105	22	150	24	31	25	10	60.8
dub Hemlo	78	19	816	50	517	48	204	36	75	23	261	28	20	16	11	60.2
GeoMean	72.3	26.3	579.6	44.6	268.5	50.7	86.6	26.7	60.6	30.9	165.3	48.4	35.9	19.2	10.0	

2005

	6/22/2005	6/29/2005	7/6/2005	7/13/2005	7/20/2005	7/27/2005	8/3/2005	8/10/2005	8/17/2005	8/24/2005	8/31/2005	9/7/2005	9/14/2005	9/21/2005	9/28/2005	2005 GeoMean
7 Falls	131	30	117	98	26	95	39	25	9	37	1120	9	9		17	42.1
Cases Bridge	228	38	276	43	96	182	42	866	41	84	2419.6	37	8	18	18	81.6
Sheldrake	261	48	291	45	137	172		19	24	44	980		517	16	33	[illegible]
Brant Field	272	70	276	210	115	231	50	88	31	40	1200	34	33	9	921	[illegible]
Shaker Moun	461	66	276	69	69	167	816	40	90	53	1550	88	63	20	44	113.4
Rec. Field	579	105	[illegible]	43	144	261	69	37	21	980	2419.6		46	18	51	[illegible]
Brace Bridge	613	83	308	24	101	291	66	35	19	572	2419.6		93	28	34	[illegible]
Spence Bridge	816	99		61	71	411	95	35	18	58	[illegible]	397	141	23	54	114.8
East Street	488	85	1120	45	68	276	63	32	43	71	2419.6	228	66	34	24	114.0
Bridge Street	770	80	[illegible]	38	90	[illegible]	79	46	55	206	687	222	83	33	31	[illegible]
Cemetery	387	101	921	47	166	613	95	52		153	2419.6	166		33	40	167.1
Audubon Hor	147	132	1200	62	137	365	71		37	95	579	192	88	30	37	123.7
Audubon Her	131	68	1730	63	83	401	77	112	37	112	435	192	125	24	29	115.2

2006

	20-Jun-06	27-Jun-06	5-Jul-06	11-Jul-06	18-Jul-06	25-Jul-06	1-Aug-06	8-Aug-06	14-Aug-06	22-Aug-06	29-Aug-06	5-Sep-06	12-Sep-06	18-Sep-06	GEOMEAN
Sheldrake	114	118	56	172	48	50	[illegible]	[illegible]	10	[illegible]	22	14	24	19	[illegible]
Shaker Mount	152	179	56	79	60	58	[illegible]	[illegible]	18	71	22			12	[illegible]
Brace Bridge	86	249	43	79	40	102	[illegible]	[illegible]	68	[illegible]	36	60	21	20	[illegible]
Spence Bridge	125	186	28	68	126	86	[illegible]	[illegible]		[illegible]		36	32	8	[illegible]
East Street		172	38	61	179		110	[illegible]	22	78	31	37	22	43	[illegible]
Bridge Street	130	229	57	69	201	57	131	[illegible]	18	[illegible]	26	26	14	28	[illegible]
Cemetary	144	214	55	52	172	59	111	[illegible]	22	72	28	20	15	22	[illegible]
Audubon Hor	178	387	49	36	118	82	[illegible]	[illegible]		51	58	22	18	18	[illegible]
Audubon Her	112	387	50	56	[illegible]	111	[illegible]	[illegible]	23	98	20	37	17	13	[illegible]
Moultroup Bri	186	309	48	28	91	55	[illegible]	[illegible]	22	[illegible]	25	20	13	12	[illegible]
Dugway West	192	461	55	181	93	63	[illegible]	[illegible]	36	107	22	1730	8	44	[illegible]
Yaggy	173	461	60	140	105	86	[illegible]	[illegible]	21	102	51	133	12	49	[illegible]
Gorge	183	326	98	138	68	74	[illegible]	[illegible]	18	[illegible]	31	77	15	34	[illegible]
Triple Buckets	291	387	86	210	56	72	[illegible]	[illegible]	11	121	16	61	13	28	[illegible]
Chalet Trail	385	313	91	108	69	62	[illegible]	[illegible]	17	102	19	38	11	22	[illegible]
Cochran Bridge	411	461	72	130	55		[illegible]	[illegible]	20	[illegible]	20	66	24	43	[illegible]
Winooski Jonesville					105	172	131	[illegible]	30	[illegible]	101	63	142	14	[illegible]
Winooski Bridge St					67	121	111	[illegible]	18	[illegible]	98	72	105	12	[illegible]
GEOMEAN	173	260	56	87	91	76	[illegible]	[illegible]	21	[illegible]	31	61	20	21	

2007

	6/18/2007	6/26/2007	7/2/2007	7/9/2007	7/16/2007	7/23/2007	7/30/2007	8/6/2007	8/13/2007	8/20/2007	8/27/2007	9/4/2007	9/10/2007	9/17/2007	GEOMEAN
Cases Bridge	74	62	68	[illegible]	[illegible]	[illegible]	46	69	[illegible]	[illegible]	23	38	[illegible]	39	[illegible]
Shaker Mtn	98	50	136	[illegible]	[illegible]	[illegible]	68	61	[illegible]	260	79	7	214	30	[illegible]
Brace Bridge	71	68	68	[illegible]	[illegible]	[illegible]	68	69	[illegible]	[illegible]	23		162	[illegible]	[illegible]
Spence Bridge	75	40	26	[illegible]	[illegible]	[illegible]	106	34	[illegible]	[illegible]	29		249	[illegible]	[illegible]
East Street	[illegible]	41	38	[illegible]	[illegible]	[illegible]	67	20	[illegible]	[illegible]	411	33		[illegible]	[illegible]
Bridge Street	127	26	67	[illegible]	[illegible]	[illegible]	71	26	[illegible]	7	1300		517	41	[illegible]
Cemetery	70	40	52	[illegible]	[illegible]	[illegible]	62	22	[illegible]	13	35	28	[illegible]	[illegible]	[illegible]
Audubon Hor	111	48	201	[illegible]	[illegible]	[illegible]	44	22	[illegible]	7	13		687	[illegible]	[illegible]
Audubon Her	58	28	41	[illegible]	[illegible]	[illegible]	24	11	[illegible]	16	7	21	435	[illegible]	[illegible]
Moultrop Bridge	78	67	48	[illegible]	[illegible]	[illegible]	39	23	[illegible]	[illegible]	14	17	387	[illegible]	[illegible]
Above Owl's Head				[illegible]	[illegible]	[illegible]	69	29	[illegible]	178			548	[illegible]	[illegible]
Dugway West	192	193	99	[illegible]	[illegible]	[illegible]	68	34	[illegible]	131	43	68	649	[illegible]	[illegible]
Yaggy	130	185	98	[illegible]	[illegible]	[illegible]	69	31	[illegible]	[illegible]	53	29	770	[illegible]	[illegible]
Gorge	133	291	83	[illegible]	[illegible]	[illegible]	60	23	[illegible]	[illegible]	36	29	727	[illegible]	[illegible]
Triple Bucket	99			[illegible]	[illegible]	[illegible]	32	27	[illegible]	[illegible]		11	281	[illegible]	[illegible]
Chalet Trail	74	192	61	[illegible]	[illegible]	[illegible]	26	18	[illegible]	[illegible]	18	5	197	[illegible]	[illegible]
Cochran Bridge	83	201	142	[illegible]	[illegible]	[illegible]	29		[illegible]	214	11		299	[illegible]	[illegible]
Winooski Jon	36	44	27	[illegible]	168	[illegible]	172	5	[illegible]	[illegible]	58	9	579	[illegible]	[illegible]
Winooski Bric	81	41	43	[illegible]	210	[illegible]	326	38	[illegible]	[illegible]	35	42	548	218	[illegible]
GEOMEAN	93.5	74.6	89.1	[illegible]	[illegible]	[illegible]	49.5	28.3	[illegible]	40.7	37.9	19.9	386.3	[illegible]	[illegible]

2008

	7/10/1900	6/30/2008	7/7/2008	7/14/2008	7/21/2008	7/28/2008	8/4/2008	8/11/2008	8/18/2008	8/25/2008	9/2/2008	9/8/2008	9/15/2008	9/22/2008	GEOMEAN
Cases Bridge	[illegible]	93	128	488	186	41	77	45	56	[illegible]	117	[illegible]	53	23	74
Shaker Mtn	[illegible]	116		488				55	86	[illegible]	18	[illegible]	105	20	[illegible]
Brace Bridge	[illegible]	142	91	488	138	167	86	236	45	[illegible]	49	[illegible]	50	15	[illegible]
Spence Bridge	[illegible]	152	122	770	147	167	111	61	40	[illegible]	26	[illegible]	56	35	[illegible]
East Street	[illegible]	291	96	1300	153	365	111	38	41	[illegible]	[illegible]	[illegible]	579	49	[illegible]
Bridge Street	[illegible]	166	72	1550	261	345	117	45	46	[illegible]	135	[illegible]	816	34	[illegible]
Cemetery	[illegible]		96	422	308	225	121	48	46	[illegible]	40	[illegible]	66	41	[illegible]
Audubon Hor	[illegible]	112	125	1550	345	205	88	54	56	[illegible]	31	[illegible]	56	46	[illegible]
Audubon Her	[illegible]	152	93	1730	365	193	93	66	30	[illegible]	35	[illegible]	45	40	[illegible]
Moultrop Bridge	[illegible]	123	199	2420	328	276	91	55	30	[illegible]	20	[illegible]	34	16	[illegible]
Dugway West	[illegible]	144	179	2420	219	167	82	76	488	[illegible]	39	[illegible]		19	[illegible]
Yaggy	[illegible]	186	155	[illegible]	687	205	96	74	99	[illegible]	29	[illegible]	62	11	[illegible]
Gorge	[illegible]	308	93	2420	411		63	68	41	[illegible]	17	[illegible]		12	[illegible]
Triple Buckets	[illegible]	152		2420	411	199	119	77	33	[illegible]	16	[illegible]	40	4	99
Chalet Trail	[illegible]	148	99	2420	272	278	166	52	25	[illegible]	9	[illegible]	50	3	97
Cochran Bridge	[illegible]	162	52	2420	488	411	93	66	31	[illegible]		[illegible]	55	60	74
Winooski Jon	[illegible]	132	18		2420	299	210	1553	63	[illegible]	19	[illegible]	59		[illegible]
Winooski Rich	[illegible]	199	54	613	1990	291	345		98	[illegible]	15	[illegible]	133	66	[illegible]
GEOMEAN	[illegible]	156	92	1259	362	214	111	75	53	[illegible]	29	[illegible]	79	22	[illegible]

2009

	[illegible]	[illegible]	7/14/2009	7/21/2009	7/28/2009	8/4/2009	8/11/2009	8/18/20089	8/25/2009	9/1/2009	9/8/2009	9/16/2009	9/22/2009	9/29/2009	GEOMEAN
Cases Bridge		[illegible]	78.41		196.9	23.07	218.72	224.68	35		10	68	11	10.89	60
Shaker Mtn	95.99	[illegible]	66.31	66.95	44.1	[illegible]	770.1	27.81	35.9	9	12		23.07	55.9	48
Brace Bridge	108.6	[illegible]	98.81	53.8	44.8	[illegible]	547.5	[illegible]	54.6	39	16	727	11		[illegible]
Spence Bridge	108.07	[illegible]	50.41	38.39	66.9	[illegible]	1203.33	54.48	21.6	75	12	276	10.89		[illegible]
East Street	193.49	[illegible]	[illegible]	[illegible]	71.7	60.86	461.11	53.81	47.9	37		107	[illegible]	41.95	89
Bridge Street	151.52	111.9	127.4	[illegible]	81.6	72.27	2419.6	49.54	[illegible]	67	17	56	30.89	34.05	80
Cemetery	201.42	117.8	81.62	[illegible]	46.5	65.04	410.58	53.81	52.9	25	30	172	[illegible]	37.86	66
Audubon Hor	[illegible]	111.9	24.62	[illegible]	51.2	60.53	172.33	51.21	[illegible]	52	22	84	64.47	76.34	62
Audubon Hen	142.09	[illegible]	52.91	50.41	83.9	64.61	[illegible]	74.91	69.7	27	19	115	8.6	56.53	55
Moultrop Bridge	172.47	[illegible]	41.66	43.47		73.28	65.04	58.63	62	36	9		8.6	48.74	45
Dugway West	196.9	[illegible]	[illegible]		56.6	61.27	68.78	[illegible]	31.4	31	29	214	9.79	55.55	56
Yaggy	307.59	142.1	[illegible]	74.91	67.7	[illegible]	34.51	49.59	79.4	36	20	112	13.36	71.73	59
Gorge		[illegible]	44.12	60.86	62.7	[illegible]	[illegible]	47.11	35	22	16		4.09	71.16	38
Triple Bucket		165.5	52.04	34.51	67.7	60.15	29.54	38.93	22.6	12	16	158		32.67	42
Chalet Trail	298.66	[illegible]	[illegible]	58.08	56.1	[illegible]	37.86	24.33	23.1		9	222	3.04	69.8	43
Cochran Bridge	261.25	[illegible]	[illegible]	56.33	48.8	90.49	20.11	[illegible]	[illegible]	38	16	121	22.55	114.46	58
Winooski Jon	960.51	[illegible]	[illegible]	37.86	54.6	235.93	40.2	[illegible]	44.3	76	46	71	5.21	329.16	75
Winooski Rich		[illegible]	98.54	48.74	45.7	146.72	46.54	25.59	52.1	76	8		19.05	207.54	[illegible]
GEOMEAN	199	[illegible]	63	63	63	65	135	50	41	35	16	139	12	60	56

