UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JUL 3 1 2013

REPLY TO THE ATTENTION OF:

WW-16J

Marcia T. Willhite, Chief
Bureau of Water
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, Illinois 62794-9276

Dear Ms. Willhite:

The U.S. Environmental Protection Agency has conducted a complete review of the final Total Maximum Daily Loads (TMDLs) for the Lake Michigan beaches within Illinois, including supporting documentation and follow up information. The TMDLs address Primary Contact Use Recreation impairments due to excess bacteria.

The TMDLs meet the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, EPA hereby approves Illinois' fifty-one (51) TMDLs for bacteria. The statutory and regulatory requirements, and EPA's review of Illinois' compliance with each requirement, are described in the enclosed decision document.

We wish to acknowledge Illinois' effort in submitting these TMDLs and look forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Mr. Peter Swenson, Chief of the Watersheds and Wetlands Branch, at 312-886-0236.

Sincerely,

Tinka G. Hyde
Director, Water Division

Enclosure

cc: Amy Walkenbach, IEPA
Abel Haile, IEPA

TMDL: Lake Michigan Beaches, Lake and Cook County, Illinois
Date: JUL 3 1 2013

DECISION DOCUMENT FOR THE APPROVAL OF THE TOTAL MAXIMUM DAILY LOADS FOR LAKE MICHIGAN BEACHES IN ILLINOIS

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves.

1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the waterbody as it appears on the State's/Tribe's 303(d) list. The waterbody should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard (see Section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the National Pollutant Discharge Elimination System (NPDES) permits within the waterbody. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) The spatial extent of the watershed in which the impaired waterbody is located;
(2) The assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) Population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
(4) Present and future growth trends, if taken into consideration in preparing the TMDL

(e.g., the TMDL could include the design capacity of a wastewater treatment facility); and

(5) An explanation and analytical basis for expressing the TMDL through *surrogate measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices (BMPs).

Comment: Illinois EPA (IEPA) completed 51 TMDLs to address primary recreational use impairments by bacteria at beaches along Lake Michigan's shoreline in Illinois. The shoreline is approximately 63 miles in length, with a total of 51 beaches across three main jurisdictional boundaries. IEPA submitted the 51TMDLs in three documents for the following areas: Lake County (9 beaches), Suburban Cook County (13 beaches), and the City of Chicago (29 beaches). This decision document addresses the 51 recreational use impairments at beaches along the Lake Michigan shoreline in Illinois (Table 1-1 in the TMDL documents and Table 1 in this document).

The impaired beaches are individual segments along the Lake Michigan shoreline (HUC 04060200). IEPA identified each beach by an assessment unit ID and assessment beach name. Illinois Department of Public Health (IDPH) and cooperating local agencies also identify the beach segments for their work in beach monitoring. Monitoring data from IDPH and other cooperating agencies were used and incorporated into the TMDLs, thus IEPA and IDPH beach names and IDs were examined to ensure monitoring data from other agencies represented the correct IEPA beach segment. Table 1 in this decision document notes any differences in IEPA and IDPH beach nomenclature (Section 1 and Table 1-1 in the TMDLs).

Pollutant of concern: The pollutant of concern is *Escherichia coli (E. coli)*, which is a fecal indicator for pathogenic bacteria that cause illness to recreational users. *E. coli* is one of many types of coliform within the fecal coliform group (Section 3.1 of the TMDLs).

Problem statement: IEPA assessed these beaches as not attaining primary contact recreation use and first included them on its 303(d) list in 2006 (Section 2.1 and 3.0 of the TMDLs). IEPA identified that beaches were closed at a high enough frequency and duration for the waters to be listed as impaired, according to the State's listing methodology (Tables 2-1 through 2-7 in Lake County TMDL, Tables 2-1 through 2-6 in Suburban Cook County TMDL, and Figures 2-1 through 2-8 in Chicago, Cook County TMDL). IEPA uses beach closure data (i.e., swim advisories and the duration of time they occurred) to assess whether a beach is impaired or if it is supporting its designated use for primary contact recreation. IEPA lists a beach on its 303(d) list if, *over a three year* period:

1. On average, one beach closure occurred per year lasting less than a week, or
2. On average, one beach closure occurred per year of one week or greater duration, or more than one bathing area closure per year.

Public health agencies and local beach mangers monitor *E. coli* to determine if a swim advisory should be given. These *E. coli* monitoring data are reported by public health agencies and are publicly available in STOrage and RETrieval system (STORET), and Program tracking, beach Advisories, Water quality standards, and Nutrients (PRAWN), both of which are EPA databases. From approximately Memorial Day to Labor Day, beaches are monitored no less than four times a week in Lake County, and five to seven times a week in Suburban Cook County and the City of

Chicago. During the 2007-2011 period, beach managers issued a swim advisory if *E. coli* exceeded the single sample maximum (SSM) of 235 colony forming units (cfu)/100 ml. For 303(d) listing purposes, IEPA defines a single beach closure as the period of consecutive days a swim advisory is in place (Section 1.0, 2.2, and 3.0 of the TMDLs).

The SSM was included in EPA's bacteria criteria promulgated in 2004 and is used to support beach management decisions on a daily basis, but was not specified as a value in EPA's criteria not to be exceeded for other Clean Water Act purposes. EPA's 2004 bacteria criteria also include a geometric mean (GM) component that is 126/100 ml for *E.* coli in fresh coastal waters. In promulgating the 2004 criteria, EPA explained that it expects that the SSM will be used for making beach closure decisions, but "[o]ther than in the beach notification and closure context, the geometric mean is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject to random variation, and more directly linked to the underlying studies on which the 1986 bacteria criteria were based."[1]. States implementing the 2004 bacteria criteria have the discretion on how to use the SSM for other purposes such as TMDLs and 303(d) list decisions. EPA does not approve a State's assessment methods for 303(d) lists, although EPA did approve and promulgate the 2004 *E. coli* criteria that are applicable to the waters covered by the TMDL. The GM is part of EPA's2004 *E. coli* criteria and the GM's relation to the SSM is discussed in Section 2 of this decision document, and at length in Section 3.1 of the TMDLs.

Priority Ranking: IEPA assigned a low priority to Lake Michigan beaches along the Illinois shoreline on its 2006 303(d) list. IEPA assigns priority to all impaired waters on its list using a two-step process which first considers the type of use impaired and its cause, and secondly the severity of pollution (Section 1.1 of the TMDLs).

[1] Water Quality Standards for Coastal and Great Lakes Recreation Waters. EPA, Federal Register, Vol. 69, No. 220, November 16, 2004, Pages 67224-5

Table 1. Lake Michigan beach segments in Lake County, Suburban Cook County, and City of Chicago that are addressed by the TMDLs submitted by IEPA. Beach segments were first listed in 2006 and appear on subsequent 303(d) lists (From Table 1-1 in the TMDL)

Assessment Unit ID	Beach ID	IDPH Name	Assessment Beach Name	Name Note[1]	Length (meters)[2]	Monitoring County/ Organization
Lake County TMDL Segments						
IL_QH-01	IL913512	North Point Marina Beach	North Point Beach		317	Lake/ Lake County Health Department (LCHD)
IL_QH-03	IL677426	Illinois Beach State Park (IBSP) North Beach	IL Beach State Park North		977	Lake/ LCHD
IL_QH-04	IL087773	Waukegan Beach (North segment)	Waukegan North Beach	LCHD considers the Waukegan Beaches to be a single beach	2219	Lake/ LCHD
IL_QH-05	IL234945	Waukegan Beach (South segment)	Waukegan South Beach	LCHD considers the Waukegan Beaches to be a single beach	339	Lake/ LCHD
IL_QH-09	IL215601	Illinois Beach State Park (IBSP) South Beach	IL Beach State Park South		5648	Lake/ LCHD
IL_QI-06	IL195441	Lake Bluff Sunrise Beach	Lake Bluff Beach (Sunrise)		406	Lake/ LCHD
IL_QI-10	IL634222	Lake Forest Forest Park Beach	Lake Forest Beach (Forest Park)		809	Lake/ LCHD
IL_QJ	IL730475	Highland Park Rosewood Beach	Rosewood Beach		292	Lake/ LCHD
IL_QJ-05	IL782704	Highland Park Avenue Boating Beach	Park Avenue Beach		204	Lake/ LCHD

(Continued)

Assessment Unit ID	Beach ID	IDPH Name	Assessment Beach Name	Name Note[1]	Length (meters)[2]	Monitoring County/ Organization
Suburban Cook County TMDL Segments						
IL_QK-04	IL942128	Glencoe Park Beach	Glencoe Beach (Glencoe Park Beach)		172	Cook/ Glencoe Park District
IL_QK-06	IL108354	Winnetka Tower Beach	Tower Beach (Winnetka Tower Beach)		167	Cook/ Winnetka Park District
IL_QK-07	IL595016	Winnetka Lloyd Park Beach	Lloyd Beach (Winnetka Lloyd Park Beach)		172	Cook/ Winnetka Park District
IL_QK-08	IL750698	Winnetka Maple Park Beach	Maple Beach (Winnetka Maple Park Beach)		76	Cook/ Winnetka Park District
IL_QK-09	IL928218	Winnetka Elder Park Beach	Elder Beach (Winnetka Elder Park Beach)		121	Cook/ Winnetka Park District
IL_QL-03	IL984895	Kenilworth Beach	Kenilworth Beach		122	Cook/ Kenilworth Water & Light Dept.
IL_QL-06	IL637664	Wilmette Gillson Park Beach	Gillson Beach (Wilmette Gillson Park Beach)		445	Cook/ Wilmette Park District
IL_QM-03	IL505764	Evanston Greenwood Beach	Greenwood Beach (Evanston Greenwood Beach)		372	Cook/ Evanston Health Dept.
IL_QM-04	IL327651	Evanston Lee Beach	Lee Beach (Evanston Lee Beach)		222	Cook/ Evanston Health Dept.
IL_QM-05	IL291926	Evanston Lighthouse Beach	Lighthouse Beach (Evanston Lighthouse Beach)		253	Cook/ Evanston Health Dept.

