Agenda

OAK CREEK WATERSHED FUTURE

- Review partial Chapter 4
- Next steps
- Comments and Questions

Chapter 4

OAK CREEK WATERSHED FUTURE

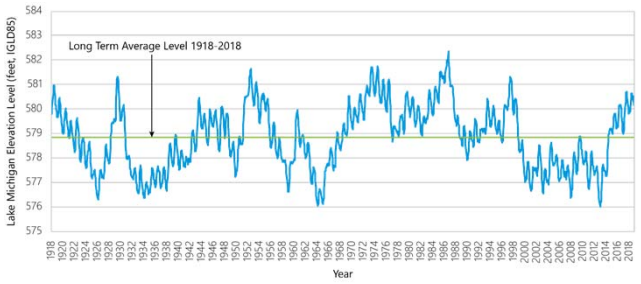
- This chapter describes:
  - The findings of planning inventories
    - Physical characteristics of streams
    - Water quantity conditions
    - Water quality conditions
    - Sources of water pollution
    - Current management practices
    - Recreational access and use
    - Archeological sites

Chapter 4

- The portions of the chapter to be reviewed includes
  - Water quantity conditions
  - History and status of the Mill Pond and dam
  - Water quality conditions (in part)

Water Quantity Conditions

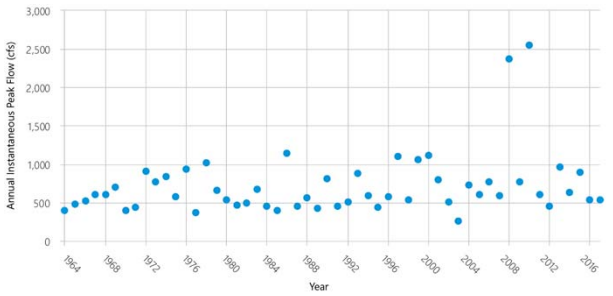
Figure 4.Lake-1
Lake Michigan Mean Monthly Water Levels: 1918-2018



Source: USACE Detroit District and SEWRPC

Water Quantity Conditions

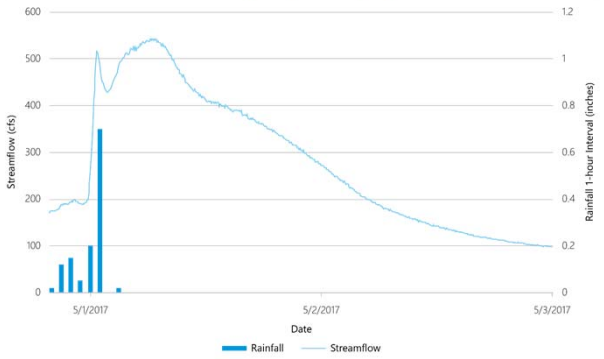
Figure Flow-B
Annual Instantaneous Peak Flows Oak Creek at 15th Avenue: Water Years 1964-2017



Source: U.S. Geological Survey and SEWRPC

Water Quantity Conditions

Figure Flow-D
Storm Event Oak Creek at 15th Avenue: April 30, 2017 to May 2, 2017



Source: U.S. Geological Survey, Milwaukee Metropolitan Sewerage District, and SEWRPC

Mill Pond and Dam

Figure 4.Dam-1
Historic Photos of the Oak Creek Mill Pond

Source: Friends of the Mill Pond & Oak Creek Watercourse, Inc.

Figure 4.Dam-2
Photos of the Oak Creek Mill Pond Dam

Source: Friends of the Mill Pond & Oak Creek Watercourse, Inc. and SEWRPC

Mill Pond and Dam

Mill Pond and Dam

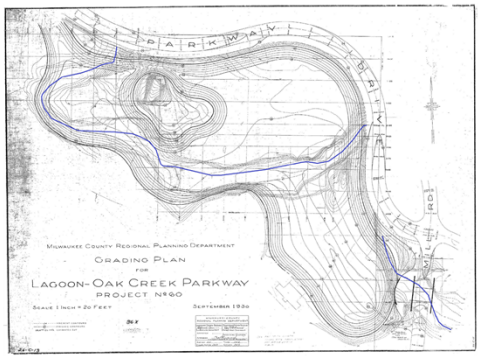
- History - Dam
  - Dam built in mid-1930s by WPA
  - Inspected by WDNR in 2012 (Appendix Dam)
    - Masonry façade on dam should be inspected
      - Completed in 2013
    - Sluice gate to dewater pond is inoperable and needs to be repaired
      - Preliminary Plans completed in 2015
      - Final Plans due to WDNR by 2021

Mill Pond and Dam

- History - Pond
  - Mill Pond built in mid-1930s as well
  - Dredged at least partially in the late 1970s and in 1990
  - Warming house renovated from 2007 to 2014