2010

	6/29/2010	7/6/2010	[illegible]	7/20/2010	7/27/2010	[illegible]	[illegible]	8/17/2010	8/24/2010	8/31/2010	9/7/2010	9/14/2010	9/21/2010	GEOMEAN
Cane Bridge	159	70.83	39.86	78.94	74.3	[illegible]	[illegible]	11.79	23.07	8.26	11	20.11	2.01	[illegible]
Shaker Mtn	43	25.3	63.41	40.44	88.47	[illegible]	[illegible]	166.4	48.59	24.82	83.29	20.34	29.78	54
Brace Bridge	39	62.44	47.87		64.37	[illegible]	[illegible]	148.32	410.58	21.57	78.94	37.88	14.49	[illegible]
Spence Bridge	69	67.66	[illegible]	68.33	47.25	[illegible]	[illegible]	83.29	178.21	10.63	178.9	28.47	20.64	68
East Street	62	32.67	[illegible]	59.8	54.61	[illegible]	218.72	69.68	34.05	41.65	65.68	34.98	18.9	[illegible]
Bridge Street	102	48.74	[illegible]	113	166.95	[illegible]	214.28	70.27	57.31	66.31	44.34	39.31	19.89	82
Cemetery	59	80.88	[illegible]	129.08	[illegible]	[illegible]	[illegible]	75.41		48.74	25.9	31.84	16.69	76
Audubon Hon	61	50.41	119.83	83.92	83.92	[illegible]	[illegible]	53.71	39.31	24.33	[illegible]	29.31	27.51	72
Audubon Hen	67	49.54	[illegible]	110.61	[illegible]	[illegible]	[illegible]	44.12	48.82	34.05	27.65	31.45	35.45	[illegible]
Moultrop Bridge			[illegible]	107.58	46.38	[illegible]	[illegible]	43.71	[illegible]		16.13	33.61	24.91	74
Dugway West	107	77.12	[illegible]	101.68	75.89	[illegible]	[illegible]	29.17	54.61	14.64		29.17	17.31	[illegible]
Yaggy	[illegible]	59.4	[illegible]	86.24	88.28	[illegible]	[illegible]	27.65	47.11	20.11	12.23	22.3	16.94	68
Gorge	105	51.22	[illegible]	90.63	63.14	[illegible]	[illegible]		47.98	21.33	14.64	13.38	13.38	[illegible]
Triple Buckets	99		[illegible]	83.92	34.05	[illegible]	[illegible]	25.3	36.41	34.84	8.2	15.96	15.79	52
Chalet Trail	135	30.51	[illegible]		31.45	[illegible]	[illegible]	20.34	[illegible]	14.64	7.36			[illegible]
Cochran Bridge	93	53.81	[illegible]	79.36	38.39	1203.33	[illegible]	24.33	54.48	30.51	40.2	13.23	7.45	63
Winooski Jon	[illegible]	19.89	32.25	49.59	65.68	[illegible]	[illegible]	[illegible]	81.28	18.83	26.21	18.89	21.82	[illegible]
Winooski Rich	2420	31.84	[illegible]	45	40.2	[illegible]		47.98	137.35	26.21	41.35	30.51	22.81	60
GEOMEAN	123.3	47.1	[illegible]	78.7	59.6	[illegible]	279	45	59	24	29	26	17	[illegible]

2012

	6/25/2012	7/2/2012	7/9/2012	7/16/2012	7/23/2012	7/30/2012	8/6/2012	8/13/2012	[illegible]	8/27/2012	9/4/2012	9/10/2012	[illegible]	GEOMEAN
Cane Bridge	209.82	33.1	17.12	307.59	182.42	29.4	[illegible]	20.11	[illegible]	113	24.62	19.89	[illegible]	42
Shaker Mtn	165.4		24.82	98.78	19.89	26.55	[illegible]	35.46	13.6	20.11	25.3		21.81	41
Brace Bridge	[illegible]	25.9	36.84	178.9	66.31	133.44	[illegible]	45.68	[illegible]	165.01	60.15	[illegible]	[illegible]	[illegible]
Spence Bridge	517.21	63.14	37.86	151.52	[illegible]	48.74	[illegible]	80.53	[illegible]	139.58	9.69	[illegible]	22.81	[illegible]
East Street		52.08	57.31	160.71	65.04	35.92	[illegible]	55.39	[illegible]	101.44		[illegible]	[illegible]	[illegible]
Bridge Street	435.17	52.04	39.86	185.76	34.51	27.85	[illegible]	54.61	12.11	143.87	23.78	[illegible]	[illegible]	[illegible]
Cemetery		75.41	48.82	123.56	33.1		[illegible]	51.22	[illegible]	143.87		[illegible]	[illegible]	[illegible]
Audubon Hon	866.44	47.25	52.84	80.86	30.13	35.92	[illegible]	52.81	34.05	123.56	60.15	[illegible]	[illegible]	71
Audubon Hen	488.44	58.33	60.15	87.66		38.77	[illegible]	50.39	[illegible]		19.48	[illegible]	[illegible]	[illegible]
Moultrop Bridge	344.8	52.01	80.88	166.95	193.49	34.05	[illegible]	50.41	[illegible]	18.69	34.98	[illegible]	[illegible]	71
Dugway West	[illegible]	63.67	61.98	83.61	387.32	[illegible]	[illegible]	49.54	[illegible]	42.84	90.63	[illegible]	[illegible]	[illegible]
Yaggy	224.66	88.59	82.9	78.94	201.42	61.27	[illegible]	61.55	[illegible]	24.05	61.27	[illegible]	[illegible]	[illegible]
Gorge		78.94	86.59		218.72	37.44	[illegible]	88.28	[illegible]	21.57	48.82	[illegible]	[illegible]	[illegible]
Triple Buckets		51.21		93.22	24.33	41.08	[illegible]	61.98	13.38	25.59	32.67	[illegible]	[illegible]	[illegible]
Chalet Trail	[illegible]		68.88	61.98	37.88	37.86	[illegible]	65.65	[illegible]	23.78	17.49	[illegible]	[illegible]	[illegible]
Cochran Bridge	461.11	50.39	100.82	101.22		178.9	[illegible]	96.31	125.91	44.34	2419.57	[illegible]	[illegible]	133
Winooski Jon	29.54	360.87	39.31	8.32	13.23	49.54	[illegible]		[illegible]	14.49	6.28	[illegible]	[illegible]	[illegible]
Winooski Richmond		38.77	24.91	37.34	23.78	95.94	[illegible]	248.9	[illegible]	19.89	27.18	[illegible]	[illegible]	[illegible]
GEOMEAN	338.6	53.9	50.9	116.2	116.2	45.3	[illegible]	53	22	56	45	[illegible]	6	
Conductivity	136	110	122.5	141.9	143	112.5	[illegible]	114.6	[illegible]	[illegible]	161.9	[illegible]	149.6	
Water temp	16.4	17.2	15.1	20.4	21	18.8	18.8	17.9	16.3	19.3	18.4	14.4	11.9	
Water level	0.59	0.71	0.63	0.38	0.39	1.00	[illegible]	0.82	0.56	0.45	0.41	[illegible]	0.48	

2013

	6/25/2013	7/2/2013	[illegible]	7/16/2013	7/23/2013	7/30/2013	8/6/2013	8/13/2013	8/20/2013	8/27/2013	9/3/2013	[illegible]	GEOMEAN
Cane Bridge	770.10	435.17	[illegible]	235.93	325.54	59.4	17.49	20.86	17.12	186	77.12	[illegible]	[illegible]
Shaker Mtn	461.11	161.62	[illegible]	54.61	486.44	63.14		27.51	53.71	435.17	146.72	38.92	102
Brace Bridge	410.58	235.93	[illegible]	33.1	178.21	48.74	26.86	44.12	47.11	123.35	101.44		[illegible]
Spence Bridge	816.41	260.25	[illegible]	26.86	150.01	69.07	18.69	[illegible]	53.33	386.40	201.42	18.69	86
East Street	816.41	517.21	[illegible]	52.91	155.25	73.28		37.34	47.96	461.11	142.09	22.55	[illegible]
Bridge Street	791.53	272.30	[illegible]	52.04	146.72	116.19	25.59	51.21	52.08	816.41	129.63	34.98	109
Cemetery	1553.12	290.93	[illegible]		190.38	114.46	27.18		52.04	1119.87	151.52		174
Audubon Hon	1299.65	461.11	[illegible]	58.78	461.11	95.9	34.98	72.27	25.59	344.80	290.93	[illegible]	[illegible]
Audubon Hen	1986.29	365.40	64.47	61.27	116.02	151.52	34.98	28.47	17.31	307.59			110
Moultrop Bridge	1553.12	344.80	[illegible]	54.61	[illegible]	155	18.9		35.92	410.58	55.96	[illegible]	[illegible]
Dugway West		365.40	[illegible]	61.98	67.01	155.25		51.22	17.49	344.80	285.10	23.07	92
Yaggy	980.39	410.58	57.31	48.74	72.15	135.4	43.71	34.54	27.85	435.17	248.9	31.84	[illegible]
Gorge		365.40	[illegible]									24.33	75
Triple Buckets	239.23	488.44	[illegible]						12.11	122.29		17.49	[illegible]
Chalet Trail	1203.33		[illegible]	52.91	46.38		40.20			115.28	387.32		116
Cochran Bridge	1413.61	378.40	[illegible]	45.65	83.29	135.4	34.51			325.54	481.11	54.48	[illegible]
Winooski Jon	980.39	228.18	[illegible]	32.67		344.11	35.45				70.27		177
Winooski Richmond				31.29	68.88	307.59	50.39	161.62		60.88			[illegible]
GEOMEAN	[illegible]	342.4	[illegible]	55.3	55.3	98.2	28.1	38.8	31.6	324.3	173.9	25	

2014

	7/1/2014	7/8/2014	7/15/2014	7/22/2014	7/29/2014	8/5/2014	8/12/2014	[illegible]	8/26/2014	9/2/2014	GEOMEAN	Median
Cane Bridge	30.69	43.77	59.4	123.58	90.49	24.05	8.32	[illegible]	1.00	8.60	20	[illegible]
Shaker Mtn	44.79	56.79	71.73	224.68		57.31	33.1	13.23	39.31	29.54	47	44.8
Brace Bridge	42.57	69.45	133.44	201.42	135.37	52.04		[illegible]	23.07	[illegible]	53	[illegible]
Spence Bridge	137.61	57.31	123.56	80.53		46.54	21.33	14.80	27.18	42.97	46	[illegible]
East Street	57.31	128.66	101.93	47.25	142.09	51.21	38.36	15.79	47.98	38.33	55	[illegible]
Bridge Street	41.35	78	135.44	54.75	224.68	39.31		[illegible]	21.33	65.04	57	[illegible]
Audubon Hon	137.35		124.98	47.37	228.18			22.05	21.33	36.36	61	[illegible]
Audubon Hen	98.67		90.63	53.14	276			25.30	18.49	29.76	56	47.4
Moultrop Bridge	124.57	137.35	137.61	45.00	365	46.54	21.33	30.51	17.31	45.00	63	83.1
Yaggy	73.28	64.2	125.91	89.68	285	96.03	36.41	20.11	18.29	28.82	60	45.8
Gorge	72.27	109.51	126.69	95.94	411	83.92	22.55	32.57	19.89	28.47	66	71.5
Triple Buckets	75.41	79.76	88.41	71.36	365	41.95	32.67	15.33		19.89	57	78.1
Chalet Trail	73.80		101.44	39.86	461	63.67	25.59	17.49	21.82		[illegible]	71.4
Cochran Bridge	59.40	166.4	261.25	166.4	435	57.08	46.54	[illegible]	13.36	31.84	[illegible]	[illegible]
Winooski Jon	48.64	48.08		71.73	[illegible]	30.89	32.25	[illegible]	39.86	86.47	[illegible]	[illegible]
Winooski Rich	[illegible]	93.38		29.17	2420	53.81	66.95	[illegible]	90.86	139.58	100	[illegible]
GEOMEAN	[illegible]	65.0	113.2	79.1	255	51.9	25.4	17.3	17.8	31.1		67.0
												[illegible]

