F1. Background

Prior to the 2002 Integrated Report (IR), the reporting of recreation use impairment in Ohio was sporadic. Section 305(b) reports (1998 and earlier) may have included an indication of the potential for recreation use impairment in various streams, but a cohesive listing was not presented. The 2002 IR employed a uniform methodology to examine readily available data on fecal coliform counts. This approach was based on counting the number of exceedances of the secondary contact recreation use maximum criterion [5,000 colony forming units (cfu)/100 ml fecal coliform or 576 cfu/100 ml *Escherichia coli* (*E. coli*)]. Any assessment unit with five or more samples over the last five years above these values was listed as having an impaired recreation use.

The 2004 IR adopted a more statistically robust methodology for assessing the recreation use attainment of the State’s surface waters linked more directly to the applicable water quality standards. The methodology adopted in 2004 continued to be used through the 2008 IR. The 2008 IR also included a preview of changes anticipated at the time for the 2010 report based on the expectation that the watershed assessment unit (WAU) would change from a larger watershed size (11-digit hydrologic unit) to a smaller watershed size (12-digit hydrologic unit) and on four anticipated revisions to the water quality standards: 1) dropping the fecal coliform criteria; 2) creation of a tiered set of classes of primary contact recreation waters based on recreation use intensity; 3) revision of the geometric mean averaging period; and 4) extension of the recreation season. Revisions to the water quality standards pertaining to the recreation use were adopted on December 15, 2009. The linkage of the methodology to the Ohio WQS is summarized in Table F-1 and subsequent text. The recreation use assessment method employed in this report is essentially the same as used in the 2010 report.

### Table F-1. Summary of the recreation use assessment methods.

<table>
<thead>
<tr>
<th>Bathing Waters</th>
<th>Indicator</th>
<th>Criterion (Table 7-13, OAC 3745-1-07)</th>
<th>Assessment Method Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>Seasonal geometric mean <em>E. coli</em> content* based on samples from the recreation season within a calendar year is 126 cfu/100 ml; single sample maximum is 235 cfu/100 ml.</td>
<td>Applied to the three Lake Erie assessment units, exceedance of the geometric mean bathing water criterion or an exceedance of the single sample maximum for more than 10% of the recreation season is considered an impairment of the bathing water use.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Contact and Secondary Contact</th>
<th>Indicator</th>
<th>Criterion (Table 7-13, OAC 3745-1-07)</th>
<th>Assessment Method Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>Seasonal geometric mean <em>E. coli</em> content* based on samples from the recreation season within a calendar year is: Primary Contact Waters Class A: 126 cfu/100 ml Class B: 161 cfu/100 ml Class C: 206 cfu/100 ml Secondary Contact Waters 1030 cfu/100 ml</td>
<td>Applied to streams and inland lakes. Data from a recreation season are assessed on a site-by-site basis and compared to the applicable geometric mean <em>E. coli</em> criterion whenever more than one sample result is available for a WAU. Assessment units are considered to be in full attainment if all sites assessed within the AU meet the applicable geometric mean criterion and in non-attainment if one or more sites assessed within the AU exceed the applicable geometric mean criterion.</td>
<td></td>
</tr>
</tbody>
</table>

* *E. coli* concentrations are expressed in colony forming units (cfu) per 100 milliliters (ml)
F2. Evaluation Method

Lake Erie (Shoreline)
Attainment of the recreation use designation for the three Lake Erie assessment units (AUs) was based upon examination of *E. coli* data from public bathing beaches provided by the Ohio Department of Health (ODH). Routine bacteria monitoring is performed by local health districts, ODH, and the Northeast Ohio Regional Sewer District (NEORSD) in order to monitor bacteria levels at public bathing beaches and advise the public when elevated bacteria are present that represent an increased risk of contracting waterborne illness as a result of exposure to pathogens while recreating in the water. This monitoring takes place at 63 public beaches in seven coastal counties. The public can access the ODH Beachguard web site to view beach advisory postings and bacteria monitoring data from monitored beaches at [http://publicapps.odh.ohio.gov/BeachGuardPublic/Default.aspx](http://publicapps.odh.ohio.gov/BeachGuardPublic/Default.aspx). The web site is updated daily during the summer recreation season.

Since 2006, beach advisory recommendations have been based upon exceedance of the single sample maximum *E. coli* criterion of 235 cfu/100 ml, consistent with provisions of the 2004 federal BEACH Act rule as well as the *E. coli* criterion applicable for bathing waters in Ohio’s water quality standards. Bacteria data collected by local or state health agencies at public beaches during the recreation season from 2006 through 2010 were included in the analysis. Ohio’s water quality standards define the recreation season as May 1 through October 31, though Lake Erie beach monitoring typically is focused between Memorial Day and Labor Day weekends.

Each of the 23 public beaches that have traditionally been sampled as part of the Lake Erie bathing beach monitoring program (Figure F-1) was individually analyzed to evaluate the percentage of recreation days during which the bathing water single sample maximum criterion of 235 cfu/100 ml was exceeded, since this is the criterion used by health departments to post a

![Figure F-1. Lake Erie public beaches sampled under Ohio’s bathing beach monitoring program.](image-url)
health advisory at a given beach. The frequency of beach advisory postings is a direct measure of recreation use impairment, since potential users may often be discouraged from utilizing a beach on days when a health advisory is posted or to avoid certain beaches altogether that are prone to frequent advisories. Additional data from beaches in Erie County (Figure F-2) and Cuyahoga County (Figure F-3) were used in this report that were not available in previous versions of this report as they have only recently begun monitoring and reporting on a routine basis and data were not previously available for these beaches.

As of July 14, 2011, there were 166 public access locations in the eight coastal counties along Ohio’s Lake Erie coastline. These public access points do not all include a swimming beach, as some are for boat access, fishing access, parks, wildlife viewing areas, etc. The Ohio Department of Natural Resources (ODNR) publishes a Lake Erie Public Access Guide that can be accessed from this web address: [http://ohiodnr.com/Coastal_Main_Menu/Access/tabid/21033/Default.aspx](http://ohiodnr.com/Coastal_Main_Menu/Access/tabid/21033/Default.aspx). This report used data collected from 63 different beaches along the coast as depicted in Figures F-1 through F-3.

