

## EXECUTIVE SUMMARY

### **Beneficial Use Monitoring Program Goal**

**The goal of the Beneficial Use Monitoring Program is to document beneficial use impairments, identify impairment sources (if possible), detect water quality trends, provide needed information for the OWQS, and facilitate the prioritization of pollution control activities.**

The Beneficial Use Monitoring Program exists as a result of the vital economic and social importance of Oklahoma's lakes, streams, wetlands, and aquifers and the associated need for their protection and management. The data contained in this report is scientifically defensible and has been collected and analyzed following procedures outlined in Use Support Assessment Protocols (USAP), developed by Oklahoma's environmental agencies. Specifically, USAPs establish a consistent method to determine if beneficial uses assigned for individual waters through Oklahoma Water Quality Standards (OWQS) are being supported. (Legitimacy of data analyzed following protocols other than those outlined in the USAP must be defended.) If the BUMP report indicates that a designated beneficial use is impaired, threatened, or otherwise compromised, measures must be taken to mitigate or restore the water quality.

Traditionally, the State of Oklahoma has utilized numerous water monitoring programs conducted by individual state and federal agencies. In general, each environmental agency designs and implements its own program with only limited participation from with other state, municipal, or federal entities. These programs collect information for a specific purpose or project (e.g., development of Total Maximum Daily Loads, OWQS process, lake trophic status determination, water quality impact assessments from nonpoint and point source pollution, stream flow measurement, assessment of best management practices, etc.). Therefore, the information is specific to each project's data quality objectives (DQOs) and is often limited to a very small geographic area.

To synchronize Oklahoma's monitoring efforts related to water quality, the State Legislature appropriated funds in 1998 to create the Beneficial Use Monitoring Program under the direction of the Oklahoma Water Resources Board, who maintains Oklahoma's Water Quality Standards. The BUMP brings the OWRB's overall water quality management program full circle. From the promulgation of OWQS, to permitting and enforcement of permits stemming from OWQS-established criteria, to non-point source controls, all agency water quality management activities are intended to work in concert to restore, protect, and maintain designated beneficial uses.

The specific objectives of the BUMP are to detect and quantify water quality trends, document and quantify impairments of assigned beneficial uses, and identify pollution problems before they become a pollution crisis. This report interprets current Oklahoma Lake data collected as part of the comprehensive, long-term program. As the program has matured, the BUMP report has become one of the most important annually published documents in Oklahoma.

## BENEFICIAL USE MONITORING PROGRAM COMPONENTS

- **Monitoring Rivers & Streams** - The OWRB is currently monitoring approximately 180 stations on a monthly basis. These sites are segregated into two discrete types of monitoring activities. The first monitoring activity is focusing on fixed station monitoring on rivers and streams and the second monitoring activity focuses on a number of sample stations with locations that rotate on an annual basis. The two monitoring components are explained below.
  - ◆ **Fixed Station Monitoring on Rivers & Streams** - Fixed station monitoring is based largely upon the 67 United States Geological Survey (USGS) 8-digit hydrologic unit code (HUC) basins present in Oklahoma. In general, at least 1 sample station was located in all of the HUC watersheds with the exception of some of the smaller HUC watersheds adjacent to the state line or in a HUC that does not contain a free flowing stream at some point during the year. After consultation with the other state environmental agencies and over time the OWRB has identified 119 fixed stations of which 99 are currently being monitored.
  - ◆ **Rotating Station Monitoring on Rivers & Streams** - Over the life of the BUMP, rotational sampling has occurred on 200 stream segments. Sample stations and variables monitored are based upon Oklahoma's 303(d) list and input from other state environmental agencies on their monitoring needs. Variables monitored as part of this program component are specific for each stream segment monitored
- **Fixed Station Load Monitoring** –The OWRB is currently working jointly with the USGS to conduct flow monitoring on all of our fixed station sites that do not have an automated flow monitoring USGS gage. This cooperative effort allows for loadings to be calculated and provides much needed data for the Use Support Assessment process.
- **Fixed Station Lakes Monitoring** - Quarterly sampling (approximately once every 90 days) of approximately 55-60 lakes annually is currently occurring. This represents approximately a 40% increase in effort over historical BUMP Lake sampling efforts. In general, a minimum of three stations per reservoir, representing the lacustrine zone, transitional zone, and riverine zone, are designated for sampling at each lake, with additional sites sampled as needed. Additional water quality parameters and lake sites were added to the lake sampling program in 2001 to aid in making use support determinations.
- **Fixed Station Groundwater Monitoring** - Limited monitoring as part of this task has occurred in the program. Results of monitoring are presented in this report. OWRB staff has made recommendations in this report related to the scope and magnitude of groundwater monitoring activities that the state should pursue in the future. Any proposed groundwater monitoring efforts will be coordinated with the Oklahoma Department of Environmental Quality (ODEQ).
- **Intensive Investigation Sampling** - Although no funding was made available for this element of the program, it is important that waters identified as impaired be restored. If routine monitoring identifies impairment, then an intensive study will be undertaken to document the source of the impairment and recommend restorative actions if possible. This task will not be conducted in year one or year two of the program, but thereafter, intensive