2015

	[illegible]	6/30/2015	7/7/2015	7/14/2015	7/21/2015	7/28/2015	8/4/2015	8/11/2015	8/18/2015	8/25/2015	GEOMEAN	Mean	Median
Cane Bridge	[illegible]	10.89	11.00	30.89	58.33	152.86	24.05	32.67	38.77	17.31	37.1	66.2	31.78
Shaker Mtn	[illegible]	9.79	13.23	47.98	27.85	195.59	90.86	58.33	172.33	40.77	60.8	117.394	[illegible]
Spence Bridge	142.1	71.73	48.86	44.79	66.31		107.58	66.41	86.24	76.34	76.7	81.35	76.34
Bridge Street	137.61	39.86	45.68	93.31	[illegible]	365.4	78.94	93.31	66.31	37.86	80.0	102.594	73.30
Audubon Hon	52.98	52.84	46.38	86.41	105.37	172.33	129.63	81.28	98.54	101.22	85.9	92.896	93.475
Audubon Hen	73.28	166.95	39.31	159.67	93.31	365.4	93.31	52.91	222.36	79.76	108.7	134.626	93.31
Moultrop Bridge	155.25	30.13	36.92	66.88	48.82	240.03	117.76	111.9	118.74	34.98	77.3	96.341	90.39
Yaggy	[illegible]	48.74	141.37	344.8	[illegible]	[illegible]	307.59	47.96	129.63	45.00	129.2	177.831	135.5
Gorge	[illegible]	55.55	107.58	172.16	56.33	435.17	[illegible]	52.08	111.23	41.03	106.8	140.475	109.405
Triple Buckets	[illegible]	66.88	50.36	135.44	60.15	517.21	290.93	73.28	191.79	51.22	113.4	155.372	93.87
Chalet Trail	71.73	54.75	28.82	172.16	48.74	235.93	198.9	[illegible]	107.58	34.98	92.6	122.91	89.655
Cochran Bridge	[illegible]	30.05	31.29	201.42	166.4	178.53	[illegible]	[illegible]	248.9	109.01	119.4	149.298	172.465
GEOMEAN	[illegible]	41.3	39.6	104.41	66.6	278.49	132.50	80.26	118.10	49.3	87.3		

2016

	6/28/2016	7/5/2016	7/12/2016	7/19/2016	7/26/2016	8/2/2016	8/9/2016	8/17/2016	8/23/2016	8/30/2016	GEOMEAN	Mean	Median
Cane Bridge	21.33	8.79	49.59	108.6	[illegible]	53.92	7.45	344.11	25.9	11.99	33.9	67.4	33.8
Shaker Mtn	[illegible]	131.35	[illegible]	[illegible]	54.48	[illegible]	26.21	325.54	53.71	17.31	80.9	114.3	88.4
Spence Bridge	[illegible]		67.66	235.93	153.88	93.28		[illegible]	44.34	24.91	101.0	132.2	120.0
Bridge Street	[illegible]	61.98	260.25	248.9	[illegible]	238.22	[illegible]	648.62	30.31	18.89	126.0	191.5	148.3
Audubon Hon	95.9	65.65	101.44	410.58	40.2	114.46	156.48		48.06	53.81	92.3	120.7	95.9
Audubon Hen	[illegible]	40.77	67.01	461.11	42.57	101.44	325.54	920.84	[illegible]	32.87	128.2	234.9	91.5
Hollow Brook	[illegible]	866.44	486.44	461.11	517.21	1986.29		>2419.6	[illegible]	178.53	822.8	[illegible]	[illegible]
Moultrop Bridge	[illegible]	[illegible]	172.33	517.21	52.01	193.49	325.54		114.46	39.31	119.5	172.3	114.5
Yaggy	44.12	86	95.94	486.44	[illegible]	307.59	[illegible]	1299.65	40.2	48.74	113.4	251.4	74.6
Triple Buckets		131.35	[illegible]	313.01	44.55	248.9	34.51		32.25	76.8	85.8	119.6	76.0
Chalet Trail	83.14	98.67	83.61	461.11	79.76	186	[illegible]	1203.33	41.65	46.22	[illegible]	227.9	81.7
Cochran Bridge	[illegible]	85.65	82.61	235.93	75.41	201.42	10.78	2419.57	34.54	307.69	112.6	349.4	79.0
GEOMEAN	[illegible]	76.4	109.49	312.18	75.7	174.97	48.8	721.80	59.0	44.8	113.5		

Huntington River Study - 2016: Year-by-Year Comparisons*

Table 3

	2004**	2005**	2006	2007	2008	2009	2010	2012	2013	2014	2015****	2016
Overall Geomean	58	110	64	88	103	57	65	61	105	53	87	114
Overall Geomean: Huntington	58	110	59	75	99	63	65	60	106	48	71	114
Overall Geomean: Richmond	Not done	Not done	72	102	85	49	66	56	98	61	112	106
Days when overall Geomean for the day > Federal	2	3	1	3	3	0	2	2	3	1	0	2
Days when overall Geomean for the day > State	4	10	6	6	9	4	5	3***	4***	2***	9***	5***
Total samples > Federal	20	48	19	39	61	12	25	27	48	11	16	32
Total samples > State* **	40	98	58	94	137	58	79	37	75	35	47	59
Overall Geomean for any site over season > Federal	0	3	0	0	0	0	0	0	0	0	0	1
Overall Geomean for a site over season > State* **	0	12	5	12	14	4	2	2	14	1	6	11

*Winooski River samples not included

**Huntington Segment only was studied

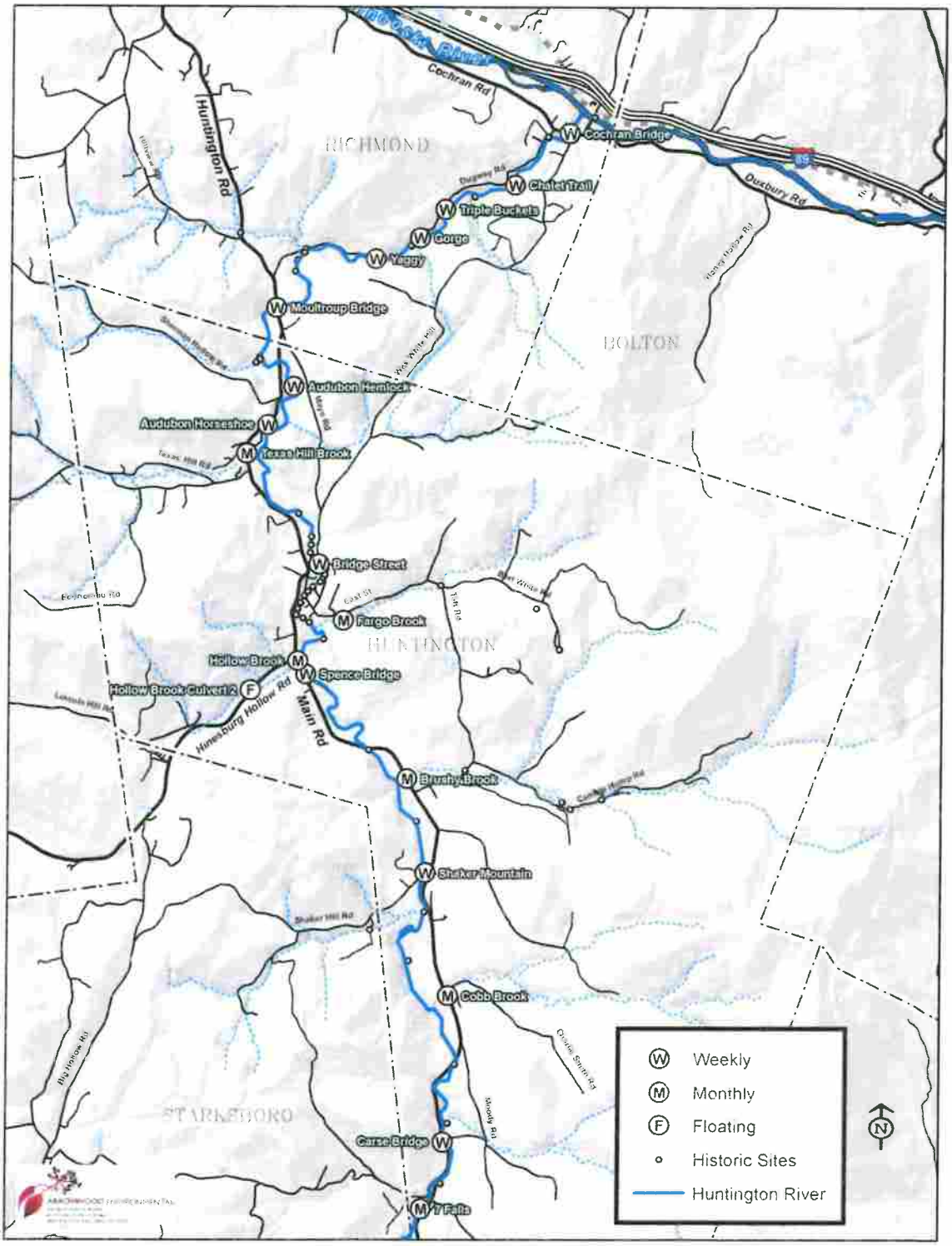
*** State Standard became Federal Standard in 2012. Indicated number based on old State Standard = 77, for purposes of comparison with previous years.

****Two fewer sites

2016 Huntington River E. coli Field Duplicates **Table 4**

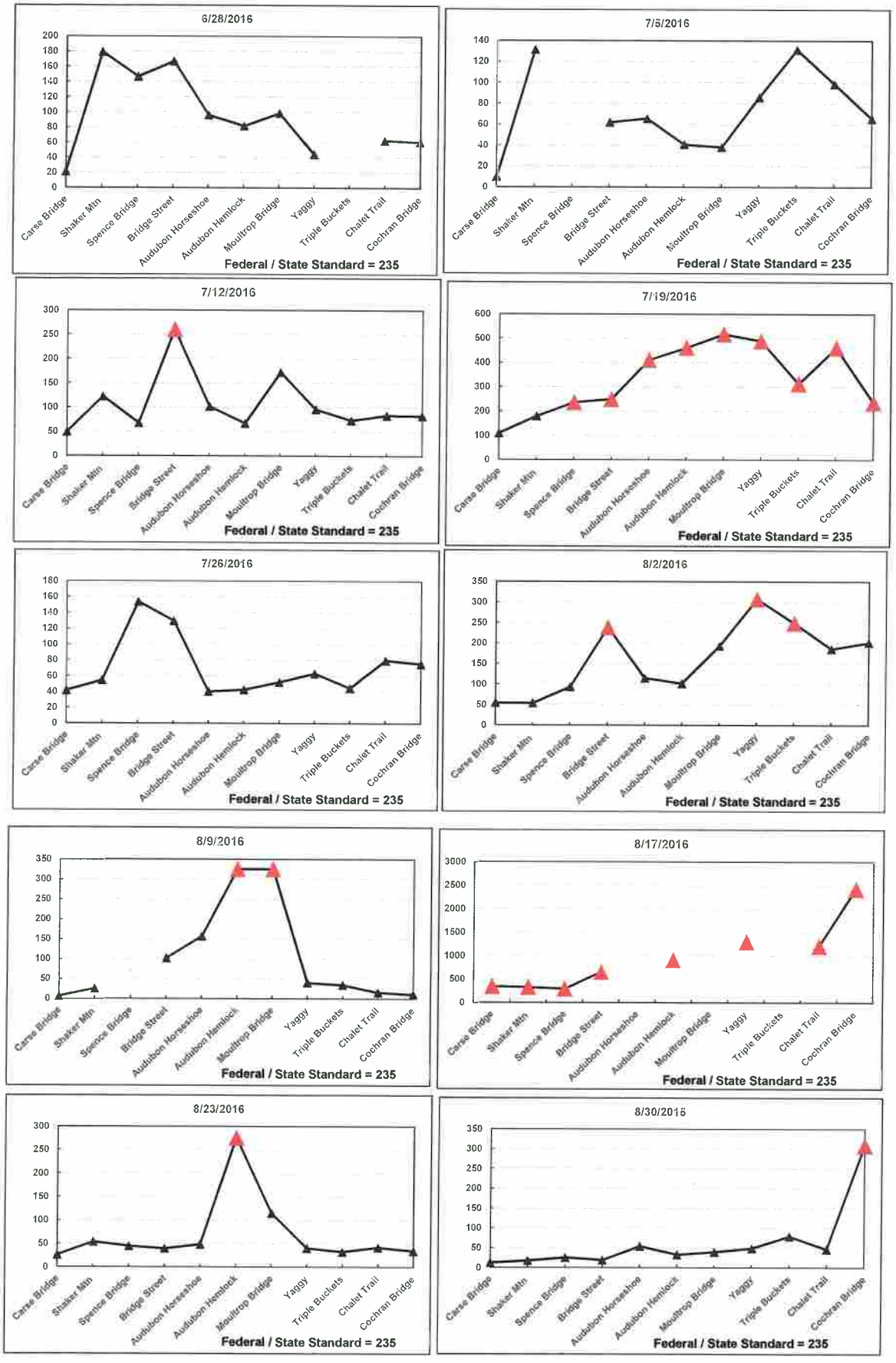
Date	Location	Results		Relative Percent	Absolute Difference
		A	B		
6/28/2016	Carse	21.33	14.8	36.1%	6.5
7/5/2016	Shaker	131.35	201.42	42.1%	70.1
7/12/2016	Hollow Brook	488.44	235.93	69.7%	252.5
7/12/2016	Moultroup	172.33	160.71	7.0%	11.6
7/19/2016	Spence	235.93	344.80	37.5%	108.9
7/26/2016	Bridge	129.63	152.86	16.4%	23.2
7/26/2016	Yaggy	63.14	76.65	19.3%	13.5
8/9/2016	Audubon Horse	156.48	230.98	38.5%	74.5
8/9/2016	Chalet	15.79	11.99	27.4%	3.8
8/17/2016	Audubon Hemlock	920.84	1119.87	19.5%	199.0
8/17/2016	Chalet	1203.33	1203.33	0.0	0.0
8/30/2016	Hollow Brook	178.53	178.53	0.0	0.0
			Mean	**26.1%**	

