

# CHAPTER 4

## KEY CONCEPTS

### 1. Walnut Creek is impaired by pollutants

Recreational uses involving direct human contact with Walnut Creek water are currently *not supported* because of high measured levels of E.coli bacteria. These levels have routinely been higher than the state's water quality standards and are the reason why the stream is listed as an impaired waterbody.

### 2. The Raccoon River and Des Moines Water Works are impacted too

The Raccoon River is also listed as impaired due to high bacteria levels. The river is also identified as being impaired due to high levels of nitrates, which risk safe drinking water supplies. During periods of high nitrate levels, Des Moines Water Works has to activate special treatment systems which reduce nitrate levels in the treated water supply.

### 3. Nutrient pollution is not just a local problem

Compounds containing nitrogen and phosphorus are carried downstream from the Mississippi River watershed to the Gulf of Mexico. Chemical and biological reactions increased by high levels of these nutrients can lower oxygen levels in the water to the point where fish and other animals cannot survive. This process has caused a "dead zone" to be formed in the Gulf which is over 5,800 square miles in area.

### 4. Past work provides insight

Several past studies offer important analyses and recommendations related to the Walnut Creek Watershed.

## HOW DO THESE CONCEPTS INFLUENCE DEVELOPMENT OF THE PLAN?

Previous studies have identified potential risks to human health and the environment. These studies identify likely sources of pollution and the reduction of pollutant loads necessary for streams to fully support their designated uses. Strategies and best management practices are identified to address these concerns, some of which may be applicable within this plan.

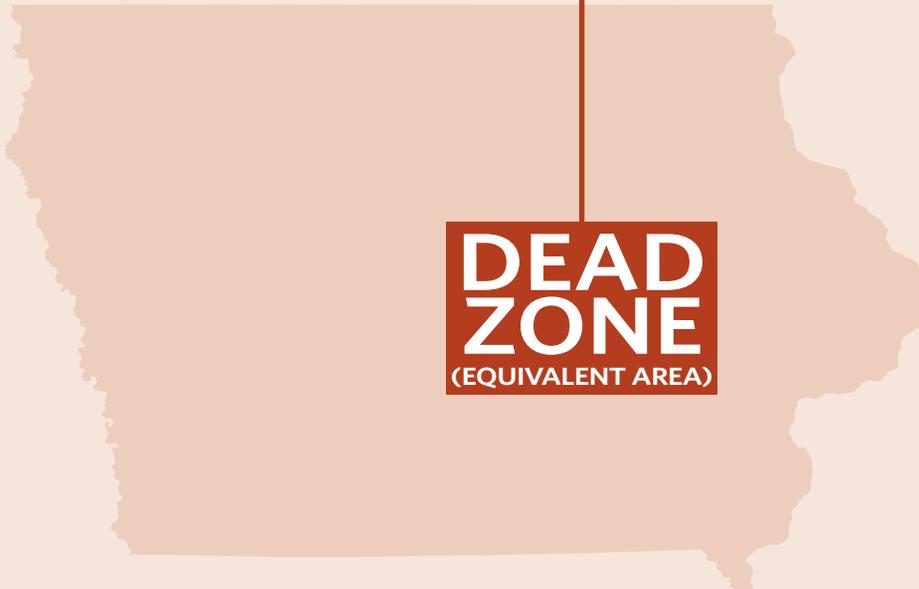


Background

Downstream waterbodies are:

1. Des Moines River
2. Lake Red Rock
3. Mississippi River
4. Gulf of Mexico

Elevated levels of nutrients such as nitrogen and phosphorus have created a 5,500-square-mile hypoxic "dead zone" in the Gulf of Mexico (10% of the size of the entire State of Iowa) \*

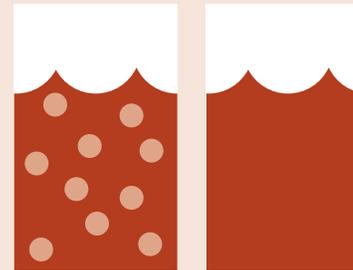


\* The size of the dead zone is the five-year average size of the hypoxic zone, based on data collected by NOAA from 2011-2015.