The total number of recreation days in a recreation season for any particular beach was determined by adding the number of days beginning with the first day of sampling and ending with Labor Day, or the date the final sample was collected (whichever was later). The total number of days that a beach exceeded the single sample maximum E. coli criterion of 235 cfu/100 ml during the recreation season (as defined above) was tallied. A measured exceedance was assumed to continue until a subsequent sample documented that the criterion was not exceeded. Similarly, a beach was presumed to meet the criterion following a measurement that met the criterion until a subsequent sample was found to exceed the criterion. Sampling frequency varied from year-to-year and from beach-to-beach. A sampling
frequency of four times per week was typical, though some beaches were sampled daily while the two beaches in the Lake Erie Islands AU were sampled only once per week.

The exceedance frequency of the bathing water criterion was determined for each beach over a five-year period (2006-2010) on an annual basis. Results for each individual beach were sorted into the corresponding Lake Erie AU for the purpose of determining the attainment status of each of the three Lake Erie AUs. The assessment status for each Lake Erie AU was based upon whether the frequency of exceedance of the single sample maximum *E. coli* criterion was greater than 10% of the recreation season, as described in the Table F-2 below.

Table F-2. Determining assessment status of Lake Erie shoreline AUs.

<table>
<thead>
<tr>
<th>Lake Erie AU Assessment Status</th>
<th>Attainment Status of Individual Beaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>Frequency of advisory postings less than 10% of recreation season for all of the beaches in the AU for all years assessed</td>
</tr>
<tr>
<td>Non</td>
<td>Frequency of advisory postings more than 10% of recreation season for one or more of the beaches in the AU for one or more of the years assessed</td>
</tr>
</tbody>
</table>

A 10% exceedance frequency was used as the threshold for attainment determination in the last four assessment cycles and has its origins in the water quality standards as well as Ohio’s 1998 State of the Lake Report prepared by the Ohio Lake Erie Commission (Ohio LEC 1998). While the stated goal in the State of the Lake report for beaches is to have clean beaches all of the time (no days under advisement), the report considered having ten or fewer days under advisement to be “excellent” (note that ten days translates to 10% of the season based on a
100-day season). The Ohio Lake Erie Commission’s latest edition of the State of the Lake Report (Ohio LEC 2004) continues to use these benchmarks in rating the swimmability of Lake Erie beaches along Ohio’s 262-mile shoreline. The 2012 IR also continues to use these criteria in determination of impairment at the assessment unit level. In addition, statistical summaries are included in Tables F-5 and F-6 for individual beaches to provide additional detail and allow performance comparisons among individual beaches.

**Rivers and Streams**

The 2012 recreation use impairment list was developed using ambient *E. coli* survey data collected from May 2006 through October 2010 by Ohio EPA as well as a limited amount of ambient stream data provided by municipal dischargers that were collected at upstream and downstream monitoring stations relative to their primary discharge location as required by their NPDES permit. Data from dischargers are limited since permits have historically been based on monitoring for fecal coliform. More NPDES dischargers are beginning to monitor for *E. coli* in lieu of fecal coliform as permits are renewed and *E. coli* monitoring is phased into increasing numbers of NPDES permits.

Approximately 11,450 *E. coli* bacteria records were evaluated in this analysis. Data were sorted into their respective 12-digit watershed assessment units (WAUs) and large river assessment units (LRAUs) using a geo-spatial analysis of the latitude/longitude data (and other geographical data if needed) associated with each *E. coli* value. Data within a WAU were further sorted by sampling location and date (calendar year) on which they were collected. Figure F-4 demonstrates the sampling coverage that would be typical for part of a study area. In this case, there are five 12-digit WAUs depicted that drain to one LRAU, the Walhonding River. Each of the five WAUs was sampled in 2010 at one location (depicted by yellow dots) toward the downstream end of the primary tributary in the WAU. Four sampling locations (green dots) are dispersed along the 16-mile stretch of the Walhonding River depicted for an average sampling density of one site per four miles of river length for the Class A primary contact recreation water. Sites were generally sampled at least on five different occasions over the course of the 2010 recreation season, though some sites were sampled more frequently.
Recreation use assessment determinations for rivers and streams are based on the following two-step process: site-by-site analysis and assessment unit analysis.

Site-by-Site Analysis

*E. coli* data from each site were compared to the geometric mean *E. coli* criterion applicable to the particular site, considering the recreation use and class (for PCR). The geometric mean was calculated using the “geomean” function in Microsoft Excel 2010® on a site-by-site basis using the pooled dataset of all *E. coli* data (minimum of two data points required but typically composed of five samples) from the site during a single recreation season. When data were available for multiple recreation seasons, the data from each season were independently analyzed for each recreation season to determine the geometric mean for each season. Further details are listed below.

- Data collected outside of the recreation season as defined in Ohio's WQS (May 1st through October 31st) were excluded from the analysis.
- Certain qualified values, such as sample results that exceeded proper holding time or those that have otherwise been indicated to have significant quality assurance deficiencies, were also excluded from the analysis.
- Values reported as “too numerous to count” (“TNVC”) were used in the analysis when it was possible to estimate a value based on the dilutions used and/or the maximum reporting limits.
- Values reported as “greater than” were also used in the analysis. A geometric mean calculated using one or more “greater than” or “TNVC” values in the data set was reported as a “greater than” geometric mean.
Values reported as “less than” values of greater than 50 were excluded since acceptable test methods can detect much lower concentrations when appropriate dilutions are used in the analysis. Values reported as less than 50 or less were used in the analysis. The value used in statistical analysis was one-half the reported “less than” value. A value of one was substituted for the purpose of computing the geometric mean in any case where a value of less than one was reported. Geometric means cannot be calculated using data sets that contain a value of zero.

Results from duplicate B were used for calculation of the geometric mean in cases where duplicate sample results were reported, except if the *E. coli* densities of the duplicate samples were more than 5x apart from one another, in which case both values were rejected.

Assessment Unit Analysis
In the second step of the analysis, the assessment status of the WAU or LRAU was determined based on the attainment status of all the individual sites within the assessment unit and within the assessment period (2004-2008) as described in Table F-3 below.