Mill Pond and Dam

1930 Grading Plan
Pond 6' to 10' deep



Mill Pond and Dam

Figure 4.Dam-5
Oak Creek Mill Pond Warming House

Source: SEWRPC

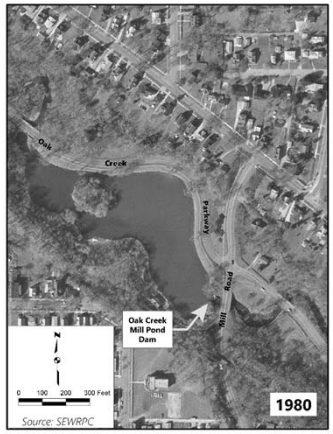
Mill Pond and Dam

- Sediment Accumulation in Pond
  - Calculation between 2015 RHD survey and 1930 construction plans
  - Volume to haul away approximately 47,100 CY or about 4,000 dump truck loads

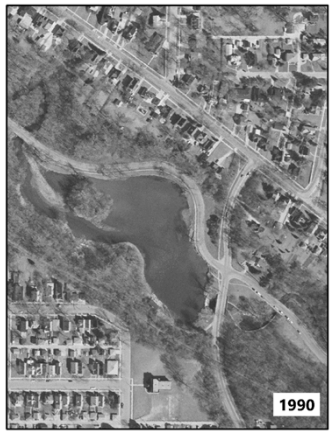
SEWRPC, 2019

Mill Pond and Dam

Partial Dredge late 1970s and 1990



Mill Pond and Dam



Mill Pond and Dam

Mill Pond and Dam

Mill Pond and Dam

Water Quality Monitoring

- Water quality samples were available for the period 1952 through 2016 from 46 sites on 7 streams
  - Mainstem Oak Creek—28 sites
  - North Branch Oak Creek—10 sites
  - Mitchell Field Drainage Ditch—4 sites
  - Four tributary streams—1 site each
- Sites differ in the amount of available data

Water Quality Monitoring

- Water quality samples were collected by several agencies
  - Milwaukee Metropolitan Sewerage District
  - Wisconsin Department of Natural Resources
  - City of Racine Public Health Department
  - Milwaukee Riverkeeper through the Water Action Volunteers Program (WDNR/UWEX)
  - U.S. Geological Survey
  - SEWRPC

Water Quality Monitoring

- Constituents sampled for include:
  - Water temperature
  - Bacteria
    - Fecal Coliform
    - *E. coli*
  - Chlorophyll-*a*
  - Dissolved oxygen
  - pH
  - Chloride
  - Specific conductance
  - Total suspended solids
  - Turbidity
  - Nutrients
    - Phosphorus
    - Nitrogen
  - Metals and metalloids
  - "Emerging pollutants"
  - Pesticides
  - PCBs
  - Fish
  - Macroinvertebrates

Water Quality Monitoring

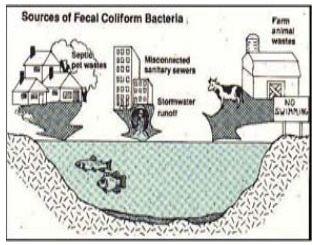
- Constituents discussed tonight include:
  - Water temperature
  - Bacteria
    - Fecal Coliform
    - *E. coli*
  - Chlorophyll-*a*
  - Dissolved oxygen
  - pH
  - Chloride
  - Specific conductance
  - Total suspended solids
  - Turbidity
  - Nutrients
    - Phosphorus
    - Nitrogen
  - Metals
  - "Emerging pollutants"
  - Pesticides
  - PCBs
  - Fish
  - Macroinvertebrates

Water Quality Monitoring

- **Bacteria** – used to judge suitability of water for human contact
  - Two groups used
    - **Fecal coliform bacteria** – a group of bacteria species found in the guts of warm blooded animals
    - *E. coli* – one species of fecal coliform bacteria
  - These do not generally cause disease
  - High concentrations may indicate the presence of contamination by fecal wastes which can carry disease-causing organisms

Water Quality Monitoring

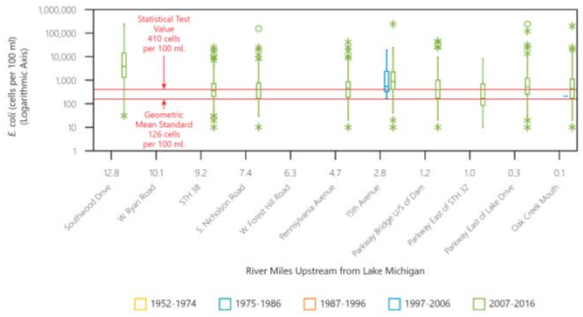
- Fecal wastes may come from sanitary sewage, agricultural and barnyard wastes, domestic pets, and wild animals



Water Quality Monitoring

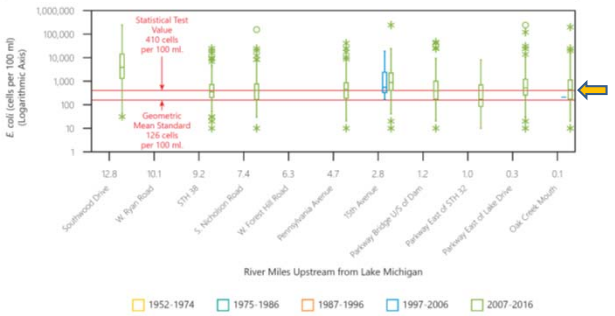
- Water quality standards for bacteria:
  - Fecal coliform bacteria
    - Geometric mean of concentrations in samples not to be higher than 200 cells per 100 ml
    - Single sample concentrations not to be higher than 400 cells per 100 ml
  - *E. coli*
    - Geometric mean of concentrations in samples not to be higher than 126 cells per 100 ml
    - Single sample concentrations not to be higher than 410 cells per 100 ml