## Walnut Creek

- Currently considered an impaired waterbody due to high levels of bacteria.
- Flows into the **Raccoon River** which is impaired due to high levels of bacteria and nitrate.

Des Moines Water Works collects water from the **Raccoon River** for drinking water use. This water must be disinfected and nitrates removed through a special process when concentrations are above a certain level.



## Iowa's Nutrient Reduction Strategy



Created to reduce the amount of nutrient load sent from Iowa to the Gulf of Mexico.

Past studies have been completed that broaden the understanding of Walnut Creek and where it fits within larger watersheds. The maximum allowable concentrations of certain pollutants are based on the designated uses of the stream. This influences if the stream is considered to be impaired, and the required reductions in pollutants that are needed in order to fully support the stream's desired public uses.

## Designated Uses

Streams have specific designation classifications based on their use. Uses such as swimming, fishing, drinking water or maintaining aquatic life fall into different classifications. Each class has a series of rules that applies to it, known as the **IDNR water quality standards**.

The listed **designated uses** for Walnut Creek (Waterbody ID Code: IA 04-RAC-0020\_1) are below:

- *Class A1 (Primary contact recreational use):* The recreation uses involve full body immersion with prolonged and direct contact with the water.
- *Class B (WW-2):* Typically smaller, perennially flowing streams capable of supporting and maintaining a resident aquatic community, but lacking the flow and habitat necessary to fully support and sustain game fish populations.

Sources:

IDNR website "What does 'Designated Use' mean?"  
<http://www.iowadnr.gov/InsideDNR/RegulatoryWater/WaterQualityStandards/DesignatedUses.aspx>  
Iowa DNR 305(b) Water Quality Assessment Database – 2014 Water Quality Assessment.  
Iowa Surface Water Classifications (567 Iowa Administrative Code 61.3).

## Impaired Waters Status

The lowest 7.6 miles of Walnut Creek are listed on the State of Iowa's 305(b) list as an impaired waterway. Streams are added to the **impaired waters** list if conditions exist that have a negative impact on one or more of the streams' designated uses. For each stream studied, each use is categorized as being fully, partially or not supported.

Portions of Walnut Creek are listed as Category 4a, meaning that it is impaired or a downward water quality trend is evident, and a TMDL (Total Maximum Daily Load report) has been prepared.

Primary contact recreation uses (Class A1) are listed as "not supported" based on data from Iowa Geological Survey snapshot monitoring from 2004 through 2008. The levels of indicator bacteria (E.coli) at multiple sampling points were far in excess of the water quality criterion established by the State of Iowa. (These criteria for E.coli are a *geometric mean* for all samples of 126 organisms per 100 milliliters (mL) and a single sample maximum of 235 orgs./100 mL)

Aquatic life support is listed as "fully supported" based on data collected in the 1998 IDNR/UHL stream biocriteria project (Class B).

The lower Raccoon River (Waterbody ID Code: IA 04-RAC-0010\_1) is listed as impaired by bacteria and nitrates. Elevated bacteria levels are the reason it is listed as "not supporting" primary contact recreation.

In addition to the uses established for Walnut Creek, the Raccoon River has the following designated uses:

*Class C (Drinking water supply):* Water is used as a raw water source of potable water supply.

*Class HH (Human health):* Waters where fish are routinely harvested for human consumption or where water is used as a drinking water supply and where fish are routinely harvested for consumption.

Source: Iowa DNR 305(b) Water Quality Assessment Database – 2014 Water Quality Assessment.

The river is also listed by the state of Iowa as a **high-quality resource**, or a water "of substantial recreational or ecological significance which possesses unusual, outstanding or unique physical, chemical or biological characteristics."

## Applicable Water Quality Standards

The TMDL established for the Raccoon River set **maximum contaminant levels (MCLs)** for both nitrate and bacteria.

The Raccoon River is listed as "fully supporting" fish consumption. However, nitrate levels frequently exceeded the maximum contaminant level for nitrate of 10 mg/L, leading to this stream segment being categorized as "not supporting" use for drinking water.