<table>
<thead>
<tr>
<th>AU Assessment Status</th>
<th>Attainment Status of Individual Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full</strong> (Category 1)</td>
<td>Sufficient data exist to calculate a geometric mean for at least one location within the WAU (or a minimum of one site for every ~5-7 river miles of a LRAU); applicable geometric mean(s) attain applicable geometric mean criterion at all assessed sites within the AU</td>
</tr>
<tr>
<td><strong>Non</strong> (Category 5)</td>
<td>Sufficient data exist to calculate a geometric mean for at least one location within the WAU (or a minimum of one site for every ~5-7 river miles of a LRAU); geometric mean(s) exceed applicable geometric mean criterion at one or more assessed sites within the AU</td>
</tr>
<tr>
<td><strong>Insufficient Data</strong> (Category 3)</td>
<td>No data (category 3) or insufficient data (category 3i) to calculate a geometric mean for any site within the WAU (or for a minimum of one site for every ~5-7 river miles of a LRAU)</td>
</tr>
</tbody>
</table>

Inland Lakes
Inland lakes were assessed in a manner similar to that described above for the rivers and streams. Inland lake data were analyzed on a site-by-site basis, with each resulting geometric mean value compared to the geometric mean criterion applicable to each site. Lake sampling locations generally included a beach and/or open water location, with 5-10 samples per location. Inland lakes are considered a component of the assessment unit(s) in which they are geographically located, so sample results from lakes may affect the assessment status of the AU(s) and the index scores for the AU(s).

The ODNR, as part of Ohio’s Bathing Beach Monitoring Program, monitors *E. coli* levels during the summer at public beaches of lakes located in state parks. While Ohio EPA was unable to establish the level of credibility of these data for use in official listing determinations for this report, a summary of the advisory postings for the 67 beaches monitored in the program is included in Table F-17. Though similar to the beach monitoring program along Lake Erie, there are several differences. Notably, the sampling frequency is much lower at the inland lake beaches compared to the Lake Erie beaches as a result of funding disparity. Secondly, because of the large geographic area, beach samples from inland lakes are analyzed by a multitude of consulting laboratories across the state.
Recruitment Use Attainment Index Score

The recreation use attainment index score provides a way to compare the relative difference between the *E. coli* concentrations at sites sampled within an assessment unit and the recreation use geometric mean criterion that applies to each of the sampled sites. Those assessment units having *E. coli* concentrations that tended to be much greater than the applicable criteria had the lowest scores, while those assessment units having *E. coli* concentrations that attained the applicable criteria, or tended to only slightly exceed the applicable criteria, had the highest scores. An index score was assigned for each site having sufficient data to calculate a geometric mean (i.e., two or more samples) by comparing the geometric mean *E. coli* concentration at the site to the applicable geometric mean criterion based on the scale depicted in Table F-4.

<table>
<thead>
<tr>
<th>Site Geometric Mean</th>
<th>Index Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meets criterion</td>
<td>100</td>
</tr>
<tr>
<td>Exceeds up to 2x criterion</td>
<td>75</td>
</tr>
<tr>
<td>Exceeds more than 2x up to 5x criterion</td>
<td>50</td>
</tr>
<tr>
<td>Exceeds more than 5x up to 10x criterion</td>
<td>25</td>
</tr>
<tr>
<td>Exceeds more than 10x criterion</td>
<td>0</td>
</tr>
</tbody>
</table>

An average index score was computed for assessment units with multiple site index scores based on data from multiple sites and/or recreation seasons. Index scores are reported in Table F-11 for the LRAUs. When only one site index score was available for an AU, that index score was used to represent the assessment unit. The index score for the AU is based upon the same scale as described above for the index score for a particular site.

F3. Results

Using the methodology outlined in the previous section and available *E. coli* data collected from 63 public beaches along Ohio’s Lake Erie 312 mile shoreline (6,330 samples); at hundreds of locations from Ohio’s rivers and streams (11,450 samples) including nine of Ohio’s largest rivers; and for 21 of Ohio’s inland lakes (240 samples); results for the recreation use attainment analysis are presented in this section. Samples used in this analysis were collected from 2006 through 2010 during the recreation season of May 1 – October 31. More detailed recreation use statistics are provided at [http://www.epa.ohio.gov/dsw/tmdl/2012IntReport/index.aspx](http://www.epa.ohio.gov/dsw/tmdl/2012IntReport/index.aspx).

F3.1 Lake Erie Public Beaches

Information about water quality conditions at Lake Erie public bathing beaches is summarized in Tables F-5 through F-8 and Figure F-5. The location of these beaches is shown in Figures F-1 through F-3. The methodology used for assessing the beaches along Ohio’s Lake Erie shoreline is unchanged from the 2010 report.

Table F-5 contains the seasonal geometric mean *E. coli* levels for 18 public beaches along the coast of Lake Erie’s western basin for the past five recreational seasons (2006-2010) while Table F-6 contains the seasonal geometric mean *E. coli* levels for 45 public beaches along the coast of Lake Erie’s central basin for the past five recreational seasons (2006-2010).

The seasonal geometric mean *E. coli* criterion for bathing waters was exceeded at six beaches in 2008, two beaches in 2009, and four beaches in 2010. Two beaches exceeded the seasonal
geometric mean bathing water criterion for the entire five year reporting period – Euclid State Park and Villa Angela. Not surprisingly, these two beaches had the most days under swimming advisory in 2006, 2007 and 2009, and among the most in 2008 and 2010. Highlighted cells in Table F-5 indicate impairment of the recreation use at a given beach in a given year. The table also indicates the number of beach advisories for each beach based upon exceedance of the single sample maximum *E. coli* criterion for beaches of 235 cfu/100 ml. This is the threshold that triggers the issuance of beach advisories, and has been used since 2006. Use of the single sample maximum *E. coli* criterion for the purpose of issuing beach advisories complies with the federal BEACH Act rule (*Water Quality Standards for Coastal and Great Lakes Recreation Waters*, 69 FR 67217, November 16, 2004), which became effective on December 16, 2004.

In Tables F-7 through F-9, the beaches are arranged alphabetically according to the Lake Erie assessment unit in which they are geographically located. The table indicates the number of days (and the percentage for all years) when Ohio’s Lake Erie public beaches exceeded Ohio’s bathing water single sample maximum criterion compared to the total number of days in the recreation season sampling period.

As depicted in Figure F-5, the frequency with which individual beaches were recommended for a swimming advisory based on elevated bacteria levels above the state water quality standards for the entire five year reporting period (2006-2010) ranged from 0% at Kelleys Island State Park beach to nearly 50% at Euclid State Park beach. Considerable variation in the frequency of advisories was observed between beaches. However, several beaches stand out as consistently good performers over the past several recreation seasons, including Battery Park, Catawba, East Harbor, Hoffman, Kelleys Island, Lakeside, Lions Park, Old Womans Creek, Port Clinton, South Bass Island, and Walnut Beach which all had a cumulative exceedance frequency under 10%. These beaches infrequently exceeded the goal of fewer than 10 days per season under advisement. There were also several beaches that performed poorly on a consistent basis with four beaches including Clifton, Edson Creek, Euclid and Villa Angela beach under advisement over 40% of the past five recreation seasons.