(Continued)

Assessment Unit ID	Beach ID	IDPH Name	Assessment Beach Name	Name Note[1]	Length (meters)[2]	Monitoring County/ Organization
IL_QM-06	IL287401	Northwestern University Beach	Northwestern University Beach		272	Cook/ Evanston Health Dept.
IL_QM-07	IL601796	Evanston Clark Beach	Clark Beach (Evanston Clark Beach)		213	Cook/ Evanston Health Dept.
IL_QM-08	IL636205	Evanston South Beach	South Boulevard Beach (Evanston South Beach)		245	Cook/ Evanston Health Dept.
City of Chicago TMDL Segments						
IL_QN-01	IL705276	Leone Beach	Touhy (Leone) Beach (Loyola Beach)	Considered part of Leone Beach by CPD	881	Cook/ CPD
IL_QN-02		Loyola Beach	Loyola (Greenleaf) Beach	Considered part of Leone Beach by CPD		Cook/ CPD
IL_QN-03	IL923491	Kathy Osterman Beach	Hollywood/ Osterman Beach (Kathy Osterman Beach)		525	Cook/ CPD
IL_QN-04	IL228136	Foster Avenue Beach	Foster Beach		297	Cook/ CPD
IL_QN-05	IL132842	Montrose Beach	Montrose Beach		837	Cook/ CPD
IL_QN-06	IL748682	Juneway Terrace Beach	Juneway Terrace (Juneway Terrace Park Beach)		57	Cook/ CPD
IL_QN-07	IL621748	Rogers Beach	Rogers Beach (Rogers Avenue Park Beach)		53	Cook/ CPD
IL_QN-08	IL120964	Howard Beach	Howard Beach (Howard Street Park Beach)		80	Cook/ CPD

(*Continued*)

Assessment Unit ID	Beach ID	IDPH Name	Assessment Beach Name	Name Note[1]	Length (meters)[2]	Monitoring County/ Organization
IL_QN-09	IL603994	Jarvis and Fargo Beaches	Jarvis Beach (Jarvis Avenue Park Beach)	Considered two separate beaches, but sampled together by CDP	217	Cook/ CPD
IL_QN-10	IL259912	Hartigan North Beach	Pratt Beach (Pratt Blvd and Park Beach)	Considered Hartigan Beach by CPD	193	Cook/ CPD
IL_QN-11	IL274491	Hartigan North Beach	North Shore/Columbia (North Shore Avenue Beach)	Considered Hartigan Beach by CPD	235	Cook/ CPD
IL_QN-12	IL798802	Hartigan South Beach	Albion Beach	Considered Hartigan Beach by CPD	61	Cook/ CPD
IL_QN-13	IL586992	Thorndale or George Lane Beach	Thorndale Beach		58	Cook/ CPD
IL_QO-01	IL666876	North Avenue Beach	North Ave. Beach		1691	Cook/ CPD
IL_QO-02	IL103378	Fullerton Shoreline	Fullerton Beach (Fullerton [Theater on the Lake])	Fullerton St. Shoreline (No swimming access)[3]	208	Cook/ CPD
IL_QO-03		North Avenue Beach	Webster Beach	Considered North Avenue Beach by CPD		
IL_QO-04		North Avenue Beach	Armitage Beach	Considered North Avenue Beach by CPD		

(*Continued*)

Assessment Unit ID	Beach ID	IDPH Name	Assessment Beach Name	Name Note[1]	Length (meters)[2]	Monitoring County/ Organization
IL_QO-05	N/A	Schiller Avenue Shoreline	Schiller Beach	Schiller Ave. Shoreline (No swimming access)[3]	N/A	No current data. Listing based on historical observations.
IL_QP-02	IL296528	Oak Street Beach	Oak St. Beach		338	Cook/ CPD
IL_QP-03	IL926480	Ohio Street Beach	Ohio St. Beach		171	Cook/ CPD
IL_QQ-01	IL820929	12th Street	12th St. Beach		325	Cook/ CPD
IL_QQ-02	IL461767	31st Street Beach	31st St. Beach		275	Cook/ CPD
IL_QR-01	IL865711	49th Street Shoreline	49th St. Beach	49th St. Shoreline (No swimming access)[3]	N/A	Cook/ CPD
IL_QS-02	IL118596	63rd Street Beach	Jackson Park/63rd St. Beach		666	Cook/ CPD
IL_QS-03	IL814025	Rainbow Beach	Rainbow		546	Cook/ CPD
IL_QS-04	IL589159	57th Street Beach	57th St. Beach		241	Cook/ CPD
IL_QS-05	IL288152	67th Street Shoreline	67th St. Beach	67th St. Shoreline (No swimming access)[3]	286	Cook/ CPD
IL_QS-06	IL581683	South Shore Beach	South Shore Beach		212	Cook/ CPD
IL_QT-03	IL376700	Calumet South Beach	Calumet Beach (Calumet South Beach)		404	Cook/ CPD

[1]This information identifies how individual segments relate to beach monitoring sites according to Chicago Park District (CPD) and Lake County Health Department (LCHD).

[2]"N/A" indicates that the beach is not indexed or monitored by IDPH; blank cells indicate that the beach is part of a larger beach for which a length is provided.

[3]Although there is no swimming access at these segments; a TMDL is still completed to address the primary contact recreation use.

Beach Characterization: The beaches are not isolated waterbodies, but part of a larger dynamic lake system which impacts the fate and transport of bacteria. Thus, relevant beach extents on land and in the lake were identified in the TMDL study (Sections 4.1, 4.8, and 4.9 in the TMDLs).

Identifying the beach extent and drainage area- Beachsheds were identified as the spatial areas that drain to the beach. The beachsheds are a unique definition of a watershed and were identified in this TMDL because the beaches are not isolated waterbodies. The reversal of the Chicago River in 1900 eliminated much of the watershed drainage to lake. Thus beachsheds in this TMDL study are often small and in some cases consist only of the direct drainage along the shoreline at the beach. Exceptions occur in Lake County where ravine systems drain surrounding areas and discharge to Lake Michigan (Figure 2.1 and Section 3.2.6 in the Lake County, Illinois TMDL). Beachshed definitions were guided by existing reports from the Illinois Department of Natural Resources (IDNR), communications with municipalities to confirm storm trunk drainage where possible, and from Light Detection and Ranging (LIDAR) data to define direct drainage areas. Beachsheds were delineated in a geographic information system (GIS) database and shared with beach management officials for their review (Section 2.1 and 6.0 of the TMDLs). Using multiple methods to inform beachshed delineation and confirmation from local sources supports that the beachsheds were a good representation of the drainage areas contributing to a beach.

Identifying the lake area impacting a beach (i.e., Beach Protection Areas, or BPA's)- The BPA's outline spatial extents in Lake Michigan that are likely to affect bacteria levels at each identified beach. The BPA's were delineated as a 500 m arc into the lake, surrounding the impaired beach. The BPA's were based on communications with regional experts and peer-reviewed studies on the impact of nearshore dynamics on water quality at Lake Michigan beaches (as cited in Section 2.1 of the TMDL documents). The BPA's identify in-lake areas that could also impact bacteria concentrations at a given beach. The BPA's did not exclude any dischargers of the pollutant from receiving a WLA in these TMDLs (Section 2.1 in the TMDLs).

Source assessment summary: In general, water quality at the impaired beaches is affected by land-based sources, hydrodynamics in Lake Michigan, and climate conditions. Each of the factors was accounted for by the data included in the TMDL analysis. After characterizing the beach area, available data were gathered, and robust source assessments were completed at a regional and beach-group level to identify which source variables were affecting *E. coli* at the beaches.

Methods- Potential sources were initially identified by reviewing Great Lakes beach water quality studies and local knowledge[2]. Next, available data on potential sources and *E. coli* were gathered from beach managers, geographic information systems (GIS), peer-reviewed studies, and databases available to the public. Sources were represented in the modeling efforts by 'source variables.' Source variables represent bacteria sources by proxy—for example, bird count data were used to represent bacteria loads from birds—the source variables were used as a proxy because direct data on bacteria counts in gull fecal matter at individual beaches is not common. Also, literature data can widely vary and may not be as geographically relevant. Gull counts, however, were widely available at the beaches in this TMDL, and often taken on the

[2] Ge et al. 2010, McLellan and Salmore 2003, and Scopel et al. 2006; as cited in Section 3.2 of the TMDLs

same date as *E. coli*, so can be used to assess relationships between sources and bacteria.

IEPA used graphical and statistical methods to identify potential source variables that had an effect on *E. coli* (Table 3-4 in each TMDL). Multilevel statistical modeling then verified the final source variables that were correlated to *E. coli* within each beach-group level. Beaches that had statistically similar *E. coli* levels in response to the same source variables were assigned to a group. This beach-group level analysis was done to improve model efficiency and power, which is described further in Section 3 of this document. The beach-group modeling quantified the relationship between sources and *E. coli* at a given beach-group and was then used to set the TMDL. These methods are further discussed in Section 3 of this decision document and in the TMDLs (Section 4.8 in the TMDLs, Appendix II in Lake County, Appendix I in Suburban and Chicago, Cook County TMDLs). This multi-step approach was used to identify the set of variables that best explained *E. coli* observations and would minimize model uncertainty.

