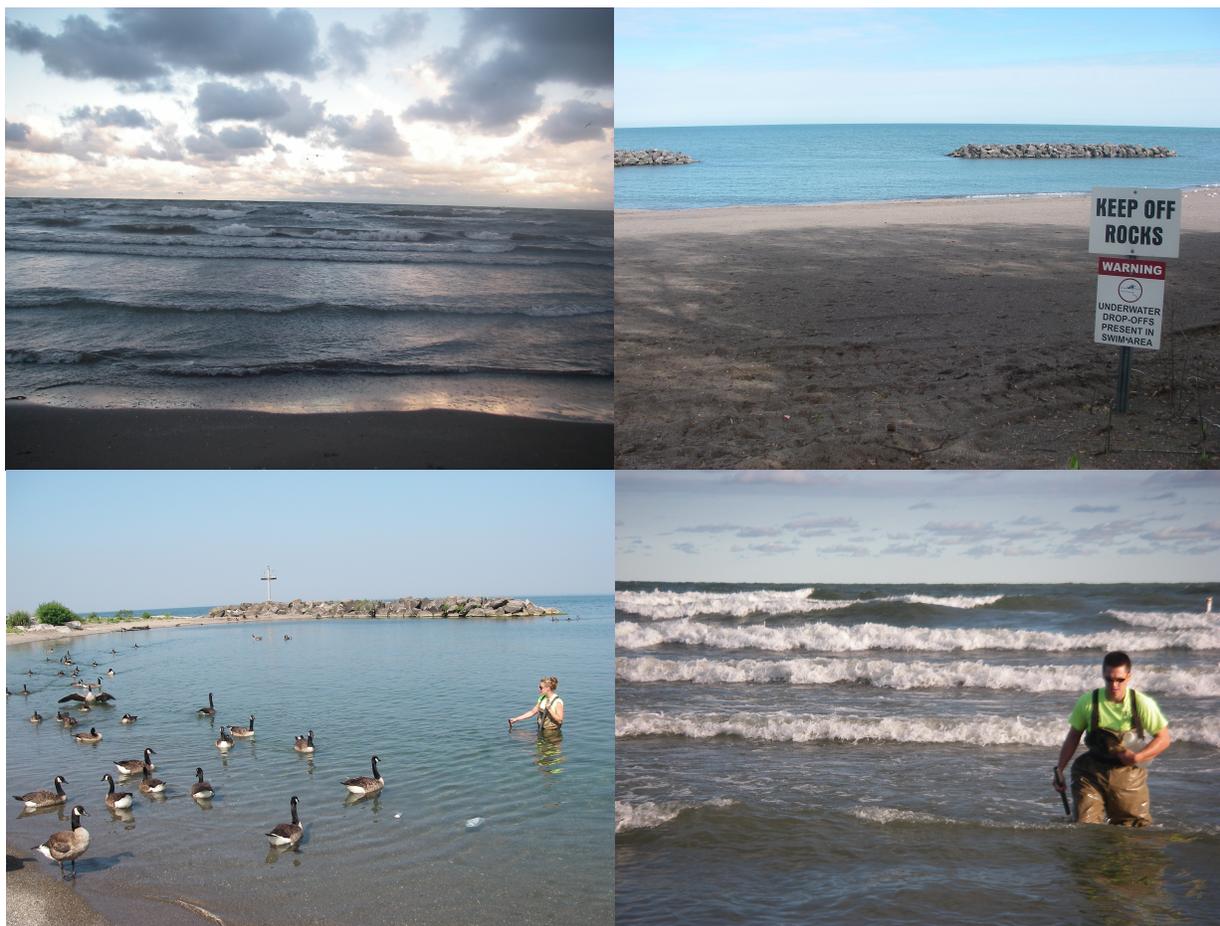


# NORTHEAST OHIO REGIONAL SEWER DISTRICT

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## 2010 Lake Erie Bacteriological Sampling Results of Edgewater, Euclid and Villa Angela Beaches



Prepared by:  
Water Quality and Industrial Surveillance Division

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## Introduction

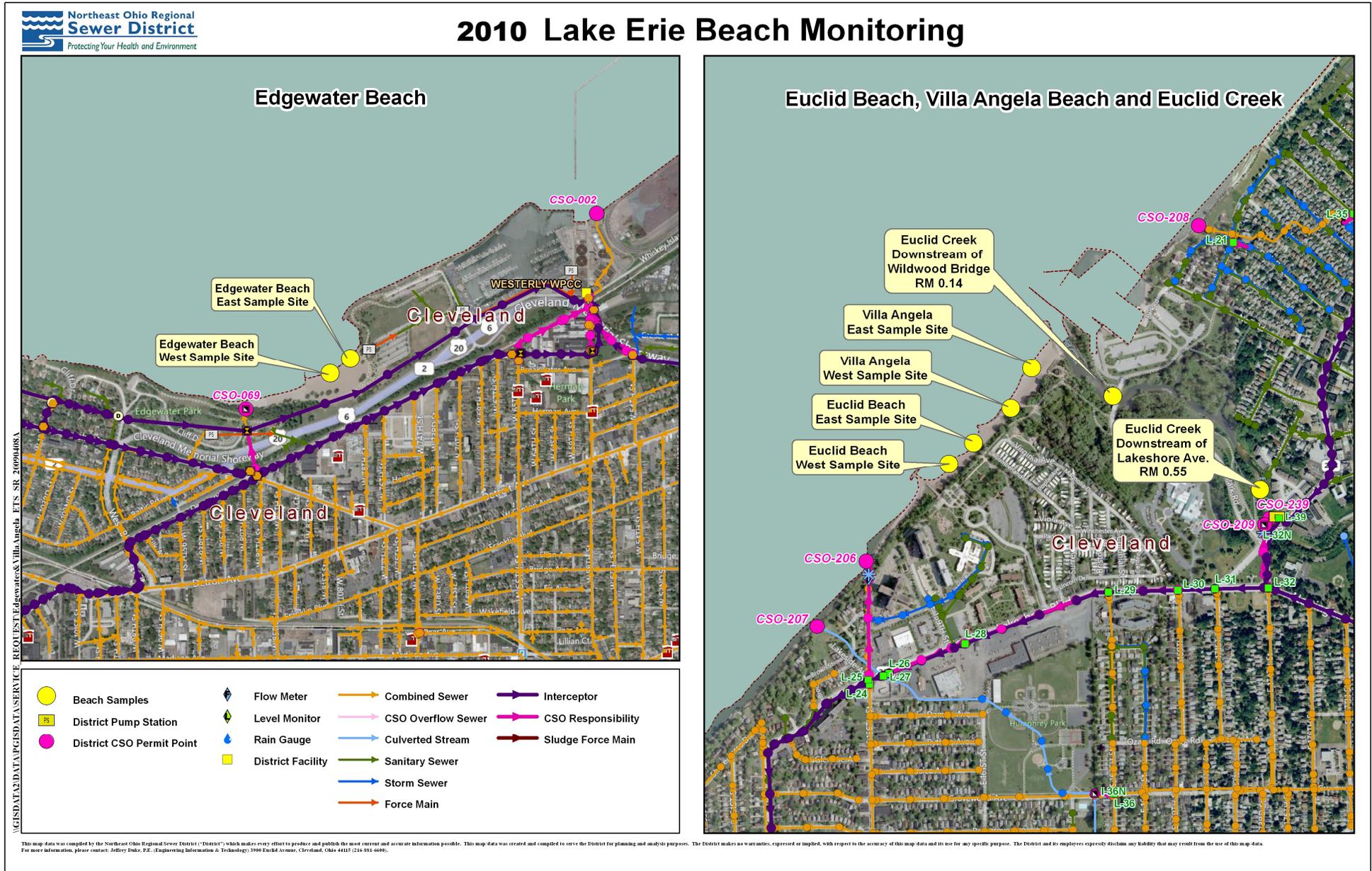
Since 1992, the Northeast Ohio Regional Sewer District (NEORSD) has conducted bacteriological sampling on Lake Erie at Edgewater Beach, Villa Angela Beach and Euclid Beach in an effort to monitor bacteriological densities at the beaches. In 2005, sampling at Euclid Creek was added to determine the impact the creek may have on the water quality at Villa Angela and Euclid Beaches.