Figure 4.X Bact-3
Concentrations of *E. coli* Bacteria at Sites Along the Mainstem of Oak Creek: 1952-2016



Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.
Source: Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Figure 4.X Bact-3
Concentrations of *E. coli* Bacteria at Sites Along the Mainstem of Oak Creek: 1952-2016

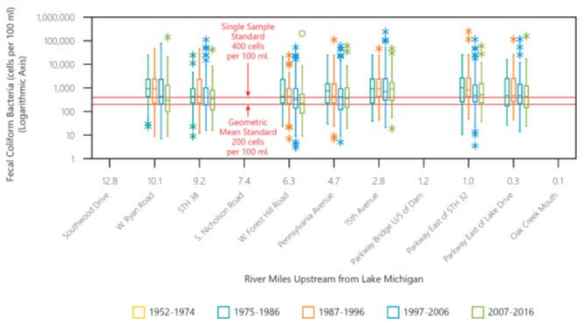


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

2007-2016: *E. coli* concentrations in over half of the samples were over the single sample criterion suggesting potential contamination with fecal wastes

Figure 4.X Bact-1
Concentrations of Fecal Coliform Bacteria at Sites Along the Mainstem of Oak Creek: 1952-2016



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Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

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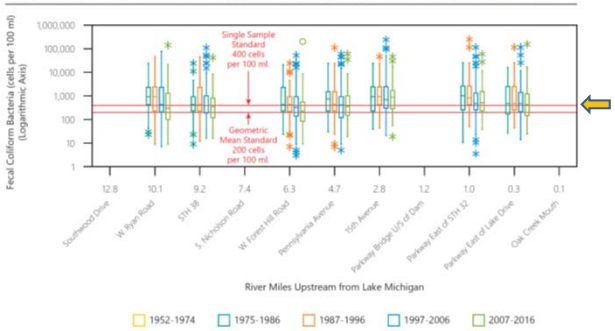
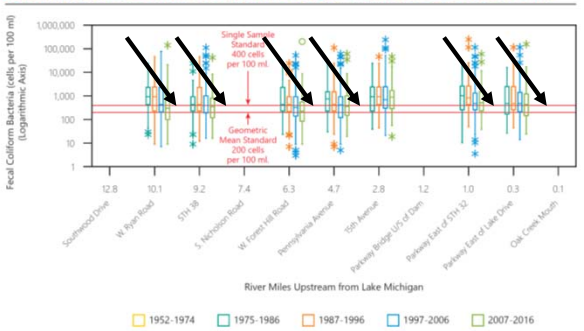


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

Recent and past high fecal coliform bacteria concentrations suggest that this is a long-standing problem

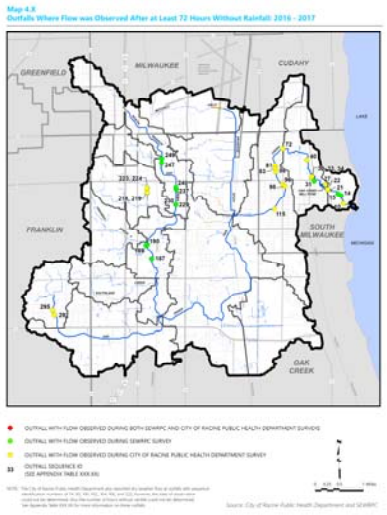
Figure 4.X Bact-1
Concentrations of Fecal Coliform Bacteria at Sites Along the Mainstem of Oak Creek: 1952-2016



Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

Fecal coliform bacteria concentrations show a downward trend over time at some stations, suggesting some improvement



- One possible source of fecal contamination is stormwater outfalls
  - Cross-connections to sanitary sewers
  - Leaking sanitary sewers
  - Bacteria from land surface
- To find some potential sources, look for water flowing out of storm sewer outfalls during dry weather
  - City of Racine Public Health Department (RHD) did this based on instream *E. coli* concentrations
  - SEWRPC staff did this as part of instream surveys
- Sample dry-weather flow to see what it contains
  - RHD sampled 23 outfalls

- When results show high *E. coli* concentrations, use microbial source tracking techniques to determine whether the bacteria come from humans or other animals
- RHD applied these techniques on flow from 20 outfalls
- Seven outfalls showed evidence of contamination coming from a human source (★)
- Five outfalls showed evidence of contamination coming from a canine source (◆)

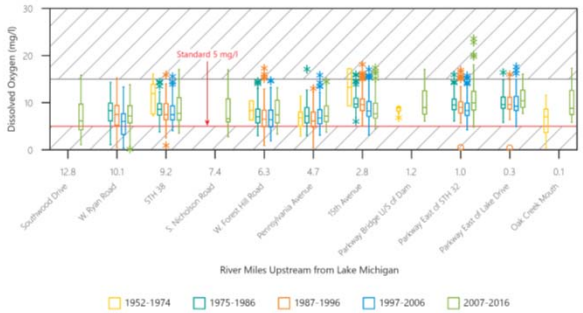
Water Quality Monitoring

- **Dissolved oxygen** – determines suitability of water as habitat for aquatic organisms
  - Affected by
    - **Temperature** determines how much oxygen water can hold → Colder water can hold more
    - **Photosynthesis** and **diffusion** from the atmosphere increase the amount in water
      - Flow and mixing can be important in this
    - **Respiration** by organisms and **decomposition** of organic material reduce the amount in water
      - Sediments with organic material can lead to lower concentrations