Results- The initial graphic and statistical assessment indicated that regional factors, such as climate and lake dynamics, had an impact on beach water quality; this was illustrated by *E. coli* spikes occurring at a similar time across multiple beaches and with a similar magnitude (Figure 2-9 in Lake County, Figure 2-7 in Suburban Cook County, and Figures 2-12 and 2-13 in Chicago, Cook County TMDLs). Quantitative analysis, through multilevel statistical modeling, indicated that localized sources appear to have more of a day-to-day impact on water quality at the beaches (See 'Final Predictor Variables' in Section 4.9 of the TMDLs). Both regional and local impacts were represented by the data used to develop the TMDLs. The finding that localized sources have a greater impact on day-to-day water quality is similar to studies of Lake Michigan beaches in Indiana[3] and Wisconsin[4], and corroborates with the hypotheses of managers of Lake Michigan beaches in Illinois[5]. In this TMDL study, the importance of localized sources on beach water quality may be more apparent than point sources due to different data availability. Point source discharge information was not as widely available compared to nonpoint source data, particularly because most point sources in this study were wet-weather related. However, a strong link between precipitation and *E. coli* was observed at all beaches, suggesting stormwater related impairments. In addition, high *E. coli* levels following large storms suggest that point sources are contributing to impairment (Section 4.9 of the TMDLs and Section 4.1.3 of the Chicago, Cook County TMDL).

Point sources- Permitted point sources include 23 municipalities with Municipal Separate Storm Sewer Systems (MS4), 2 North Shore Sanitary District (NSSD) wastewater sources, and 3 industrial facilities with permitted stormwater discharges. Section 5 in this decision document lists the names and permit numbers of these facilities. Some facilities identified in Lake County were not given a WLA because they are reasonably assumed by IEPA to not contribute to *E. coli* (Appendix I of the TMDL). These facilities are permitted to discharge non-process cooling water and backwash for zebra and quagga mussel control (Section 4.1, 4.2, and 4.3 in the TMDLs).

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[3] Nevers, M.B., R.L. Whitman. 2008. Coastal Strategies to Predict *Escherichia coli* Concentrations for Beaches along a 35 km Stretch of Southern Lake Michigan. Environmental Science and Technology, 42:4454-4460.
[4] McLellan, S.L., and A.K. Salmore. 2003. Evidence for localized bacterial loading as the cause of chronic beach closings in a freshwater marina. *Water Research 37*(11):2700–2708. As cited in Section 3.2 of the TMDLs.
[5] Lake Michigan Bacteria TMDL for Illinois Beaches, Advisory Group Meeting Notes. November 9, 2010.

Nonpoint sources- Nonpoint sources identified by beach managers and statistical modeling included:

- Avian/wildlife/pet feces;
- re-growth in beach sand,
- re-suspension,
- urban runoff (non-permitted stormwater), including runoff from impervious areas in the beachsheds, and overland flow (Section 4.1 of the TMDLs).

The source variables that were identified to be impacting *E. coli* and that were analyzed through modeling were: bacteria from birds, runoff, re-suspension, point source loads, and bacterial growth and die-off (Table 3-4 of the TMDLs). Lake effects, such as wave height, wind direction, and wave intensity, were also variables frequently correlated with *E. coli*. These source variable factors are a proxy for *E. coli* loads resulting from re-suspension of sand in the nearshore that increases bacteria in the water column. Each of the modeled sources were classified as either manageable or non-manageable (e.g., wave height, embayment from hard structures), and while effects of both variables were considered when setting allocations, allocations were only assigned to variables that were assumed as manageable, such as, rainfall, beach slope, and gull count, which can be addressed by capturing runoff, grooming a beach, and gull management, respectively. In some instances, it may be possible to remove a breakwall or physical structure to manage embayment. Though the TMDL modeled allocations assuming that embayment conditions would remain, the Illinois Beaches Implementation Tool could be used to identify how allocations would still be met if changes were made to existing embayment structures (Section 9 of this decision document).

The final predictor variables include 'manageable' and 'non-manageable' variables and are discussed in Section 4.9 of the TMDL (See Table 4-10 in the Lake County TMDL, Tables 4-11 through 4-14 in the Suburban Cook County TMDL, and Tables 4-10 through 4-12 in the Chicago Cook County TMDL). The manageable source variables in the final models were bird count (bacteria in avian fecal matter), rainfall (bacteria in permitted and unpermitted stormwater), impervious cover (bacteria in runoff from impervious cover), and beach slope (re-suspended bacteria in the swash zone and re-growth in beach sands). Beaches with little slope along the shoreline can lead to standing water along the beach that encourages re-growth of bacteria. Beach slopes also impact wave energy at the shoreline and the potential for that energy to re-suspend bacteria.

Data sources: The data sources used in the TMDL study are described below and in Section 3.0 and 3.1 of the TMDLs. The period of record examined in the TMDL study was 2006-2011. Specific periods differed across the study area due to data availability and were 2006-2011 for Lake County, 2008-2011 for Suburban Cook County, and 2007-2011 for City of Chicago. Data that met quality specifications in an EPA approved Quality Assurance Procedure Plan (QAPP) were included in analyses[6]. Where data did not meet QAPP specifications they were considered in implementation planning where relevant (e.g., beaches with litter problems suggest need to improve trash collection). (Section 3.0, 3.1, and 5.1 of the TMDL documents; Appendix III in Lake County TMDL, and Appendix II in Suburban and Chicago, Cook County TMDLs).

[6] Quality Assurance Project Plan for Lake Michigan Beaches Bacteria TMDL and Implementation Plan, September 2011. Admin. record no. 3

E. coli data collected during 2006-2011 were retrieved from STORET, PRAWN, and from local beach managers. Physical beach characteristics, such as embayment and orientation in the lake, were identified from Arc GIS World Imagery from 2011. Additional source data were collected from beach monitoring groups (e.g. Adopt a beach program), and Beach Sanitary Surveys (BSS) conducted by beach managers during the study period. Beach slope and impervious cover were obtained from LIDAR data recorded in 2008[7]. Shoreline substrate data were retrieved from a study done along the Illinois Lake Michigan shoreline[8] (Sections 3.2.1 through 3.2.6 of Lake County and Suburban Cook County TMDLs, and Sections 3.2.1 through 3.2.7 in the Chicago, Cook County TMDL).

Land use- Lake County land uses were identified from a 2005 land use data inventory available in a GIS. Land uses in Cook County were identified from the 2006 National Land Cover Data (NLCD) (Figures 3.3, 3.4, and 3.3 in Lake County, Suburban Cook County, and City of Chicago TMDL documents, respectively). In summary, land uses are predominantly urbanized, including low to high density, interspersed with parklands, coastal plains, wetlands, open space, and some industrial and marine developments (Section 3.2.3 in the TMDLs).

Climate- Climate data were collected from the 2006-2011 period across the project area. Given that precipitation is highly spatially variable, IEPA examined multiple rainfall gages and selected rainfall data from the stations with the most continuous and reliable data. In Lake County, four stations managed by the Lake County Stormwater Management Commission were used to represent the nine beaches. For beaches in both suburban Cook County and the City of Chicago, 6 National Climatic Data Center rain gages represented 42 beaches. Rainfall data at a beach was collected from the nearest gage (Table A.III-2 in Appendix III of the TMDLs) (Section 3.2.2 of the TMDLs).

Lake effects-To estimate the lake effects that impact beach water quality, Great Lakes Coastal Forecasting System (GLCFS) data were downloaded from a coordinate location in the lake that was nearest to the beach (Appendix B of the Illinois Beaches Implementation Tool, Appendix III in TMDL documents). These data describe the hydrodynamics in a lake system in terms of wave height, wind speed, wind direction, and water level. Categorical wave intensity data (calm, whitecaps, etc) were also collected by beach managers and used in the TMDL study (Section 3.2.1 of the TMDLs).

Future growth: The WLA in the TMDLs is set at the GM of 126 cfu/100 ml. This requires that any new or expanded point-sources maintain discharges to comply with the GM and WLA in the TMDLs (e.g., new or expanded dischargers, new outfalls within the jurisdiction of an existing permit, new development within an MS4 municipality that discharges to a beach). To comply with the TMDL each of the existing outfalls, and any new outfalls, subject to an MS4 permit must be consistent with the WLA described in the TMDLs (Section 4.6 of the TMDLs).

EPA finds that the TMDL document submitted by IEPA satisfies requirements concerning this

[7] E-mail dated May 1, 2013 from Michele Eddy, RTI to Marcy Kamerath, EPA. Admin. record no. 7.
[8] Creque, S.M., K.M. Stainbrook, D.C. Glover, S.J. Czesny, and J.M. Dettmers. 2010. Mapping bottom substrate in Illinois waters of Lake Michigan: Linking substrate and biology. *Journal of Great Lakes Research 36*:780–789.As cited in Section 3.2.4 of the TMDL.

first element.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. (40 C.F.R. §130.7(c)(1)). EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) - a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

Comment:

Designated Use: Lake Michigan beaches are designated as general use waters that must support primary contact recreation (Title 35 Illinois Administrative Code Part 303.443b and Part 302.505).