High variation in bacteria levels was also seen between seasons for some beaches. For example, Lakeview beach was under advisement for 11 days in 2007, but under advisement for 44 days in 2008. Century beach was under advisory just two days in 2007, but was under advisory for 53 days in 2008. The annual median number of days under advisement was highest in 2010 at 19 days compared to the rest of the reporting years which had medians of 13-14 days under advisory. The annual average geometric mean of all beaches ranged from a low of 53.9 in 2009 to a high of 71.7 in 2010. The annual mean *E. coli* level of all beaches ranged from a low of 41.4 in 2007 to a high of 57.5 in 2010.

Impairment of the bathing water recreation use was determined by pooling data from beaches in each of the three Lake Erie assessment units and calculating the percentage of days in the recreational season when the *E. coli* criterion was exceeded. A threshold of impairment was set at 10 days per season based upon the Ohio Lake Erie Commission’s evaluation system (Ohio LEC 1998). This translates to a seasonal exceedance frequency of 10%, as the recreation season at Lake Erie’s beaches in Ohio typically runs from Memorial Day weekend through Labor Day weekend. Results are shown in Table F-10. As in previous assessment cycles, the 2012 assessment results indicate that the Lake Erie Islands assessment unit fully supports the recreation use while the western basin and central basin assessment units do not support the recreation use. The overall total recreation days in exceedance of the bathing waters criterion on a percentage basis was 16.8% in the western basin (16 beaches) and 21.8% (45 beaches) in the central basin.
Table F-5. Seasonal geometric mean *E. coli* levels and advisory postings at public Lake Erie shoreline beaches in the western basin.

<table>
<thead>
<tr>
<th>Beach</th>
<th>2006 Seasonal geomean</th>
<th># of days posted</th>
<th>2007 Seasonal geomean</th>
<th># of days posted</th>
<th>2008 Seasonal geomean</th>
<th># of days posted</th>
<th>2009 Seasonal geomean</th>
<th># of days posted</th>
<th>2010 Seasonal geomean</th>
<th># of days posted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Park</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>10</td>
<td>2</td>
<td>179</td>
<td>40</td>
</tr>
<tr>
<td>Bay View East</td>
<td>88</td>
<td>40</td>
<td>193</td>
<td>46</td>
<td>112</td>
<td>36</td>
<td>71</td>
<td>15</td>
<td>60</td>
<td>9</td>
</tr>
<tr>
<td>Bay View West</td>
<td>93</td>
<td>27</td>
<td>188</td>
<td>50</td>
<td>88</td>
<td>34</td>
<td>63</td>
<td>23</td>
<td>60</td>
<td>9</td>
</tr>
<tr>
<td>Camp Perry</td>
<td>9</td>
<td>8</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Catawba Island</td>
<td>92</td>
<td>21</td>
<td>31</td>
<td>8</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Crane Creek</td>
<td>61</td>
<td>12</td>
<td>106</td>
<td>42</td>
<td>147</td>
<td>39</td>
<td>112</td>
<td>30</td>
<td>112</td>
<td>30</td>
</tr>
<tr>
<td>Crystal Rock</td>
<td>11</td>
<td>4</td>
<td>23</td>
<td>12</td>
<td>10</td>
<td>0</td>
<td>13</td>
<td>1</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>East Harbor</td>
<td>8</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Kelleys Island</td>
<td>61</td>
<td>8</td>
<td>79</td>
<td>5</td>
<td>112</td>
<td>5</td>
<td>112</td>
<td>30</td>
<td>112</td>
<td>30</td>
</tr>
<tr>
<td>Kiwanis</td>
<td>14</td>
<td>0</td>
<td>15</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>79</td>
<td>29</td>
<td>79</td>
<td>29</td>
</tr>
<tr>
<td>Lakeside</td>
<td>26</td>
<td>14</td>
<td>19</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>12</td>
<td>1</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Lion’s Park</td>
<td>14</td>
<td>0</td>
<td>15</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>79</td>
<td>29</td>
<td>79</td>
<td>29</td>
</tr>
<tr>
<td>Maumee - Erie</td>
<td>95</td>
<td>23</td>
<td>75</td>
<td>25</td>
<td>67</td>
<td>17</td>
<td>44</td>
<td>20</td>
<td>51</td>
<td>15</td>
</tr>
<tr>
<td>Maumee - Inland</td>
<td>47</td>
<td>10</td>
<td>62</td>
<td>20</td>
<td>91</td>
<td>18</td>
<td>78</td>
<td>8</td>
<td>68</td>
<td>9</td>
</tr>
<tr>
<td>Pickerel Creek</td>
<td>45</td>
<td>9</td>
<td>51</td>
<td>11</td>
<td>27</td>
<td>4</td>
<td>93</td>
<td>32</td>
<td>93</td>
<td>32</td>
</tr>
<tr>
<td>Port Clinton</td>
<td>23</td>
<td>8</td>
<td>20</td>
<td>13</td>
<td>16</td>
<td>9</td>
<td>18</td>
<td>10</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>South Bass Island</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Whites Landing</td>
<td>64</td>
<td>10</td>
<td>61</td>
<td>10</td>
<td>91</td>
<td>24</td>
<td>91</td>
<td>24</td>
<td>91</td>
<td>24</td>
</tr>
</tbody>
</table>

Empty cells indicate no data were available for the beach during that year. Highlighted cells indicate impairment of the recreation use. Impairment is triggered by an exceedance of the geometric mean on a seasonal basis (*Seasonal geomean*) or if the single-sample maximum criteria (*SSM*) are exceeded more than 10% of the time during a season. The beach season is defined for this analysis as the time *E. coli* monitoring commences, typically in late May, though the end of the Labor Day weekend. The number of days posted is determined by counting the number of days a criteria is exceeded. Days for which no monitoring data were collected are presumed to be in exceedance if the preceding day’s bacteria level exceeded the criteria. Unmonitored days are presumed to be below the criteria when preceded by a monitored day that was below the criterion. The beach at Crane Creek was closed after 2007 and transferred to the Magee Marsh Wildlife Refuge managed by ODNR.
Table F-6. Seasonal geometric mean E. coli levels and advisory postings at public Lake Erie shoreline beaches in the central basin.