Water Quality Monitoring

- Water quality standards for dissolved oxygen:
  - Dissolved oxygen should be equal to or greater than 5.0 milligrams per liter (mg/l)
- Overly high concentrations (supersaturation) can injure or kill aquatic organisms

Figure 4.X Dissolved Oxygen-1
Concentrations of Dissolved Oxygen at Sites Along the Mainstem of Oak Creek: 1952-2016



Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Saturation levels of dissolved oxygen of 140 percent and higher can cause fish kills. A 15 mg/l dissolved oxygen concentration translates to a saturation of approximately 150 percent at an average water temperature of 14° C.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

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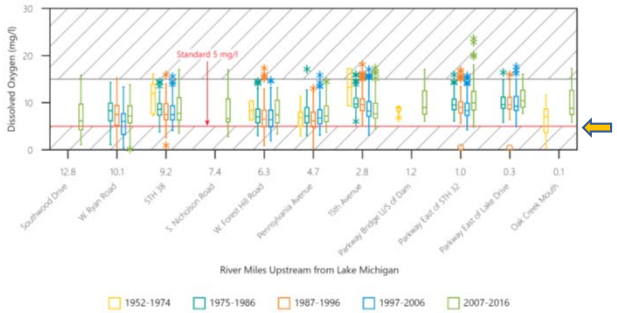

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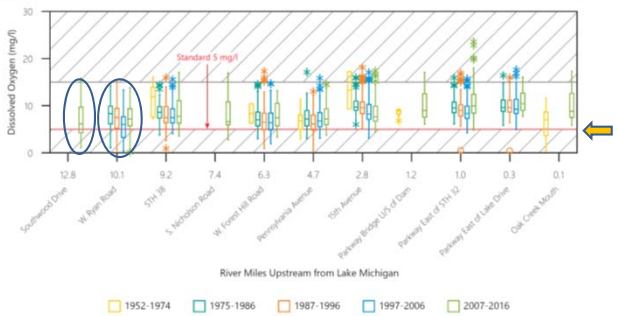
Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Concentrations were mostly above the water quality standard

Figure 4.X Dissolved Oxygen-1
Concentrations of Dissolved Oxygen at Sites Along the Mainstem of Oak Creek: 1952-2016



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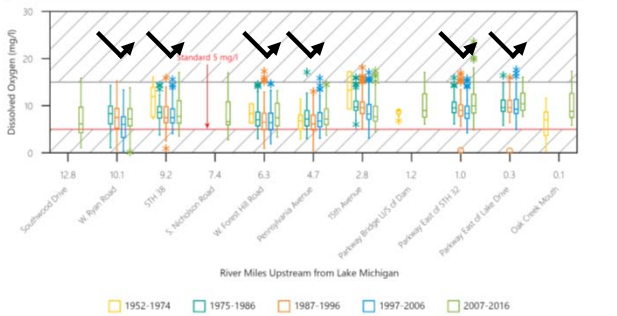
Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Lower concentrations at upstream stations which may reflect low flows, drop structures, sediment, and discharges from stormwater outfalls

Figure 4.X Dissolved Oxygen-1
Concentrations of Dissolved Oxygen at Sites Along the Mainstem of Oak Creek: 1952-2016



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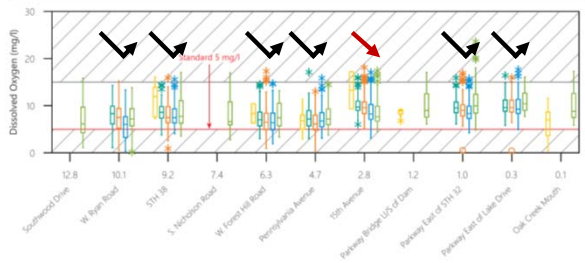
Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Most sites show recent increase in concentration following long-term decrease

Figure 4.X Dissolved Oxygen-1
Concentrations of Dissolved Oxygen at Sites Along the Mainstem of Oak Creek: 1952-2016



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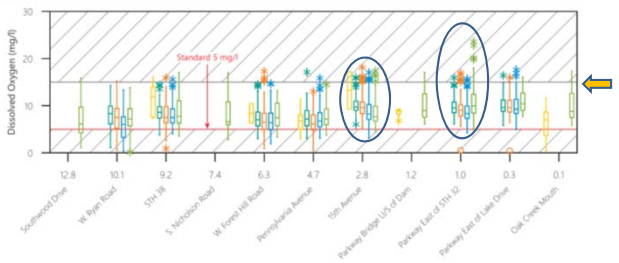
Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Most sites show recent increase in concentration following long-term decrease

Decreasing trend at 15th Avenue – urban land use, discharges from outfalls

Figure 4.X Dissolved Oxygen-1
Concentrations of Dissolved Oxygen at Sites Along the Mainstem of Oak Creek: 1952-2016



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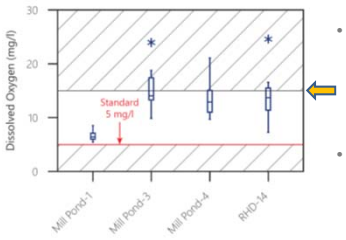
Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Evidence that supersaturation may be occurring at some sites.