Source: IDNR 305(b) Water Quality Assessment Database  
<https://programs.iowadnr.gov/adbnnet/assessment.aspx?aid=12318>

The Raccoon River TMDL report set the MCL for nitrate for single samples at 9.5 mg/L (which includes a factor of safety below the acceptable limit established by the state (10.0 mg/L)). The MCL for bacteria for single samples was established to be 200 organisms / 100 mL, which also includes a factor of safety below the state water quality standard (235 org./100mL). These standards are to be applied to major tributaries of the river (such as Walnut Creek) which have been designated as impaired by these pollutants of concern.

## Previous Studies

### *Water Quality Improvement Plan for Raccoon River (TMDL)—2008*

The federal **Clean Water Act** required the Iowa Department of Natural Resources (IDNR) to develop a Watershed Improvement Plan, also known as a Total Maximum Daily Load (TMDL), for waters that have been identified on the state's 303(d) list as impaired by a pollutant. These plans determine current pollutant loads and determine the required reductions needed to bring levels back below the desired standard. Three segments of the Raccoon River have been identified as impaired by

nitrate and five segments by the **pathogen indicator bacteria** (E.coli TMDL, p.12). The segment of Walnut Creek in Polk County, downstream of I-80/35 is one of several Class A1 streams within the Raccoon River watershed which were within the report prepared for the overall Raccoon River TMDL.

Surface water from the Raccoon River is used as a drinking water source for the Cities of Des Moines and Panora. Because of this, the Class C water quality standard applies to the Raccoon River at these two locations. Between 1996 and 2005, nitrate concentrations at the Des Moines Water Works (DMWW) exceeded state water quality standards 24.0% of the time. Higher concentrations were observed during April, May and June as well as November and December. Nitrate concentrations were highest during higher flows, with an average concentration of 10.0 mg/L when flow rates were in the highest 25% of recorded levels (TMDL, p 12).

E. coli is used as the indicator bacteria for Class A waters (waters with a recreational use where human contact is likely to occur). Sampling data suggests that all Class A1 waters in the Raccoon River watershed could be considered as “not supporting” their designated uses. Therefore, the conclusion of the Raccoon River TMDL report was to assign a maximum contaminate level (MCL) to all of these streams within the watershed which had not been previously classified (TMDL, p 14).

Highest concentrations were observed during May, June and July, although concentrations above 10,000 organisms/100mL were observed in some samples collected at DMWW in all months except February and December. Highest concentrations were observed when flows were highest, with the median concentration being 665 organisms/100mL in the highest upper 25% flow range (TMDL, p 14). **Non-point sources** were expected to contribute up to 99% of the total loading, on days when observed concentrations were higher than the established standards (TMDL, p 15).

The TMDL report projects that reductions of nitrate loading of 48% would be required to reduce nitrate concentrations to 9.5 mg/L for all storm events. Loading of E.coli is projected to require more than 95% reduction to reduce levels to 200 org./100mL for all ranges of flow, with more than 99% reductions required when flows are in the upper 70% of observed levels.

For a more detailed summary about the TMDL report for the Raccoon River, refer to the technical memo on this topic included in the appendix of this management plan.

Five load reduction strategies were analyzed by computer modeling as part of the TMDL report:

1. Reducing the rate of ammonia fertilizer application.
2. Remove all cattle from the streams.
3. Remove all human waste from the watershed.
4. Convert all row crop lands located on slopes greater than 9% slopes to CRP grassland.
5. Convert all row crop lands located on floodplain soils to CRP.

*Several other strategies were also listed to address nitrate and bacteria pollution:*

- Strategically construct new wetlands near tile outlets.
- Implement urban stormwater **best management practices** (BMPs).
- Changing fall applications of fertilizer to spring.
- Changing fertilizer application method.
- Use **nitrification inhibitors**.
- Improved **manure management**.
- Adopt comprehensive farm **nutrient management plans** using NRCS Conservation Practice Standard 590.
- Adopt **conservation tillage**.
- **Contour planting and terracing**.
- Use **cover crops**.