investigations will be conducted as warranted. If water bodies are not identified for intensive study as part of this task, then monies will be reallocated to Tasks 1 and 3. Other entities (i.e., tribal or governmental units outside of Oklahoma) are involved as circumstances dictate or allow.

## **PROGRAM HISTORY/OVERVIEW**

Sampling of the numerous lakes, streams, and rivers across this state was initiated in the summer and fall of 1998. Lake sampling in connection with the Beneficial Use Monitoring Program began in July of 1998. Sampling on numerous streams and rivers began in earnest in November of the same year. The two sampling programs, one for lakes and one for streams, had separate starting dates for a number of reasons. First, the OWRB has been conducting a lake-sampling program during the warmer summer months since 1990 as part of the Federal Clean Lakes Program. This historical lake sampling program was funded through federal dollars with the express purpose of determining lake trophic status. The trophic status of a reservoir can range from oligotrophic (low biological productivity) to hypereutrophic (excessive biological productivity). In general, the more productive a reservoir, the more water quality problems it is likely to experience. Federal dollars to fund this trophic state assessment of our state's lakes were discontinued in 1994. At that time, the OWRB searched for other funding sources, and through working with the Secretary of the Environment and the Oklahoma Conservation Commission, the Water Board was able to obtain a one time federal 319 nonpoint source grant to continue the lake trophic state assessment program. The OWRB subsequently initiated a quarterly lake sampling program in the spring of 1998 and was able to roll the existing lake program into the BUMP. Since 1998, both the number of lakes sampled annually and monitored water quality constituents for have increased as the program has continued to adapt to meet the data quality needs for Oklahoma. It is hoped that the program can be further enhanced in the future to increase its usefulness to the environmental decision making process in Oklahoma.

The OWRB has developed Use Support Assessment Protocols (USAP) for lakes and streams, which are essential if the state is to be consistent in identifying waters that are not meeting their assigned beneficial uses or are threatened. The Water Resources Board has incorporated the USAP into Oklahoma Administrative Code (OAC) 785:46 to ensure that consistent determinations for impairments are made by the all of the monitoring agencies.

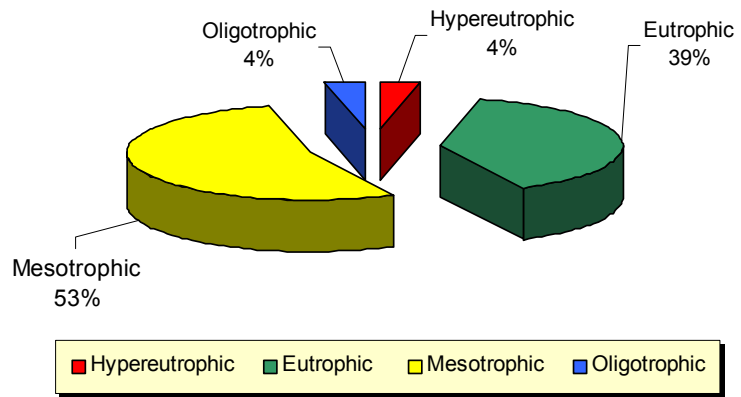
**The state must follow consistent procedures for listing waters as impaired. Using the OWRB Use Support Assessment Protocols, it has been possible for OWRB staff to assess whether threats or impairments are present in our waterways. With continued funding, identification of impaired waters will be accomplished on additional waters.**