Figure 1 – Site Map

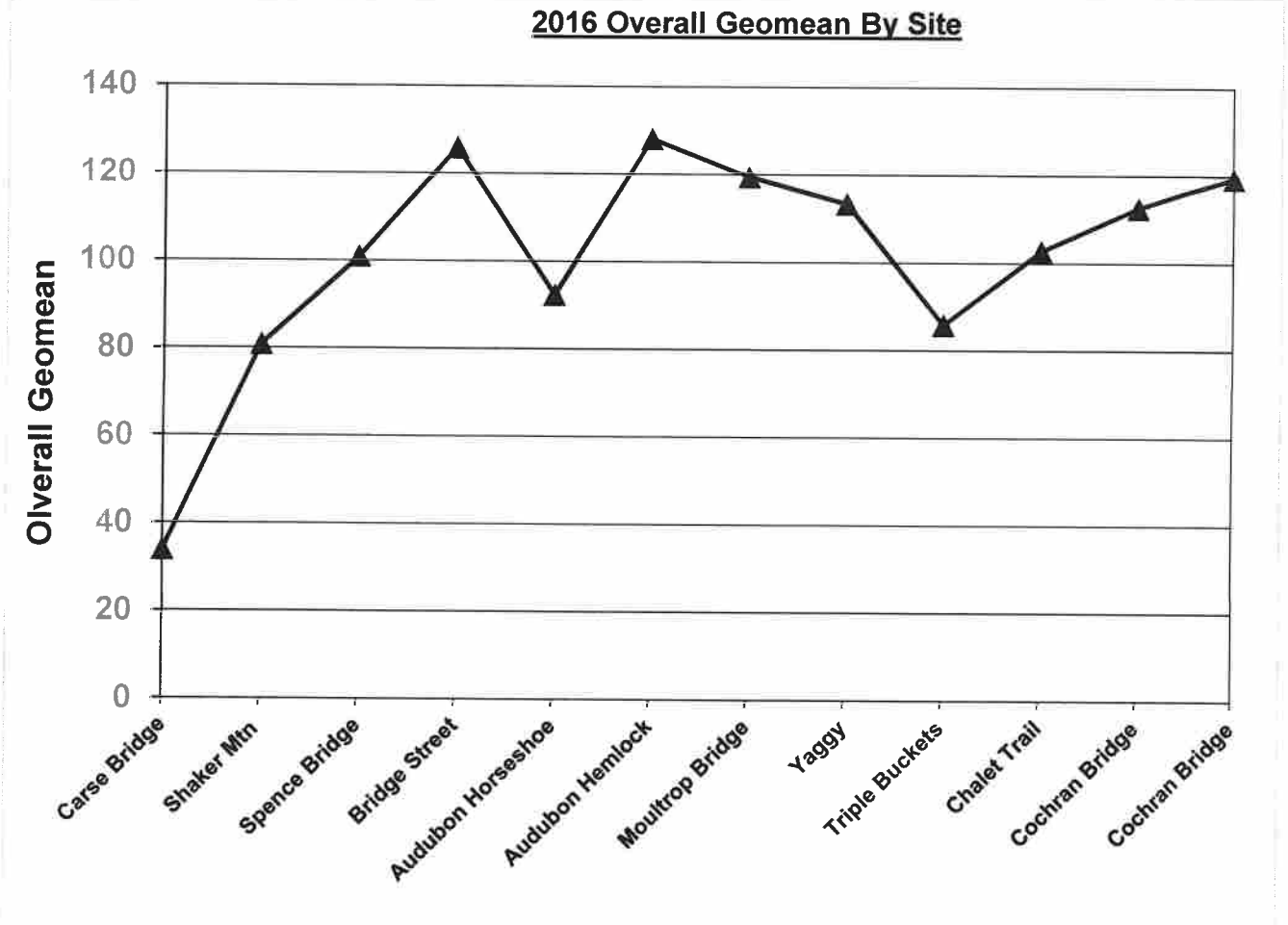


HUNTINGTON RIVER E. COLI STUDY RESULTS - 2016

Figure 2

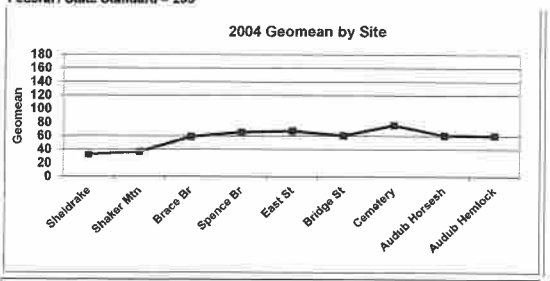


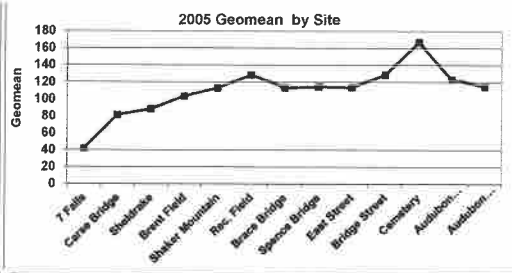
Huntington River Study - 2016: Overall Geomeans by Site **Figure 3.1**

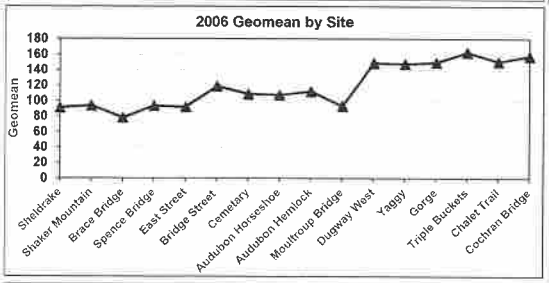


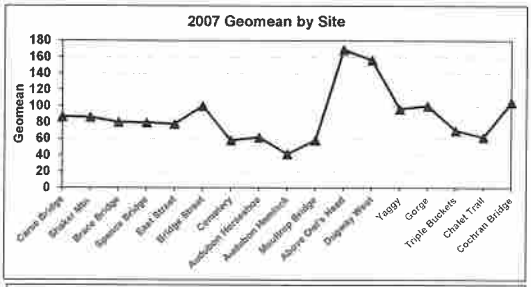
Compiled Results - Geomean per Site - All Years
Federal / State Standard = 235