Figure 4.X Dissolved Oxygen-6
Concentrations of Dissolved Oxygen at Sites in the Oak Creek Mill Pond: 2015-2016



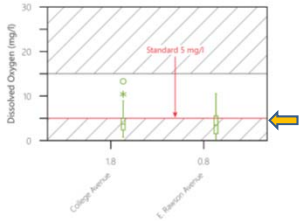
Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Saturation levels of dissolved oxygen of 140 percent and higher can cause fish kills. A 15 mg/l dissolved oxygen concentration translates to a saturation of approximately 150 percent at an average water temperature of 14° C.

Source: City of Racine Public Health Department and SEWRPC

- Supersaturation is likely occurring in the portions of the Mill Pond away from the main path of water flow
- This may be causing large daily swings in concentration
  - High concentrations during day
  - Low concentrations during night
- This can be very stressful to fish in the pond

Figure 4.X Dissolved Oxygen-3
Concentrations of Dissolved Oxygen at Sites Along the Mitchell Field Drainage Ditch: 1952-2016



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Saturation levels of dissolved oxygen of 140 percent and higher can cause fish kills. A 15 mg/l dissolved oxygen concentration translates to a saturation of approximately 150 percent at an average water temperature of 14° C.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, City of Racine Public Health Department, and SEWRPC

- Dissolved oxygen concentrations are very low in the Mitchell Field Drainage Ditch
  - Concentrations are below the 5.0 mg/l standard in over half the samples taken during 2007-2016
  - Possible causes include aircraft deicing compounds, degradation of organic matter in sediment behind beaver dams, discharges of unknown substances into this stream

Figure 4.X Dissolved Oxygen-8
Turbid Blue Water in the Mitchell Field Drainage Ditch About 640 Feet Downstream from College Avenue Culvert: September 29, 2017

Source: SEWRPC

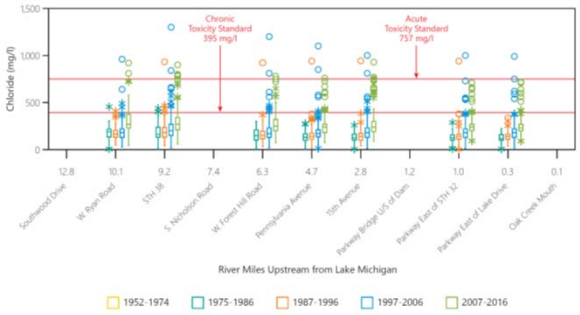
Water Quality Monitoring

- **Chloride** – Naturally present at low concentration
  - Not decomposed, altered, or removed by natural processes
  - Highly soluble→ goes where the water goes
  - Too much imparts salinity to water and can be harmful to organisms
  - Sources include deicing salts, water softening, chemical fertilizers, sewage, and animal wastes

Water Quality Monitoring

- Water quality standards for chloride:
  - Acute toxicity standard: daily maximum not to exceed 757 mg/l
  - Chronic toxicity standard: four-day maximum not to exceed 395 mg/l

Figure 4.X Chloride-1
Concentrations of Chloride at Sites Along the Mainstem of Oak Creek: 1952-2016



Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

Figure 4.X Chloride-1
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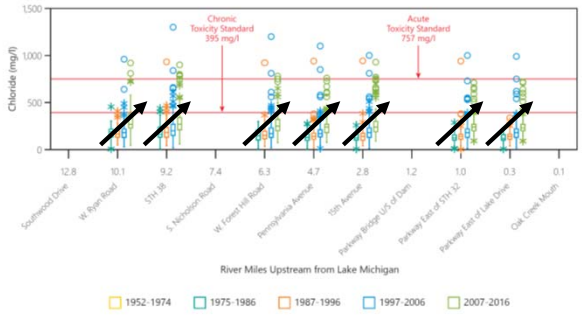
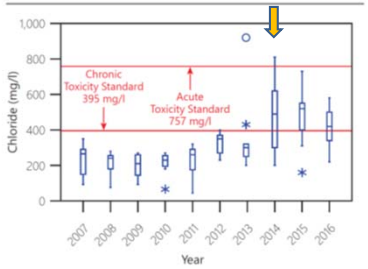


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

Chloride concentrations have increased over time. This is similar to what we have seen in other waterbodies in Southeastern Wisconsin

Figure 4.X Chloride-6
Annual Distributions of Choride Concentrations in Oak Creek at W. Ryan Road (RM 10.1): 2007-2016