In 2010, the NEORSD continued these sampling efforts by monitoring the *E. coli* densities at Edgewater, Villa Angela, and Euclid Beaches and Euclid Creek. This sampling served two purposes: 1) *E. coli* results were used to communicate beach conditions to the public and 2) *E. coli* results were used to evaluate water quality standards attainment. In this report, an evaluation of water quality standards attainment will be made from the *E. coli* results from each sample site.

The sampling was completed by NEORSD Level 3 Qualified Data Collectors certified by Ohio EPA in Chemical Water Quality Assessment, as well as trained personnel, as explained in the NEORSD study plan *2010 Lake Erie Bacteriological Sampling of Edgewater, Euclid and Villa Angela Beaches*, which was approved by Ohio EPA on May 14, 2010. Sample analyses were conducted by NEORSD's Analytical Services accredited by the National Environmental Laboratory Accreditation Program.

Figure 1 is a map of the sampling locations at Edgewater, Euclid and Villa Angela Beaches and Euclid Creek. Table 1 indicates the sampling sites with respect to location, site or river mile (RM), latitude/longitude and description.

Figure 1: Map of Sampling Sites



**Table 1. List of Lake Erie and Euclid Creek Sampling Sites**

Location	Site	Latitude	Longitude	Description	Quadrangle	Purpose
Edgewater Beach	East	N41.4893°	W81.7392°	Eastern half of the beach. In line with the brick stack on the other side of the freeway.	Cleveland South	Public notification of water quality conditions at bathing beaches, determination of water quality standards attainment, evaluation of the impact of point and non-point sources
Edgewater Beach	West	N41.4887°	W81.7404°	Western half of the beach. In line with the large metal pole on the other side of the freeway.	Cleveland South	
Villa Angela Beach	East	N41.5851°	W81.5677°	Eastern half of beach, mid-distance between the 3 <sup>rd</sup> and 4 <sup>th</sup> break walls.	East Cleveland	
Villa Angela Beach	West	N41.5861°	W81.5667°	Western half of beach at the beginning of the 2 <sup>nd</sup> break wall.	East Cleveland	
Euclid Beach	East	N41.5843°	W81.5686°	Eastern half of beach in line with the East side of the pile of stones on the beach.	East Cleveland	
Euclid Beach	West	N41.5838°	W81.5694	Western half of the beach, between the two break walls, at the second set of stairs.	East Cleveland	
Euclid Creek	RM 0.55	N41.5831°	W81.5594°	Downstream of Lakeshore Boulevard.	East Cleveland	
Euclid Creek	RM 0.14	N41.5854°	W81.5641°	Downstream of Wildwood Bridge.	East Cleveland	

## Sampling Methods

Bacteriological sampling was conducted from May 3, 2010 to October 28, 2010. From May 3<sup>rd</sup> through May 13<sup>th</sup>, water samples were collected from each beach site four days a week (Monday through Thursday). Beginning May 17<sup>th</sup> and lasting through September 10<sup>th</sup>, samples were collected at each beach site seven days a week. From September 13<sup>th</sup> through October 28<sup>th</sup>, sampling returned to four days a week (Monday through Thursday). On October 5<sup>th</sup>, 6<sup>th</sup> and 21<sup>st</sup>, samples were not collected at the beaches due to insufficient sampling personnel; on September 4<sup>th</sup> and 8<sup>th</sup>, samples were not collected at Euclid and Villa Angela Beaches due to inclement weather; and on October 28<sup>th</sup> samples were not collected at Euclid Beach due to inclement weather. A total of 890 samples were collected from all three of the beaches during 2010. The two sites on Euclid Creek were sampled daily, five times a week (Monday through Friday) from June 1<sup>st</sup> through September 10<sup>th</sup>, excluding July 5<sup>th</sup> and September 6<sup>th</sup> (observed holidays). A total of 144 samples were collected from Euclid Creek river miles (RMs) 0.55 and 0.14 during 2010.

Field analysis included the use of a Hanna HI 98129 meter to measure pH, water temperature and conductivity. All water samples and field parameters were collected as specified in the most current NEORSD Beach Sampling Standard Operating Procedure (SOP), *The Ohio Department of Health Ohio Bathing Beach Monitoring Program Quality Assurance Project Plan, April 2009*, (effective dates of 9/29/08-9/28/11) and the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009).

Bacteriological grab samples were collected in a 2-liter sterilized polypropylene container. Samples at each location were collected approximately 6-12 inches below the surface in water that was approximately three feet deep. At the time of collection, field parameters were taken and field observations were made pertaining to the beach and water conditions. All observations were recorded on a Beach Sampling Field Data Form. All samples were placed in a cooler with ice and stored in a locked NEORSD vehicle until the samples were transferred to NEORSD's Analytical Services (AS) sample receiving. Samples were then released to an AS Sample Control Specialist using a Chain of Custody. All Beach Sampling Field Data Forms, Chains of Custody and Certificates of Analysis are available upon request from the Water Quality and Industrial Surveillance division, Environmental Assessment Group and the Analytical Services division.

The quality assurance and quality control of water sample collections included obtaining one field blank once per month from a randomly selected beach. The field blanks that were collected showed no signs of contamination during the sampling and transporting process.

## **Beach Results and Discussion**

The *E. coli* results from each beach site were compared to the Ohio water quality standards to determine recreation use attainment. The three beaches are designated as Bathing Water for the Protection of Recreation Use (Ohio EPA, 2010). The Bathing Water criteria includes an *E. coli* criterion not to exceed a single sample maximum of 235 colony-forming units per 100 milliliters (CFU/100mL) in more than ten percent of the samples taken during any thirty-day period and a seasonal geometric mean criterion of 126 CFU/100mL. The criteria are only in effect during the recreation season, which is defined as, "the period from May first to October thirty-first" (Ohio EPA, 2010).