Water Quality Criteria: In 2004, EPA promulgated federal *E. coli* criteria for the protection of primary contact uses. The *E. coli* criteria are applicable to Great Lakes recreational waters, including the Lake Michigan beaches in Illinois. The criteria are codified in 40 CFR Part 131.41 and include a GM of 126 cfu/100 ml, and a SSM of 235 cfu/100 ml for use in beach notification and closure decisions. Illinois bacteria criteria for fecal coliform exist for Lake Michigan waters and are contained in Title 35 Ill. Adm. Code Part 302.505. The criteria state that a water shall not exceed a GM of 200 cfu/100 ml over a period of 30 days using no less than five samples, and that the waters shall not exceed 400 cfu/100 ml more than 10% of the time. IEPA identified the beaches as impaired due to excess *E. coli* on its 2006 and subsequent 303(d) lists. For this reason the TMDLs are developed for *E. coli* and are based on the State's applicable GM of 126 cfu/100 ml for *E. coli*.

Both fecal and *E. coli* numerical criteria were designed to protect recreational users from illness; however *E. coli* has been identified as the more accurate indicator of health-risk associated with recreational use[9]. EPA established fecal coliform water quality criteria in 1976 based on available data on illness related to swimming in polluted waters. Studies completed by the United States Public Health Services in the late 1940's had identified that a significantly higher number of swimmers had illnesses after swimming in waters with 2300-2400 total coliform

[9] Health Effects Criteria for Fresh Recreational Waters. 1984. EPA-600/1-84-004.

cfu/100 ml. Studies later estimated that fecal coliforms constituted 18% of total coliforms and this translator was applied to 2300 and 2400 total coliforms to identify a fecal coliform value of 414-432, respectively. A factor of safety was applied by dividing the fecal coliform value in half, which was then rounded to 200 cfu/100 ml. This was set as a water quality criterion to provide protection from illness due to swimming in polluted waters. In the 1980's EPA conducted further studies on the relationships between illness rate and bacterial indicators and found that *E. coli* was a more accurate indicator of illness rate with respect to fecal coliform. These studies became the basis for EPA's 1986 *E. coli* criteria to protect recreational use[10].

In 2004, EPA promulgated federal criteria for *E. coli* based on EPA's 1986 criteria values. When the 1986 criteria values were developed, a GM of 126 cfu/100 ml was selected on the basis that water quality with a GM above 126 had a detectable effect on illness rate. The illness rate associated with the GM was estimated to be 8 out of 1000[11]. An upper limit was also calculated to reduce the chance of an unnecessary beach closure based on a single sample. This upper limit was 235 cfu/100 ml and represents the 75% confidence interval from the dataset whose GM was 126 cfu/100 ml[12]. Thus the SSM and GM are linked to the same dataset and same illness rate, but the SSM provides a value to base beach closure decisions on a single sample with a given level of confidence that a decision to close or not close a beach is appropriate.

In 2012, EPA recommended new Recreational Water Quality Criteria (RWQC), which directs states to adopt these criteria by December of 2015. The RWQC include a GM and a statistical threshold value (STV). The STV approximates the 90th percentile of the water quality distribution used to derive the GM criteria and is intended to be a value that should not be exceeded by more than 10 percent of the samples taken. Two sets of numeric concentrations are recommended based on differing illness rates. The first recommendation is a GM of 126 cfu/100 ml and an STV of 410 cfu/100 ml, which supports an estimated illness rate of 36 bathers out of 1000 based on the National Epidemiological and Environmental Assessment of Recreational Water (NEEAR) definition of gastrointestinal illness, which is not limited to illnesses which exhibit a fever. The second recommendation is a GM of 100 cfu/100 ml and an STV of 320 cfu/100 ml, which supports an illness rate of 32 bathers out of 1000[13]. A beach action value (BAV) equal to the SSM of 235 cfu/100 ml is provided in the RWQC for use in making beach notification decisions, but the BAV or SSM is not required by the RWQC to be a part of the State's bacteria criteria[14].

The RWQC have not been adopted by IEPA and are not currently applicable to the Illinois Lake Michigan beaches. EPA understands that the TMDL, as written, would provide protection above or at least equivalent to the RWQC. This is because where the TMDLs are achieved, the study predicts that 235 cfu/100 ml (i.e., the SSM) would not be exceeded by more than 4 to 10% across the beaches in the study area, which means beach water quality is not expected to exceed either the 320 or 410 cfu/100 ml STV values more than 10% of the time and would consistently

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[10] *Ibid.*,21-27

[11] Water Quality Standards for Coastal and Great Lakes Recreation Waters. EPA, Federal Register, Vol. 69, No. 220, November 16, 2004, Page 67220.

[12] *Ibid.*, 67224-5

[13] The illness rate associated with a GM of 126 is higher in the 2012 criteria because the definition of illness was expanded from the earlier definition of illness used to develop the 1986/2004 bacteria criteria. See Recreational Water Quality Criteria Draft, Office of Water EPA-820-F-12-058, pp 12-15.

[14] Recreational Water Quality Criteria Draft. Office of Water EPA -820-F-12-058.

achieve the GM of 126 cfu/100 ml, when attaining the TMDL (Section 3.1 of the TMDL). Should IEPA adopt criteria that are more stringent than these conditions, the TMDL may be modified.

Target: The target for developing the TMDL was the *E. coli* GM. This target was selected on the basis that the GM criterion was designed to provide the level of illness rate protection that supports primary contact use. The rate of SSM exceedence that could occur and still achieve the GM when meeting the TMDL was also provided for informational purposes in the TMDL documents, though that exceedence rate is an indicator of whether the GM is being met, rather than a second requirement to achieve the TMDL. This design is supported in part because:

> ..the single sample maximum values in the 1986 bacteria criteria document were not developed as acute criteria; they were developed as a statistical construction to allow decision makers to make informed decisions to open or close beaches based on small data sets...they may give States and Territories the ability to make waterbody assessments where they have limited data for a waterbody. However, the single sample maximums were not designed to provide a further reduction in the design illness level provided for by the geometric mean criterion. (69 FR 67225, November 16, 2004).

The GM of 126 cfu/100 ml is associated with the accepted estimated illness rate of 8 out of 1000 recreators. When the criteria were set, the single sample maximum was determined as the upper 75th confidence interval of the GM of 126 cfu/100 ml. A confidence interval describes a range that is expected to contain the true population parameter (in this case, the mean) over repeated observations; the upper 75th confidence interval of the GM denotes a value that is expected to be at or above the true GM 75 percent of the time. The promulgation of *E. coli* criteria in 2004 clarified that the GM "is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure...and more directly linked to the underlying studies on which the 1986 bacteria criteria were based[15]". That is, the GM value corresponds to the estimated illness rate. By comparison the SSM, which was originally calculated as the upper 75% confidence interval of the GM, is the upper limit of a range of mean *E. coli* conditions that correspond with an illness rate of 8 out of 1000 (with a given level of confidence). Thus, the SSM was not originally designed for use as a value not to be exceeded by a given amount, but to indicate whether mean conditions may not support water quality goals using only a single or few samples so that decisions to close or open a beach could be made on a daily basis (Section 3.1 and Appendix IV of the TMDLs).

EPA believes a TMDL based on the GM, and that also estimates a corresponding rate of SSM exceedence is appropriate for addressing primary contact use impairments as indicated by excess *E. coli* at the Illinois Lake Michigan Beaches. First, the TMDL target selected by IEPA provides illness protection to the level intended by the 2004 federal bacteria criteria which are applicable for these beaches. Next, the allocations produced in the TMDL result in reduction requirements that would improve water quality at the beaches to a level where the GM would consistently be achieved and the SSM is predicted to not be exceeded by more than 4-10% of the time, based on the data collected at the Illinois Lake Michigan beaches (The predicted rate of SSM exceedence were provided for each beach group in Section 4.9.2 of the TMDLs. Specifically in tables titled

[15] *Ibid.* 10, at 67724

"Manageable Variable Thresholds Required to Meet the Load Allocation," in the column "Predicted Percent of SSM exceedences when GM is Attained," in Section 4.9.2 of the TMDL). Third, while Illinois' impairment list methodology is based on closures (and thus implicitly on SSM), the list methodology is a process used to assess impairment status, rather than a codified and EPA approved standard. IEPA designed these TMDLs to address primary contact recreational use impairments caused by bacteria, as indicated by excess *E. coli,* and identified on IEPA's 2006 and subsequent 303(d) lists.

EPA finds that the TMDL document submitted by IEPA satisfies requirements concerning this second element.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable *critical conditions* and describe their approach to estimating both point and nonpoint source loadings under such *critical conditions*. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

Comment: The TMDL, or loading capacity, can be written as:

$$TMDL = WLA + LA + MOS;$$

Where the Waste Load Allocation (WLA) is the allowable discharge given to point sources in the TMDLs, Load Allocation (LA) represents allowable loads from nonpoint sources, and Margin of Safety (MOS) represents assumptions that account for uncertainty inherent in the TMDL.

The loading capacity is the amount of *E. coli* that can occur at a beach and not exceed 126 cfu/100 ml over a rolling 30-day GM. To achieve this loading capacity point source discharges received a WLA equal to the GM water quality criterion of 126 cfu/100 ml, with the exception of

"excess flow" facilities (See Section 5 in this decision document for more detail). For nonpoint sources, the LA is equal to the GM water quality criterion of 126 cfu/100 ml, and IEPA defined conditions for sources to be met to achieve the LA. These conditions are called 'Manageable Variable Thresholds' and are identified in Section 4.9.2 of the TMDLs. The TMDL model also predicts that when the GM is met the SSM value (i.e. 235 cfu/100 ml) will not be exceeded by more than 4-10% of the time as presented in Section 4.9.2 of the TMDLs.