## **Results of Lakes Sampling Efforts**

Data collected by OWRB on a quarterly basis for 54 lakes was used for this report. For the current sample year, data was collected from the September of 2002 through September of 2003. The results of the sampling efforts are summarized below. As shown in Figure 1, a relatively small percentage (4%) of lakes sampled were determined to have serious water quality nutrient concerns based upon their classification as hypereutrophic reservoirs. Lakes classified as hypereutrophic have the potential for beneficial use impairments due to low dissolved oxygen concentrations, taste and odor problems, nutrient inputs, excessive productivity, and general lake aesthetics. Hypereutrophic waters are adversely impacted

primarily by excessive nutrients and primary productivity and should be monitored intensively in the future to document the presence or absence of “beneficial use impairments.” Thirty-nine percent of the lakes sampled were classified as eutrophic, characterized by high primary productivity and nutrient rich conditions. A eutrophic lake also has the potential for beneficial use impairments, though the potential is less than for hypereutrophic waters. Mesotrophic waters have a small potential for beneficial use impairments and overall are representative of good water quality, low to moderate levels of nutrients, and productivity. Of the lakes sampled, 53% were classified as mesotrophic. Oligotrophic waters have very low levels of primary productivity and usually low concentrations of nutrient constituents. In Oklahoma, oligotrophic waters are either very clear waters with little nutrient inputs and genuinely good water quality conditions, or the waters are very turbid with the absence of sufficient ambient light inhibiting lake productivity. Only two of the 54 lakes sampled were classified as oligotrophic. In this case, Lakes Elmer Thomas and Talawanda Lake No. 2 were classified as oligotrophic. In this instance, both lakes had very low levels of inorganic turbidity and are very clear and beautiful lakes. Based on the results for trophic state index calculations, 44% of the waters sampled were exhibiting high to excessive levels of primary productivity and nutrient rich conditions.

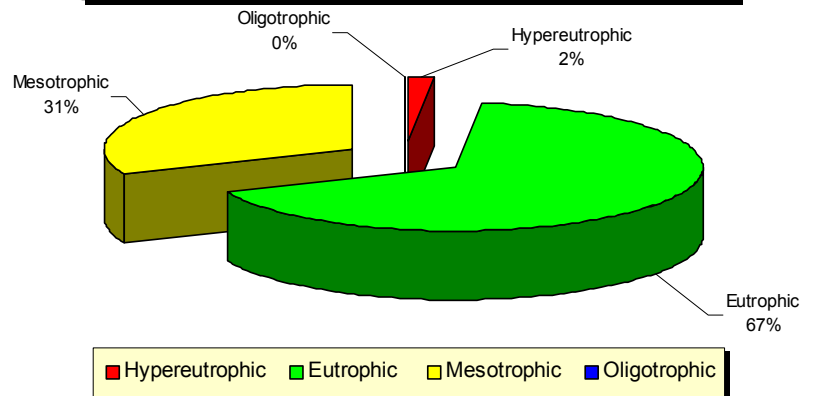
**Trophic Status of Lakes for Sample Year 2002-2003 (n=54)**



**Figure 1. Trophic Status of Lakes Sampled in 2002-2003**

The distribution changes when the lake surface acres for each reservoir are classified into the corresponding trophic status. Results in Figure 2 are quite different than Figure 1, indicating the lakes classified as eutrophic were larger in surface acres than the lakes classified as mesotrophic and hypereutrophic. When you look at lake trophic status broken out by the number of lake surface acres in each trophic state category, 67% of all surface acres sampled were eutrophic, 31% were mesotrophic, 02% were hypereutrophic, and less than 1% were oligotrophic. The two largest reservoirs sampled in 2002-2003 were classified as eutrophic (Eufaula and Texoma), which skewed the surface acres percentages heavily towards the eutrophic category. In general, the larger reservoirs in the state have more extensive watersheds and are generally deeper than smaller lakes, which increases the likelihood of beneficial use impairments being present since a larger surface area is available. During stratification, the larger/deeper reservoirs have a greater