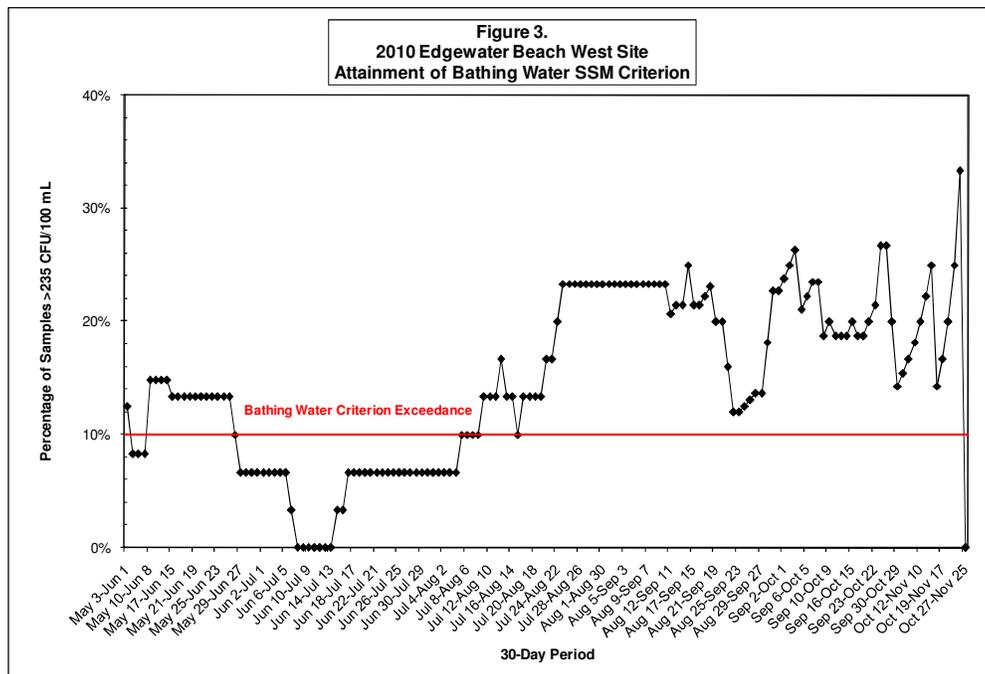
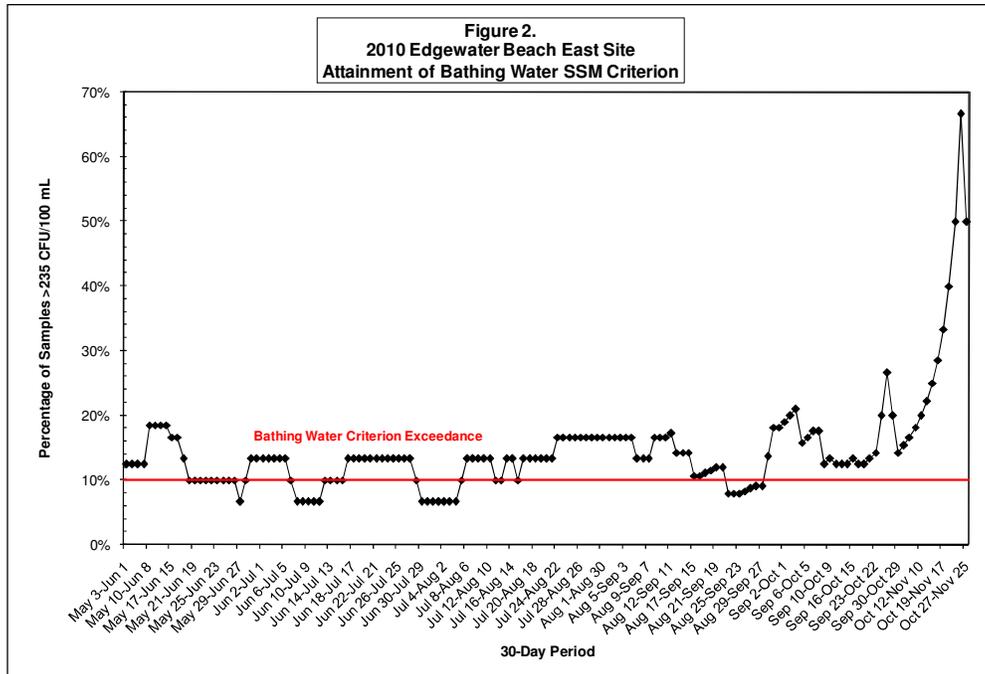
### **Edgewater Beach**

During the recreation season, 150 bacteriological samples were collected at each Edgewater Beach site. This corresponds to a total of 149 thirty-day periods<sup>1</sup> at each site. At Edgewater Beach East, 40 thirty-day periods (27%) were in attainment of the single sample maximum (SSM) criterion, while 109 thirty-day periods (73%) exceeded the criterion (Figure 2). At Edgewater Beach West, 49 thirty-day periods (33%) were in

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<sup>1</sup> Based on not less than 2 samples collected within a thirty-day period.

attainment of the SSM criterion, while 100 thirty-day periods (67%) exceeded the criterion (Figure 3). Although there were multiple exceedances of the SSM criterion, both sites were in attainment of the seasonal geometric mean (SGM) criterion (Figure 8).



A possible explanation for the exceedances of the SSM criterion is wet weather. Wet weather is defined as: greater than 0.10 inches of rain but less than 0.25 inches, samples collected that day and the following day are considered wet weather samples; for

greater than 0.25 inches, the samples collected that day and the following two days were considered wet weather samples. Sixteen percent of the recreation season at Edgewater Beach was considered wet weather<sup>2</sup>. Furthermore, wet weather events may cause Combined Sewer Overflows (CSOs), storm sewer runoff from various sources, and urban runoff to enter Lake Erie.

There are three NEORSD CSOs in the vicinity of Edgewater Beach that are monitored daily by NEORSD’s Sewer System Maintenance and Operation (SSMO) department. These CSOs discharged a total of 14 times to Lake Erie during the recreation season and may have had an effect on *E. coli* densities at the sampling sites (Table 2). CSO 002, an overflow at NEORSD Westerly Water Pollution Control Center from the Combined Sewer Overflow Treatment Facility, discharged eight times during the sampling season. CSO 071 at Harborview Drive and West 117<sup>th</sup> Street overflowed five times and CSO 069 at upper Edgewater Beach overflowed once. Although these CSOs are in close proximity to the beach, it is unknown if these overflow events had an impact on the water quality at Edgewater Beach. Other sources of contamination to the beach water may include avian waste and beach sand.