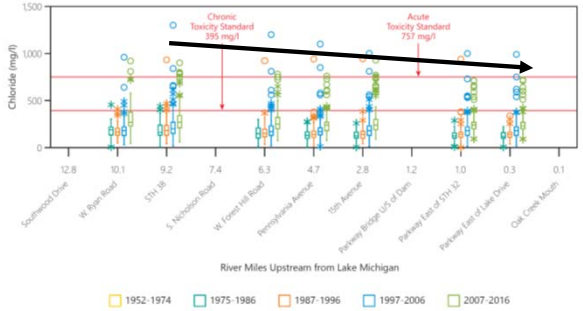


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: Milwaukee Metropolitan Sewerage District, and SEWRPC

Some of the increase in Oak Creek occurred as a sudden jump in about 2014. This occurred at all stations for which we have enough data to examine

Figure 4.X Chloride-1
Concentrations of Chloride at Sites Along the Mainstem of Oak Creek: 1952-2016

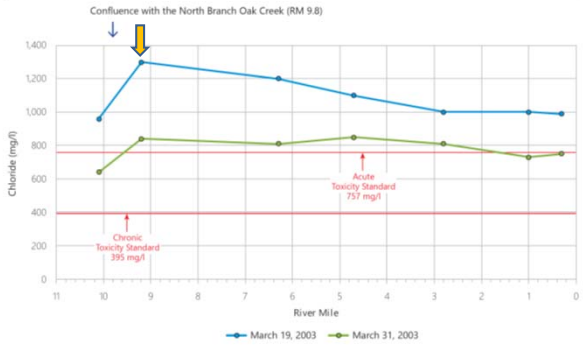


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

Chloride concentrations tend to decrease from upstream to downstream. BUT, there is one major exception to this:

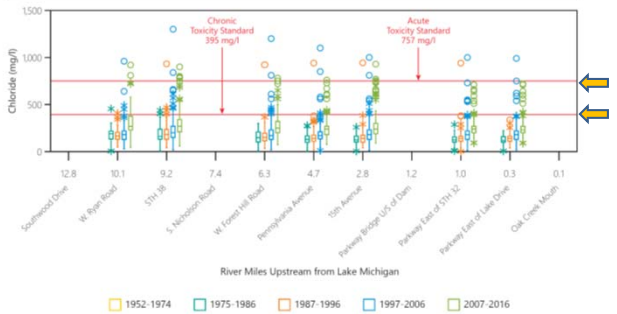
Figure 4.X Chloride-4
Chloride Concentrations Along the Mainstem of Oak Creek: March 2003



Source: U.S. Geological Survey and SEWRPC

Chloride concentrations consistently increased between W. Ryan Road and STH 38. May be due to high amount of urban development in the North Branch of Oak Creek subwatershed or runoff from highways.

Figure 4.X Chloride-1
Concentrations of Chloride at Sites Along the Mainstem of Oak Creek: 1952-2016



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Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

2007 -2016: Chloride concentrations in 3 percent of samples were higher than the acute toxicity standard. Chloride concentrations in 17 percent of samples were higher than the chronic toxicity standard

Water Quality Monitoring

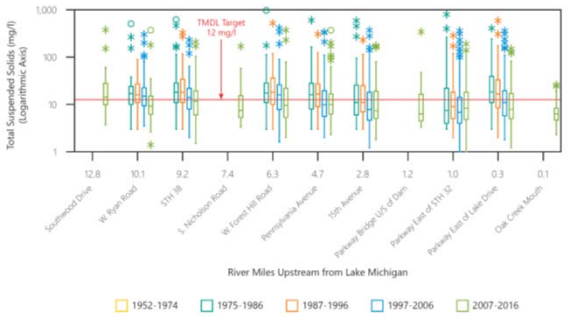
- **Total suspended solids (TSS)** – Particles of sand, silt, clay; planktonic organisms; and fine organic and inorganic debris suspended in water
  - Kept suspended by flow
  - When flow slows down, larger and heavier particles settle out
  - Can cause sedimentation, reduced water clarity
  - Other materials such as nutrients, organic molecules, metals, and microorganisms can adsorb to these particles

Water Quality Monitoring

- Wisconsin has no water quality standard for total suspended solids
- As a guideline to tell the difference between better and worse concentrations, we used the target set in the Milwaukee Basin TMDL
  - The concentration of TSS should not exceed 12 mg/l

Stream with high concentration of suspended solids →

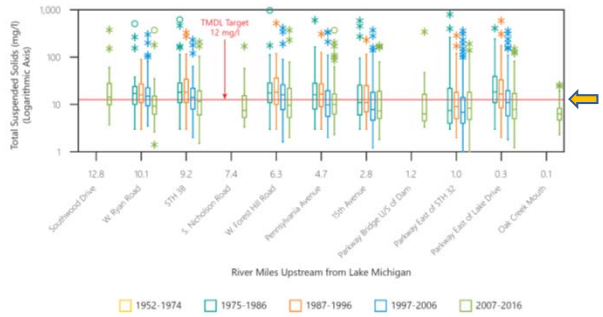
Figure 4.X TSS-1
Concentrations of Total Suspended Solids (TSS) at Sites Along the Mainstem of Oak Creek: 1952-2016



Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Figure 4.X TSS-1
Concentrations of Total Suspended Solids (TSS) at Sites Along the Mainstem of Oak Creek: 1952-2016