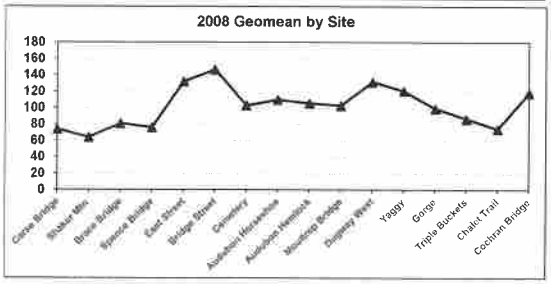
Figure 3.2

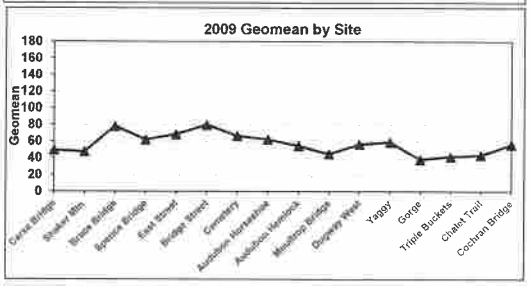


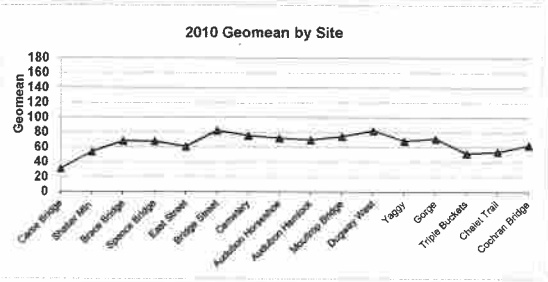


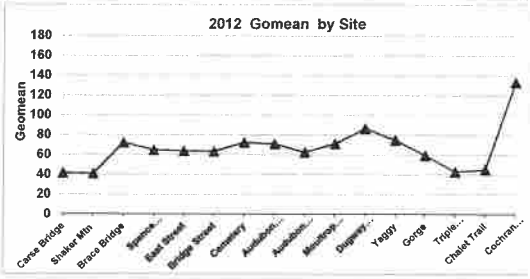


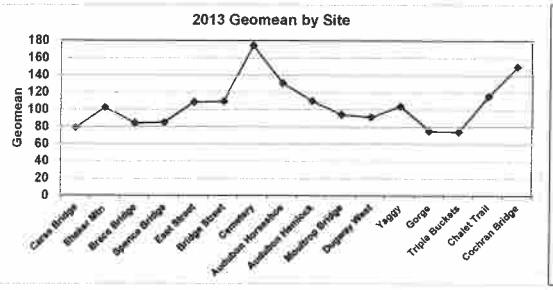


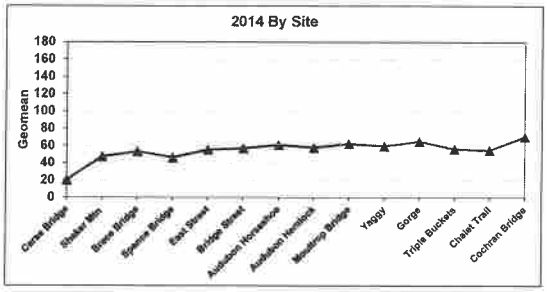


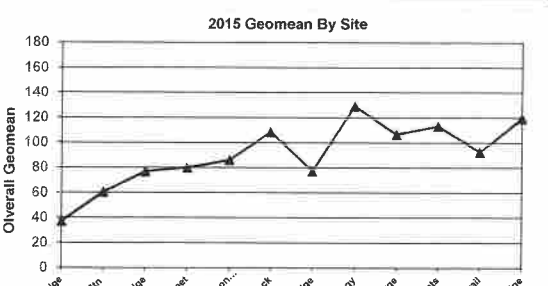


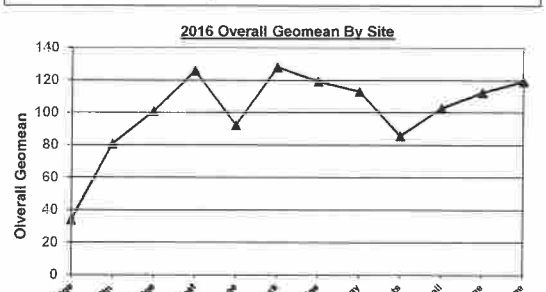








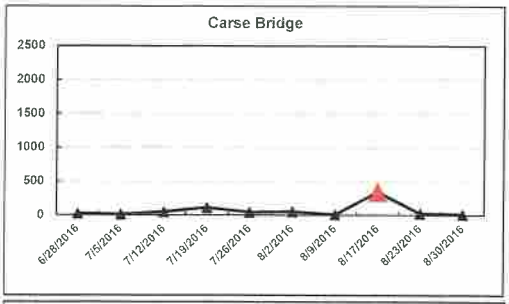


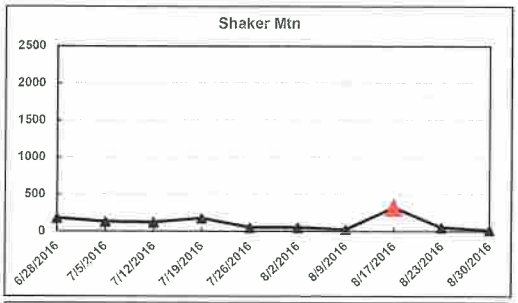


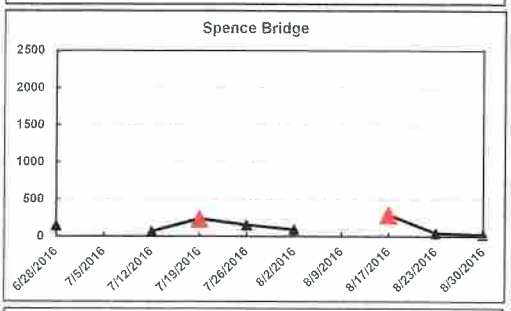
Huntington River Study - 2016

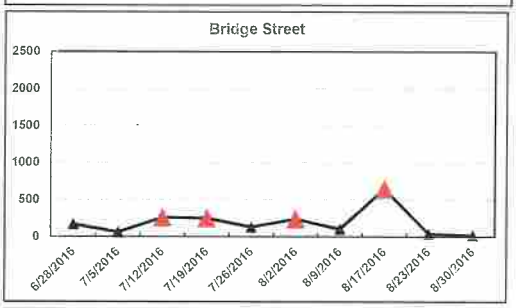
Federal Standard = 235

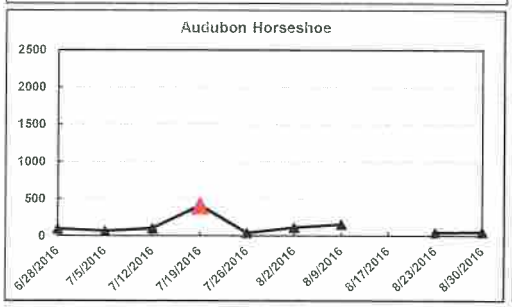
Figure 4.1: Scale 2500

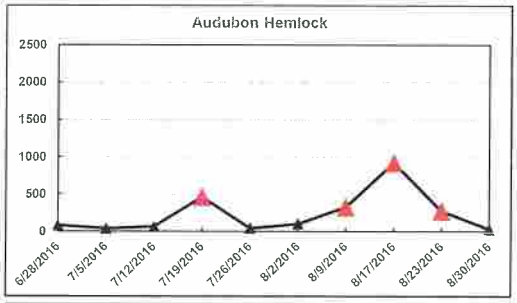


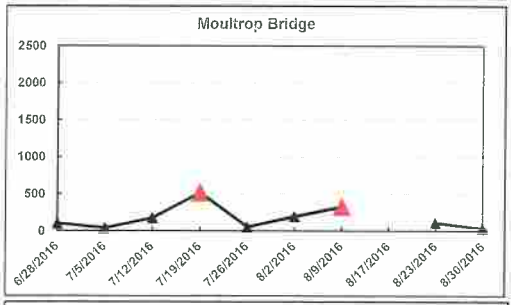


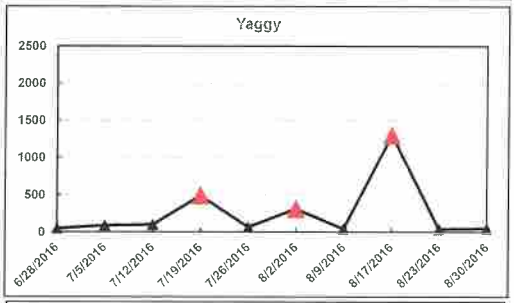


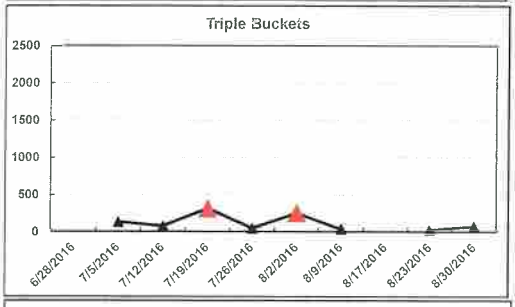


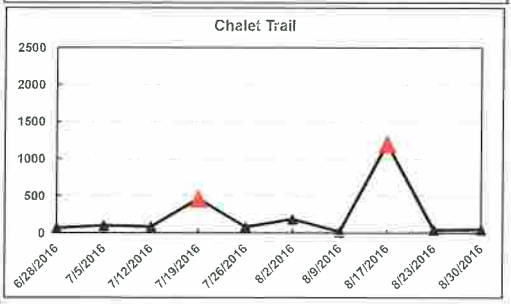


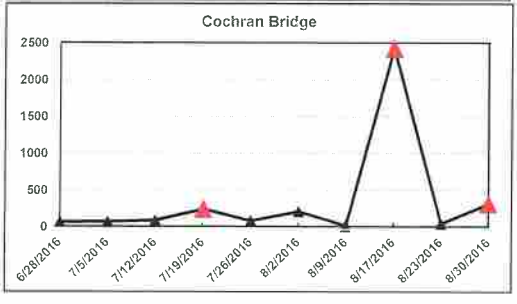








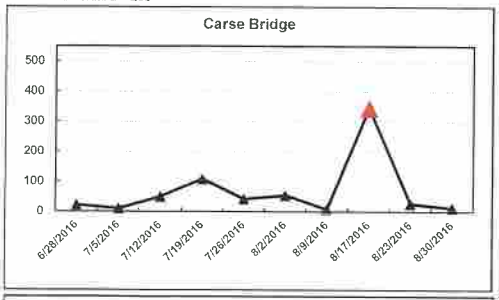


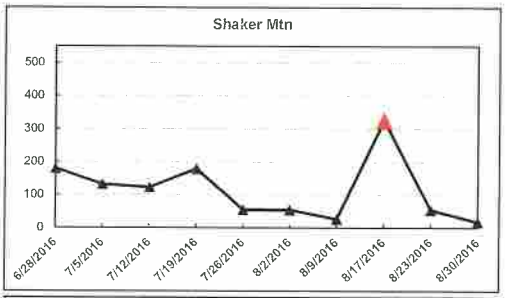


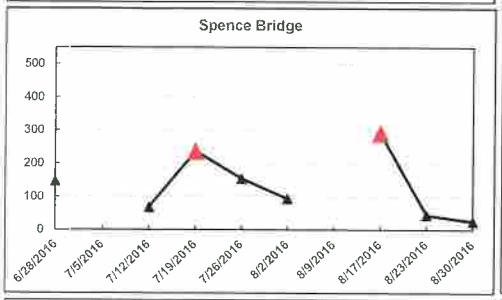
Huntington River Study - 2016

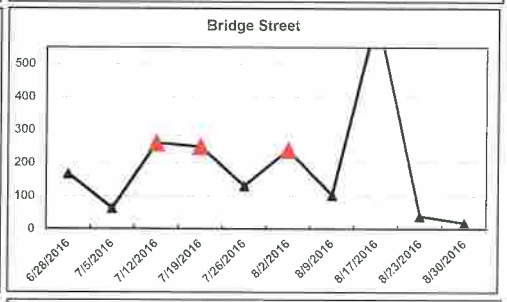
Federal Standard = 235

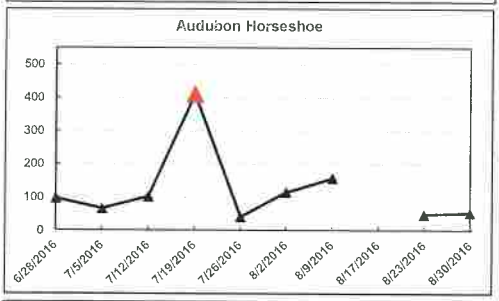
Figure 4.2: Scale 500

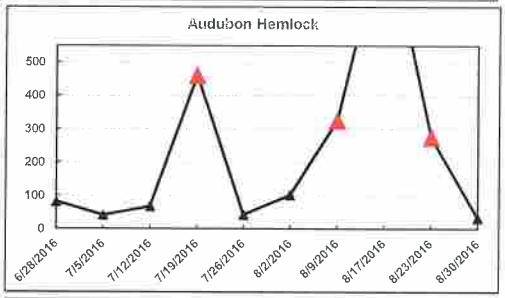


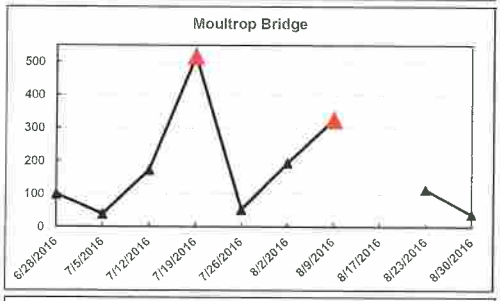


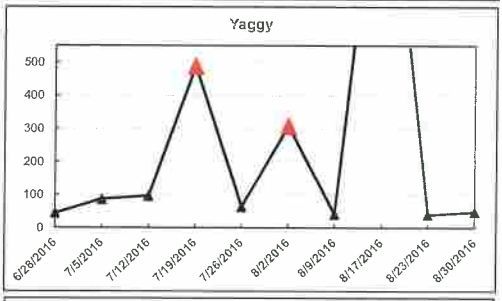


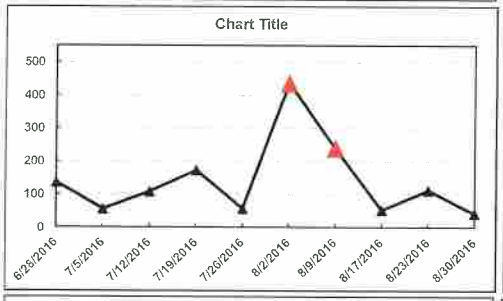


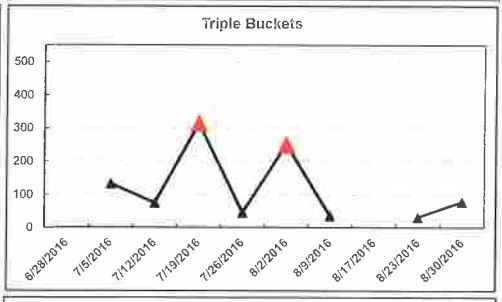


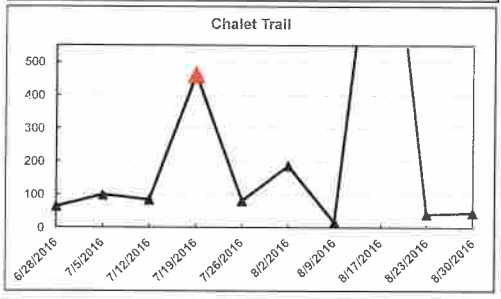


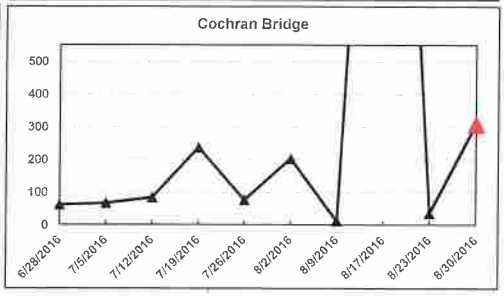






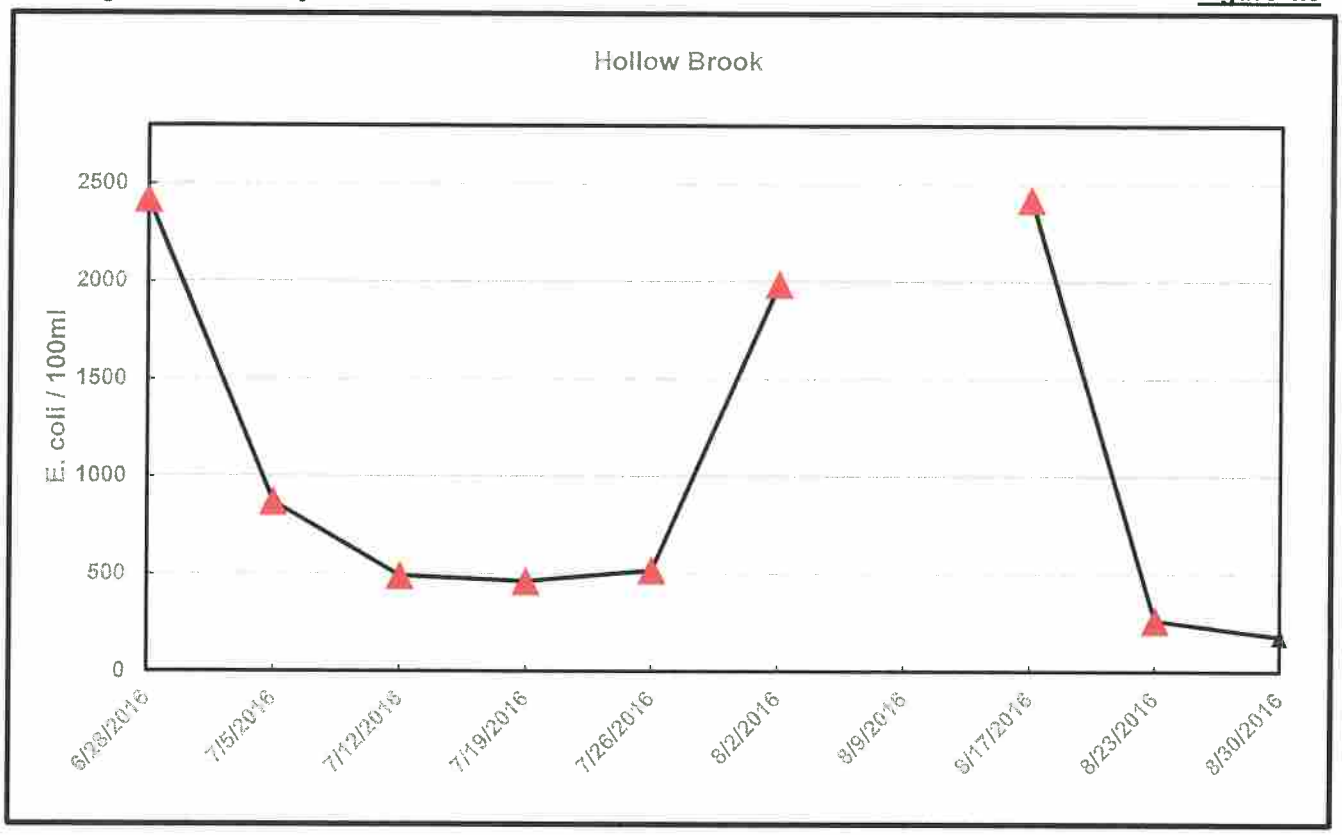






Huntington River Study - 2016 - Hollow Brook

Figure 4.3



Federal / State Standard = 235

Huntington River Study - 2016 - Rotating Sites

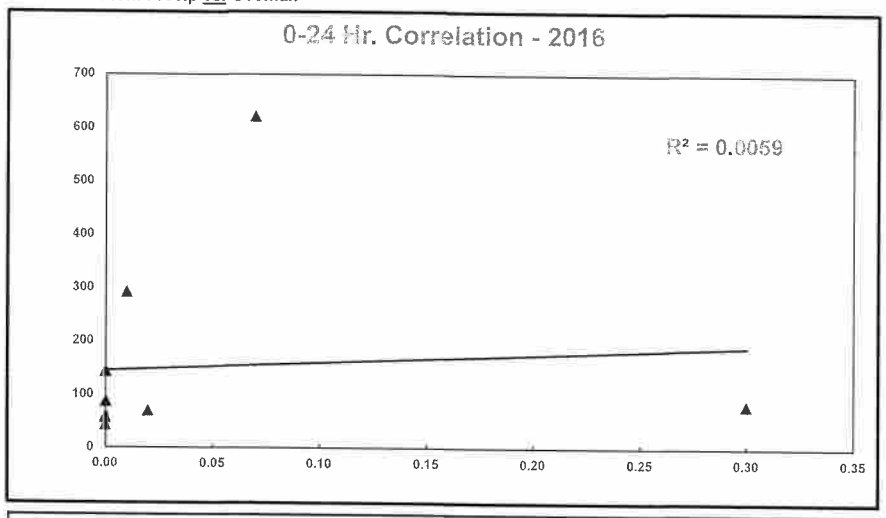
E. Coli / 100 ml

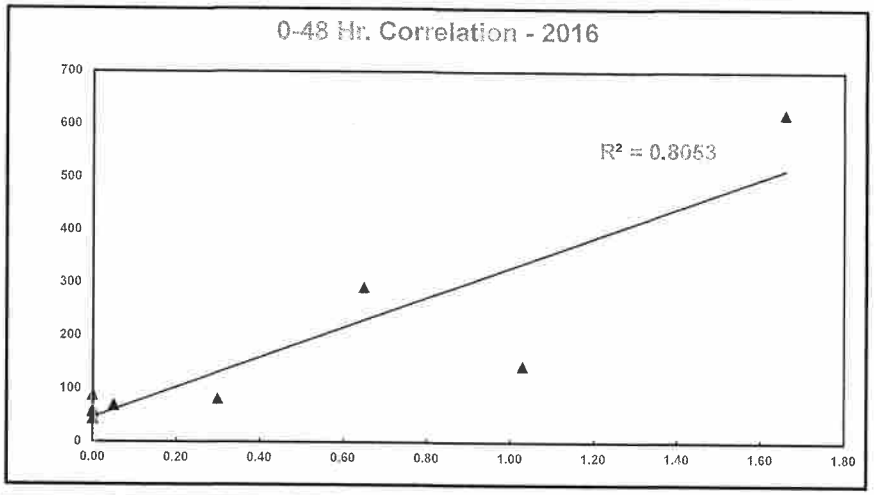
Figure 4.4

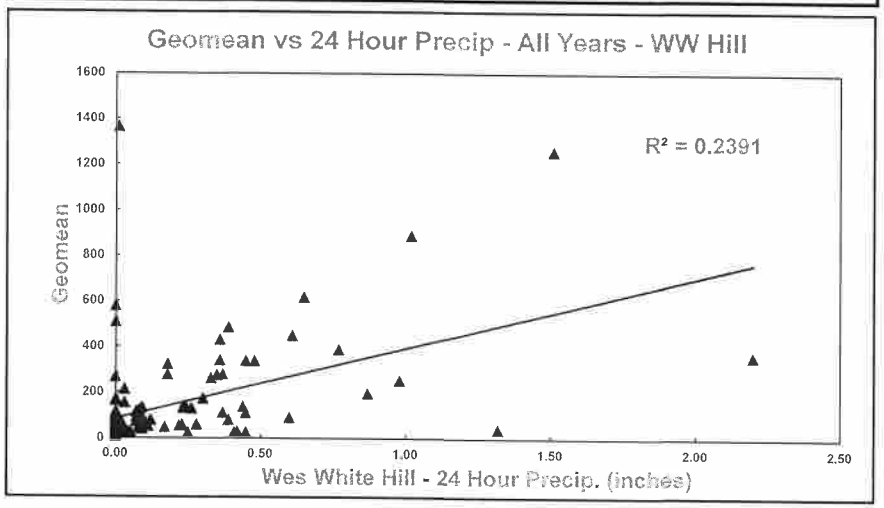
	7-Falls	Sheldrake	Brent	Rec	Weaver	Jones	Cobb	Carpenter	Brushy	Brushy Taft Br	Brushy-Taft Culvert	Hollow	Hollow-Culvert	Fargo	Texas Hill	Sherman	Sherman Upper	Owl's Head	Above Owl's	Moultroup Meadow	Billy Brook	Jones	Overall Geomean
2004																							
2005																							
	131	261	272	579																			
	30	48	70	30	61	3	1	114	29	17	125	186		7	52	14	5						339
	117								192		1120												64
	98	45	210	43					31	29	130												509
	26	137	115	144																			66
	95	172	231	261	75	142	44	488	345			291		225	68								92
	39		50	69												111							271
	25	19	88	37			15	1120															81
	9	41	24	21				77			2420												54
	37	44	40	980			43	71	2420														30
	1120	980	1200	2420		435	816	2420	2420			2420		2420	1120								106
	9	34			18				13		579												1367
	9	517	33	46																			102
		18	9	18																			60
	17	33	921	51		98	6	8				27		7	8								23
2006																							42
	49	114																					
		116	160	387			78	102	98			461		156									173
		56																					280
		178																					56
		48																					87
	11	50	93	51			34	17	185			34		84				93					92
		130																					89
		32																					165
		10																					55
	9	39	13	20			6		37			30		7									21
		22																					84