### ***Raccoon River Watershed Water Quality Master Plan—2011***

This plan was prepared by Agren, Inc., funded by a grant from the Iowa Department of Natural Resources (DNR) to the Missouri and Mississippi Divide RC & D. The plan states that it “does not define specific outcome targets for water quality, nor does it prescribe a specific vision of what constitutes an environmentally and economically prosperous Raccoon River basin. Rather, it focuses on common needs that have been identified by, and are broadly supported by, multi-disciplinary experts and watershed stakeholders.” (p 3-4)

The plan organized identified priorities into nine recommendations (p 5):

1. Develop a regional planning organization to guide implementation of the Raccoon River Watershed Water Quality Master Plan.
2. Conduct public education to improve awareness of water quality and instill a personal commitment to water quality improvement among all watershed residents.
3. Focus outreach and education efforts to farm operators and agricultural landowners on nutrient and drainage management strategies.
4. Aggressively pursue opportunities to facilitate private-sector conservation planning services.
5. Take full advantage of emerging technologies and LiDAR elevation data to identify areas of concern and target practices based on landscape characteristics at the field level.
6. Target implementation of agricultural best management practices to priority **subwatersheds** and **priority impairments**.
7. Enhance effectiveness of nutrient control and removal practices by encouraging a "stacked" approach to nutrient management such as reduce, trap, and treat.
8. **Monitor** water quality at the subwatershed scale to characterize existing conditions and evaluate effectiveness of watershed projects and conservation practices.
9. Continue to assess long-term water quality status and trends in the Raccoon River and enhance these efforts as resources allow.

The plan discussed the topic of **subsurface tile** drainage. "Although subsurface tile decreases runoff from the surface of a field, subsurface flow and leaching losses of nitrate are increased. This is due mostly to an increase in flow volume and the 'short-circuiting' of subsurface flow, but also in part to the increased mineralization and formation of nitrate in the soil profile (Randall, Goss, and Fausey 2010). Subsurface tile drainage provides a direct channel from farm fields into adjacent surface water streams." (page 21)



Source: Polk County SWCD

Other findings listed were as follows:

- An organization is needed to carry out a strategic mission for the entire Raccoon River watershed, however to be effective, projects would need to target smaller geographic areas (p 25).
- The Iowa Stormwater Management Manual was identified as an under-used resource for educating communities on the issue of stormwater management and low-impact development (p 31).
- Recent surveys identified a lack of awareness among agricultural landowners regarding the impact of row crop production in tile drained landscapes (p 33).
- Proper messaging regarding the priority problem and the need for action needs to be developed. The absentee landowner needs to be successfully engaged (p 36).
- Creating an effective payment or incentive program to engage agronomists is important (p 41).
- A table of agricultural best management practices that were evaluated is included (p 50).
- The Walnut Creek watershed was listed as very low priority for nitrate reduction (p 55).
- The plan also listed the Walnut Creek watershed as very low priority for pathogen reduction (p 59). (This seems to be contradicted by available monitoring data which shows extremely high pathogen levels, especially in the urbanized area of the watershed).
- Phosphorus reduction was listed as a higher priority in areas outside the Walnut Creek watershed (p 64).
- Sediment reduction within the Walnut Creek watershed was listed as a medium priority (p 66).

A nutrient reduction strategy is described on page 73 of the Raccoon River plan, stating "adequate control of nutrients will require a combination of best management practices that 1) reduce the source of nutrients; 2) trap nutrients before they enter water sources; and 3) treat tile drainage water or surface runoff to reduce nutrients." A table of nutrient BMPs categorized by source reduction, trapping and treatment is included on that same page.

### ***Iowa Nutrient Reduction Strategy—Updated 2014***

The subtitle of this report is "a science and technology based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico." It was prepared by the Iowa Department of Agriculture and Land Stewardship (IDALS) along with the IDNR and Iowa State University's College of Agriculture and Life Sciences.

It was developed following the creation of the 2008 Gulf Hypoxia Action Plan that calls for states to create strategies to reduce pollutant loadings to the Gulf of Mexico. The Action Plan set a goal of at least 45% reduction in total nitrogen and total phosphorus loads. The Iowa Nutrient Reduction Strategy outlines steps to prioritize watersheds and resources, improve current state programs and increase voluntary efforts to reduce nutrient loadings (Executive Summary).

The Nutrient Strategy assigns pollutant loadings to both **point** and **non-point sources**. It assumes that a 4% reduction in nitrogen and 16% reduction in phosphorus can be accomplished by point source reductions such as improvements at wastewater treatment plants. The remaining 41% of nitrogen and 29% of phosphorus reductions are identified as being accomplished through non-point source reductions (page 3).