For the Illinois Lake Michigan Beaches TMDLs, allocations were given in concentrations of cfu/ml, rather than allocations being expressed as billion organisms per day. The rationale for this decision was that estimating the volume of a beach would be necessary but could not be achieved without introducing considerable uncertainty into the TMDL. However, the factors that affect volume and flushing rates at a beach were included in the statistical modeling effort to account for their impacts on *E. coli* concentrations that were observed. These factors were lake hydrodynamics, beach orientation, and embayment. Thus, the resulting management thresholds that were identified in the TMDL to meet the LA, reflect the various hydrologic conditions that were observed at the beaches during the study period, and meeting those management thresholds are predicted to achieve the water quality standard under those various loading conditions on any given day (Section 3.2.1 and Section 3.2.5 of the TMDLs). Setting the WLA to equal the water quality criterion requires that permits be consistent with the WLA for any volume of discharge.

Model Summary: The steps of the TMDL analysis included: a) data collection, b) initial analysis, c) grouping analysis, d) multilevel regression modeling of observed conditions, and e) load reduction calculations. For all analyses, statistical assumptions were checked to make sure the use of statistical models was appropriate (Section 4.8 of the TMDLs). Data collection and an overview of the approach are discussed in Section 1 of this decision document. Further details on the steps and allocation calculations are provided below.

Initial analysis to identify potential sources- Initial analyses identified the potential variables that were correlated to *E. coli* using graphical and statistical analyses. Graphical analyses included scatter plots, time-series plots, and box and whisker plots. Example graphs of the exploratory analyses are included in the linkage analysis of the TMDLs (Section 3.2 of the TMDLs). Statistical analyses in this stage included data mining techniques such as Classification and Regression Tree (CART) models and single ordinary least squares regression. These statistical methods were used to identify the degree that different dependent variables, in this case the many possible variables affecting *E. coli*, could explain the observed *E. coli* data. The p-value, adjusted r-squared, and other model fit parameters were compared to identify which variables were related to *E. coli.*

The use of multiple methods in initial analyses and the systematic comparison of model fit parameters demonstrated the validity of the results. Initial analysis methods are explained in further detail in Section A.2 of Appendix II in Lake County, and Appendix I in Suburban and Chicago, Cook County TMDLs. The outcome of initial analyses was the identification of potential variables that affect *E. coli.* These variables are listed in Table 3-4 of the TMDLs. The link between these variables and *E.coli* were then quantified in subsequent analyses conducted for each beach or beach-group (Section 3.2 and Section 4.8.1 in the TMDLs).

Group analysis- To improve model efficiency and power, individual beaches were modeled within groups. Beaches that had statistically similar *E. coli* levels in response to the same source

variables were assigned to a group. Assigning beaches to groups greatly improved model fit compared to using a regional model, and provides a larger dataset than if beaches were modeled individually. The grouping approach reasonably assumes that data from the beaches within a group, which were found to be statistically similar, can be analyzed in a larger dataset together. This enhances explanatory power and provides sufficient data for model validations which improves model predictions. The final beach groups are identified in Tables 4-11, 4-10, and 4-9 in the Lake County, Suburban Cook, and Chicago, Cook County TMDLs, respectively (Section 4.8.2 of the TMDLs).

In Suburban and Chicago, Cook County TMDLs an additional group was modeled to account for gull count data collected in BSS' done in 2011 at select beaches. (Gull count data were collected in all years in Lake County). These groups were noted in the TMDL as BSS groups and supplement the main beach groups, discussed above. The allocations for gull count in the Cook County beaches were determined from BSS-based groups and were added to allocations identified by the main beach groups. The combined thresholds are shown in Table 2 in this decision document.

Multilevel regression modeling-Multilevel regression analysis was used to quantify the relationships between sources and water quality that would later be used to calculate allocations. Multilevel regression is a statistical approach that was used to identify the combination of source variables that predicted *E. coli* with the lowest model error. That is, the multilevel regressions identify the sources that best explain the *E. coli* concentrations. It also identifies the level of impact that each variable has on *E.coli*. A multilevel regression model was used in order to account for physical, jurisdictional, and water quality differences observed across the project area. The beach group-level model allowed for the greatest precision given the data available and improved model fit (Section 4.8 of the TMDLs).

The final multilevel regression models that were selected for use in determining the TMDL had the greatest explanatory power (as measured by the Bayesian Information Criteria (BIC)) and low Restricted Maximum Likelihood Estimator Deviance (REML). The BIC and REML are two common model fit parameters that quantify model error. The final regression models identified the source variables that best predicted the *E. coli* observations collected at the beaches (Section A.3 in Appendix II in Lake County, and Appendix I in Suburban and Chicago, Cook County TMDLs). The final predictor variables include 'manageable' and 'non-manageable' variables and are in Section 4.9 of the TMDL. The manageable source variables in the final models were bird count (bacteria in avian fecal matter), rainfall (bacteria in permitted and unpermitted stormwater), impervious cover (bacteria in runoff from impervious cover), and beach slope (re-suspended bacteria in the swash zone and re-growth in beach sands).

Load reduction calculations- Finally, the multilevel regression models were used to calculate allocations in order to meet the TMDL. Once the final statistical model was selected and statistical assumptions were confirmed to be met, the sources were adjusted until the model predicted that water quality would not exceed a GM of 126 cfu/100 ml (Section 4.8 and Appendix I of the TMDL). Thus the model identified the conditions that the source variables must meet to attain the TMDL loading capacity target. These conditions were called management thresholds in the TMDL and formed the load allocations. When achieving these conditions, the models predicted that the SSM would not be exceeded more than 4-10% of the time at the beaches (Section 4.8, 4.9.2, Appendix III, and Appendix IV of the TMDLs). This

estimate of SSM exceedence differs from the rate observed in 2006-2011 because the predicted rate of exceedence is based on what is expected assuming thresholds are met and the TMDL is achieved (Section 4.9 in the TMDLs).

Due to the difference in data availability for point and non-point sources, the effects of individual point sources on E. coli were not quantified in the multilevel models. However, rainfall was consistently correlated to all beaches, and high *E. coli* concentrations coincide with observed wet-weather discharges. Furthermore, illicit connections have been observed and/or are suspected sources in Lake County and Suburban Cook County. Concentration-based WLAs were given to point sources, which were found to be primarily wet-weather related, to ensure they do not cause or contribute to water quality impairments (Section 4.1.2 and 4.7 of the TMDLs).

Model justification: A review of options to develop the TMDL was completed in 2011. IEPA, in consultation with EPA and the technical advisory committee (TAC), selected the final approach used to develop the TMDLs. In summary, the statistical approach was selected because it was driven by the source and *E. coli* data collected at the beaches themselves, thus relationships quantified between source variables and *E. coli* were specific to the beaches in this study. This approach provided flexibility to account for and quantify the effects of different source variable types collected at the beaches (binary, continuous, and categorical). The approach made it possible to simultaneously examine the effect of land-based sources and lake-effects on *E. coli* at a beach. The model also allowed various scenarios to be analyzed for implementation planning purposes. Last, the method provided a way to identify and minimize uncertainty by assessing model fit[16].

Model verification: Each step of the data gathering and modeling exercises were corroborated and validated using quantitative techniques where possible. First, during data collection all data were screened to ensure they met QAPP specifications. Initial source variables selected were corroborated by using multiple graphical and statistical analyses (e.g., box and whisker plots, linear regression, Classification and Regression Tree Analysis, etc). Next, each variable dataset was tested to ensure the standard assumptions of normality, equal variance, and absence of autocorrelation were met, and the data were transformed using standard techniques where required. Then, the strength of the multilevel regression models used to generate the TMDL were systematically assessed with model performance parameters (i.e., BIC, REML) and vetted to make sure final variables in the models made sense within the context of current scientific understanding. The level of statistical significance reported for the final source variables confirmed that applicable sources were included in the models (Appendix III in Lake County, and Appendix II in Suburban and Chicago, Cook County TMDLs). Modeled versus observed *E. coli* distributions were illustrated within each TMDL and demonstrate that the model closely approximates observed conditions (Figure(s) 4.1 in Lake County, Figure 4-1-4.4 in Suburban Cook, and 4.1-4.3 in Chicago, Cook County TMDLs).

Critical conditions: IEPA identified critical conditions by assessing which conditions were associated with the highest observed *E. coli* concentrations over the period of record. Various critical conditions were observed, rather than one distinct event or time period. In general, warmer air and water temperatures coincided with higher bacteria. Also, storm conditions

[16] RTI. January 2011. Bacteria TMDLs for Illinois Lake Michigan Beaches Options Summary Report. Admin. record no. 4

characterized by high waves, precipitation, and turbidity were associated with the highest *E. coli* readings. The TMDL documents identify critical conditions observed at each beach in Table 4-8 in Lake County TMDL, and Table 4-7 in Suburban and Chicago, Cook County TMDLs. These conditions were considered in the allocations given that both source and water quality data observed during critical conditions were included in the data to develop the source-response relationships that were the basis for management thresholds set to achieve the load allocation. Point sources must achieve the water quality standard under any condition and therefore the WLAs also account for critical conditions (Section 4.5 of the TMDLs).

EPA finds that the TMDL document submitted by IEPA satisfies requirements concerning this third element.