**Lake Surface Acres by Trophic State for Lakes Sampled in 2002-2003**



**Figure 2. Lakes surface acres segregated by trophic state.**

portion of the water column that becomes anoxic for long periods of time, which also increases the potential for nutrient release from sediments. It is obvious that many reservoirs in Oklahoma are experiencing adverse environmental impacts. However, with the available data it is not possible to adequately assess if lakes are meeting their assigned beneficial uses as they relate to nutrients. At this time, 14 lakes have been identified by the OWRB as “Nutrient-Limited Watersheds” (NLW) in the OWQS and efforts should be taken to definitively determine if NLW waters are meeting their uses through initiation of a Nutrient Impairment Study to definitively determine the presence or absence of nutrient impairments in our NLW lakes. NLW are lakes with a TSI  $\geq$  62, based on Carlson’s trophic state classification system and using chlorophyll-*a* as the trophic state indicator. Lakes sampled as part of the BUMP, their trophic status, and potential threats or impairments are listed in Table 1.

**Table 1.** Lakes Sampled by the BUMP with Associated Use Attainment Status.

LAKE NAME	COUNTY	W.Q. SEGMENT #	YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
AMERICAN HORSE	BLAINE		2003	D.O.				
ARBUCKLE	MURRAY	310800	2003	D.O.				
ARCADIA	OKLAHOMA	520710	2003	D.O. TURBIDITY				
ARDMORE CITY	CARTER	310800	2003	D.O.				
ATOKA	ATOKA	410400	2002	TURBIDITY				TRUE COLOR
BELLCOW	LINCOLN	520700	2002	PH – PL				
BIRCH	OSAGE	121300	2003	D.O. TURBIDITY				TRUE COLOR
BIXHOMA	WAGONER		2002	D.O. PH – PL				
BLUESTEM	OSAGE	121300	2002	D.O. TURBIDITY				TRUE COLOR
BOOMER	PAYNE	620900	2002	TURBIDITY				
BROKEN BOW	MCCURTAIN	410210	2001	PH – PL				
BRUSHY CREEK	SEQUOYAH	220200	2001	D.O. PH – PL				
BURTSCHI ‡	GRADY		2002					
CANTON	BLAINE	720500	2002	TURBIDITY PH – PL				
CARL ALBERT	LATIMER	410310	2001	D.O. PH – PL				
CARL BLACKWELL	PAYNE	620900	2002	D.O.				
CARTER	MARSHALL	310800	2001					
CEDAR (MENA)	LEFLORE	410210, 410300	2001	D.O. PH – PL				
CHANDLER	LINCOLN	520700	2003	D.O.				
CHICKASHA ‡	CADDO	310830	2003					
CLAREMORE	ROGERS	121500	2002	D.O.				NLW
CLEAR CREEK	STEPHENS	310810	2003	D.O.		ENTERO.		
CLEVELAND CITY	PAWNEE		2002	D.O.				
CLINTON	WASHITA	310830	2002	TURBIDITY				

LAKE NAME	COUNTY	W.Q. SEGMENT #	YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
COALGATE CITY	COAL	410400	2002	D.O. TURBIDITY				
COMANCHE	STEPHENS	311300	2003	D.O.				
COPAN	WASHINGTON	121400	2003	TURBIDITY D.O.				
CROWDER	WASHITA	310830	2002	D.O.				NLW
CUSHING MUNICIPAL	PAYNE	620900	2002	D.O. TURBIDITY				
DAVE BOYER (WALTERS)	COTTON	311300	2001	TURBIDITY				TRUE COLOR
DRIPPING SPRINGS	OKMULGEE	520700	2002	D.O.				
DUNCAN	STEPHENS	310810	2003	D.O.				
EL RENO	CANADIAN		2003	TURBIDITY				
ELK CITY	BECKHAM	311500	2002	TURBIDITY				NLW
ELLSWORTH	COMANCHE	311300	2002	TURBIDITY				
ELMER THOMAS	COMANCHE	311300	2003	D.O.				
ETLING, CARL	CIMARRON	720900	2001	TURBIDITY				
EUCHA	DELAWARE	121600	2003	D.O.				NLW
EUFULA	HASKELL	220600	2003	D.O. TURBIDITY				TRUE COLOR
FAIRFAX CITY	OSAGE	621200	2002					
FORT COBB ‡	CADDO	310830	2002					NLW
FORT GIBSON ◻	CHEROKEE	121600	2001	TURBIDITY				
FORT SUPPLY †	WOODWARD	720500	2002	TURBIDITY PH – PL				NLW
FOSS	CUSTER	310800, 310810 310820, 310830 310840	2003	D.O. TURBIDITY				
FREDERICK	TILLMAN	311310	2003	TURBIDITY				
FUQUA	STEPHENS	310810	2003	D.O.		ENTERO.		TRUE COLOR
GRAND LAKE	MAYES	121600	2001	D.O. TURBIDITY				
GREAT SALT PLAINS	ALFALFA	621010	2002	TURBIDITY PH – PL			SULFATES & CHLORIDES	NLW
GREENLEAF	MUSKOGEE	120400	2001	D.O.				
GUTHRIE	LOGAN	620910	2002					NLW
HEALDTON CITY	CARTER	311100	2001					
HEFNER	OKLAHOMA	520520, 520530	2002	D.O.				
HENRYETTA ♦	OKMULGEE	520700	2003	D.O.				
HEYBURN	CREEK	120420	2003	D.O. TURBIDITY		ENTERO.		
HOLDENVILLE	HUGHES	520800	2002	D.O.				
HOMINY MUNICIPAL	OSAGE	121300	2002	D.O.				

