



## Section 319

# NONPOINT SOURCE PROGRAM SUCCESS STORY

# Nebraska

## Community-Based Efforts Decrease Algae Toxins in Carter Lake

### Waterbody Improved

Runoff and lakebed sediment resuspension led to elevated nutrient and turbidity levels in Carter Lake (which lies in both Iowa and Nebraska). As a result, Iowa placed Carter Lake on its Clean Water Act (CWA) section 303(d) list because of excess algae and turbidity (in 2004) and low dissolved oxygen (in 2008). The Nebraska Department of Environmental Quality (NDEQ) added Carter Lake to the state's 2006 CWA section 303(d) list because of phosphorus, nitrogen, chlorophyll *a*, algal toxins and pH impairments. A community-based implementation effort to restore the lake has successfully reduced nutrient concentrations and blue-green algae (and their microcystin toxins). As a result, NDEQ will propose to remove Carter Lake's algae toxin impairment from the state's 2012 CWA section 303(d) list.

### Problem

Carter Lake (Figure 1) is a 315-acre oxbow lake along the Missouri River. The lake, which is in both Nebraska and Iowa, drains approximately 2,722 acres of primarily urban-residential and commercial land.

Elevated nutrients in the lake have caused a number of water quality problems. Total phosphorus levels in the lake have exceeded 300 parts per billion (ppb) while nitrogen levels were as high as 5,100 ppb. The occurrence of blue-green algae blooms (associated with high nutrient levels) led officials to begin monitoring for microcystin toxin in 2004. The first samples collected from the lake exceeded the beach posting criterion of 15 ppb. In 2005 the beach posting criterion was changed to 20 ppb. From 2005 through 2008, 10 of the 83 toxin samples collected exceeded 20 ppb, causing officials to post warnings at the beach for 21 weeks.

As a result of the water quality problems, Iowa placed Carter Lake on its 2004 CWA section 303(d) list because of excess algae and turbidity. NDEQ added Carter Lake to the Nebraska's 2006 CWA section 303(d) list because of phosphorus, nitrogen, chlorophyll *a*, pH and algal toxin impairments. NDEQ also added PCBs (in fish tissue) to the list of Carter Lake impairments in 2004.

Iowa Department of Natural Resources (IDNR) and NDEQ prepared a total maximum daily load for algae/algal toxins, chlorophyll *a*, total phosphorus, total nitrogen and pH at Carter Lake in 2007. Nutrient sources were linked to nonpoint source runoff from the watershed and from the organic-rich sediment in the bottom of the lake. Lakebed sediments were frequently resuspended by boat wakes and the bottom-feeding activity of rough fish (such as carp, quillback and bullheads).



Figure 1. Officials apply alum and sodium aluminate to Carter Lake.

### Project Highlights

In 2006 the cities of Carter Lake (Iowa) and Omaha (Nebraska) joined forces with local and state agencies to begin a Community-Based Planning Process. As part of the planning process, a group of interested citizens formed the Carter Lake Environmental Assessment and Rehabilitation (CLEAR) Council. In 2008 the CLEAR Council, with assistance from its local and state agency partners, completed the Carter Lake Water Quality Management Plan. The plan outlines more than \$6 million worth of possible restoration work. With a plan in place, partners initiated the Carter Lake Water Quality Project in 2008. First, the partners hired a project coordinator using CWA section 319 funds from Nebraska (years 1-2) and Iowa (years 3-4).

Partners have completed many watershed treatments, including installing grass swales and rain

gardens. The city of Carter Lake installed five rain gardens with a combined total area of 17,503 square feet (Figure 2). Partners are conducting an extensive nutrient educational effort targeted at fertilizer use and pet waste management; they recently expanded the education effort to include aquatic vegetation management. In-lake treatments consisted of applying algaecide, alum and sodium aluminate (see Figure 1), establishing a 100-acre no-wake zone with a 5-mile-per-hour watercraft speed limit to minimize displacement of sediments, and renovating the fishery (replacing rough fish with largemouth bass, bluegill and channel catfish).