<table>
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<th>2009 Seasonal geomean</th>
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Empty cells indicate no data were available for the beach during that year. Highlighted cells indicate impairment of the recreation use. Impairment is triggered by an exceedance of the geometric mean on a seasonal basis (Seasonal geomean) or if the single-sample maximum criteria (SSM) are exceeded more than 10% of the time during a season. The beach season is defined for this analysis as the time E. coli monitoring commences, typically in late May, though the end of the Labor Day weekend. The number of days posted is determined by counting the number of days a criteria is exceeded. Days for which no monitoring data were collected are presumed to be in exceedance if the preceding day’s bacteria level exceeded the criteria. Unmonitored days are presumed to be below the criteria when preceded by a monitored day that was below the criterion.
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old Womans Creek East</td>
<td>5/96</td>
<td>1/96</td>
<td>0/103</td>
<td>9/103</td>
<td>15/398 (3.8%)</td>
<td></td>
</tr>
<tr>
<td>Old Womans Creek West</td>
<td>13/96</td>
<td>11/98</td>
<td>2/105</td>
<td>1/103</td>
<td>27/402 (6.7%)</td>
<td></td>
</tr>
<tr>
<td>Parklawn Beach</td>
<td>10/103</td>
<td>13/98</td>
<td>23/201 (11.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Royal Acres Beach</td>
<td>20/104</td>
<td>36/97</td>
<td>56/201 (27.9%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawmill Creek</td>
<td>11/96</td>
<td>0/96</td>
<td>3/105</td>
<td>30/103</td>
<td>44/400 (11.0%)</td>
<td></td>
</tr>
<tr>
<td>Sherod Creek</td>
<td>38/96</td>
<td>19/96</td>
<td>29/105</td>
<td>40/103</td>
<td>126/400 (31.5%)</td>
<td></td>
</tr>
<tr>
<td>Shoreby Club Beach</td>
<td>34/104</td>
<td>7/97</td>
<td>41/201 (20.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shorehaven Beach</td>
<td>63/104</td>
<td>14/97</td>
<td>77/201 (38.3%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Showse Park</td>
<td>14/96</td>
<td>19/96</td>
<td>13/105</td>
<td>14/103</td>
<td>60/400 (15.0%)</td>
<td></td>
</tr>
<tr>
<td>Sims Beach</td>
<td>34/104</td>
<td>28/97</td>
<td>62/201 (30.8%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar Creek</td>
<td>13/96</td>
<td>12/96</td>
<td>14/105</td>
<td>28/103</td>
<td>67/400 (16.8%)</td>
<td></td>
</tr>
<tr>
<td>Utopia Beach</td>
<td>20/104</td>
<td>14/97</td>
<td>34/201 (16.9%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vermilion River East</td>
<td>38/96</td>
<td>25/96</td>
<td>23/105</td>
<td>32/103</td>
<td>118/400 (29.5%)</td>
<td></td>
</tr>
<tr>
<td>Vermilion River West</td>
<td>29/96</td>
<td>13/98</td>
<td>22/105</td>
<td>34/103</td>
<td>98/402 (24.4%)</td>
<td></td>
</tr>
<tr>
<td>Villa Angela State Park</td>
<td>44/105</td>
<td>63/104</td>
<td>49/109</td>
<td>46/114</td>
<td>42/106</td>
<td>244/538 (45.4%)</td>
</tr>
</tbody>
</table>
### Table F-8. The number of days per season (and the percentage for all years) when Ohio Lake Erie public beaches exceeded Ohio’s single sample maximum *E. coli* criterion compared to the total number of days in the sampling period, 2006 – 2010, for the Islands AU.

<table>
<thead>
<tr>
<th>Beach</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>All years (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wagar Beach</td>
<td>10/103</td>
<td>27/98</td>
<td>37/201 (18.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walnut Beach</td>
<td>12/84</td>
<td>6/83</td>
<td>11/95</td>
<td>5/105</td>
<td>10/105</td>
<td>44/472 (9.3%)</td>
</tr>
</tbody>
</table>

### Table F-9. The number of days per season (and the percentage for all years) when Ohio Lake Erie public beaches exceeded Ohio’s single sample maximum *E. coli* criterion compared to the total number of days in the sampling period, 2006 – 2010, for the Western Basin AU.

<table>
<thead>
<tr>
<th>Beach</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>All years (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Bass Island State Park</td>
<td>0/84</td>
<td>1/78</td>
<td>0/93</td>
<td>0/104</td>
<td>7/92</td>
<td>8/450 (1.8%)</td>
</tr>
<tr>
<td>Kelleys Island State Park</td>
<td>0/84</td>
<td>0/78</td>
<td>0/93</td>
<td>0/104</td>
<td>0/92</td>
<td>0/451 (0.0%)</td>
</tr>
<tr>
<td>Battery Park</td>
<td>4/94</td>
<td>0/105</td>
<td>2/103</td>
<td>6/302 (2.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bay View East</td>
<td>3/96</td>
<td>13/98</td>
<td>13/105</td>
<td>40/103</td>
<td>69/402 (17.2%)</td>
<td></td>
</tr>
<tr>
<td>Bay View West</td>
<td>40/96</td>
<td>46/98</td>
<td>36/105</td>
<td>15/103</td>
<td>137/402 (34.1%)</td>
<td></td>
</tr>
<tr>
<td>Camp Perry</td>
<td>28/92</td>
<td>50/85</td>
<td>34/95</td>
<td>23/105</td>
<td>9/105</td>
<td>144/482 (29.9%)</td>
</tr>
<tr>
<td>Catawba Island State Park</td>
<td>8/91</td>
<td>8/86</td>
<td>1/95</td>
<td>3/105</td>
<td>2/105</td>
<td>22/482 (4.6%)</td>
</tr>
<tr>
<td>Crane Creek State Park</td>
<td>21/91</td>
<td>8/91</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>29/182 (15.9%)</td>
</tr>
<tr>
<td>Crystal Rock</td>
<td>12/98</td>
<td>42/105</td>
<td>39/103</td>
<td>93/306 (30.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Harbor State Park</td>
<td>4/91</td>
<td>12/85</td>
<td>0/93</td>
<td>1/105</td>
<td>0/105</td>
<td>17/479 (3.5%)</td>
</tr>
<tr>
<td>Kiwanis</td>
<td>8/98</td>
<td>5/105</td>
<td>30/103</td>
<td>43/306 (14.1%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lakeside</td>
<td>14/91</td>
<td>10/85</td>
<td>5/95</td>
<td>1/105</td>
<td>9/105</td>
<td>39/481 (8.1%)</td>
</tr>
<tr>
<td>Lion's Park</td>
<td>0/96</td>
<td>1/98</td>
<td>0/105</td>
<td>29/103</td>
<td>30/402 (7.5%)</td>
<td></td>
</tr>
<tr>
<td>Maumee Bay State Park (inland)</td>
<td>10/91</td>
<td>20/85</td>
<td>18/95</td>
<td>8/105</td>
<td>9/105</td>
<td>65/481 (13.5%)</td>
</tr>
<tr>
<td>Maumee Bay State Park (Erie)</td>
<td>23/91</td>
<td>25/85</td>
<td>17/95</td>
<td>20/105</td>
<td>15/105</td>
<td>100/481 (20.8%)</td>
</tr>
<tr>
<td>Pickerel Creek</td>
<td>9/96</td>
<td>11/98</td>
<td>4/105</td>
<td>32/103</td>
<td>56/402 (13.9%)</td>
<td></td>
</tr>
<tr>
<td>Port Clinton</td>
<td>8/91</td>
<td>13/91</td>
<td>9/95</td>
<td>10/105</td>
<td>6/105</td>
<td>46/487 (9.4%)</td>
</tr>
<tr>
<td>Whites Landing</td>
<td>10/98</td>
<td>10/105</td>
<td>24/103</td>
<td>44/306 (14.4%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure F-5. Frequency of advisory postings at Ohio's Lake Erie public beaches.
Table F-10. Bathing water geometric mean \(E. \text{coli}\) exceedance frequency at 63 Lake Erie public beaches from 2006-2010 (pooled by Lake Erie AU to report use support).