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

Comment: IEPA identified nonpoint sources contributing to water quality at the beaches and assigned a LA of 126 cfu/100 ml to those source variables. In order to achieve the LA, the conditions, or thresholds that need to be achieved at the beaches within specific beach-group models were identified (Section 4.8 of the TMDLs).

The thresholds were determined by adjusting the 'manageable' source variables until the statistical beach group model(s) (i.e., multiple linear regression) predicted that the water quality at the beach would consistently meet or be below 126 cfu/100 ml. The rate of SSM exceedence that would occur when meeting those conditions was also predicted. The effects of 'non-manageable' source variables (e.g., wind, waves, month) on bacteria were accounted for in the final allocations by holding those variables at observed conditions while targets for manageable sources were determined (Section 4.9 of the TMDLs).

Table 2. Management thresholds for nonpoint source variables to be achieved in order to meet the load allocation (i.e. be at or below a GM of 126 cfu/100 ml). Thresholds were given to sources that were found to impact *E. coli*. All of the thresholds identified for a beach group must be achieved. A '–' indicates that a variable was not correlated to *E. coli* within the beach group, based on the data available.

Beach Location	Beach Name(s)	Management Thresholds to achieve LA					Predicted SSM exceedence when GM attained (%)
		Daily gull count ≤	24-hour rainfall below (in)[17]	48-hour rainfall below (in)[14]	Slope increase (%)	Reduce impervious area (%)	
Lake County	Forest Park, Rosewood, IBSP South, Waukegan North	50	1	—	1	—	9
	Park Avenue Boating, IBSP North	60	1.5	—	—	—	8
	Sunrise	65	2	—	—	—	7
	Waukegan South	25	0.2	—	3	—	5
	North Point Marina	40	0.2	—	2	—	5
Suburban Cook County	Elder	—	0.4	—	—	15	8
	Northwestern, South Boulevard	50	0.4			15	10
	Glencoe, Gillson	—	—	1.35	—	—	9
	Lighthouse, Clark, Greenwood, Lee	50	—	1.35	—	—	9
	Tower, Lloyd, Maple, Kenilworth	—	—	1.5	—	—	7
Chicago, Cook County	Montrose, Kathy Osterman	90	0.5	—	2	—	8.7
	Hartigan, Loyola, Thorndale, North Ave	—	0.5	—	2	—	8.7
	Foster, Leone, Oak, Ohio	90	0.7	—	2	—	8.7
	Howard, Rogers, Jarvis, Juneway	—	0.7	—	2	—	9.2
	12th, 31st	60	0.7	—	—	10	9
	57th, 63rd, South Shore	90	0.8	—	—	10	8

[17] Mitigation of runoff from storms at or above 1" 24-hour events through capture, infiltration, or diversion away from the beach. Rainfall amounts at or above this value had a statistical effect on *E. coli* levels. Rainfall thresholds can include effects from overland flow, stormwater outfalls (permitted and unpermitted), and lock openings which causes the Chicago River to discharge to Lake Michigan. Illicit detection surveys can help address effects related to stormwater outfalls. Actions outside of the TMDL are occurring that can help address the impact of lock openings and are discussed in Section 5 of this decision document.

	Rainbow, Calumet South	60	0.75	—	—	10	9

EPA finds that the TMDL document submitted by IEPA satisfies requirements concerning this fourth element.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

Comment: IEPA assigned WLAs to point sources that discharge the pollutant of concern to Lake Michigan (Section 4.2.1 in the TMDLs). With the exception of the two NSSD discharges, point sources must meet a rolling 30-day GM for *E. coli* of 126 cfu/100 ml to achieve the WLA. WLAs based on a rolling 30-day GM are appropriate for point sources expected to discharge at a rate or frequency that could provide sufficient data to calculate a mean.

There are two point sources that do not discharge at a rate or frequency such that a rolling 30-day GM can meaningfully be calculated. These two point sources are the Gurnee and Waukegan NSSD facilities. Instead of providing a WLA based on a rolling 30-day GM, these two point sources are instead given a WLA that is equal to 400 cfu/100 ml for fecal coliform. The NSSD facilities have continuous discharges to the Des Plaines River where fecal coliform criteria apply. During the 2007-2011 study period, zero discharges to Lake Michigan were reported from the Gurnee facility, and seven discharges were reported during the recreational season over this 5-year period from the Waukegan facility, two of which exceeded the facility permit limits (Table 4-2 of the Lake County TMDL). In contrast to other point sources, the NSSD facilities discharge to Lake Michigan at a rate too infrequent to calculate a representative GM, thus the WLA reflects that an upper limit must not be exceeded. The WLA is set using fecal coliform as the pollutant to be monitored to provide consistency across all NSSD bacteria monitoring being carried out. The daily maximum fecal coliform WLA for the two NSSD facilities is expected to

be protective of the Lake Michigan recreational uses. The WLAs in Table 3 below are for the NSSD discharges to Lake Michigan and reflect that discharge loads/concentrations must be treated to a level so that so that fecal coliform does not exceed 400 cfu/100 ml. Both *E. coli* and fecal coliform numerical criteria were designed to protect recreational users from illness and both levels are associated with detectable effects related to pathogenic bacteria and illness rate. *E. coli* monitoring at NSSD facility discharges to Lake Michigan should be considered to ensure these discharges consistently are protective of the *E. coli* criteria.

Discharges from Publicly Owned Treatment Works (POTWs) that receive secondary treatment and disinfection are allowable under the Clean Water Act provided they are consistent with any applicable water quality-based requirements. By comparison, Sanitary Sewer Overflows (SSOs) that are untreated discharges from POTWs are not allowable under the Clean Water Act. The WLAs from the TMDLs are summarized below in Tables 3, 4 and 5 for Lake County, Suburban and Chicago Cook County TMDLs, respectively.

A WLA was not assigned to discharges to the Chicago River that impact Lake Michigan when locks open following large storm events. Non-TMDL related efforts are underway to improve impacts on water quality from these events. EPA has lodged a consent decree, which requires the Tunnel and Reservoir Development (TARP) project to be completed by 2029 to increase capacity for stormwater and reduce frequency of river reversal events. In addition, EPA approved new standards which designated portions of the Chicago Area Waterway system (CAWs) for primary contact use, and as a result, the ability to disinfect must be in place at two Metropolitan Water Reclamation District (MWRD) facilities by March of 2016. Disinfection of wastewater discharges will reduce *E. coli* concentrations in the CAWs, and may lessen the impact from river water quality on beaches following a river reversal.

Table 3. *E. coli* WLA assigned to point sources in Lake County, Illinois

NPDES Permittee	Permit No.	WLA (cfu/100 mL)
Wastewater		
NSSD-Waukegan discharges to Lake Michigan	IL0030244	400[1]
NSSD-Gurnee discharges to Lake Michigan	IL0035092	400[1]
Municipal Stormwater		
Beach Park Village	ILR400164	126
East Skokie Drainage District	ILR400491	126
Highland Park, City of	ILR400352	126
Highwood, City of	ILR400353	126
Illinois Department of Transportation	ILR400493	126
Lake Bluff, Village of	ILR400366	126
Lake County	ILR400517	126
Lake Forest, City of	ILR400367	126
North Chicago, City of	ILR400402	126
Shields Township	ILR400123	126
Union Drainage District Middle Fork	ILR400518	126
Waukegan Township	ILR400148	126

NPDES Permittee	Permit No.	WLA (cfu/100 mL)
Waukegan, City of	ILR400465	126
West Skokie Drainage District Middle Fork	ILR400490	126
Winthrop Harbor, Village of	ILR400477	126
Zion, City of	ILR400482	126
Industrial Stormwater		
Outboard Marine (Bombardier-Waukegan)	IL0002267	126
Abbott Labs-N Chicago	IL0001881	126

[1] WLAs are for fecal coliform. These are non-continuous discharges with facility permit limits for fecal coliform.

Table. 4. *E. coli* WLA assigned to point sources in Suburban Cook County, Illinois

NPDES Permittee	Permit No.	WLA (cfu/100 mL)
Municipal Stormwater		
Evanston, City of	ILR400335	126
Glencoe Village	ILR400198	126
Wilmette, Village of	ILR400473	126
Winnetka, Village of	ILR400476	126
Kenilworth, Village of	ILR400214	126
Industrial Stormwater		
Winnetka Water & Electric	IL0002364	126

Table. 5. *E. coli* WLA assigned to point sources in Cook County, Illinois

NPDES Permittee	Permit No.	WLA (cfu/100 mL)
Municipal Stormwater		
Chicago City	ILR400164	126
Union Drainage District No. 1 Middle Fork	ILR400518	126

EPA finds that the TMDL document submitted by IEPA satisfies requirements concerning this fifth element.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance

explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

Comment: IEPA provided an implicit margin of safety by using a conservative approach when setting thresholds to meet load allocations. When the TMDL was set, threshold conditions were identified for sources so that the average *E. coli* levels measured at a beach would meet or be below a GM of 126 cfu/100 ml. As an example, the mean GM that would be observed at Waukegan beach when the TMDL is implemented will be 90 cfu/100 ml, and the corresponding rate of SSM exceedence will decrease from 30% to 9% (See Table A.IV.1 in Lake County TMDL). This approach was used for all of the beach groups and all of the TMDLs (Section 4.3, Appendix III, and Appendix IV in the TMDLs).