		14																					27
		24																					49
		19	16	16			1	16	8			36							43				16
2007																							22
	11		71						20			326		3	44								88
																							70
																							64
																							284
	5		98						18			88		9	12								97
																							97
																							50
																							28
									22			23											431
	2		66				3					28											41
																						7	38
																							20
	14		30				5		16			10			104								389
2008																						5	39
	43		77	131		45	34	80	365			91		19	50			98					
	35			111		105			101			921		82	74			77					156
	64					33	37	770	64			48		41	16			22					214
																							59
			31	53																	299		92
2009																							29
	48.4			79.4					86.3			79.8			43.5								
	20.34			50.36				29.17	30.89			71.16		27.51	23.3								198
	7.45			11.99				29.54	128.68			71.73		8.32	104.6			5.07					68
	29.54			48.63				27.85	38.41			27.28			15.79								36
									83.92														60
																							135
			191.79															27.2					41
2010																							198
							14		31			367		121	47								
							5.16	14.64	10.89			184.18		30.51	13.23								123.3
							14.49	8.6	272.3			410.58		7.38	16.95							0.99	89.6
															16.94							10.89	59
																							47.1
2012																							
				172.16					70.83					33.61									
				87.56			6.26	29.76	9.79			579.43		6.32	21.82								338
				29.41			9.6					178.9		4.13	18.9								70
				13.36					7.45					30.6	11								22
2013																							17
	613.14			1119.87			63.82		193.49			1413.61		104.97	308.82								
	285.1						118.74		133.17			920.84		160.71	109.18								888.6
	13.36			39.31			23.07	13.36	14.64			150.01		13.5	35.45								140.5
2014																							31.6
				67.01			8.6	5.21							7.24								
									37.34			648.82		24.62	9.69								89.1
												7.45											79.1
															7.45								17.3
				63.61			41.35																17.8
2015																							255
	21.09					7.31			7.45			122.29		23.07	13.5								
	116.19								79.76			770.1		435.17	50.41								41.3
									55.55			1119.87	195.59	41.35	19.67								276.6
2016																							49.3
	1						103	104	105			2419.57		107	108								
												866.44											110.4
							9.69		44.79			488.44			49.59								76.4
												461.11											109.6
												517.12											312.18
												1986.29											76.7
												2420											178
												261.25											721
												178.53											59
														9.79	17.31								44.8
	7-Falls	Sheldrake	Brent	Rec	Weaver	Jones	Cobb	Carpenter	Brushy	Brushy Taft Br	Brushy-Taft Culvert	Hollow	Hollow-Culvert	Fargo	Texas Hill	Sherman	Sherman Upper	Owl's Head	Above Owl's	Moultroup Meadow	Billy Brook	Jones	48.8

Correlation: Precip vs. Geoman

Figure 5







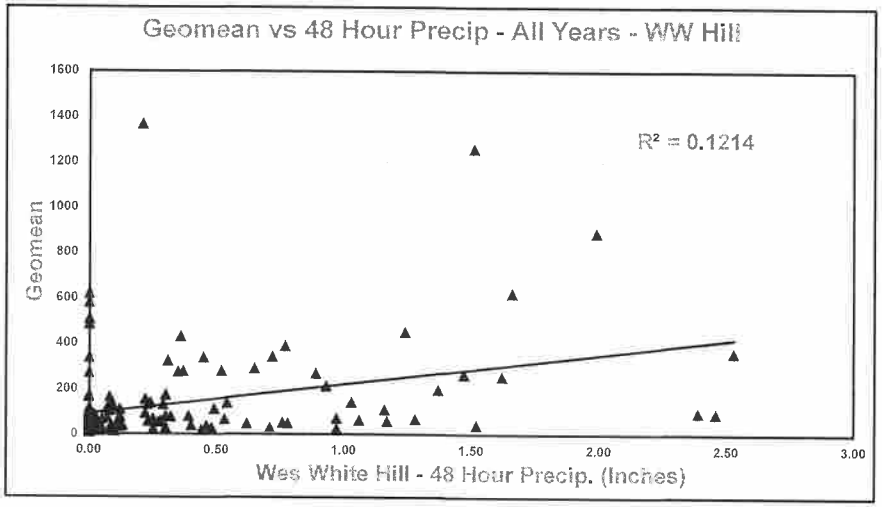
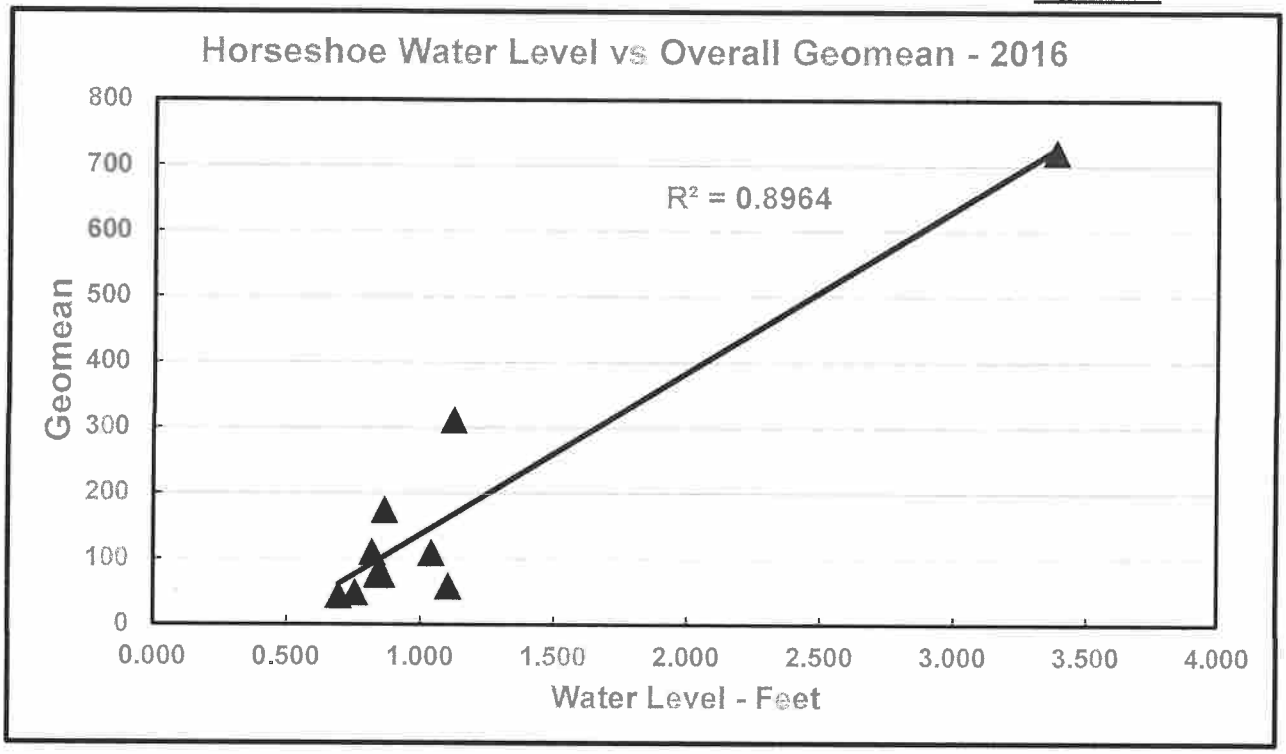


Figure 6.1


Horseshoe Water Level vs Overall Geomean - 2016
Geomean
800
700
600
500
400
300
200
100
0
R² = 0.8964
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
Water Level - Feet