**Table 2. Number of Monitored NEORSD CSO Overflows during 2010 Recreation Season**

CSO	Location	Number of Overflows	Beach/Creek Potentially Affected
069	Upper Edgewater Beach	1	Edgewater
071	Harborview Drive and West 117 <sup>th</sup> Street	5	Edgewater
002	NEORSD Westerly Water Pollution Control Center from the Combined Sewer Overflow Treatment Facility	8	Edgewater
001	Storm overflow at Easterly Wastewater Treatment Plant	3	Euclid Beach, Villa Angela
206	North end of East 156 <sup>th</sup> Street at Lake Erie	22	Euclid Beach, Villa Angela
242	East 142 <sup>nd</sup> Street and Lakeshore Boulevard	13	Euclid Beach, Villa Angela
239	Lakeshore Boulevard at Euclid Creek	40	Euclid Beach, Villa Angela, Euclid Creek

In the study, “Evaluation of Avian Waste and Bird Counts as Predicators of *Escherichia coli* Contamination at Door County, Wisconsin Beaches” by Kleinheinz, McDermott, & Chomeau (2006), researchers counted avian waste along 13 beaches in Wisconsin three times a week. The purpose was to evaluate avian *E. coli* density in beach water. Results indicated that at 30% of the beaches, the number of birds was positively correlated with *E. coli* densities in beach water. Therefore, if the relationship between the number of birds observed and *E. coli* densities at Door County beaches holds true, then in the Cleveland area, bird feces may be a contributing factor to increased *E.*

<sup>2</sup> Rainfall data obtained from NEORSD’s Division Avenue Pump Station Rain Gauge.

*coli* densities in the water at Edgewater Beach. When examining the number of birds at the three beaches, Edgewater Beach had the highest average number of birds during sampling of all the beaches: average west=28; average east=126 (Table 3).

<b>Beach</b>	<b>Site</b>	<b>Average Number of Birds</b>
Edgewater	East	28
	West	126
Euclid	East	21
	West	21
Villa Angela	East	34
	West	12

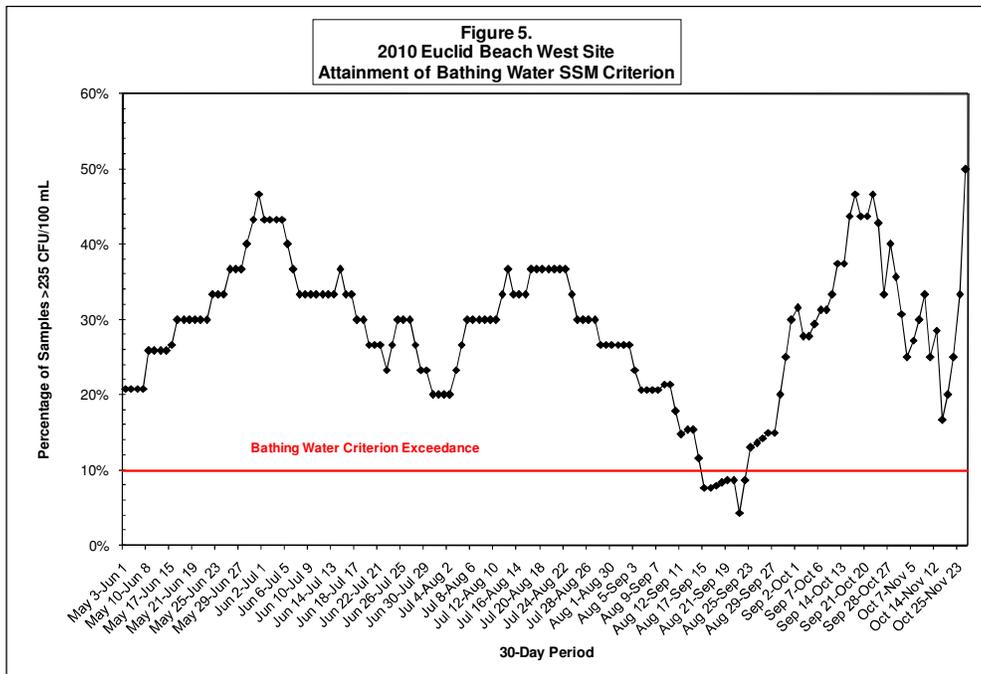
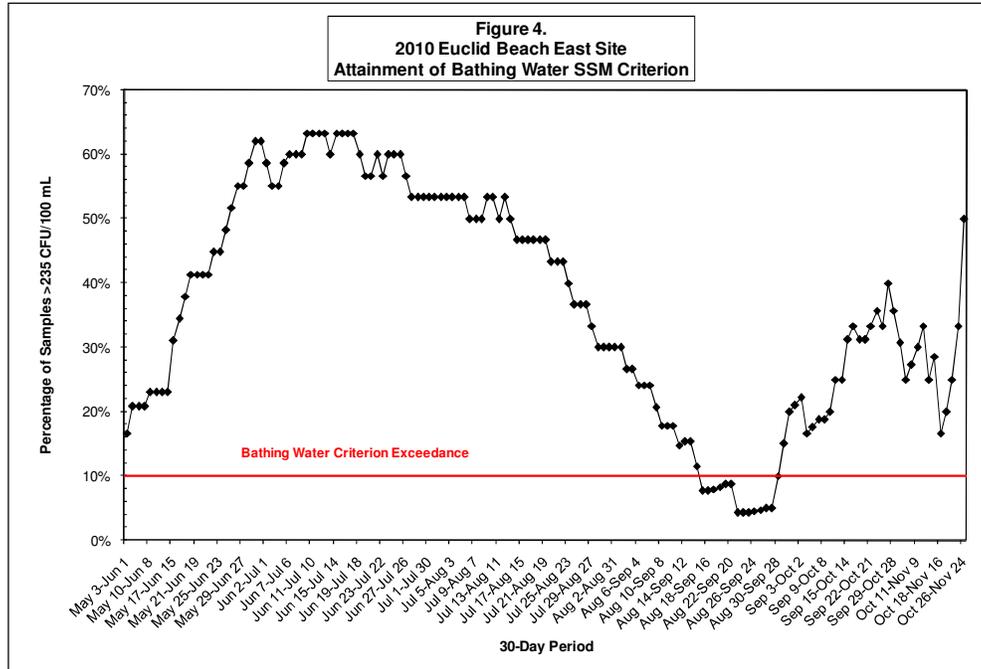
Beach sand may also have an impact on *E. coli* densities in the water. In the study, “Foreshore Sand as a Source of Escherichia coli in Nearshore Water of a Lake Michigan Beach” by Whitman and Nevers (2003), researchers discovered that *E. coli* concentrations in sand and water were significantly correlated, with the highest concentration being found in foreshore sand<sup>3</sup>, followed by those in submerged sediment and water of increasing depth. The study also stated that foreshore beach sand is an important non-point source of *E. coli* to lake water because it is capable of supporting high density bacteria for sustained periods, independent of lake, human, or animal input. If this is also the case in the Cleveland area, then beach sand may be contributing to the high *E. coli* densities at Edgewater Beach. Wave action must be taken into account, though, as it may influence the early colonization and distribution of *E. coli* in beach sand and the subsequent release of sand or sediment-borne *E. coli* in lake water (Ischii, Hansen, Hicks & Sadowsky, 2007).