<table>
<thead>
<tr>
<th></th>
<th>Western Basin</th>
<th>Central Basin</th>
<th>Lake Erie Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of beaches</td>
<td>16</td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>Total recreation days</td>
<td>5,598</td>
<td>16,300</td>
<td>901</td>
</tr>
<tr>
<td>Total days in exceedance</td>
<td>940</td>
<td>3552</td>
<td>8</td>
</tr>
<tr>
<td>Percentage of days in exceedance</td>
<td>16.8%</td>
<td>21.8%</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Average # of days (E. \text{coli}) criteria exceeded per beach per season(^1)</td>
<td>11.8</td>
<td>15.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Attainment status</td>
<td>Does not support</td>
<td>Does not support</td>
<td>Full support</td>
</tr>
</tbody>
</table>

\(^1\)Calculated by dividing the total days in exceedance in a basin by the number of beaches in the basin, then dividing that result by the number of seasons (5) from which the exceedance data were obtained.

F3.2 Rivers and Streams

Approximately 11,700 bacteria measurements were evaluated for the 2012 recreation use support analysis of streams, rivers, and inland lakes in Ohio. Ohio’s recreation use support analysis is based on an examination of \(E. \text{coli}\) data collected in Ohio’s rivers, streams and inland lakes during the recreation season. Almost all of the data used in the 2012 assessment of recreation use support were collected by Ohio EPA, though some discharger-based monitoring data (~330 records) began to become available in the 2009 recreation season with an increasing amount in 2010. Ohio continues to replace fecal coliform monitoring requirements with \(E. \text{coli}\) monitoring requirements as permits are renewed, so the amount of \(E. \text{coli}\) discharge monitoring data that is available in coming years is expected to grow significantly. Table F-11 provides a summary of Ohio EPA’s recreation use monitoring effort and its translation to use assessment annually for the past five recreation seasons.

Table F-11. Annual Ohio EPA \(E. \text{coli}\) sampling effort and recreation use assessment (using Ohio EPA data) in Ohio streams, rivers, and inland lakes, 2006-2010 recreation seasons.

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Samples Collected by Ohio EPA</td>
<td>2,568</td>
<td>1,985</td>
<td>3,211</td>
<td>1,800</td>
<td>1,800</td>
</tr>
<tr>
<td># of Site Geometric Means Computed</td>
<td>383</td>
<td>389</td>
<td>527</td>
<td>272</td>
<td>272</td>
</tr>
<tr>
<td># of Unique WAUs Assessed</td>
<td>129</td>
<td>140</td>
<td>197</td>
<td>165</td>
<td>155</td>
</tr>
<tr>
<td># of Unique LAUs Assessed</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

The \(E. \text{coli}\) data used in this report were primarily collected by Ohio EPA, typically as part of routine ambient monitoring associated with annual drainage basin surveys conducted around the state. Using the methodology described in Section F2, it was possible to assess the status of recreation use attainment status of 575 distinct WAUs of the 1,538 (37%) WAUs in Ohio based on current data (2006-2010). This figure includes those WAUs in which data were collected between 2006 and 2010, regardless of the category of the AU. Ohio has completed bacteria TMDLs for 341 of the 1,538 WAUs in Ohio (22%).

On an annual basis, Ohio is able to assess the recreation use of ~8-13% of the WAUs in the state using data collected by Ohio EPA, with an average of about 10% of the WAUs per year. At this rate, the maximum current assessment information that will be possible at any given time using Ohio EPA-generated data will be for about half of the state’s WAUs, assuming that there is no assessment duplication within any given WAU during any five-year data period and limiting the sampling effort to the minimal amount needed per WAU to make an assessment determination as described in Section F2.
The overall attainment and impairment rates and the changes between reporting years are summarized in Table F-12. Attainment and impairment rates in Table F-12 are based on the total number of watersheds for which sufficient data were available in this reporting cycle, and not on the total number of assessment units in the state. For the 487 assessment units having sufficient data available to determine the recreation use assessment status in 2010, 13% fully supported the use while 87% did not support the use. These results are comparable to the 2012 recreation use analysis, which finds 15% of the assessment units fully supporting the use while 85% did not support the recreation use (where sufficient data were available to determine the status).

Table F-13 contains the attainment rates of the \( E. \text{coli} \) recreation use geometric mean criteria on an individual site basis. Attainment of the applicable geometric mean \( E. \text{coli} \) criterion is comparatively higher on an individual site basis as seen in Table F-13 relative to full support percentages for WAUs shown in Table F-12. Attainment rates at individual sites designated PCR Class A or Class B are roughly 2-3 times higher than the full support rates for WAUs. This illustrates that some of the WAUs in non-support do have individual sites within them that were in attainment of the applicable \( E. \text{coli} \) criterion. Overall, attainment rates between 2010 and 2012 exhibited little variation.