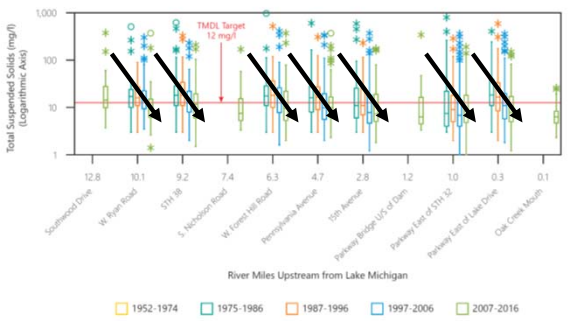
Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

2007 -2016

TSS concentrations in 37 percent of samples were higher than the guideline

Figure 4.X TSS-1
Concentrations of Total Suspended Solids (TSS) at
Sites Along the Mainstem of Oak Creek: 1952-2016

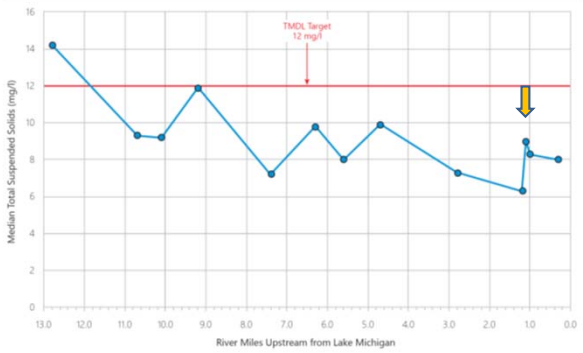


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Decreasing TSS concentrations over time. May be due to stormwater management efforts and changes in land use

Figure 4.X TSS-4
Median Concentrations of Total Suspended Solids (TSS) at Sites Along Oak Creek: 2007-2016



TSS concentrations generally decrease from upstream to downstream.
The Mill Pond appears to be a source of sediment to downstream reaches

Water Quality Monitoring

- **Phosphorus** – Nutrient needed for plant and algal growth
  - Sources include mineralization of sediment, resuspension of sediment, stormwater runoff, fertilizers, discharges
  - In freshwater systems availability of phosphorus can be the factor that controls how much plant and algal growth occurs
  - Dissolved phosphorus is phosphorus in solution
  - Total phosphorus is dissolved phosphorus and phosphorus in suspended particles

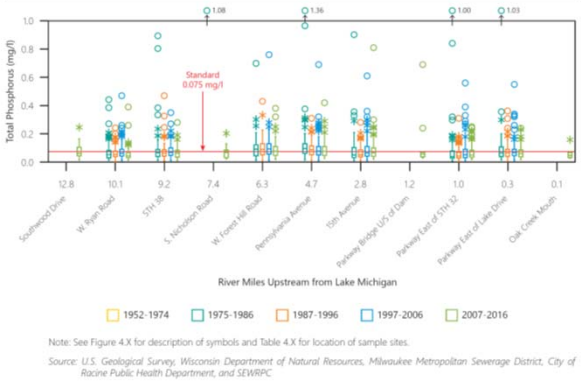
Water Quality Monitoring

- Water quality standard for phosphorus:
  - Total phosphorus is not to exceed 0.075 mg/l

Stream with an excess of phosphorus

Stream without an excess of phosphorus

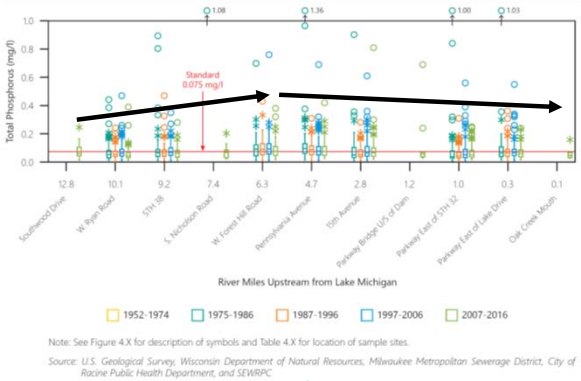
Figure 4.X Tot-P-1
Concentrations of Total Phosphorus at Sites Along the Mainstem of Oak Creek: 1952-2016



Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Figure 4.X Tot-P-1
Concentrations of Total Phosphorus at Sites Along the Mainstem of Oak Creek: 1952-2016

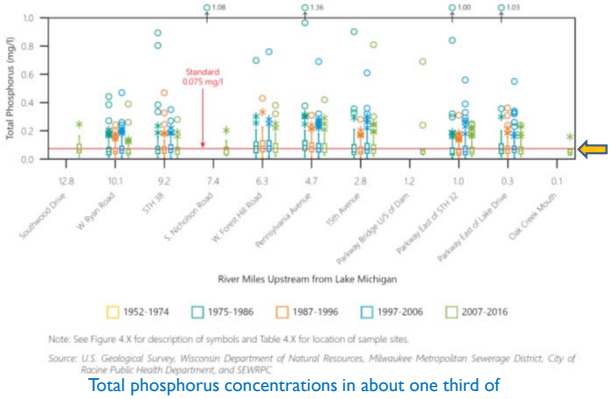


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Total phosphorus concentrations increase from upstream to downstream in upper reaches of Oak Creek and decrease from upstream to downstream in lower reaches.