### **Euclid Beach**

During the recreation season, 146 bacteriological samples were collected at Euclid Beach East, corresponding to 145 thirty-day periods. At this site, 14 thirty-day periods (10%) were in attainment of the SSM criterion, while 131 thirty-day periods (90%) exceeded the criterion (Figure 4). At Euclid Beach West, a total of 147 samples were collected, corresponding to 146 thirty-day periods. At the West site, eight thirty-day periods (5%) were in attainment of the SSM criterion, while 138 thirty-day periods (95%) exceeded the criterion (Figure 5). Similar to Edgewater Beach, both Euclid Beach sites were in attainment of the SGM criterion (Figure 8).

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<sup>3</sup> The area of a shore that lies between the average high tide mark and the average low tide mark.



A possible explanation for the exceedances of the SSM criterion is wet weather. Wet weather may cause CSOs, storm sewer runoff, and urban runoff that might contain elevated *E. coli* densities to enter the lake. Twenty-two percent of the recreation season at Euclid and Villa Angela Beaches was considered wet weather<sup>4</sup>. There are four NEORSD CSOs in the vicinity of Euclid and Villa Angela Beach that are monitored daily

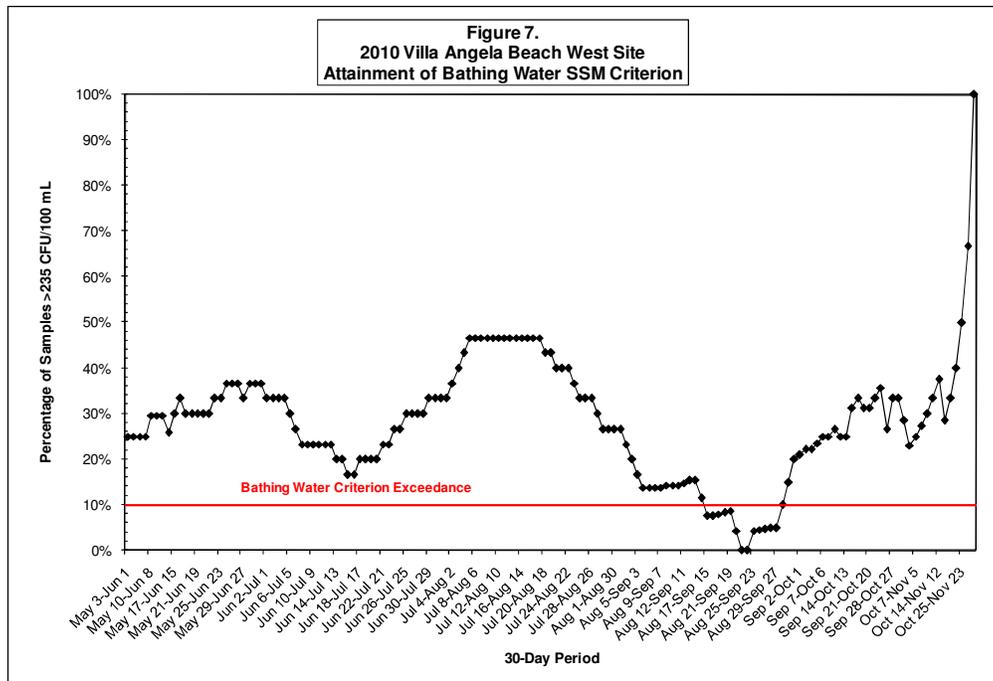
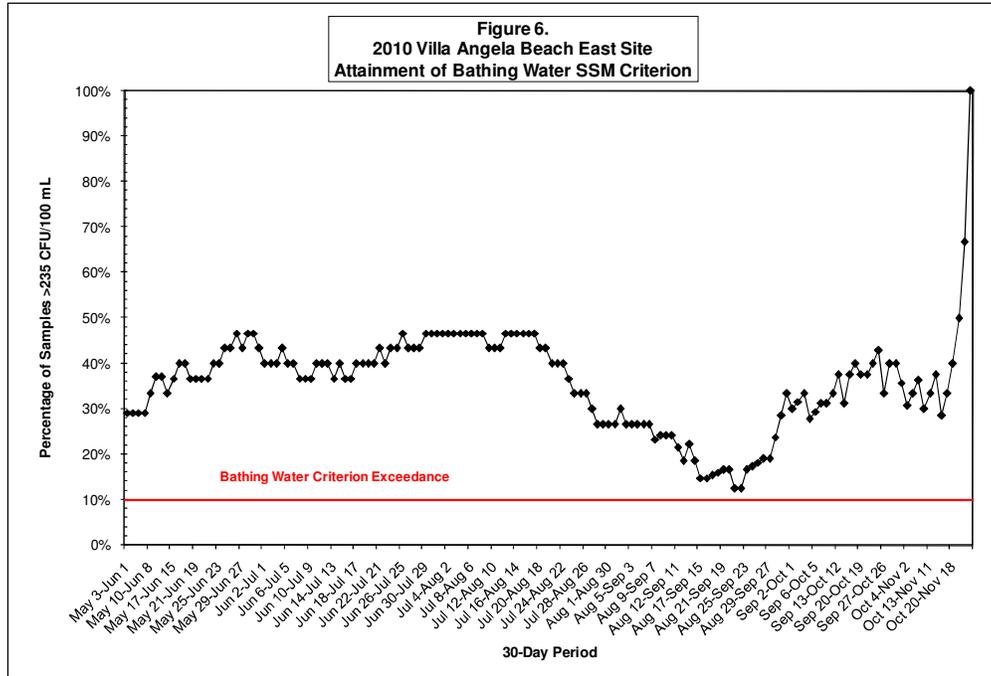
<sup>4</sup> Rainfall data obtained from NEORSD's Easterly Wastewater Treatment Plant Rain Gauge.

by NEORSD's SSMO department. These CSOs discharged a total of 78 times during the recreation season and may have had an effect on *E. coli* densities at the sampling sites. CSO 001, a storm overflow at Easterly Wastewater Treatment Plant, discharged 3 times to Lake Erie. CSO 206, at the north end of East 156<sup>th</sup> Street at Lake Erie, overflowed 22 times. CSO 242, at East 142<sup>nd</sup> Street and Lakeshore Boulevard, discharged 13 times to Lake Erie. CSO 239, located just north of Lakeshore Boulevard at Euclid Creek, discharged 40 times. Also, CSO 207, at East 156<sup>th</sup> Street and Lakeshore Boulevard, and CSO 208, north of Neff Road and East Park Drive, which are not monitored by the SSMO department, may have overflowed during the recreation season. Although these CSOs are in close proximity to the beaches, it is unknown if these overflow events had an impact on the water quality at Euclid Beach. Aside from CSOs, other sources of contamination to beach water may include avian waste and beach sand.