**Recreation Use Attainment Index Score**

Since assessment units can often be composed of monitoring sites having a range of \( E. \text{coli} \) geometric means and the range of impairment can be wide between assessment units, a recreation use index was developed to provide some differentiation between those assessment units composed of monitoring sites that greatly exceed the criteria versus those where exceedances are comparably low. The index scores also serve as a useful tool in the TMDL prioritization process (see Section J1.1 for more details). Index scores were only assigned to those assessment units for which sufficient \( E. \text{coli} \) monitoring data were available to assess the recreation use support as described in Section F2. Index scores range from 0-100 depending

<table>
<thead>
<tr>
<th>Recreation Use 1</th>
<th>Applicable Geometric Mean Criterion 2</th>
<th>Percentage of All Sites Attaining ( E. \text{coli} ) Geometric Mean Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
<td>2012</td>
</tr>
<tr>
<td>PCR Class A</td>
<td>126 cfu/100 ml</td>
<td>44%</td>
</tr>
<tr>
<td>PCR Class B</td>
<td>161 cfu/100 ml</td>
<td>30%</td>
</tr>
<tr>
<td>PCR Class C</td>
<td>206 cfu/100 ml</td>
<td>15%</td>
</tr>
<tr>
<td>SCR</td>
<td>1,030 cfu/100 ml</td>
<td>67%</td>
</tr>
</tbody>
</table>

1. PCR stands for primary contact recreation; SCR stands for secondary contact recreation
2. \( E. \text{coli} \) concentrations are expressed in colony forming units (cfu) per 100 milliliters (ml)
on the magnitude of exceedance of the site(s) from the applicable criterion within the AU. An index score of 100 indicates that all sites sampled within the assessment unit fully attained the applicable geometric mean \(E. coli\) criterion, while lower scores indicate a progressively greater average level of exceedance from the criteria for monitored sites within the AU. Figure F-6 summarizes the index scores for the WAUs. The median assessment unit index score in 2012 is 62.5, slightly lower from the median index score of 65.0 for 2010.

![Figure F-6. Histogram of recreation use index scores for Ohio's WAUs.](image)

The recreation use attainment status of Ohio's 1,538 WAUs is summarized in Table F-14. This table differs slightly from the summary presented in Table F-12 as this table accounts for those watersheds for which TMDLs have been completed and placed into category 4A.
### Table F-14. Summary assessment status of the recreation use in Ohio’s WAUs.

<table>
<thead>
<tr>
<th>Assessment Category</th>
<th>Number of Assessment Units Categorized</th>
<th>Percentage of Assessment Units Categorized</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59</td>
<td>103</td>
</tr>
<tr>
<td>3</td>
<td>888</td>
<td>673</td>
</tr>
<tr>
<td>4</td>
<td>266</td>
<td>341</td>
</tr>
<tr>
<td>5</td>
<td>325</td>
<td>421</td>
</tr>
<tr>
<td>Total</td>
<td>1,538</td>
<td>1,538</td>
</tr>
</tbody>
</table>

There are also 23 large rivers in Ohio, eight of which are further divided into two or more subdivisions for a total of 38 large river assessment units. Large river assessment units have drainage areas greater than 500 square miles and comprise in total 1,236 river miles in the state. The large river assessment units were analyzed independently of the WAUs through which they flow and LRAU data were not included in WAU assessments. Table F-15 summarizes the results of the analysis of *E. coli* data for the large river assessment units and the resulting recreation use support determinations and index scores. Sufficient data were available to determine the use support status for 15 of the 38 LRAUs (40%). These 15 LRAU subdivisions had an average spatial sampling frequency ranging from 2.3 to 7.0 stream miles. Ohio EPA would need to collect samples from 35-49 sites per year on large rivers (minimum of 175-245 samples) per year in order to be able to maintain up-to-date recreation use assessments and index scores for all of the LRAUs within the state.

The LRAU with the greatest sampling intensity in terms of sampling location frequency was the Great Miami River between the Mad River and Fourmile Creek confluences, with an average distance of 2.3 river miles between sampling stations. Of the 15 LRAUs having sufficient data to assess, only one (Walhonding River) fully supported the use while the remaining 14 were not supporting the use. Five of the twelve non-supporting LRAUs are in fact very close to reaching full attainment, having index scores of 90 or greater. The Scioto River downstream of Columbus (Olentangy River confluence to Big Darby Creek confluence) had the lowest index score (21) followed by the Cuyahoga River (38) of all the index scores calculated for the 15 assessed LRAUs.
Table F-15. Summary assessment status of the recreation use in Ohio’s LRAUs.

<table>
<thead>
<tr>
<th>LRAU</th>
<th>Length (miles)</th>
<th># Sampling Stations</th>
<th>Avg Length per Station (miles)</th>
<th>Index Score</th>
<th>Assessment Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auglaize River</td>
<td>12.86</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>3</td>
</tr>
<tr>
<td>Blanchard River</td>
<td>35.65</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>3</td>
</tr>
<tr>
<td>Cuyahoga River</td>
<td>25.34</td>
<td>9</td>
<td>2.7</td>
<td>38</td>
<td>4Ax</td>
</tr>
<tr>
<td>Grand River</td>
<td>41.28</td>
<td>1</td>
<td>41.3</td>
<td>n/a</td>
<td>4A</td>
</tr>
<tr>
<td>Great Miami River – Tawawa Creek to Mad River</td>
<td>48.93</td>
<td>9</td>
<td>5.4</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>Great Miami River- Mad River to Fourmile Creek</td>
<td>43.10</td>
<td>19</td>
<td>2.3</td>
<td>81</td>
<td>5</td>
</tr>
<tr>
<td>Great Miami River – Fourmile Creek to the mouth</td>
<td>38.38</td>
<td>8</td>
<td>4.8</td>
<td>91</td>
<td>5</td>
</tr>
<tr>
<td>Hocking River – Scott Creek to Margaret Creek</td>
<td>32.58</td>
<td>2</td>
<td>16.3</td>
<td>n/a</td>
<td>5h</td>
</tr>
<tr>
<td>Hocking River – Margaret Creek to the mouth</td>
<td>36.38</td>
<td>1</td>
<td>36.4</td>
<td>n/a</td>
<td>5h</td>
</tr>
<tr>
<td>Licking River</td>
<td>30.21</td>
<td>7</td>
<td>4.3</td>
<td>98</td>
<td>5</td>
</tr>
<tr>
<td>Little Miami River – Caesar Creek to O’Bannon Creek</td>
<td>26.92</td>
<td>7</td>
<td>3.8</td>
<td>98</td>
<td>4A</td>
</tr>
<tr>
<td>Little Miami River – O’Bannon Creek to the mouth</td>
<td>24.00</td>
<td>6</td>
<td>4.0</td>
<td>85</td>
<td>4A</td>
</tr>
<tr>
<td>Mad River</td>
<td>18.38</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>3</td>
</tr>
<tr>
<td>Mahoning River</td>
<td>37.00</td>
<td>3</td>
<td>11.8</td>
<td>n/a</td>
<td>3i</td>
</tr>
<tr>
<td>Maumee River – Indiana border to Tiffin River</td>
<td>42.11</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>3</td>
</tr>
<tr>
<td>Maumee River – Tiffin River to Beaver Creek</td>
<td>34.44</td>
<td>2</td>
<td>17.2</td>
<td>n/a</td>
<td>3i</td>
</tr>
<tr>
<td>Maumee River – Beaver Creek to Maumee Bay</td>
<td>31.32</td>
<td>1</td>
<td>31.3</td>
<td>n/a</td>
<td>3i</td>
</tr>
<tr>
<td>Mohican River</td>
<td>27.58</td>
<td>6</td>
<td>4.6</td>
<td>68</td>
<td>5</td>
</tr>
<tr>
<td>Muskingum River – Walhonding River to Licking River</td>
<td>34.94</td>
<td>5</td>
<td>7.0</td>
<td>75</td>
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</tr>
<tr>
<td>Muskingum River – Licking River to Meigs Creek</td>
<td>46.78</td>
<td>8</td>
<td>5.8</td>
<td>77</td>
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</tr>
<tr>
<td>Muskingum River – Meigs Creek to the mouth</td>
<td>29.42</td>
<td>5</td>
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<tr>
<td>Paint Creek</td>
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<td>7</td>
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<td>Raccoon Creek</td>
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<td>37.6</td>
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<td>Sandusky River – Tymochtee Creek to Wolf Creek</td>
<td>43.00</td>
<td>5</td>
<td>8.6</td>
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<td>Sandusky River – Wolf Creek to Sandusky Bay</td>
<td>22.73</td>
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<td>32.70</td>
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<tr>
<td>Scioto River – Olentangy River to Big Darby Creek</td>
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<td>8</td>
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<td>5</td>
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<td>Scioto River – Paint Creek to Sunfish Creek</td>
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<td>Stillwater River</td>
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### F3.3 Inland Lakes