Additional margin of safety was provided by minimizing sources of uncertainty in the analyses. All input data were tested to ensure datasets met standard statistical assumptions for normality, equal variances, and spatial autocorrelation (Appendix II in Lake County and Appendix I in Suburban and Chicago, Cook County TMDLs). Where data met QAPP specifications and met standard statistical assumptions they were included in the modeling. The data that were included represented a wide range of observations that coincided with a wide range of bacteria levels (i.e., the dataset contained observations at the lower and upper detection limits of the laboratory methods) (Section 4.3 of the TMDLs). The range of conditions captured in the dataset for this TMDL limits sources of error due to small sample size and sample bias. For the source variables, the range of conditions represented by the observations are reported in the TMDL documents (Tables 4-12 and 4-13 in Lake County TMDL, Tables 4-17 through 4-19 in Suburban Cook County TMDL, and Tables 4-18 through 4-20 in the Chicago, Cook County TMDL).

EPA finds that the TMDL document submitted by IEPA satisfies requirements concerning this sixth element.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Comment: IEPA accounted for seasonal variation by using *E. coli* and source monitoring data collected during May to September from 2006-2011, which included varying climate conditions within and across years. Average annual precipitation across the study area ranged from approximately 12 to 30 inches (Tables 4.7, 4.7, and 4.6 in Lake County, Suburban Cook County, and Chicago Cook County TMDLs). IEPA accounted for variation that occurs within an individual recreation season by including the sampling month as a variable in the statistical model. IEPA observed that as the season progressed, *E. coli* concentrations generally increased. Sampling month was a non-manageable variable that was included in the model when setting allocations in order to account for the effect of seasonal variation on water quality. Other seasonal climatic factors that impact water quality were included in the model in terms of wave

height, wave intensity, and rainfall which can vary across years and within a season (Section 3.2.1 of each TMDL document).

EPA finds that the TMDL document submitted by IEPA satisfies requirements concerning this seventh element.

8. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

Comment: The TMDL identified sources that were causing impairments at the different beaches and assigned management thresholds for nonpoint sources to achieve in order to meet the load allocation. Concentration-based WLAs were assigned to point sources and will be incorporated into permits as they are updated to be consistent with the WLA.

Implementing the WLA: WLAs will be incorporated into the permits upon reissuance. The following is a list of permitted facilities along with their current permit expiration dates:

- NSSD – Waukegan WWTP (NPDES Permit No. IL0030244) renewal request received Nov. 2011. Current expiration 4/30/2012.
- NSSD – Gurnee WWTP (NPDES Permit No. IL0035092). Renewal request received June 2011. Current expiration 11/30/2011
- Abbot Labs (NPDES Permit No. IL0001881). Expiration date is 9/30/2016
- Outboard Marine (NPDES Permit No. IL0002267). Permit expired 6/1/1992. Permit will not be renewed. Awaiting No Further Remediation letter.
- Winnetka Water and Electric (NPDES Permit NO. IL0002364). Permit expired on 1/31/09. Permit renewal is in progress.

The MS4 communities are covered under the General NPDES Permit No. ILR40 that expires on March 31, 2014. The TMDL will be incorporated into the MS4 General Permit by reference. The General Permit will remain in effect until a new General Permit is reissued (Appendix IV Lake County TMDL, Appendix III Suburban and Chicago Cook County TMDLs).

Implementing the management thresholds to achieve the LA: Management thresholds were assigned to address nonpoint sources. To meet the TMDL, all of the thresholds identified in Table 2 per beach group should be met. An example set of management thresholds is shown in Table 6 below. In the example below, bird count, 24-hour rainfall, and slope should be managed to the level specified to achieve water quality at Forest Park, Rosewood, and Illinois Beach State Park. Specifically, this would require gull management BMPs to reduce gull populations at or

below 50 individuals per day, mitigate and manage runoff from storms at or above 1" 24-hour events through capture, infiltration, or diversion of runoff draining to the beach[18], and increasing the slopes at the beach by 1% to reduce re-growth of bacteria in beach sands and re-suspension of bacteria in the swash zone. Average beach slopes that were observed over the project period serve as baseline beach slope data and are provided in Section 4.9.2 of the TMDLs. If these management thresholds are achieved, the statistical model predicts that the GM of the water quality at these beaches will be at or below 126 cfu/100 ml and no more than 9% of the samples are predicted to exceed the SSM.

For beaches where impervious cover targets are given, the effective impervious cover (impervious cover whose runoff would drain to the beach) should not exceed the percentage listed. If current percentages exceed that amount, then BMPs should be implemented to capture and treat, infiltrate, or divert, runoff from those surfaces that would drain direct to the beach. Where infiltration practices are put in place they should be designed and implemented so they do not inadvertently promote re-growth in beach sands.

Table 6. Example of management thresholds for Beach Group 1 in Lake County document. Excerpt from Table 2 of the decision document.

TMDL document	Example Beach Group	Thresholds to nonpoint source variables achieve the LA					Predicted SSM exceedance when GM is attained (%)
		Bird count at or below	Reduce 24-hour rainfall below (in)	Reduce 48-hour rainfall below (in)	Increase in slope (%)	Reduce impervious area (%)	
Lake County	Forest Park, Rosewood, IBSP South, Waukegan North	50	1	—	1	—	9

Identifying the BMPs to meet management thresholds: The TMDLs identified the BMPs to be implemented to address sources for each beach. The BMP recommendations reflect the modeling results and local input[19]. That is, the TMDL modeling results identified the sources to be addressed (e.g., gull count, beach slope, and rainfall runoff), and local managers completed a survey to identify preferred and available BMPs to address those sources (Section 5.0 and 5.1 of the TMDLs).

The implementation recommendations in the TMDLs were either source control or mitigation-type BMPs that were further classified into six categories according to the results of the TMDL:

[18] Rainfall had a detectable effect at beaches when storms at or above a given storm-size occurred. This indicates that unpermitted runoff and overland flow may be reaching the beach as a result of storms of the noted size in the management thresholds. However, rainfall thresholds in the TMDL aggregate effects from overland flow, stormwater outfalls (permitted and unpermitted), and, in some instances, lock openings which causes the Chicago River to discharge to Lake Michigan. Data for each of these individual stormwater related sources did not exist in sufficient amounts to estimate individual impacts from wet-weather events. Thus rainfall amounts were used to identify the impact of these wet-weather sources and to indicate which storm events are generally associated with poor water quality. Point sources must still achieve the WLA, regardless of storm-event size. Non-point source management measures should address overland flow and unpermitted runoff from storm-events at or larger than the storm size indicated in the management thresholds.

[19] ECT Consulting. 2012. Illinois Lake Michigan Beach Bacteria Best Management Practice Option Survey. Admin record no. 4

Source assessment, stormwater management, gull management, beach management, public education, and enforcing ordinances. The BMPs available in each of these categories were summarized, including cost information, where available, to implement BMPs on a per unit or project-wide basis. The implementation plans also recommended a level of effort associated with the BMPs (Section 5.1.1 of the TMDLs), and summarized percent removal efficiency of different BMPs based on other studies (Table 5-2 in Section 5.1.1.2 of the TMDLs).

EPA finds that this criterion has been adequately addressed.

9. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a NPDES permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

Comment:
Point Sources: Reasonable assurance that the WLAs will be implemented is provided by 40 CFR 122.44(d)(1)(vii)(B),which requires that NPDES permit effluent limits are consistent with assumptions and requirements of all WLAs in an approved TMDL. IEPA implements its storm water and NPDES permit programs and is responsible for incorporating WLAs into permits. Current NPDES permits will remain in effect until the permits are reissued; provided that IEPA receives the NPDES permit renewal application prior to the expiration date of the existing NPDES permit. The WLAs will be incorporated into the permits upon reissuance by IEPA. Current and future facilities subject to the NPDES MS4 permits would be required to properly select, install, and maintain BMPs required under the permit to reduce bacteria loads from these sources (Section 5.1 of the TMDLs).

Reasonable assurance that WLA will be incorporated into MS4 permits is provided by the current General NPDES MS4 Permit ILR40. Part III- Special Conditions (C) of ILR40 requires the permitted entity to review their storm water management plan and determine whether the discharges within their jurisdiction are meeting the TMDL allocation or approved watershed

management plan. If they are not meeting the TMDL allocations, they must modify their storm water management program to implement the TMDL or watershed management plan within eighteen months of notification by IEPA of the TMDL or watershed management approval. The special conditions of the general permit also require the permitted entity to describe and implement a monitoring program to determine if storm water controls are meeting the WLA (Appendix IV of Lake County, Appendix III in Suburban and Chicago, Cook County TMDLs, General NPDES Permit No. ILR40).

Nonpoint Sources: The following factors give reasonable assurance that load allocations will be achieved and are summarized in this section:

- stakeholder input on the TMDL and implementation plans,
- the demonstrated capacity of beach managers,
- detailed and achievable management thresholds,
- distribution of a tool to explore and adapt management plans, and
- potential funding options.

Stakeholder input- Throughout TMDL development, stakeholders provided input on the TMDL and implementation plans primarily through surveys and five meetings between IEPA, US EPA, consultants, and a TAC. The TAC members represented beach management (public health), wastewater, and Great Lakes advocates (Table 6-1 in the TMDLs). The TAC members provided available source and monitoring data, were surveyed to help select the final BMP recommendations, and some have recently conducted implementation and assessment action at the beaches. The TAC meeting dates and purposes are summarized in Section 6.0 of the TMDLs and this engagement helped assure that local implementing agencies were aware of the TMDLs, and the impact of different sources identified in the TMDLs, and the actions needed to improve them. Agencies that have conducted beach management or clean-up actions in the past and are likely to continue include agencies represented in the TAC, agencies doing existing beach improvement work (Tables 5-4 in the TMDLs), and monitoring agencies listed in Table 1 in this decision if not already listed elsewhere.