Similar to Edgewater Beach, bird waste may also play a role in *E. coli* densities at Euclid Beach. The bird community at Euclid Beach (Table 3) may contribute to avian fecal contamination in the water and thus a potential increase in bacteriological density in beach water. The same can be said of beach sand, which has the potential to contaminate beach water.

### **Villa Angela Beach**

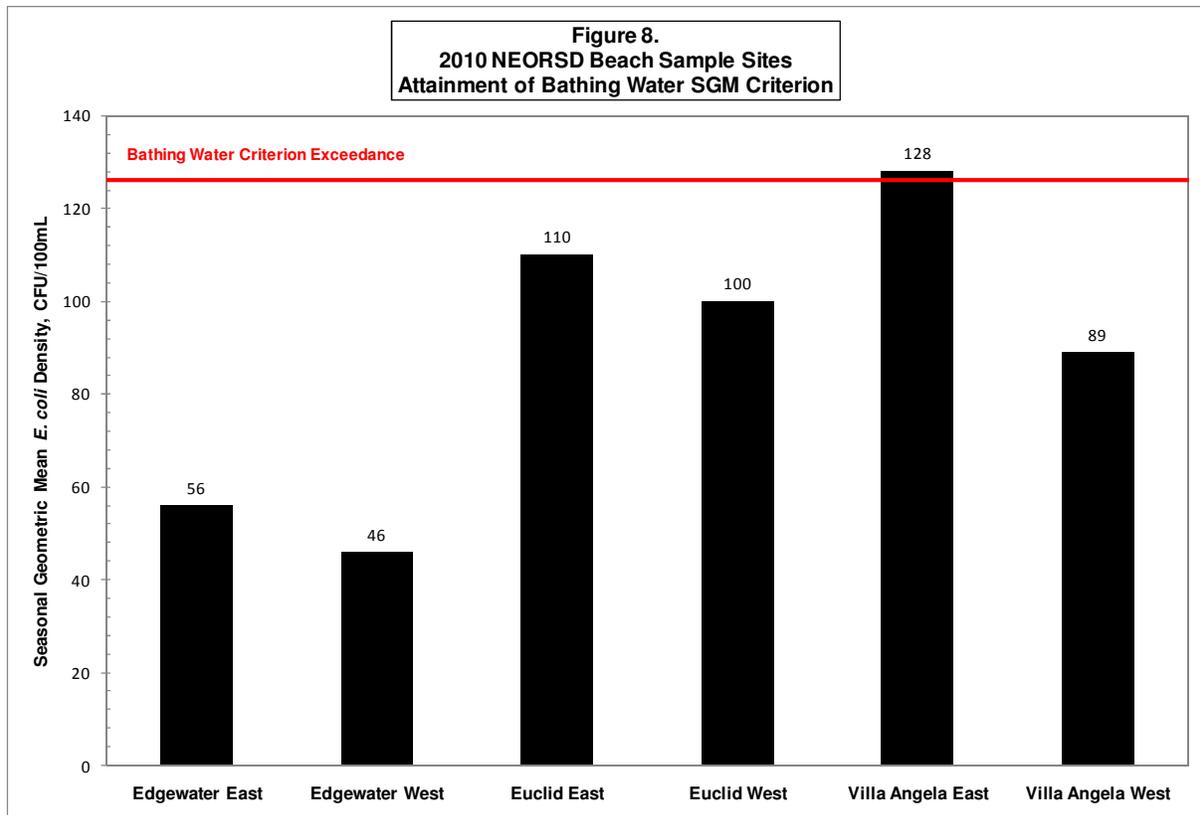
During the recreation season, 149 bacteriological samples were collected at Villa Angela Beach East, corresponding to 148 thirty-day periods. At this site, all thirty-day periods (100%) exceeded the SSM criterion (Figure 6). At Villa Angela Beach West, a total of 148 samples were collected, corresponding to 147 thirty-day periods. At the West site, 14 thirty-day periods (9%) were in attainment of the SSM criterion, while 133 thirty-day periods (91%) exceeded the criterion (Figure 7). At this beach, the West site was in attainment of the SGM criterion, but the East site was not (Figure 8).



A possible explanation for the exceedances of the SSM criterion at both sites and SGM criterion at the East Site could be wet weather. Wet weather may cause CSOs, storm sewer runoff, and urban runoff to enter the lake that may contain elevated *E. coli* densities. As previously mentioned, there are four monitored NEORSD CSOs in the vicinity of Villa Angela and Euclid Beach that discharged a total of 78 times during the recreation season. Although these CSOs are in close proximity to the beach, it is

unknown if the overflow events had an impact on the water quality at Villa Angela Beach.