Data availability for inland lakes is relatively limited compared to that for streams and rivers. In fact, the assessment for inland lakes is based upon a total of only 240 samples from 21 lakes, compared to over 11,200 samples collected from streams and rivers. Ohio EPA has only recently begun to routinely conduct bacteria sampling in lakes as part of its renewed inland lakes program. The data in this report were primarily collected in 2008-2010, with a few samples collected in 2006 at inland lakes. It is expected that the 2014 report will contain more data, allowing for the recreation use assessment of additional lakes as the inland lakes sampling program is now established. However, the Ohio EPA has a relatively limited capacity in its lake sampling program. Additional details on the inland lakes sampling program can be found in Section I2 of this report and on Ohio EPA’s web page at the following address: [http://www.epa.ohio.gov/dsw/inland_lakes/index.aspx](http://www.epa.ohio.gov/dsw/inland_lakes/index.aspx).

Table F-16 summarizes the assessment results for the recreation use of inland lakes. Geometric means were very low both at open water locations and at beach or other sample locations. Based on the geometric means, the inland lakes sampled in 2006-2010 are attaining the Class A and Bathing Water *E. coli* criteria at all locations sampled, although it is notable that bacteria levels can also spike above the 235 *E. coli*/100 ml water single sample criterion typically used as the threshold for posting swimming advisory information at a beach.

<table>
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<tr>
<th>Lake</th>
<th>Sample Location</th>
<th>Sample Year</th>
<th>Number of Samples</th>
<th>Geometric Mean</th>
<th>Maximum Value</th>
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<tr>
<td></td>
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<td>4</td>
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<tr>
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<tr>
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</tr>
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<td>100</td>
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<tr>
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<td>L-1</td>
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<td>9</td>
<td>100</td>
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<td>L-2</td>
<td>2010</td>
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<td>59</td>
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<td>51</td>
<td>310*</td>
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<td>100</td>
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<td></td>
<td>2009</td>
<td>5</td>
<td>&lt;1</td>
<td>2</td>
<td>100</td>
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</table>

*Value exceeds the single sample maximum bathing water criterion.
The ODNR Division of Parks and Recreation also conducts routine bacteria sampling of public bathing beaches at inland state park beaches pursuant to Ohio Revised Code sections 1541.032 and 3701.18. Advisory signs are posted whenever notified by the Director of the ODH that the bacteria levels in the waters tested present a possible health risk to swimmers. Advisory postings are recommended whenever the \textit{E. coli} density of a water sample exceeds the bathing water single sample maximum of 235 cfu/100 ml. Sampling frequency at the inland state park beaches is generally once every two weeks. This sampling frequency is much less intense compared to sampling frequency at the Lake Erie beaches, which is typically four or more days per week.

Table F-17 summarizes the advisory postings from 2006 through 2010 at 67 of the state’s inland state park beaches. These data are presented in the Integrated Report for informational purposes and not for official use support determinations since the level of data credibility was indeterminate at the publication of this report. Its inclusion here is intended to notify readers of the existence of this sampling program for these popular recreational resources in Ohio and to provide some information as to the relative amount of data and relative water quality conditions with respect to bacteria indicators. Should Ohio EPA affirm the data as level 3 credible data in the future, it will be considered in the process for making official use support determinations.
Table F-17. Swimming advisory postings at Ohio’s inland lake public beaches (2006-2010).

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<th>County</th>
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<th>2007a</th>
<th>2008a</th>
<th>2009a</th>
<th>2010a</th>
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* Indicates the number of advisories posted followed by the number of samples collected.

Beaches at inland state park lakes are tested for bacteria less frequently compared to those beaches along Lake Erie. Sampling intensity did pick up at some lakes in 2010, notably at Alum Creek Lake, Buck Lake, Buckeye Lake and Grand Lake St. Marys where 30-40 samples were collected at each sampling location in 2010. Still, some of the Lake Erie shoreline beaches are sampled almost as many times in a single month.

The sample results in Table F-17 indicate that at most inland lake beaches, the bacteria criteria are not frequently exceeded, resulting in fewer postings compared to some of the beaches along Lake Erie. Overall, the frequency of exceedances for all the beaches during the five-year reporting period was 8.4%. However, sample results at some inland lake beaches indicated a need for posting an advisory more often during some years. For example, over 60% of the samples collected during the 2010 recreation season at the main west side of beach at Grand Lake St. Marys exceeded the applicable single sample bathing water criterion. More frequent sampling, particularly at beaches where previous sampling data indicates an increased chance of exceeding the recreation criteria, should be considered by beach managers so that the public can be adequately informed of actual water quality conditions at the time of their visit.