Other work that will be implemented includes adding stormwater detention cells, installing grass swales, creating wetlands, stabilizing the shoreline, performing targeted lake dredging and conducting a second alum treatment. Partners expect to completely implement the restoration efforts described by the plan in 2013.



Figure 2. The city of Carter Lake installed five rain gardens to treat stormwater runoff.

## Results

Monitoring conducted since 1990 shows that the restoration efforts have made a difference. Nutrient levels have dropped, resulting in lower algal densities and decreased levels of the microcystin toxin (Table 1). The beach has not been closed by high microcystin levels since before the in-lake alum and algaecide treatment in 2010 (Figure 3). On the basis of those data, NDEQ will propose to remove Carter Lake's algal toxin impairment from Nebraska's 2012 CWA section 303(d) list. The lake will remain on Nebraska's impaired waters list for phosphorus, nitrogen, chlorophyll *a*, pH and PCBs (in fish tissue).

**Table 1. Carter Lake nutrients and microcystin data (1990–2011)**

	1990–2009 Average levels (ppb)	2010–2011 Average levels (ppb)
Total nitrogen	2,782	1,340
Total phosphorus	185	70
Algae microcystin toxin	8.63 <sup>a</sup>	0.31

<sup>a</sup> Microcystin data includes the average for 2004–2009 only.

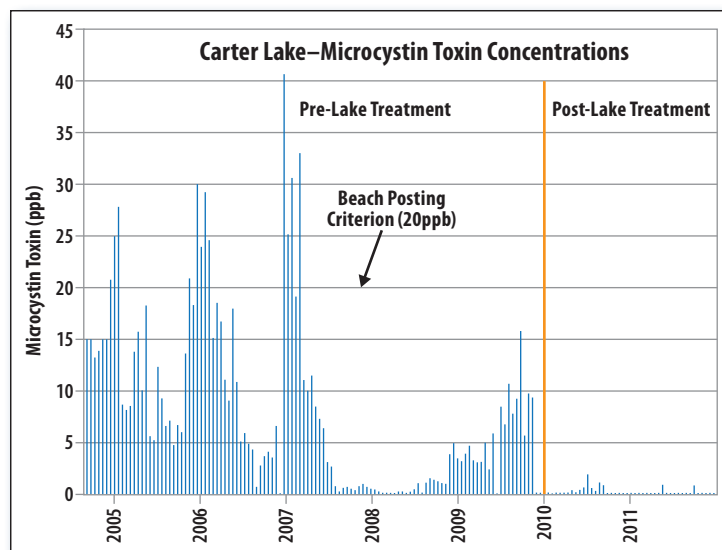


Figure 3. Implementing in-lake treatment and watershed restoration practices helped to eliminate beach closings.

Carter Lake's water clarity has improved, creating a secondary problem of aquatic vegetation overgrowth. Although the vegetation hampers water-based recreation, it has helped the newly stocked game fish flourish. In July 2011 the project team initiated vegetation harvesting in critical areas of the lake. A vegetation management plan will be developed and implemented to address future concerns.

## Partners and Funding

Numerous agencies and stakeholders are involved in planning, implementing and monitoring this approximately \$4.7-million water quality/lake restoration project. Partners include IDNR, Nebraska Game and Parks Commission, Omaha, Papio-Missouri River Natural Resources District, city of Carter Lake, University of Nebraska-Lincoln, Iowa State University, Metropolitan Area Planning Agency, Iowa Division of Soil Conservation, NDEQ, West Pottawattamie County Soil and Conservation Service District, and Carter Lake Preservation Society. Eight different funding sources are supporting water quality management plan implementation. To date, \$2,357,198 has been provided through Nebraska Game and Parks Commission Aquatic Habitat Program, NDEQ CWA section 319 funds, IDNR Special Appropriations, Omaha and the city of Carter Lake. In addition to those, future funding will be supplied through IDNR CWA section 319, Nebraska Environmental Trust and Papio-Missouri River Natural Resources District.



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