Demonstrated capacity- Recent beach improvement activities conducted by local and federal agencies assure that beach managers have technical capacity to implement the BMPs and management actions recommended by the TMDL. The TMDL document summarizes 16 recent projects implemented by local and federal agencies to improve beaches (Table 5-4 of the TMDLs). Examples included completing BSS' to assess 10 beaches, ring-billed gull management, stream and ravine restoration, dune construction, and beach grooming. The BMPs that are recommended in the TMDL have demonstrated prior success. Specifically, some recent successes have been documented in peer-reviewed literature for gull management at Chicago beaches[20] and beach grading at beaches in Racine, WI[21], both of which are common BMPs recommended to address the water quality at the beaches covered in the TMDLs.

Detailed and achievable implementation targets- The TMDLs identified detailed implementation

[20] Engeman, R.M. et al. 2012. Egg Oiling to Reduce Hath-year ring-billed gull numbers on Chicago's beaches during swim season and water quality test results. *EcoHealth* 9(2):195-204. As cited in Section 5.1 of the TMDLs

[21] Kinzelman J., et al. 2003. Evaluation of beach grooming techniques on *Escherichia coli* density in foreshore sand at North Beach, Racine, WI. *Lake and Reservoir Management* 19(4)349-354. As cited in Section 5.1 of the TMDL.

targets to address sources that were verified, through statistical methods, to be contributing to *E. coli* impairments. This assures that the sources that are to be addressed are the sources causing or contributing to the impairment. Also the statistical models describe how a unit change in each threshold is expected to improve *E.coli*. Thus the specific conditions that source variables need to meet are predicted from statistical relationships based on all available and relevant data. This provides assurances that the specific management thresholds (e.g., reduce daily gull counts, increase beach slope by 1%, etc) are expected to meet water quality goals. Furthermore, when the management thresholds were selected, the entire range of observed data for gull count, beach slope, and impervious cover were consulted to ensure that recommendations were assigned at a level that had been observed at the beaches some time during the project period. This assures that the management thresholds are not unachievable.

Tool for management planning- While detailed and specific management thresholds were set in the TMDL, this does not prohibit a manager from adapting their implementation plans if unforeseen site constraints would prevent achieving the thresholds in the TMDL. A software program, the Illinois Beaches Implementation Tool, was developed for stakeholders to explore alternative implementation plans that would still meet water quality. The program was developed after local stakeholders expressed interest in accessing the model used to derive the TMDLs. The program allows the user to test different implementation scenarios by modifying the variables that are known to impact *E. coli* at a beach. Providing this tool to stakeholders helps assure that implementation actions are catered to each beach. An example illustrates why an entity may want to adapt management thresholds: if a breakwall and slope at a beach are two main causes of bacteria impairments, but beach grooming cannot be completed on a consistent basis to achieve the management threshold, an agency and/or community may be interested in modifying the breakwall. A manager can use the tool to test whether removing a breakwall and maintaining current slope conditions would still achieve the TMDL. Stakeholder access to the tool increases reasonable assurance that implementation goals can be adapted to each beach while still attaining water quality goals[22].

Two trainings were provided for this tool on April 22 and 23, 2013. The trainings were attended by beach management authorities from Lake and Suburban Cook County, EPA's Beach Act coordinator, EPA's contact for the 319 program in Illinois, local state and academic researchers, Illinois Department of Natural Resources Coastal Zone Management program contact, and Illinois EPA[23].

Federal, state and local funding opportunities that may support TMDL implementation actions were identified in Table 5-3 in the TMDLs. Eight funding programs from five federal agencies, four programs from two state agencies, one local funding program for Lake County, and two other funding sources were identified. Generally the projects support stormwater mitigation, reduction of nonpoint sources, and coastal zone restoration. These funding opportunities have been successfully used to complete beach improvement projects by local implementing agencies (Section 5.1.4. of the TMDLs).

A timeline for achieving the management thresholds was not specified as implementation will vary according to funding availability and the priorities of the multiple municipalities and

[22]RTI. April 2013. Illinois Beaches Implementation Tool Users Guide. Admin. record no. 5
[23] Sign-in sheet from April 22 and 23, 2013 training for Illinois Beaches Implementation Tool. Admin. record no. 6

implementing agencies that have jurisdiction for 51 beaches covered in the TMDL study. However past experience in completing beach improvement projects demonstrates that where funding is available, gull populations can be managed at a particular beach and produce results within the same year. Beach grooming practices and implementation BMPs at a beach in Racine, WI also produced improvements at the beach within one recreation season. The timeline to incorporate WLAs into permits is discussed in Section 8 in this decision document.

EPA finds that this criterion has been adequately addressed.

10. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

Comment: Monitoring to track the effectiveness of the TMDL could be supported by baseline data summarized in the TMDL documents and existing monitoring programs. Baseline conditions were characterized for the TMDL; the number of SSM and GM exceedences observed per year at each beach is reported in the TMDL (Table 2-8 in Lake County, Table 2-6 in Suburban Cook County, and Table 2-9 in Chicago, Cook County TMDL). Funding to monitor *E. coli* at the beaches has been supported through the Beach Act, and should that funding continue, datasets before and after the TMDL will be available to assess water quality improvements. Beach monitoring data are publicly available on STORET and PRAWN databases and could be used to calculate the GM and SSM exceedence frequency before and after TMDL implementation (Section 2.2 of the TMDLs).

The model used to develop the TMDL also predicted the rate that the SSM would be exceeded and still achieve the GM. These values were provided for each beach group in Section 4.9.2 of the TMDLs (In Tables titled "Manageable Variable Thresholds Required to Meet the Load Allocation," in the column titled "Predicted Percent of SSM exceedences when GM is Attained," in Section 4.9.2 of the TMDL). This rate of SSM exceedence ranged from 4-10% across the different beaches and could be used as a general indicator of whether a TMDL is being achieved. If SSM exceedence over the predicted SSM rate is consistently occurring, and recommended thresholds for non-point sources are being achieved, it may indicate that additional measures are needed to improve beach water quality.

The TMDL documents specifically recommended that additional surveys of illicit stormwater connections be completed so that illicit stormwater sources can be identified and eliminated. In addition the TMDL also suggests that the IEPA Resource Management Mapping Service could be used to track BMP placement and implementation projects. Information on BMP locations could help identify if BMPs were related to any changes in beach water quality (Section 5.1.3 of the TMDLs).

EPA finds that this criterion has been adequately addressed.

11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

Comment: Public participation occurred through TAC meetings, a total of four public meetings, and through public notice of the TMDL documents. IEPA sought participation from technical experts in beach management and the wastewater industries, and from the non-profit sector. The TAC meetings were held in Chicago on the following dates to discuss progress and receive feedback.

- November 9, 2010: Discuss options for TMDL methods and gather relevant data
- April 13, 2011: Review of project plan and available data
- March 15, 2012: Review of initial findings and required assumptions
- October 23, 2012: Discussion of implementation options and draft TMDL results

Through these meetings, IEPA gathered relevant data for the TMDL, corroborated assumptions and beach characterizations, and assessed whether draft implementation plans were viable.

IEPA held two general public meetings in Lake and Cook County to discuss draft TMDL results on March 16, 2012. The public comment period for the draft TMDL opened on February 26, 2013, and closed March 28, 2013. Two public meetings were held on February 26, 2013, in Lake and Cook County, Illinois. The public notice for the meeting was announced on IEPA's website and in a press release. The announcements provided details of meeting time and location and information on how to access the TMDL documents for review. Individuals who had participated or previously expressed interest in the TMDL received an e-mail announcing the public notice. The drafts were available at the IEPA website: http://www.epa.state.il.us/water/tmdl/.

IEPA received one comment letter from the Alliance for the Great Lakes dated March 28, 2013. The comments expressed strong concerns about the precision of the TMDL, the lack of consideration of an upper limit for bacteria, and inconsistency with IEPA's listing methods

(referred to as listing standards in the comment letter). The primary concerns were addressed either through clarification in the TMDL document and/or in the responsiveness summary (Appendix IV in Lake County TMDL, and Appendix III in Suburban and Chicago, Cook County TMDLs).

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this eleventh element.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a *technical review* or *final review and approval.* Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the waterbody, and the pollutant(s) of concern.

Comment: On June 3, 2013, EPA received a submittal letter dated May 22, 2013 signed by Marcia Willhite, Bureau of Water Chief, addressed to Tinka Hyde, EPA Region 5, Water Division Director. The submittal letter identified the waterbodies for which the TMDLs were developed. The locations of the waterbodies were provided in the supporting documentation. The letter explicitly states that the Illinois Lake Michigan beach TMDLs were being submitted for final approval by EPA under Section 303(d) of the Clean Water Act.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this twelfth element.

13. Conclusion

After a full and complete review, EPA finds that the TMDLs for the 51 Lake Michigan beaches identified in Table 1 of this decision document satisfy all of the elements of approvable TMDLs. This approval is for **fifty-one (51) TMDLs**, addressing a total of 51 bacteria impairments at 51 Lake Michigan beaches.

EPA's approval of this TMDL does not extend to those waters that are within Indian Country, as defined in 18 U.S.C. Section 1151. EPA is taking no action to approve or disapprove TMDLs for those waters at this time. EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under the CWA Section 303(d) for those waters.