The Strategy projects that nitrogen losses are a greater concern in tile drained landscapes. The largest losses are expected to occur with sustained flows occurring in the spring and at times with little evapotranspiration and nutrient uptake. In steeper, hilly areas, phosphorus losses can be greater. Surface runoff and transported sediment are common carriers of phosphorus. The largest losses can occur after rainfall events (page 9). Streambank erosion is also identified as potentially significant source of phosphorus loading (page 10).

The Strategy includes the Iowa Nonpoint Source Nutrient Reduction Science Assessment. This is based on **peer-reviewed studies of in-field, edge-of-field and watershed scale practices** and treatments to determine potential reductions in total nitrogen and phosphorus.

The framework for the Nutrient Reduction Strategy includes several major points (pages 18-26). Key items relatable to the Walnut Creek watershed are underlined.

1. Prioritization of Watersheds. In 2013, the Water Resources Coordinating Council (**WRCC**) selected nine priority watersheds to focus targeted conservation and water quality efforts. The North Raccoon River was listed as one of these nine priority watersheds.
2. Determine Watershed Goals. The WRCC is tasked with coordination of indicators to provide stakeholders with information to establish baselines and report progress.
3. Ensure Effectiveness of Point Source Permits. The goal is to have major **Publicly Owned Treatment Works** (POTWs) install improvements to reduce nutrient outflow. Permitted animal feeding operations will continue to be monitored. Iowa point sources, IDNR, IDALS and WRCC will work to develop a nutrient trading credit program, based on 2003 EPA guidance.
4. Agricultural Areas. Setting priorities includes a focus on conservation, in- and off-field practices, pilot projects and implementation of nutrient trading. Research and Technology will continue to identify new technologies and solutions, develop private and public support for more research and continue to gain a better understanding of the Gulf Hypoxia Zone. An approach to improved outreach, education and collaboration is outlined. Programs for farmer recognition and a statewide education and marketing campaign is identified as a need. Sources of potential funding are briefly described.
5. Storm Water, Septic Systems, Minor POTWs and Source Water Protection. No specific nutrient reductions are identified for urban stormwater runoff. However, a focus is given to infiltration of the water quality volume (runoff from a 1.25" rainfall event). By managing this volume, reductions of 80-85% of annual runoff volumes could be achieved. Septic systems are proposed to be addressed through time of sale inspections to identify and correct leaky systems. The Iowa Source Water Protection Program educates the public and local officials on the importance of protecting groundwater drinking water resources. A link to potential funding sources is provided.
6. Accountability and Verification Measures. A technical work group will define the process for providing a regular nutrient load estimate. The IDNR will track progress of implementing the reduction strategy for permitted point sources. A system for tracking non-point sources and improvements is outlined.
7. Public Reporting. WRCC will develop public annual reports. Watershed management plans are expected to include strategies to assess and demonstrate progress in achieving load reductions.
8. Nutrient Criteria Development. IDNR continues to review and assess water quality, with development of a suitable nutrient criteria as a long-term goal.

Section 2 of the Nutrient Reduction Strategy contains the science assessment. Some key findings of note, as related to the development of a plan for the Walnut Creek watershed:

- Key practices for nitrogen removal:
  - Nitrogen management practices, **cover crops** and **living mulches**.
  - Land use changes to energy crops, **perennial vegetation** or **extended rotations**.
  - Wetlands, drainage water management, **buffers** and **bioreactors** are edge-of-field practices with greatest potential for nitrogen reduction.
- Key practices for phosphorus removal:
  - Reducing tillage and cover crops can significantly reduce phosphorus loss.
  - Land use changes from corn-soybeans to energy crops, perennial vegetation or extended rotations.
  - Edge of field practices that settle sediment such as ponds and stream buffers.
- The Science Team will publish an updated practice list as an addendum to the Reduction Strategy,
- Table 2 (p 6) and Table 3 (p 7) have details on expected load reductions for nitrogen and phosphorus for various practices and their expected impact on corn yield.



Source: USDA



Source: USDA