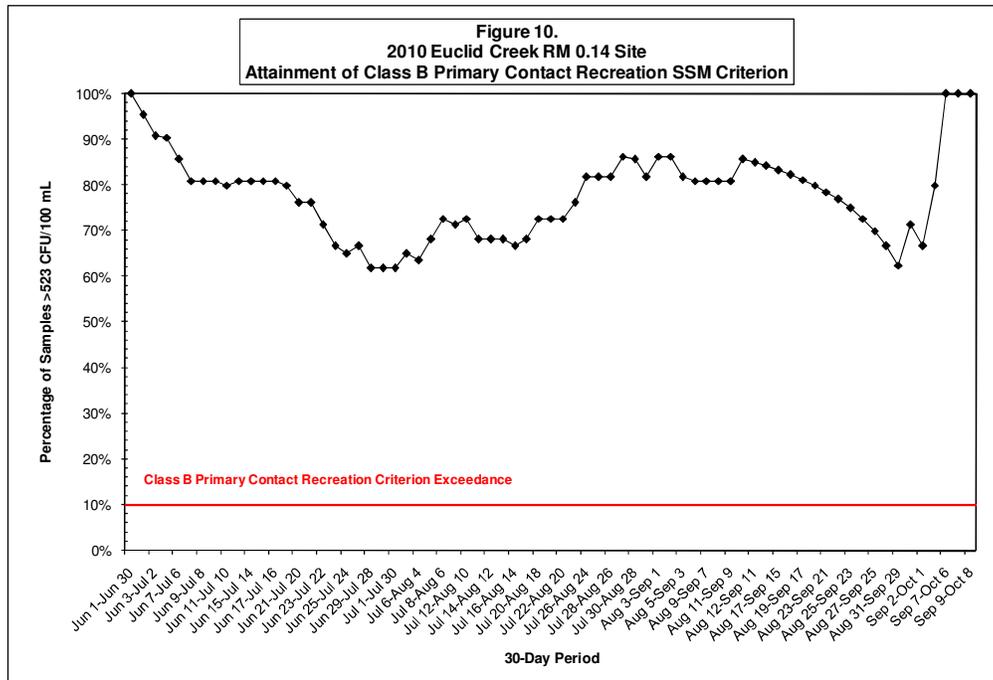
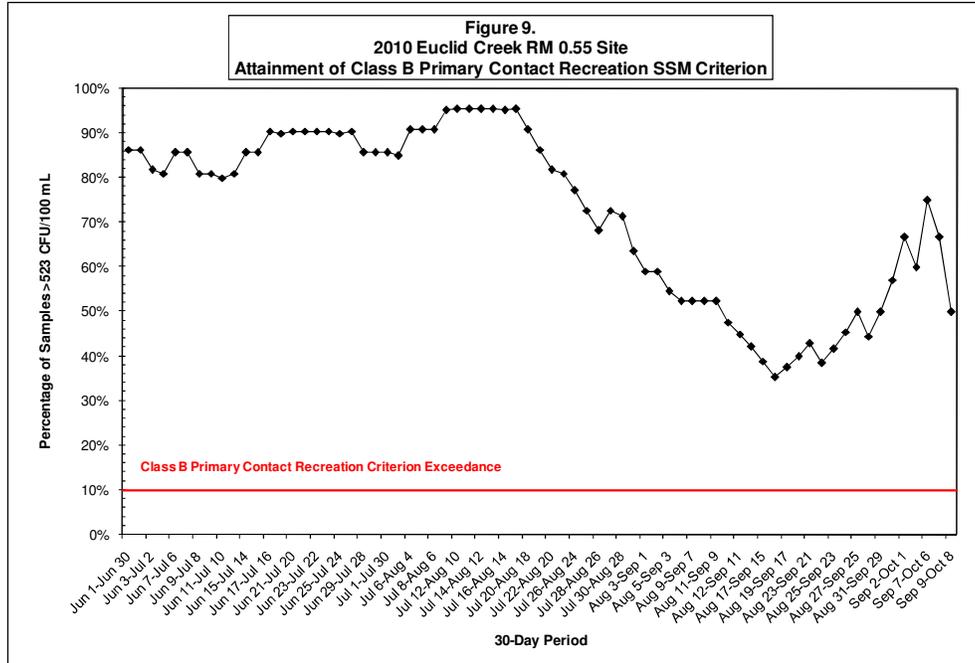
The average number of birds on Villa Angela Beach was 12 and 34 for the West and East sites, respectively, during the sampling season (Table 3). Similar to Edgewater and Euclid Beaches, bird waste may be contributing to the elevated *E. coli* densities observed. Again, another contributing factor to elevated *E. coli* densities is beach sand, which has the potential to contaminate beach water.

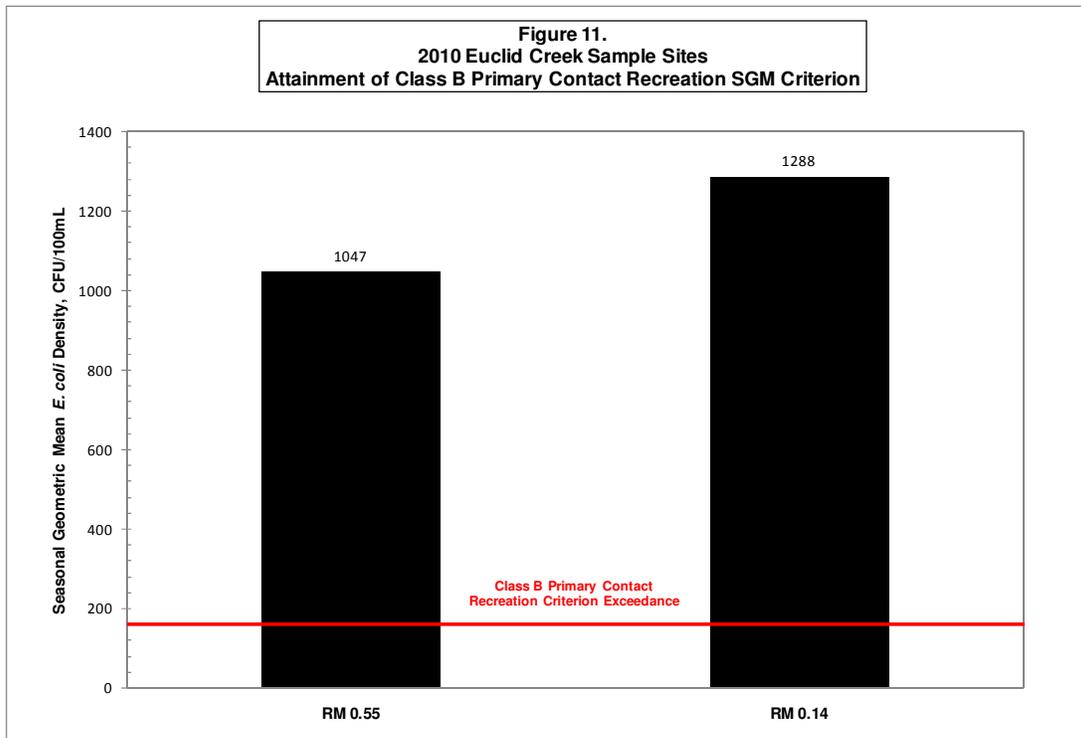


## Euclid Creek Results and Discussion

The *E. coli* results from both creek sites were compared to the Ohio water quality standards to determine recreation use attainment. Euclid Creek is designated as Class B Primary Contact Recreation for the Protection of Recreation Use (Ohio EPA, 2010). The Class B Primary Contact Recreation criteria includes an *E. coli* criterion not to exceed a single sample maximum of 523 CFU/100mL in more than ten percent of the samples taken during any thirty-day period, and a seasonal geometric mean criterion of 161 CFU/100mL. The criteria are only in effect during the recreation season (Ohio EPA, 2010).

During the recreation season, 72 bacteriological samples were collected at each creek site. This corresponds to a total of 71 thirty-day periods at each site. At both creek sites, all thirty-day periods (100%) exceeded the SSM criterion (Figures 9 and 10). Additionally, both sites exceeded the SGM criterion (Figure 11).





A possible explanation for the exceedances of the SSM and SGM criterion could be wet weather. Looking at wet weather occurrences in 2010, 20% of the recreation season at Euclid Creek was considered wet weather<sup>5</sup>. Wet weather may cause CSO overflows, storm sewer runoff, and urban runoff to enter the creek that may contain elevated *E. coli* densities. As previously mentioned, CSO 239 overflowed 40 times to Euclid Creek during the recreation season. Also, CSO 210, located under the Saint Clair Avenue Bridge, and CSO 209, located just north of Lakeshore Boulevard, which are not monitored by the SSMO department, may have overflowed during the recreation season. Although these CSOs discharge to Euclid Creek, it is unknown if the overflow events had an impact on the water quality in Euclid Creek.