Figure 4.X Tot-P-1
Concentrations of Total Phosphorus at Sites Along the Mainstem of Oak Creek: 1952-2016

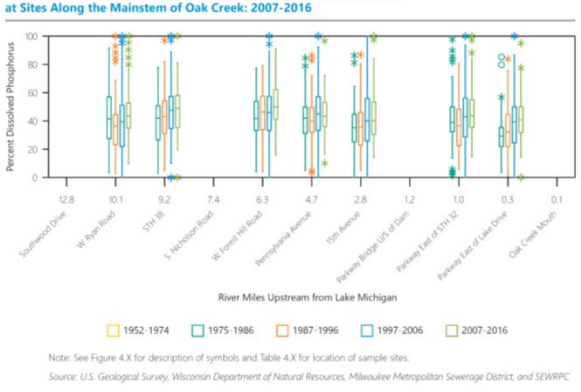


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, City of Racine Public Health Department, and SEWRPC

Total phosphorus concentrations in about one third of samples from 2007-2016 were higher than the water quality standard.

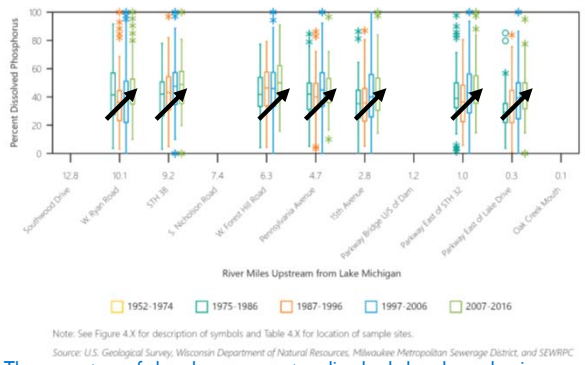
Figure 4.X Tot-P-5
Percentage of Total Phosphorus Consisting of Dissolved Phosphorus at Sites Along the Mainstem of Oak Creek: 2007-2016



Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

Figure 4.X Tot-P-5
Percentage of Total Phosphorus Consisting of Dissolved Phosphorus at Sites Along the Mainstem of Oak Creek: 2007-2016

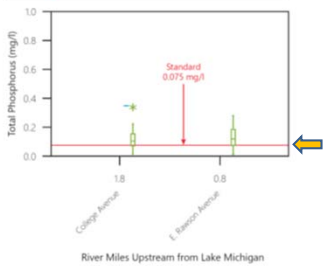


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC

The percentage of phosphorus present as dissolved phosphorus has increased over time. This may reflect the decrease in total suspended solids concentration

Figure 4.X Tot-P-3
Concentrations of Total Phosphorus at Sites Along the Mitchell Field Drainage Ditch: 1952-2016

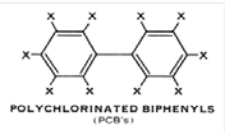


Note: See Figure 4.X for description of symbols and Table 4.X for location of sample sites.

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, City of Racine Public Health Department, and SEWRPC

- Phosphorus concentrations in those tributary streams that data are available for were similar to those in the mainstem, **EXCEPT**
- Mitchell Field Drainage Ditch had high total phosphorus concentrations
- Average concentration was about twice that in the mainstem of Oak Creek
- Concentrations in almost two thirds of the samples were higher than the water quality standard

- **Polychlorinated biphenyls (PCBs)** – class of persistent organic pollutant
  - 209 different compounds
  - Bioaccumulating toxins
  - Can contaminate fish
  - Used in insulators, lubricating oils, inks, adhesives, synthetic rubbers, ncr paper
  - Not manufactured in U.S. since 1977, but many are still in use



- **Sampling of PCBs in sediment in Oak Creek**
  - 2001 Mill Pond surface sediment sampled
    - Some PCBs found, average concentration 0.118 milligrams PCB per kilogram sediment (mg/kg)
  - 2016 USGS sampled surface sediment in Mill Pond and at the mouth of Oak Creek
    - Low concentration in Mill Pond sediment (0.040 mg/kg)
    - Higher concentration at Creek mouth (3.200 mg/kg)
  - 2018 WDNR sampled surface sediment at six locations between the Mill Pond and mouth
    - Found PCBs at three locations downstream of the Pond

Water Quality Monitoring

Based on follow up investigation, WDNR concluded:

- Source is likely closer to sampling locations and not located upstream
- Concentrations are below thresholds requiring further action

Water Quality Monitoring

- Major conclusions
  - High fecal indicator bacteria concentrations indicate some fecal contamination
  - Dissolved oxygen concentrations are good except
    - Upstream portions of Oak Creek
    - Mitchell Field Drainage Ditch
  - Chloride concentrations are increasing
  - Total suspended solids concentrations have decreased
  - Phosphorus concentrations are often high
  - PCBs have been found in sediment near Oak Creek's mouth

Next Steps

- Complete the rest of Chapter 4 text
- Receive comments on new Chapter 4 text from the Advisory Group and Stakeholders in early 2020

Website and Contact Information

- Communication
  - Opportunity for written comments today
  - SEWRPC website for Draft documents, meeting materials, and comments

  www.sewrpc.org/OakCreekWRP
- Contact
  - Laura Herrick – Chief Environmental Engineer
    262-953-3224 or lherrick@sewrpc.org