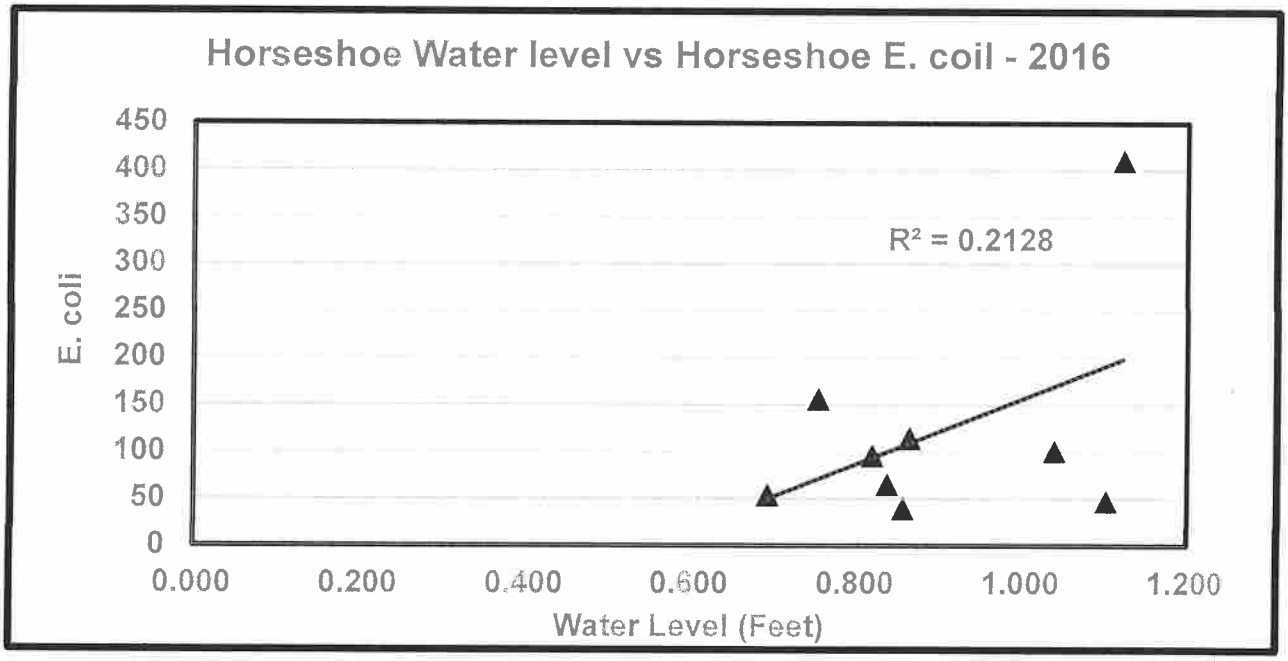
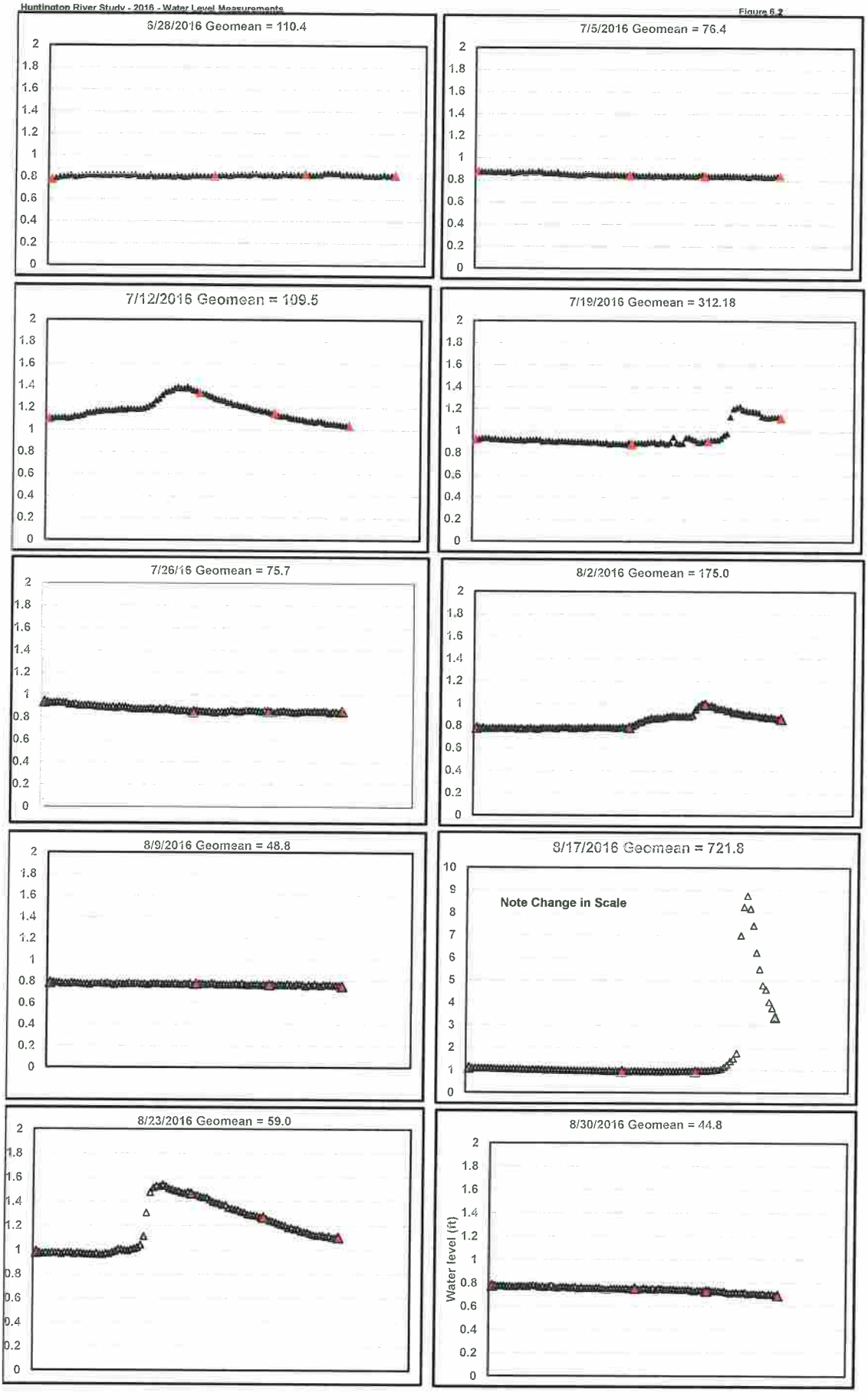
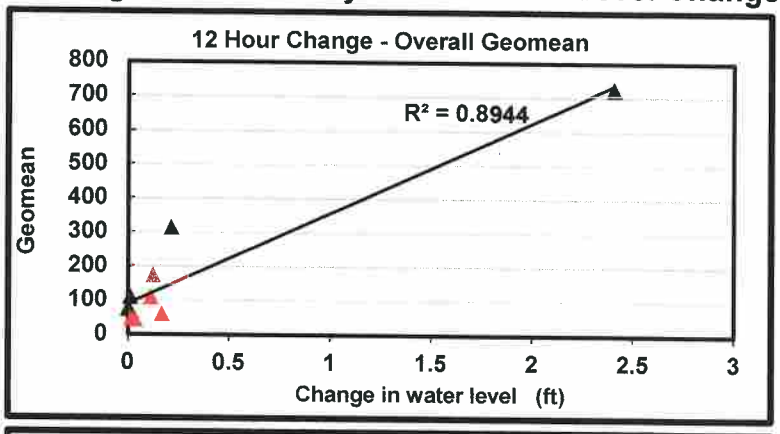

Horseshoe Water level vs Horseshoe E. coil - 2016
E. coli
450
400
350
300
250
200
150
100
50
0
R² = 0.2128
0.000
0.200
0.400
0.600
0.800
1.000
1.200
Water Level (Feet)

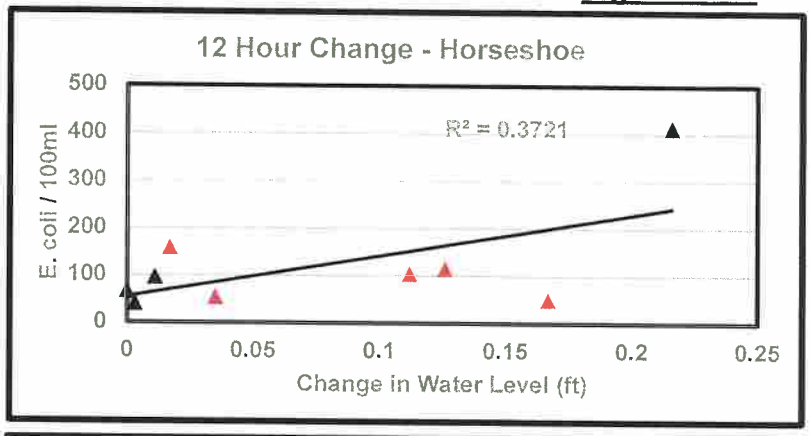
Figure 6.2

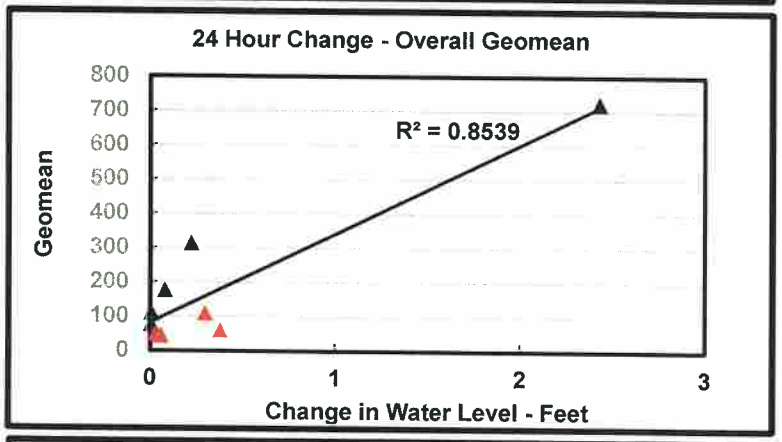

6/28/2016 Geomean = 110.4
7/5/2016 Geomean = 76.4
7/12/2016 Geomean = 109.5
7/19/2016 Geomean = 312.18
7/26/16 Geomean = 75.7
8/2/2016 Geomean = 175.0
8/9/2016 Geomean = 48.8
8/17/2016 Geomean = 721.8
Note Change in Scale
8/23/2016 Geomean = 59.0
8/30/2016 Geomean = 44.8
Water level (ft)

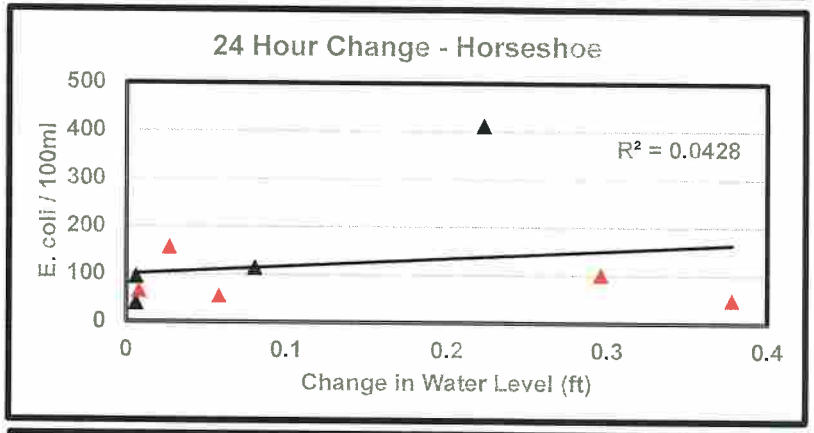
Huntington River Study - 2016- Water Level Change