Dry weather flow to Euclid Creek may also have an effect on *E. coli* densities at RMs 0.55 and 0.14. Investigations by WQIS personnel on Euclid Creek in 2005, 2006 and 2007 revealed eight storm sewer outfalls in the cities of Cleveland and Euclid that had continuously elevated densities of *E. coli* entering the creek during dry weather. In 2010, WQIS personnel and the City of Euclid verified that two outfalls are no longer a source of bacteriological contamination to the creek. The remaining six storm sewer outfalls as well as CSOs outside of the NEORSD service area and sanitary sewer overflows may still be impacting the water quality at the sampling sites.

<sup>5</sup> Rainfall data obtained from NEORSD's South Euclid Rain Gauge.

### **Impact of Euclid Creek on Villa Angela and Euclid Beaches**

Due to its close proximity, *E. coli* densities measured in Euclid Creek may be impacting the sampling sites on Villa Angela and Euclid Beaches. In the report titled “Interaction and Influence of Two Creeks on *Escherichia coli* Concentrations of Nearby Beaches: Exploration of Predictability and Mechanisms” (Nevers, Whitman & Frick, 2007), it was discovered that *E. coli* contamination in creeks had the greatest effect on *E. coli* densities at surrounding beaches. The transportation of *E. coli* from the creeks to the beaches was significantly influenced by wind speed and direction, currents, wave height and shoreline orientation. Thus, bacteria that enter Euclid Creek may travel downstream and eventually be released into Lake Erie. Once there, prevailing winds and currents may push the bacteria toward Euclid and Villa Angela Beaches and the sampling locations. Thus, *E. coli* densities on Euclid Creek may impact *E. coli* densities, and attainment of the recreation criteria, at Euclid and Villa Angela Beaches.

Furthermore, because Euclid Creek is located adjacent to Villa Angela Beach, the creek may be having a greater influence on bacteriological densities at Villa Angela Beach East (Figure 12). Villa Angela Beach East had an average *E. coli* density of 668 CFU/100mL, while the West site averaged 422 CFU/100mL. The difference in *E. coli* densities between the two sites may be attributed to their location relative to Euclid Creek. Bacteria that enter the lake may not reach the West Site in densities as high as those observed at the East site, due to dilution and dispersion from currents. This may explain why Villa Angela Beach East site was in non-attainment of the SGM criterion, while the West site was in attainment.

**Figure 12. Orientation of Euclid Creek and Villa Angela Beach**



## Conclusions

In 2010, beach sampling sites exceeded the SSM criterion at least 67% of the time, with one site exceeding the criterion 100% of the time (Table 4). Attainment of the criterion varied from 33% attainment at one site to 0% attainment at another. Although this is true, a majority of the sampling sites were in attainment of the SGM criterion (Table 5).

Beach	Site	Thirty-day periods	Thirty-day periods in attainment of criterion	% Attainment	Thirty-day periods in exceedance of criterion	% Exceedance
Edgewater	East	149	40	27%	109	73%
	West	149	49	33%	100	67%
Euclid	East	145	14	10%	131	90%
	West	146	8	5%	138	95%
Villa Angela	East	148	0	0%	148	100%
	West	147	14	9%	133	91%

Beach	Site	Attainment of Criterion (YES/NO)
Edgewater	East	YES
	West	YES
Euclid	East	YES
	West	YES
Villa Angela	East	NO
	West	YES

The Euclid Creek sampling sites exceeded the SSM criterion 100% of the time, with no attainment at either site (Table 6). Additionally, both sites exceeded the SGM criterion in 2010 (Table 7).

Creek	Site	Thirty-day periods	Thirty-day periods in attainment of criterion	% Attainment	Thirty-day periods in exceedance of criterion	% Exceedance
Euclid Creek	RM 0.55	71	0	0%	71	100%
	RM 0.14	71	0	0%	71	100%

Creek	Site	Attainment of Criterion (YES/NO)
Euclid Creek	RM 0.55	NO
	RM 0.14	NO

When comparing the 2010 beach data to the 2009 data, a greater percentage of thirty-day periods exceeded the SSM criterion at the beaches in 2009 than 2010. Five out of six sites exceeded the SSM criterion 100% of the time in 2009 (Table 8), while only one out of six sites exceeded the SSM criterion 100% of the time in 2010 (Table 4). The results of the SGM criterion at the beach were identical in 2009 and 2010, as only 1 site exceeded the SGM criterion in both years (See Tables 5 & 9).

Beach	Site	Thirty-day periods	Thirty-day periods in attainment of criterion	% Attainment	Thirty-day periods in exceedance of criterion	% Exceedance
Edgewater	East	152	0	0%	152	100%
	West	152	13	9%	139	91%
Euclid	East	152	0	0%	152	100%
	West	152	0	0%	152	100%
Villa Angela	East	152	0	0%	152	100%
	West	152	0	0%	152	100%

Beach	Site	Attainment of Criterion (YES/NO)
Edgewater	East	YES
	West	YES
Euclid	East	YES
	West	YES
Villa Angela	East	NO
	West	YES

The 2010 Euclid Creek data was identical to the 2009 data, as both sites exceeded the SSM criterion 100% of the time and both sites exceeded the SGM criterion in 2009 and 2010 (See Tables 6 & 10, Tables 7 & 11). Overall, the 2010 sampling results were similar to the 2009 sampling results with the exception of a greater percentage of thirty-day periods exceeding the SSM criterion in 2009 than 2010. This difference in attainment may be attributed to seasonal variability (i.e., rainfall, wind speed, wave action) from year to year.

Beach	Site	Thirty-day periods	Thirty-day periods in attainment of criterion	% Attainment	Thirty-day periods in exceedance of criterion	% Exceedance
Euclid Creek	RM 0.55	99	0	0%	99	100%
	RM 0.14	71	0	0%	71	100%

Creek	Site	Attainment of Criterion (YES/NO)
Euclid Creek	RM 0.55	NO
	RM 0.14	NO

Elevated *E. coli* densities continue to be observed at the Edgewater, Villa Angela, and Euclid Beaches as well as Euclid Creek. Many factors, such as CSOs, sanitary sewer overflows, storm sewer and urban runoff, beach sand, and avian waste may be contributing to the elevated *E. coli* densities at Edgewater, Euclid and Villa Angela Beaches, and Euclid Creek. Further monitoring at the beaches and creek will continue to characterize and help to identify the issues that may be impacting these sites.

In 2011, the NEORSD entered into a consent decree with the United States Environmental Protection Agency, Ohio Environmental Protection Agency, Department of Justice, and the Ohio Attorney General’s Office to reduce the volume of raw sewage that discharges into the environment during rain events. This 25-year CSO control program will help reduce the number of CSO overflows into Lake Erie and Euclid Creek. Bacteriological sampling results from 2010 will serve as baseline data for this program, as new CSO controls come online in the coming years. As these controls come online, NEORSD hopes to better identify the sources and causes of the elevated *E. coli* densities at the beaches.

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Analytical Services Division – Completed analysis for all water chemistry sampling

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