LAKE NAME	COUNTY	W.Q. SEGMENT #	YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
HUDSON	OSAGE		2002					
HUDSON	MAYES	121600	2003	D.O.				
HUGO	CHOCTAW	410300	2003	TURBIDITY D.O.				TRUE COLOR
HULAH	OSAGE	121400	2003	TURBIDITY				NLW
HUMPHREYS	STEPHENS	310810	2003	D.O.				
JEAN NEUSTADT	CARTER	310800	2003	D.O.				
JOHN WELLS	HASKELL	220200	2002	D.O. PH – PL				
KAW	OSAGE	621210	2003	TURBIDITY D.O.				TRUE COLOR
KEYSTONE	TULSA	621200	2002	TURBIDITY				NLW
KONAWA	SEMINOLE		2002					
LANGSTON	LOGAN	620900	2002	D.O.				
LAWTONKA	COMANCHE	311300	2002					
LIBERTY	LOGAN	620910	2002	D.O.				
LLOYD CHURCH	LATIMER	220100	2001	D.O. PH – PL TURBIDITY				
LONE CHIMNEY	PAWNEE	621200	2002	D.O.				
LUGERT-ALTUS	GREER	311500, 311510	2003	PH – PL				NLW
MAYSVILLE/WILEY POST	MCCLAIN		2002	D.O. TURBIDITY				
MCALESTER	PITTSBURG	220600	2003	TURBIDITY D.O.				
MCGEE CREEK	ATOKA	410400	2002	D.O. PH – PL				TRUE COLOR
McMURTRY	NOBLE	620900	2002	D.O.				
MEEKER	LINCOLN	520700	2002	TURBIDITY				TRUE COLOR
MURRAY	LOVE	311100	2001	D.O.				
NANIH WAIYA	PUSHMATAHA		2003	D.O.				
NEW SPIRO	LEFLORE	220100	2001	D.O.				
OKEMAH	OKFUSKEE	520700	2002	D.O.				
OKMULGEE	OKMULGEE	520700	2002	D.O.				
OOLOGAH	ROGERS	121510	2003	TURBIDITY D.O.				
OVERHOLSER	OKLAHOMA	520520, 520530	2002	D.O. TURBIDITY				NLW
OZZIE COBB	PUSHMATAHA	410300	2003	D.O. PH – PL				NLW
PAULS VALLEY CITY	GARVIN	310810	2003	D.O.				
PAWHUSKA	OSAGE	121600	2003	D.O.				
PAWNEE	PAWNEE	621200	2002					