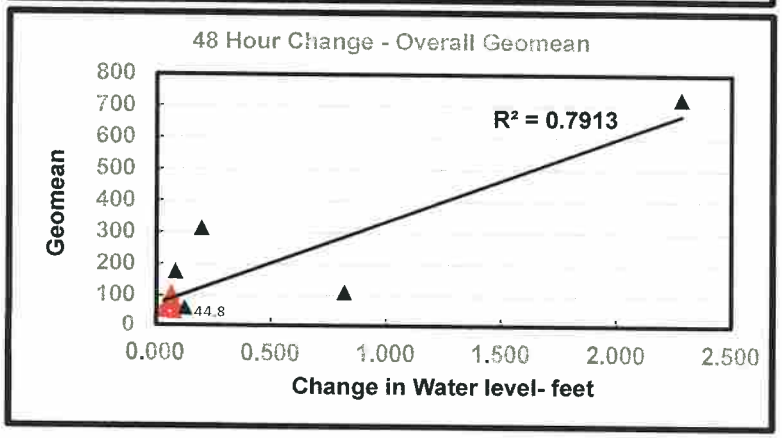
Figure 6.3.1

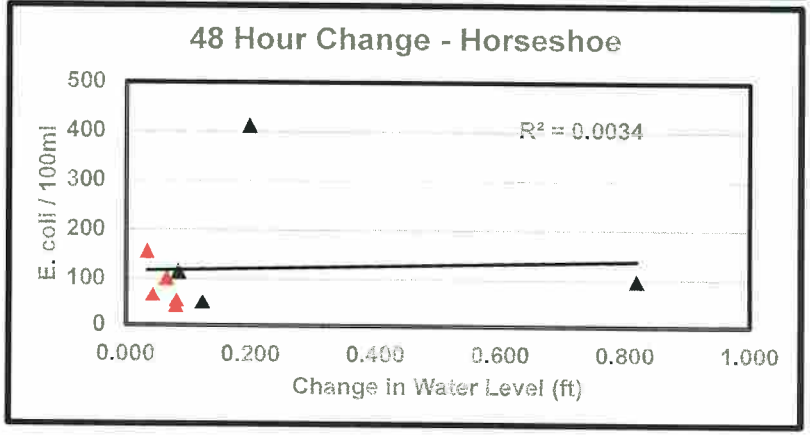




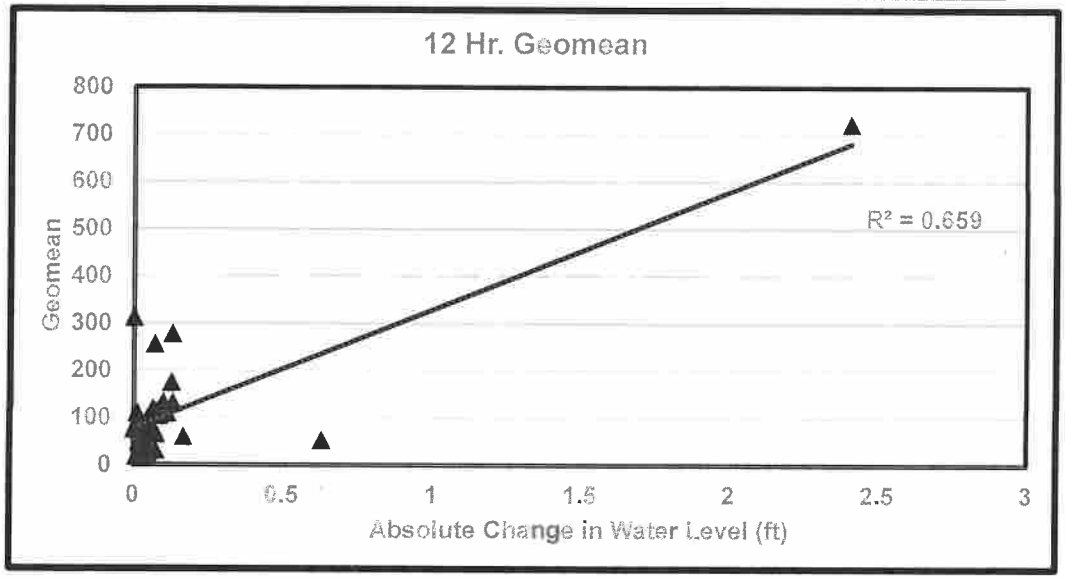


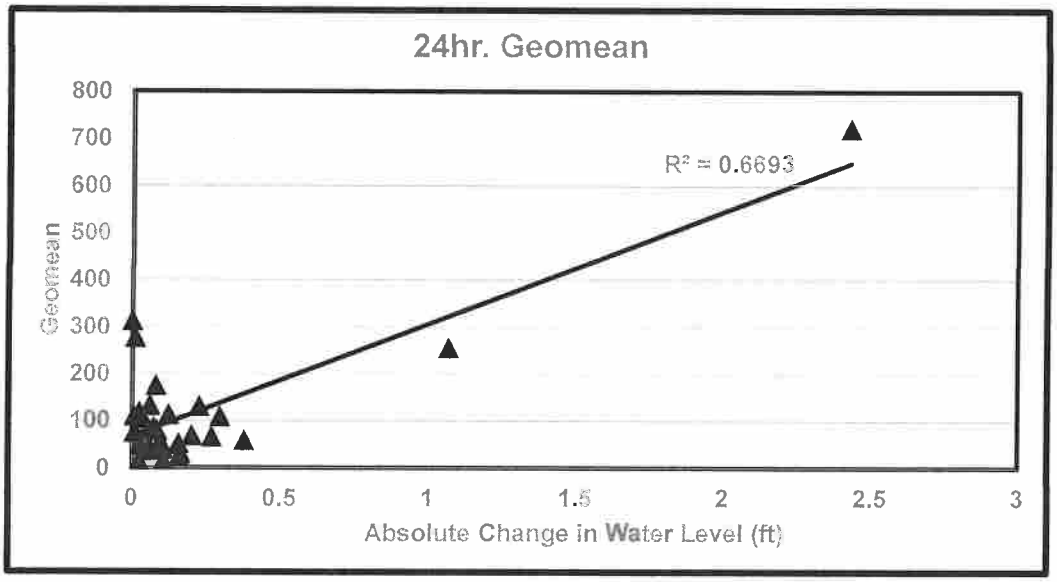






Huntington River Study - 2016- Water Level - All Years **Figure 6.3.2**





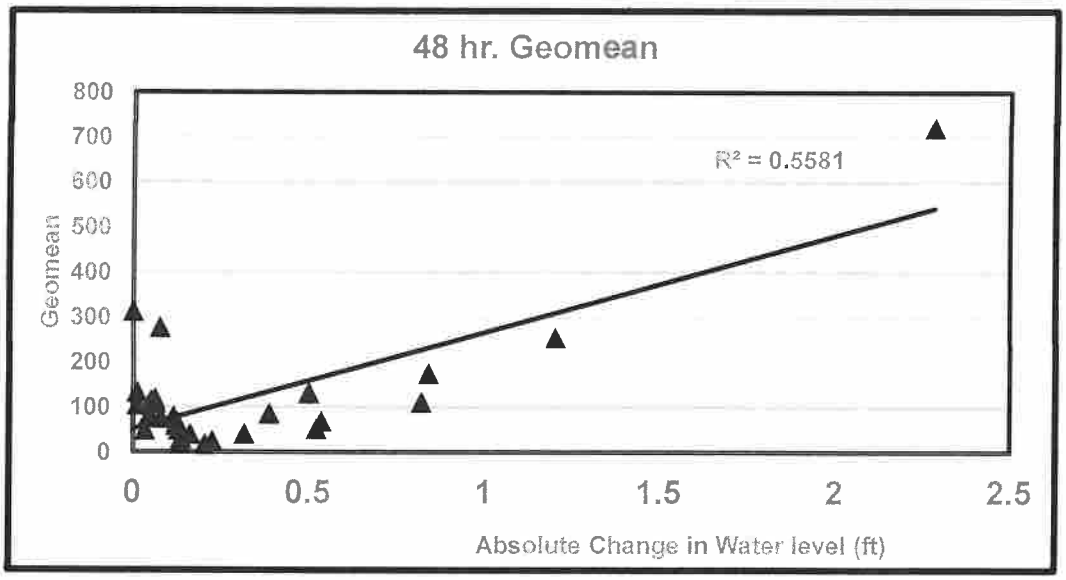
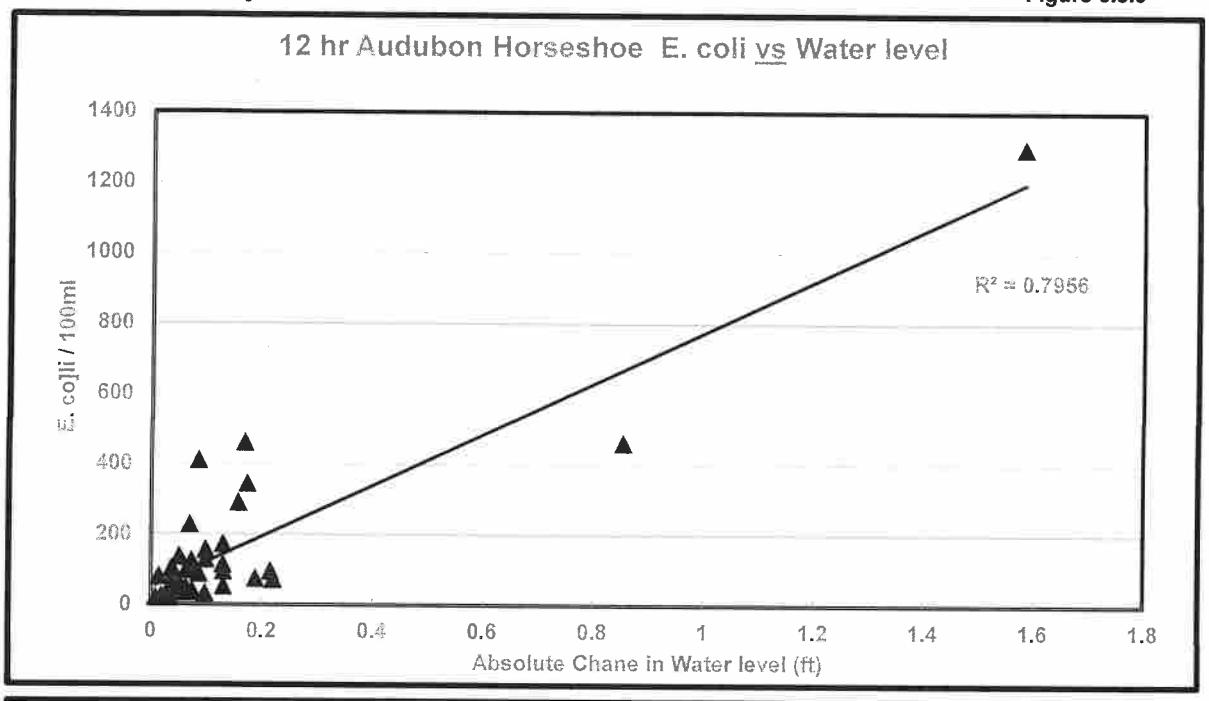
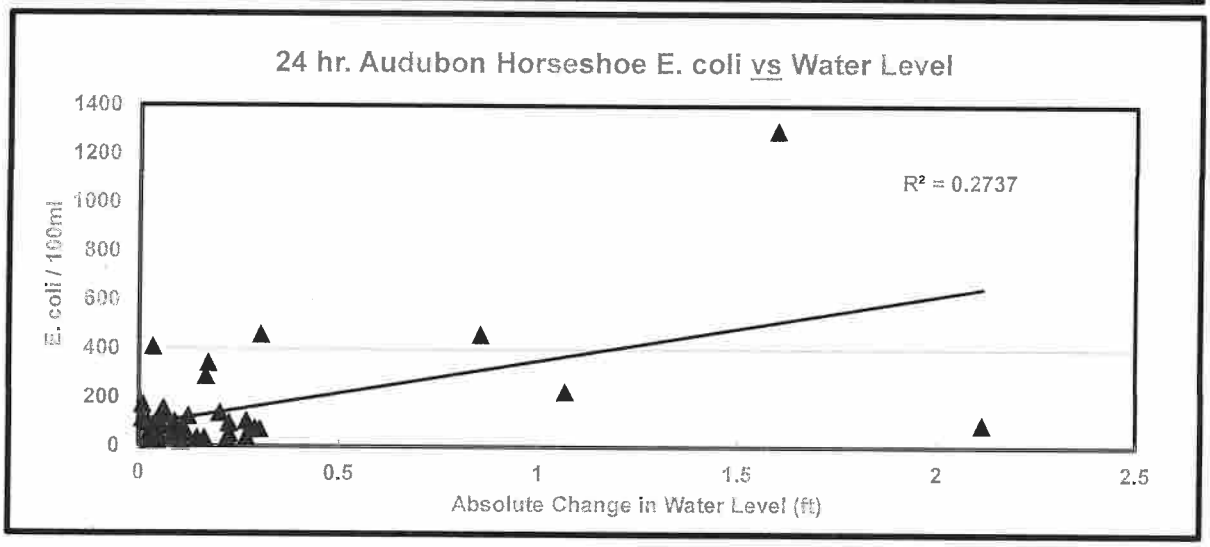
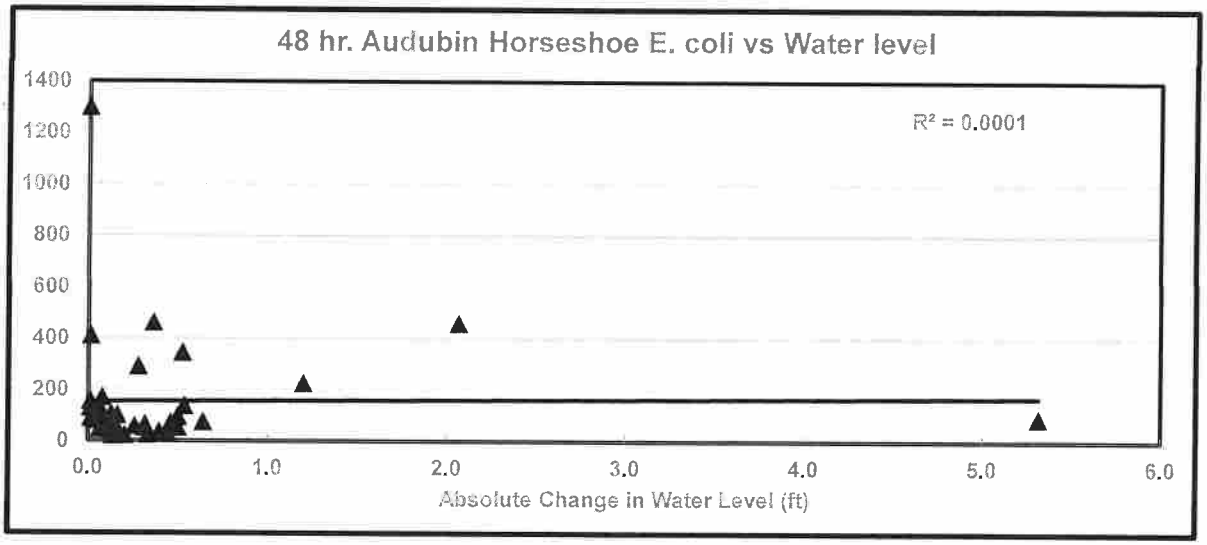


Figure 6.3.3


12 hr Audubon Horseshoe E. coli vs Water level
E. colli / 100ml
1400
1200
1000
800
600
400
200
0
R² = 0.7956
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Absolute Chane in Water level (ft)


24 hr. Audubon Horseshoe E. coli vs Water Level
E. coli / 100ml
1400
1200
1000
800
600
400
200
0
R² = 0.2737
0
0.5
1
1.5
2
2.5
Absolute Change in Water Level (ft)


48 hr. Audubin Horseshoe E. coli vs Water level
1400
1200
1000
800
600
400
200
0
R² = 0.0001
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Absolute Change in Water Level (ft)

Huntington River Study - 2016: Box Plots

Figure 7