LAKE NAME	COUNTY	W.Q. SEGMENT #	YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
PERRY	NOBLE	621200	2003	TURBIDITY				
PINE CREEK	MCCURTAIN	410210	2002	D.O. TURBIDITY PH – PL				TRUE COLOR
PONCA	KAY	621200	2003	D.O.				
PRAGUE CITY	LINCOLN	520510	2003	D.O.				
PURCELL	MCCLAINE	520610	2002	D.O.				
RAYMOND GARY	CHOCTAW	410300	2000	D.O. PH – PL				
R.C. LONGMIRE	GARVIN	310810	2003	D.O.				
ROBERT S. KERR	SEQUOYAH	220200	2003	TURBIDITY				TRUE COLOR
ROCK CREEK	CARTER	310800	2003	D.O.				
ROCKY (HOBART) ‡	WASHITA	311500	2001					
SAHOMA	CREEK	120420	2002	D.O. TURBIDITY				
SARDIS	PUSHMATAHA	410310	2003	D.O.				
SHAWNEE TWIN # 1	POTTAWATOMIE	520510	2002					
SHAWNEE TWIN # 2	POTTAWATOMIE	520510	2002					
SHELL	OSAGE	120420	2002	D.O.				
SKIATOOK	OSAGE	121300	2003	D.O.				
SOONER	PAWNEE		2003	D.O.				
SPAVINAW •	MAYES	121600	2003	D.O.				NLW
SPORTSMAN	SEMINOLE	520500	2002					
STANLEY DRAPER	CLEVELAND		2002	TURBIDITY				TRUE COLOR
STILWELL CITY	ADAIR	220200	2001	D.O.				
STROUD	CREEK	520700	2002	D.O.				
TALAWANDA # 1	PITTSBURG	220600	2003	D.O. PH – PL				
TALAWANDA # 2	PITTSBURG	220600	2003	D.O.				
TAYLOR (MARLOW) ◻	GRADY	310840	2003	TURBIDITY D.O.				NLW
TECUMSEH	POTTAWATOMIE	520510	2002	TURBIDITY				TRUE COLOR
TENKILLER FERRY	SEQUOYAH	121700	2002	D.O.				
TEXOMA	BRYAN	311100, 310800	2003	D.O. TURBIDITY				
THUNDERBIRD	CLEVELAND	520810	2001	D.O. TURBIDITY				TRUE COLOR
TOM STEED	KIOWA	311500	2003	TURBIDITY PH – PL				
VANDERWORK	WASHITA	310830	2002	D.O.				NLW
VINCENT, LOYD	ELLIS	720500	2000					

LAKE NAME	COUNTY	W.Q. SEGMENT #	YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
W.R. HOLWAY	MAYES		2003	D.O.				
WAURIKA	JEFFERSON	311210	2003	D.O. TURBIDITY				
WAXHOMA	OSAGE		2002	D.O. PH - PL				
WAYNE WALLACE	LATIMER	220100	2003	D.O. PH - PL				
WEBBERS FALLS	MUSKOGEE	121400	2001	TURBIDITY				
WES WATKINS	POTTAWATOMIE	520510	2002					
WETUMKA	HUGHES		2001	TURBIDITY				
WEWOKA	SEMINOLE	520500	2002	TURBIDITY				
WISTER †	LEFLORE	220100	2003	PH - PL TURBIDITY				NLW TRUE COLOR
YAHOLA ●	TULSA	121300	1999					

† Lake Listed Based Upon 1995 U.S. Army Corps. Of Engineers Intensive Study

‡ These Lakes will not be recommended for listing as part of the next WQS revision due to insufficient data

♣ Lake Listed Based Upon OWRB Phase I Clean Lakes Study

♦ Lake does not fit the classic definition of oligotrophy, as inorganic particulates are the controlling factor in limiting biological productivity

● Lake was not assessed through the BUMP, but through another OWRB project

▣ These Lakes will be recommended for NLW listing as part of the next WQS revision process

### IMPAIRMENT CODES

NS = NOT SUPPORTING

PS = PARTIALLY SUPPORTING

PL = PROVISIONALLY LISTED

### ACRONYMS

NLW = NUTRIENT LIMITED WATER

D.O. = DISSOLVED OXYGEN

ENTERO. = ENTEROCOCCI

### ASSIGNED OWQS BENEFICIAL USES

FWP = FISH & WILDLIFE PROPAGATION

AES = AESTHETICS

PPWS = PUBLIC & PRIVATE WATER SUPPLY

AG = AGRICULTURE

PBCR = PRIMARY BODY CONTACT RECREATION